Updated Supplemental Remediation Investigation Report

Former Pope & Talbot Wood-Treating Site

ECSI ID #959

St. Helens, Oregon

Prepared for:

Port of Columbia County
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Project No. 0034-001-005
January 17, 2020

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Prepared by:

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1.0 INTRODUCTION

Cascadia Associates, LLC (Cascadia), on behalf of the Port of Columbia County ("Port"; formerly Port of St. Helens), has updated the Supplemental Remedial Investigation (RI) Report for the Former Pope & Talbot (P&T) wood-treating facility (Environmental Cleanup Site Information [ECSI] #959) located in St. Helens, Oregon. This updated supplemental RI was conducted to address deficiencies in the original RI (GeoEngineers, 2000) and initial phases of the supplemental RI (AMEC, 2014) as noted by the Oregon Department of Environmental Quality (DEQ) in a series of comment letters between March 18, 2010 (DEQ, 2010a) and August 2019 (DEQ, 2019c).

The former P&T wood-treating site is located at 1550 Railroad Avenue in St. Helens, Oregon (**Figure 1-1**), and is currently owned by the Port. To be consistent with prior environmental reports, the upland portion of the 1550 Railroad Avenue Port-owned property is referred to herein as the "Site". Please note for clarity that the "Site" is different from the term "Locality of Facility" (LOF) used in this and prior reports to include upland and offshore contaminated areas.

The Site and its LOF have been the subject of a Remedial Investigation/Feasibility Study (RI/FS) since DEQ issued an Order of Consent No. WMCSR-NWR-95-05 (Order) in 1995. The 1995 Order named the Port and P&T as potentially responsible parties (PRPs). Between 1996 and 2006, multiple investigation activities were completed on behalf of the PRPs, including the initial RI, which was predominately focused on the upland areas (GeoEngineers, 2000). In May 2007, following the completion of a baseline Human Health Risk Assessment (HHRA) (Kennedy/Jenks Consultants, 2006), P&T submitted a draft outline for a Feasibility Study (FS) report to DEQ (Bridgewater Group, Inc., 2007), which was predominately focused on residual contamination beneath the Site's upland areas. In August 2007, DEQ issued a letter stating that it was not able to evaluate the proposed cleanup alternatives because the offshore extent of contamination had not been fully delineated (DEQ, 2007b). In November 2007, P&T declared bankruptcy and the Port became the sole PRP responding to the 1995 Order.

1.1 SITE AREA DESIGNATIONS

In 2008, DEQ approved formally subdividing the upland portion of the Site into two parcels: Area 1 and Area 2 (DEQ, 2008). Area 1 is 25.15 acres in size and includes the locations of the former wood-treating plant, former transfer table, loading platforms (including docks), and the underground portion of the creosote pipeline. Area 2 covers 17.32 acres and includes the northeastern portion of the Site, which has been minimally impacted by historical creosote wood-treating activities. **Figure 1-2** presents the entire Site, significant historical features, and the Area 1/Area 2 division.

The U.S. Army Corps of Engineers (USACE) Ordinary High-Water Mark (OHWM) is a jurisdictional benchmark for administering its regulatory program in navigable waterways under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. The OHWM, as defined in 33 CFR 328.3, is the line on the riverbank established by fluctuations of water and indicated by

physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation, or the presence of litter and debris. For purposes of the RI/FS, land above the OHWM is referred to as "upland" and the portion of the riverbank/sediment below the OHWM is referred to as "in-water." The OHWM at the Site appears to correspond to a vertical elevation of approximately 14 feet relative to the North American Vertical Datum of 1988 (NAVD88).

The 2000 RI, 2006 HHRA, and 2006 ERA concluded that upland portions of Area 2 would not be part of active remediation to address residual creosote (AMEC, 2008). DEQ approved a Conditional No Further Action (NFA) request for Area 2 provided the Port met the following conditions:

1. Any soil excavated on the Site would have to be sampled according to a soil management plan approved by DEQ and the soil managed appropriately based on sampling results;
2. Any excavation would be managed under an appropriate health and safety plan;
3. Use of groundwater at the Site would be restricted; and
4. Soil erosion would be controlled using best management practices.

Most supplemental RI activities occurred within Area 1 and in-water areas offshore of Area 1. However, this Updated Supplemental RI Report includes the findings of shoreline inspections conducted adjacent to Area 2. Data presented are generally those collected since 2010 and the start of the supplemental RI (**Section 1.2**), with some exceptions as noted within the report.

1.2 OBJECTIVES AND PHASES OF THE SUPPLEMENTAL REMEDIAL INVESTIGATION

The following RI data gaps required resolution prior to moving forward with completion of the FS:

1. Define the lateral and vertical extent of creosote as a nonaqueous phase liquid (NAPL) in offshore sediment adjacent to the Site;
2. Further define the upland extent of NAPL and/or contaminated soil areas potentially contributing to offshore contamination;
3. Further assess groundwater conditions beneath Area 1 and the quality of groundwater discharging into the adjacent surface water bodies (Scappoose Bay and Milton Creek); and
4. Further evaluate risk to aquatic receptors near but outside the offshore extent of NAPL.

Between 2008 and 2013, multiple supplemental RI activities were conducted on behalf of the Port to delineate the nature and extent of creosote-related impacts within Scappoose Bay and Milton Creek adjacent to the former wood treatment operations (i.e., Area 1). In July 2011, DEQ requested the characterization of dissolved-phase creosote constituents in sediment porewater outside the NAPL delineated areas. The initial porewater assessment was completed in 2012, except for beneath the unstable former transfer table dock. The transfer table dock deck was removed,

allowing sediment beneath the dock to be investigated in October 2013. On May 22, 2014, a draft Supplemental RI report, with updates to the HHRA and ERA, was submitted to DEQ (AMEC, 2014). In March and September 2015, DEQ issued a series of comments on the draft Supplemental RI Report on (DEQ, 2015a, 2015b), which led to a dispute with the Port over the need for active remediation within approximately 6 acres of Scappoose Bay. Working closely with DEQ, the Port completed additional offshore data gap investigations between 2017 and 2018 to further assess risk to ecological receptors within the disputed offshore areas (Cascadia, 2017a, 2017b, 2017c 2018, 2019a). The results of these latest supplemental RI activities led DEQ to conclude that the objectives of the RI had been fulfilled. Completion of the RI objectives facilitated the identification of upland and in-water "priority action areas" (PAAs) requiring active remedy consideration in the FS versus those offshore areas where remedies less invasive than capping or dredging, such as enhanced or monitored natural attenuation, are likely to be appropriate (DEQ, 2019a). The PAAs are characterized by (1) creosote as NAPL in media (soil, groundwater, sediment, surface water) that is readily accessible to human and ecological receptors (e.g., groundwater seep in riverbank, upper 1 foot of sediment, surface water), and/or (2) contaminant concentrations that result in unacceptable ecological risk with a high degree of certainty (e.g., dissolved-phase constituents above ecological criteria).

NAPL is a term used to describe the petroleum hydrocarbons in creosote that exist as a separate, immiscible phase when in contact with water and/or air. Differences in the physical and chemical properties of water and NAPL result in the formation of a physical interface between the liquids which prevents the two fluids from mixing. The upland extent of NAPL includes areas where a distinct immiscible phase creosote liquid was observed in subsurface soil samples or measured in groundwater monitoring wells. The offshore extent of NAPL includes sediment, riverbank seeps, porewater, and surface water areas exhibiting a moderate to heavy petroleum sheens.

1.3 REPORT ORGANIZATION

This Supplemental RI Report contains the following sections.

1. Introduction.
2. Site Background – A summary of current and past land use, prior environmental studies conducted at the Site, the previous understanding of Site physical conditions (soil and groundwater), and the previous understanding of Site-related contamination.
3. Supplemental RI Activities – A summary of investigation activities conducted under the supplemental RI.
4. Updated Site Setting – A summary of the Site setting (geology and hydrogeology) based on the supplemental RI activities.

5. Nature and Extent of Contamination – A summary of Site contamination in soil, groundwater, groundwater seeps, sediment, sediment porewater, surface water, and the occurrence of NAPL.
6. Contaminant Fate and Transport – A description of contaminant transport from release areas to areas where contaminants are currently distributed in various Site media.
7. Beneficial Water Use Determination – An update of the Beneficial Water Use Determination (BWUD).
8. Data Completeness Evaluation – A summary of supplemental RI data collected and an evaluation of the completeness of those data (i.e., whether supplemental RI objectives have been met).
9. Conceptual Site Model – An updated summary of the Conceptual Site Model (CSM).
10. Risk Assessment Conclusions – A summary of project conclusions for human health and ecological receptors.
11. Hot Spots and Priority Action Areas – A summary of the determination of Site hot spots, as defined in DEQ guidance, and identification of priority action areas.
12. Conclusions – A summary of key conclusions from the RI and supplemental RI activities, including a statement of RI completion and next steps.

2.0 SITE BACKGROUND

A wood-treating facility was established at the Site in 1912, and wood-treating operations continued until 1960. The primary wood-treating formula used was creosote. Pentachlorophenol (PCP) and chromated copper arsenate were apparently used in limited quantities in 1953/1954. The Port purchased the property in 1963, and since then, the Site has either been vacant or leased for the following industrial uses:

- Pole peeling and pole storage facility (1974 to 1991);
- Storage yard for a marine construction/dredging company (1993 to 1998);
- Small private wood-working business (2000 to 2005);
- Marine log salvage and sawmill (2006 to 2008);
- Log storage, pole peeling, and sawmill (2009 to 2012); and
- Miscellaneous small-scale private businesses (2014 to present).

Historical site plans and aerial photographs are provided in **Appendix A**.

The Site was vacant between 1960 and 1974 after the wood-treating plant was removed by P&T. The Port arranged for the Site to be filled in the early 1970s in an effort to level and raise its surface grade by several feet. Fill material is reported to consist of dredge material generated from deepening of the Columbia River. This fill material overlies native alluvium that represented the ground surface during the time of wood-treating operations, and comprises the fill identified in RI boring logs, as further discussed in **Section 2.3.1**.

2.1 LAND USE

The Site encompasses 42 acres located within the city limits of St. Helens, Oregon. The Site is generally vacant, aside from a leased shop/warehouse building located in the western half of the Site. Adjacent land uses include railroad tracks and undeveloped land to the north and City-owned industrial development (formerly Boise Paper Solutions) to the northeast. Milton Creek forms the western Site boundary, and Scappoose Bay and the Multnomah Channel of the Willamette River form the southern and eastern Site boundaries. An aerial photograph showing Site conditions as of 2018 is provided in **Figure 1-2**.

The Site is currently designated as part of the Railroad Avenue Industrial Park (RAIP) by the Port. The RAIP is zoned as Heavy Industrial by the City of St. Helens (City of St. Helens, 2012; Port, 2012). The Heavy Industrial zoning designation is intended to provide appropriate locations for intensive manufacturing activities in areas separated from sensitive land uses, such as schools (City of St. Helens, 2014). Permitted and conditional uses for land zoned for Heavy Industrial use are described in the City of St. Helens Municipal Code, Section 17.32.140.

2.2 PREVIOUS STUDIES

Studies conducted prior to the 2000 RI Report are described in Section 3 of that report and are identified below.

Pre-RI Activities

- The United States Environmental Protection Agency (EPA) conducted a site inspection in 1989 (Ecology & Environment, Inc., 1990).
- P&T conducted a "Vadose Zone Contamination Investigation" of the site in 1993 (Harding Lawson Associates [HLA], 1994).

Studies used as part of the original 2000 RI Report are identified below.

1996-1998 RI Activities

- P&T and the Port initiated the RI in 1996 with an investigation of upland soil and groundwater and in-water sediment and surface water immediately adjacent to the Site's shorelines (GeoEngineers, 2000). All media samples were submitted for chemical analysis for one or more of the following contaminants of potential concern (COPC): total petroleum hydrocarbons (TPH); volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), chlorinated phenols; dioxins/furans, and select metals (arsenic, cadmium, chromium, copper, lead, and zinc).
- In 1998, P&T and the Port further investigated surface soil, subsurface soil, groundwater, riverbank seeps, surface water, and bedrock (including permeability testing) for creosote-related constituents. Additionally, Site roadbed material (surface soil) was evaluated for the presence of polychlorinated biphenyls (PCBs; GeoEngineers, 2000).

Studies conducted after the data set used in the 2000 RI Report, but before the commencement of the supplemental RI in 2010, are summarized below.

1999-2006 RI/RA Activities

- Annual groundwater monitoring was conducted in 1999, 2000, 2001, 2003, 2004, 2005, and 2006 (Bridgewater Group, Inc., 2004, 2005, 2006). Groundwater samples were analyzed for TPH, benzene, toluene, ethylbenzene, and total xylenes (BTEX); polycyclic aromatic hydrocarbons (PAHs); and dissolved metals (arsenic, cadmium, chromium, copper, lead, and zinc).
- Sediment sampling was completed in 2003, 2004, and 2005 as part of an ERA (Bridgewater Group, Inc., and Kennedy/Jenks Consultants, 2006). Offshore surface sediment samples obtained adjacent to the Site and from background locations were analyzed for one or more of the following constituents: PAHs, arsenic, total organic carbon (TOC), total sulfides, ammonia, grain size distribution, and bioassay testing.

- A baseline HHRA and ERA was completed in 2006 (Bridgewater Group and Kennedy Jenks Consultants, 2006).

2.3 PHYSICAL SITE CONDITIONS

The current understanding of Site physical conditions is largely unchanged from that presented in the 2000 RI Report.

The former P&T facility was constructed on an outcrop of Columbia River basalt bedrock thinly mantled with recent alluvial sediments. The Site, located along the western boundary of the Portland basin, is within a complex of streams, sloughs, and wetlands where regional groundwater discharges. The topography of the Site upland areas is relatively flat, with a gentle downward slope toward Area 2 from the central portion of Area 1. The shoreline along Scappoose Bay/Multnomah Channel and Milton Creek is generally characterized by relatively steep, vegetated embankments. The elevation of the Site ranges between approximately 15 and 25 feet (relative to NAVD88). Area 1 upland topography and in-water bathymetry is illustrated on **Figure 2-1**. The Site margins, particularly the northeastern portion, are prone to annual flooding. As mentioned above in **Section 1.1**, land above the OHWM (approximately 14 feet NAVD88) is referred to as "upland" and the portion of the riverbank/sediment below the OHWM is referred to as "in-water."

2.3.1 Soil Conditions

Soil encountered at the Site consists of fill underlain by native soil, which in turn is underlain by basalt bedrock. A summary of the subsurface conditions is provided below; more detail on each of these units, based on information from the 2000 RI and 2014 supplemental RI, is provided in **Section 4.1**. **Figure 2-2** shows a conceptual cross section of each these units:

- The imported fill consists predominantly of dredge sand with localized areas of silt, coarse gravel, cobbles, wood chips, and metal and brick debris. For the purposes of this report, this unit is defined as the "Fill Zone."
- Native soil beneath the Fill Zone consists primarily of silt with varying amounts of fine sand, clay, and organic matter. Basalt fragments was encountered near the transition to bedrock. For the purposes of this report, this unit is defined as the "Native Soil."
- Basalt bedrock was generally encountered at depths between 6 and 35 feet below ground surface (bgs). Bedrock beneath the Site is part of the Grande Ronde flows of the Columbia River Basalt. For the purposes of this report, this unit is defined as the "Basalt Bedrock."

2.3.2 Groundwater Conditions

Groundwater encountered beneath the Site is unconfined and resides seasonally within the Fill Zone and within the Native Soil and Basalt Bedrock (**Figure 2-2**). A summary of groundwater conditions is provided below, as supported by Table 4 and Appendix B of the 2000 RI Report.

- Shallow groundwater beneath the Site occurs from immediately below the ground surface to depths of about 12 feet bgs, depending on the season.
- The water table generally replicates the surface topography in the upland/central portion of the Site, with maximum groundwater elevations in the central portion of the Site and groundwater flow (discharge) to the nearest surface water body.
- Hydraulic conductivity within the Fill Zone is approximately 1 to 2 orders of magnitude greater than within the Native Soil. Hydraulic conductivity within the Native Soil is generally 2 to 3 orders of magnitude greater than in the underlying Basalt Bedrock, in the limited locations where the basalt had sufficient permeability for testing.

Additional details regarding the Site's hydrogeologic conditions are presented in **Section 4**.

2.4 PREVIOUS UNDERSTANDING OF SITE-RELATED CONTAMINATION

The previous understanding of the nature and extent of soil, groundwater, and surface water contamination for the Site was based on results of the RI, as presented in the 2000 RI Report. The approximate locations of upland RI explorations and sampling locations are shown in the 2000 RI Report, Figures 7 through 10, and are included on **Figure 2-3** in this report.

The previous understanding of the nature and extent of sediment contamination offshore from the Site was based primarily on surface sediment sampling and analysis performed for the ERA in 2003 through 2005, as presented in the ERA Summary Report (Bridgewater Group, Inc., and Kennedy/Jenks Consultants, 2006).

Previous environmental investigations and risk assessments and the associated reports addressed the entire Site; however, the following summary of contaminant conditions focuses on Area 1 of the Site.

2.4.1 Contaminants of Potential Concern

COPCs that have been identified for the Site are presented in the Final Work Plan (GeoEngineers, 1996). The list of COPCs was developed based on the EPA presumptive remedies guidance document (EPA, 1993) and data presented in Appendix C of the 2000 RI Report. In general, the Site's list of COPCs in upland soil, groundwater, surface water, and/or sediment resulting from the historical wood-processing and -treating activities that occurred at the Site consists of the following:

- TPH;
- VOCs and SVOCs;
  - PAHs make up the majority of SVOCs detected in Area 1, resulting from the use of creosote as the primary wood-treatment product;

  - Certain petroleum-related VOCs, likely originating from the use of "fuel oil" as a creosote solvent or carrier oil;

- Certain metals, resulting from limited use of metal-based wood-treating chemicals during Site operations;
- Minor amounts of PCP and dioxins/furans, resulting from a very limited period (months) of PCP use reported at the Site; and
- Minor amounts of PCBs in surface soil, resulting from apparent presence of PCBs in roadbed oil placed on the Site surface after the wood-treating plant ceased operations and the dredge sand fill had been placed on the Site.

2.4.2 Source Areas

The former wood-treating operations resulted in releases of related raw materials and wastes to the historical (1919 through 1959) ground surface within Area 1. Specific releases are not documented; for the purpose of the RI, sources are defined based on knowledge of historical operations and investigation results that are indicative of creosote releases to the former ground surface (i.e., contamination near the Fill Zone/Native Soil contact). During plant operations, leaks and spills of creosote, a dense non-aqueous phase liquid (DNAPL[1]), seeped into the ground and collected in the Native soil above the Basalt Bedrock within an approximately 4-acre portion of Area 1.

The main upland source area at the Site includes the former wood-treatment plant (i.e., retort pump house and retorts) and former creosote and fuel oil aboveground storage tanks (ASTs) located west and northwest of the wood-treatment plant. This area generally is encompassed by the extent of NAPL as defined through RI activities. Other ancillary operations located within Area 1 appear to have contributed to more localized subsurface contamination in upland areas, such as the yard west of the former ASTs, the buried creosote pipeline, and former transfer table (upland portion). Other ancillary operations immediately adjacent to Area 1, such as the historical wastewater discharge pipe, the former hog fuel loading dock and hopper, and the former transfer table dock, appear to have contributed to more localized contamination of surface and/or near-surface sediment in shoreline and in-water areas. Another significant source of in-water impacts is creosote contaminated wood debris derived from log peeling operations, hog fuel storage and other plant activities. This wood waste material appears to have been shed from the upland, over-water operations, and/or from log rafts historically moored along the shoreline. The woody material, much of it saturated with creosote, settled out over time and eventually was incorporated into the offshore sediment profile. Presently, creosote contaminated wood debris occurs along approximately 1,500 feet of the Scappoose Bay shoreline, extending from the manmade cove

[1] The terms NAPL and DNAPL are used interchangeably in this report.

downstream to the boundary between upland Area 1 and 2. An additional area of creosote contamination was recently discovered offshore of Area 2.

2.4.3 Soil Contamination

Field evidence of creosote contamination was observed in soil samples obtained from most of the RI explorations completed in Area 1, generally near the Native Soil/Basalt Bedrock contact (2000 RI Report Appendix C, Tables C-1 through C-6). Soil contamination related to wood-treating compounds was not encountered at depths of less than 5 feet in any of the Area 1 explorations. In explorations completed within close proximity of the former wood-treating operations, creosote impacts were observed throughout the entire thickness of the Native Soil unit (depths ranging between about 5 feet bgs to the Native Soil/Basalt Bedrock contact at approximately 18 feet bgs). The vertical thickness of creosote-impacted soil appears to decrease with distance from the wood treatment plant and ASTs and is mainly limited to the vicinity of the Native Soil/Basalt Bedrock contact (depths greater than 10 feet bgs). The distribution of creosote-affected soil in the Area 1 explorations was initially interpreted to have resulted from creosote spreading laterally across the upper surface of Basalt Bedrock, and to a lesser extent along the Fill Zone/Native Soil contact; however, more recent data and analysis suggest lateral migration is a minor factor in creosote distribution, as discussed further in **Section 6.3**.

Soil impacted by TPH (specifically oil-range hydrocarbons) was encountered in explorations MW-4A/MW-4B and MW-5, which were completed behind the existing office/shop building at depths of 3 and 5 feet bgs. This localized area of oil-impacted soil located west-northwest of the former wood treatment operations does not exhibit a creosote signature.

2.4.4 Groundwater Contamination

In general, TPH, VOCs, and SVOCs associated with creosote were detected in groundwater samples obtained from monitoring wells and Geoprobe® explorations completed in the vicinity of the former wood treating operations (2000 RI Report Appendix C, Tables C-7 through C-16). BTEX represents the majority of VOCs detected in groundwater samples, whereas PAHs represent the majority of the SVOCs detected in groundwater samples. Relatively low levels of metals and chlorinated phenols were detected in Area 1 groundwater samples.

2.4.5 Nonaqueous-Phase Liquid

A visible creosote-petroleum product, described herein as NAPL, was observed in subsurface soil samples and in groundwater monitoring wells in Area 1 (represented by the shaded upland area shown on Figure 27 of the 2000 RI Report). NAPL present in this portion of the Site appears to have resulted from the proximity of this area to the former wood treating plant and the topography of the Basalt Bedrock surface. The specific gravity (density), viscosity, and interfacial tension of the NAPL that has periodically accumulated in monitoring wells MW-2 and MW-3A ranges between 0.99 and 1.041 grams per milliliter (g/mL), 30 and 48 centipoise, and 22.2 and 22.9 dynes per centimeter, respectively (Section 7.2.3.2 of 2000 RI Report). The bedrock significantly inhibits downward

vertical migration of the NAPL, based on the physical properties of creosote samples and *in-situ* hydrogeologic data gathered from RI rock core borings.

Chemical analysis of NAPL collected from the bottom of MW-2 and MW-3A indicated the residual creosote is dominated by diesel-range hydrocarbons (which did not match the diesel standard fingerprint) and PAHs (Tables C-18 through C-21 of 2000 RI Report).

Confirming the vertical and lateral extent of upland NAPL and/or areas of contaminated soil potentially contributing to offshore contamination was an objective of the supplemental RI (DEQ, 2010a). Defining the lateral and vertical extent of NAPL beneath Milton Creek and Scappoose Bay adjacent to Area 1 and Area 2 was identified as one of the most important RI data gaps and supplemental RI objectives (DEQ, 2010a).

2.4.6 Seep Water

During periods of low surface water, small localized groundwater seeps have been observed along the steeper sections of the Scappoose Bay and Milton Creek shoreline adjacent to Area 1. Many of these seeps appear to daylight near the Fill Zone/Native Soil interface. Creosote-impacted seeps occasionally are accompanied by a sheen or visible NAPL, although at times the sheen has been a natural (organic) sheen not related to creosote. The platy relatively odorless biogenic sheens, (easily distinguished from the fluid and odoriferous petroleum sheens), likely emanate from areas where upland creosote contamination and wood debris is more completely biodegraded. BTEX and PAHs were detected in October 1998 seep water samples obtained from the Scappoose Bay and Milton Creek shorelines (Section 7.2.4, Figures 10, 23, 24, 25, and Tables C-24 and C-25 of the 2000 RI Report).

2.4.7 Sediment

Shallow sediment conditions (upper 10 centimeters [cm]) along the Area 1 shoreline at the Site were explored by obtaining a series of discrete and composite sediment samples along eight transects and background locations as part of the RI and initial phases of the ERA. The approximate locations of RI and ERA sediment samples are shown on Figure 7 of the 2000 RI Report and on **Figure 2-3**.

Four rounds of surface sediment sampling and analysis were performed along and/or offshore of Site Area 1 and Area 2, with sampling events in 1996, 2003, 2004, and 2005.

The 1996 samples were collected as composite and discrete samples from segments along the Milton Creek and Scappoose Bay shorelines adjacent to Areas 1 and 2. The 2003, 2004, and 2005 samples were primarily collected offshore of Area 1 with a few surface sediment samples obtained upstream and downstream of the Site. The PAH concentrations measured in the 2003 to 2005 sediment samples (with total PAHs ranging from 0.04 to 192 milligrams per kilogram [mg/kg]) are generally consistent with the concentrations measured in the 1996 samples (with total PAHs ranging from 0.18 to 49 mg/kg), although variations were noted in specific samples collected

within close proximity of one another. These variations in sediment bulk chemistry appear to be a function of sediment heterogeneity (e.g., irregular creosote distribution, presence of treated wood debris, varying grain size distribution, and varying amounts of organic material) and not attributed to temporal changes in contaminant mass flux from upland source areas.

Two rounds of bioassay tests were performed for the 2006 ERA to evaluate potential risk to resident benthic invertebrate populations (Bridgewater Group, Inc., and Kennedy/Jenks Consultants, 2006, Section 2.3). The total PAH concentrations in the 18 samples submitted for bioassay testing ranged from 5 mg/kg (in a reference area sample) to 80 mg/kg. Bioassay testing comprised the following three tests:

1. 10-Day amphipod survival test (*Hyalella azteca*);
2. 10-Day midge survival test (*Chironomus tentans*); and
3. 10-Day midge growth test (*Chironomus tentans*).

All of the sediment samples passed the bioassay testing protocols, with no sediment samples causing a significant or marked toxicity response in test organisms compared to control samples. These results appear to indicate that standard screening benchmarks used to evaluate the potential toxicity of PAHs in sediment (e.g., threshold effect level, probable effect level, threshold effect concentration, median effect concentration, and extreme effect concentration) overestimate the toxicity of creosote-derived PAHs and TPH to benthic invertebrates. It is important to note that none of the sediment samples submitted for bioassay testing contained NAPL. Statistically significant toxicity is expected in sediments with NAPL or total PAH concentrations greater than 250 mg/kg (Anderson et al., 2011). However, the upstream reference samples used for statistical comparison exhibited significant organism mortality rates confounding the results of the bioassay testing conducted as part of the 2006 ERA.

Defining the extent of NAPL in surface sediment adjacent to Site Area 1 and Area 2 and monitoring the bioavailable fraction of residual creosote contamination in surface sediment became important supplemental RI objectives. A clearly related objective that primarily affects the FS was to evaluate whether or not migration of NAPL and/or dissolved-phase contamination into the biologically active zone of sediment (i.e., within 12 inches mudline) is actively occurring and/or is likely to occur in the future (via shoreline seeps or from deeper sediment contamination).

3.0 SUPPLEMENTAL RI ACTIVITIES

As discussed in **Section 1.2**, the supplemental RI work was intended to address data gaps in the RI previously completed for the Site in 2000, and tasks DEQ identified as necessary to be completed prior to preparing an FS. The data collection events discussed in this section comprise the following:

1. Groundwater quality monitoring in September 2010, August 2011, and February, May, and August 2012;
2. Area 1 shoreline NAPL inspections in 2010, 2011, and 2012;
3. TarGOST® investigation (Phase 1 delineation of NAPL) in 2011;
4. Offshore / upland borings and sediment / soil sampling and analysis (Phase 2 delineation of NAPL) in 2011;
5. Sediment porewater (*ex-situ*) with co-located bulk sediment sampling in July 2012 (high river stage and high groundwater elevation) and October 2012 (low river stage and low groundwater elevation);
6. Dock Area Investigation in 2013 (NAPL delineation and bulk sediment sampling);
7. Assess offshore groundwater discharge areas and surface sediment sheen occurrence in 2017;
8. Surface water, sediment porewater (*in-situ*) and co-located bulk sediment sampling in 2017; and
9. Area 2 shoreline NAPL inspection in 2018.

Supplemental RI has been completed under the following work plans:

- *Draft Supplemental Remedial Investigation Work Plan for Area 1* (Draft Supplemental RI Work Plan) dated August 13, 2010 (AMEC, 2010a). The Draft Supplemental RI Work Plan encompassed the tasks identified in the May 20, 2010 DEQ-provided scope of work and is a continuation of the 1995 Order.
- *Final Revised Supplemental Remedial Investigation Work Plan*, submitted to DEQ on January 3, 2011 (Supplemental RI Work Plan) (AMEC, 2011a).
- *Addendum to the Supplemental Remedial Investigation Work Plan for Area 1*, submitted to DEQ on May 24, 2011 (AMEC, 2011b).
- *Sediment Porewater Sampling (PWS) Work Plan* dated June 2012 (PWS Work Plan) (AMEC, 2012b).
- *Revised Work Plan for Limited Sediment Investigation (LSI)* (a.k.a., Beach Coring Investigation), dated September 27, 2012 (LSI Work Plan) (AMEC, 2012c).

- *Work Plan for Dock Area Investigation (DAI)*, dated September 16, 2013 (DAI Work Plan) (AMEC, 2013b).
- *Phase 1 and 2 Offshore Data Gap Investigation Work Plan*, April 26. 2017 (Cascadia, 2017a); and
- *Phase 3 Offshore Data Gap Investigation Work Plan*, dated August 29, 2017 (Cascadia, 2017c).

The following sections describe the specific objectives and scope of work for each supplemental RI data collection event. A list of sample/analysis locations and dates is provided in **Table 3-1**, and sampling/analysis locations are shown on **Figure 3-1**. Investigation results are discussed in **Section 4.0** (Updated Site Setting) and **Section 5.0** (Nature and Extent of Contamination). Details regarding field methods are provided in **Appendix B**.

3.1 GROUNDWATER MONITORING, 2010 THROUGH 2012

One of DEQ's objectives for the supplemental RI was to confirm current groundwater conditions beneath Area 1, the extent of DNAPL, and the quality of groundwater discharging from Area 1 uplands to the adjacent surface water bodies. Area 1 monitoring well locations are shown on **Figure 3-2**.

Groundwater monitoring data were overlain on top of the estimated lateral extent of NAPL in soil to identify areas of the Site where creosote NAPL may be functioning as a source of dissolved-phase groundwater contamination (source material). The term "source material" is adopted from EPA (EPA, 1991) and is generally defined as "material that contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, to air, or acts as a source for direct exposure."

Eight new groundwater monitoring wells were installed as part of the supplemental RI to: (1) confirm the lateral extent of NAPL, (2) further investigate the presence of NAPL near Milton Creek, and (3) replace damage well MW-2 with MW-2A to further investigate the thickness of NAPL present in the source area. Following installation of the new wells, the monitoring well network in Area 1 comprised the following twenty (20) wells: MW-1, MW-2A, MW-3A, MW-3B, MW-4A, MW-4B, MW-5, MW-6A, MW-7, MW 8, MW-9, MW-10, and MW-18 through MW-25.

In accordance with the Supplemental RI Work Plan (AMEC, 2011a), four consecutive quarters of groundwater and NAPL monitoring have occurred at monitoring wells located within Area 1. Groundwater monitoring for the supplemental RI was conducted on the following dates:

- September 7 and 8, 2010 (baseline sampling conducted during supplemental RI work plan development);
- August 8 and 9, 2011 (first quarterly event);
- February 20 through 22, 2012 (second quarterly event);

- May 3 and 4, 2012 (third quarterly event); and
- August 14 and 15, 2012 (fourth quarterly event).

The scope of each investigation is summarized in the sections below. Groundwater samples were collected using low-flow sampling techniques with a peristaltic pump connected to new polyethylene tubing lowered to the middle of the screened interval. Groundwater quality parameters were measured during well purging to ensure that the samples were representative of formation water. Boring and well construction logs are provided in **Appendix C**, and the chemical analytical program is discussed in **Appendix D**.

3.1.1 September 2010

Groundwater quality monitoring was conducted on September 7 and 8, 2010, as part of developing the Supplemental RI Work Plan (AMEC, 2010b). Site monitoring wells were gauged to determine groundwater elevations, two surveyed surface water monitoring points were gauged to determine the surface water elevation, and monitoring wells in Area 1 were sampled. Monitoring wells MW-12A and MW-12B were not locatable during gauging event, and monitoring wells MW-7 and MW-8 were dry and could not be gauged or sampled.

Groundwater samples were collected from all existing monitoring wells in Area 1 except for except for those wells noted above. Specifically, samples were collected from monitoring wells MW-1, MW-3A, MW-3B, MW-4A, MW-4B, MW-5, MW-6A, MW-9, MW-10, and MW-18.

Groundwater samples were analyzed for the following constituents (**Table 3-1**):

- Fuels, including gasoline-range hydrocarbons by Method NWTPH-Gx and diesel- and oil-range hydrocarbons by Method NWTPH-Dx, and selected samples were also analyzed by Method NWTPH-HCID;
- Dissolved metals (arsenic, cadmium, chromium, copper, lead, and zinc) by EPA Method 6020;
- VOCs (BTEX only) by EPA Method 8260B; and
- PAHs by EPA Method 8270D SIM.

As requested by DEQ, a groundwater sample was collected from the base of the screened interval in MW-1 to assess whether or not constituent concentrations would be higher in groundwater samples collected from deeper in the screened interval and closer to the top of the Basalt Bedrock, where DNAPL may preferentially accumulate. In general, detected concentrations of BTEX, dissolved metals, PAHs, and total petroleum hydrocarbons were slightly higher in samples collected from the bottom of the screened interval as compared with samples collected from mid-screen. Detections from samples collected at the bottom of the screened interval were on average 17 percent higher than from samples collected at mid-screen (AMEC, 2010b).

3.1.2 August 2011

Between July 18 and July 25, 2011, eight additional groundwater monitoring wells (MW-2A and MW-19 through MW-25) were installed in Area 1 as part of the supplemental RI. Details regarding installation of the additional supplemental RI groundwater monitoring wells are provided in **Section 3.4.2**.

In accordance with the supplemental RI Work Plan (AMEC, 2011a), the first of four consecutive quarterly groundwater monitoring events was conducted on August 8 and 9, 2011 (AMEC, 2012a). Monitoring wells across the entire Site were gauged to determine groundwater elevations, two surveyed surface water monitoring points were gauged to determine the surface water elevation, and monitoring wells in Area 1 were sampled. Wells MW-8, MW-10, and MW-16 were not gauged because MW-8 was dry, an obstruction was present in MW-10 about 4 to 5 feet below the top of the casing, and MW-16 could not be located due to surface obstructions.

Groundwater samples were collected from monitoring wells MW-1, MW-2A, MW-3A, MW-3B, MW-4A, MW-4B, MW-5, MW-6A, MW-9, MW-18, and MW-19 through MW-25.

Groundwater samples were analyzed for the following constituents:

- Diesel-range hydrocarbons by Method NWTPH-Dx;
- Dissolved metals (arsenic, cadmium, chromium, copper, lead, and zinc) by EPA Method 6020; and
- PAHs by EPA Method 8270D SIM.

3.1.3 February, May, and August 2012

The remaining three quarterly groundwater quality monitoring events took place in February, May, and August 2012 (AMEC, 2013a). During each event, Site monitoring wells from both Area 1 and Area 2 were gauged to determine groundwater elevations, and two surveyed surface water monitoring points were gauged to determine the surface water elevation in Scappoose Bay and Milton Creek. All monitoring wells within Site Area 1 were sampled during each event, with a few exceptions as noted below.

The depth to groundwater was measured in Site groundwater monitoring wells on February 20, May 3, and August 14, 2012. Wells MW-8 and MW-16 were not gauged because MW-8 was dry, and MW-16 could not be located. Water levels in Scappoose Bay and Milton Creek were measured during each event.

The February sampling event was completed on February 20 to 22; the May sampling event was completed on May 3 and 4; and the August sampling event was completed on August 14 and 15. During each event, groundwater samples were collected from the existing network of monitoring wells in Area 1 except for MW-8 and MW-16, for the reasons stated above. Well MW-7 was sampled only in May, because it contained insufficient water to sample during the other events. Samples were

collected during all three events from monitoring wells MW-1, MW-2A, MW-3A, MW-3B, MW-4A, MW-4B, MW-5, MW-6A, MW-9, MW-10, and MW-18 through MW-25.

Groundwater samples were analyzed for the following constituents:

- Diesel-range hydrocarbons by Method NWTPH-Dx;
- Dissolved metals (arsenic, cadmium, chromium, copper, lead, and zinc) by EPA Method 6020; and
- PAHs by EPA Method 8270D SIM.

Additional groundwater samples were collected during the August 2012 event for the following additional analyses:

- Groundwater samples from monitoring wells MW-3A, MW-21, and MW-24 were collected and analyzed for freely dissolved PAHs in accordance with ASTM International (ASTM) Standard Test Method D 7363-11 (Determination of Parent and Alkyl Polycyclic Aromatics Using Solid-Phase Microextraction [SPME] and Gas Chromatography/Mass Spectrometry in Selected Ion Monitoring Mode). A total of 34 PAH analytes are reported by this method, which is designed to remove colloids suspended in groundwater samples. These samples were collected with the intention of comparing groundwater quality at selected monitoring wells in the upland source area to results from offshore sediment and porewater samples. It is important to note that the August 2012 groundwater samples from MW-3A were significantly more turbid than samples obtained from MW-21 and MW-24. The impact of turbidity on the analytical results in groundwater is discussed in more detail in **Section 5.4**.
- A sample of NAPL was collected from monitoring well MW-3A by lowering the tubing to the bottom of the screened interval after a water sample was collected from the middle of the screened interval. The sample was analyzed for 34 PAHs by EPA Method 8270 to assist in understanding the chemistry of source area NAPL as it relates to NAPL observed in offshore sediment.

3.2 SHORELINE INSPECTIONS

One of DEQ's objectives for the supplemental RI was to map the lateral and vertical extent of NAPL along the Site's shorelines during periods of low surface water levels. As mentioned in **Section 1.0**, during a September 2008 Site visit during low-water conditions, visual and olfactory evidence of creosote-impacted surface sediment was noted along various portions of the Scappoose Bay and Milton Creek shoreline adjacent to Area 1. Potential contributing sources to these surface sediment impacts include historical direct discharge (e.g., wastewater discharge, over-water dock/transfer table operations, hog fuel storage), upland NAPL migration, and/or discharge of contaminated groundwater. Additional investigation of surface and subsurface sediment contamination was requested by DEQ for evaluating the extent and source(s) of offshore contamination (DEQ, 2010a). To that end, annual low-water shoreline inspections were conducted between 2010 and 2012

adjacent to Area 1, and again in 2017/2018 along Area 1 and Area 2 shorelines to designate specific areas where NAPL (i.e., creosote sheen, product, and/or tar body) was observed in near-surface sediment, and to refine the locations and boundaries of visible creosote-impacted water seeps in the bank.

Area 1 shoreline inspections along Milton Creek and Scappoose Bay were subsequently performed in 2010, 2011, 2012, and 2017 during low water/low tide (generally in late September and early October), when much of the shoreline sediment within the intertidal zone was visible and directly accessible. Area 2 shoreline inspections along Scappoose Bay performed in 2018 are discussed below in **Section 3.7.6**. The shoreline inspections were designed to document observations and collect sufficient data to bound areas of NAPL impacts, and areas where sediment porewater would be expected to exceed ecological risk-based screening levels. The uppermost foot of sediment, which is the estimated biologically active zone at the Site, is the critical interval for these observations and assessment of risk. Unacceptable risk was defined by either the presence of NAPL or porewater concentrations of COPCs above acceptable levels, as discussed further in **Section 10.0**.

A summary of the scope of each shoreline inspection/investigation is provided in the sections below. Sediment sampling methodology is provided in **Appendix B**. Inspection locations and observations are summarized on **Figure 3-3.** The chemical analytical program, including data validation results, is summarized in **Appendix D**.

3.2.1 2010

On October 4 and 5, 2010, a visual inspection of the Area 1 shoreline was conducted under DEQ oversight to designate specific areas where petroleum sheen, creosote NAPL, and tar bodies were observed in near surface sediment within the intertidal zone of Scappoose Bay and the entire reach of Milton Creek bordering the Site (AMEC, 2010c). The designated, marked shoreline locations were incorporated into subsequent supplemental RI tasks designed to determine the vertical and lateral distribution of shoreline NAPL.

The visual inspection was conducted during daily low tides to observe conditions during maximum shoreline exposure. In Scappoose Bay, saturated sediments as far as 42 feet riverward from the OHWM shoreward were inspected. In Milton Creek, the full reach of the creek from the railroad bridge at the northeast corner of the Site to the discharge point at Scappoose Bay was inspected. Evidence of contamination was observed in multiple locations, indicated by sheen and staining of exposed surface sediments. Some of the sheen observed along Scappoose Bay and Milton Creek was biogenic in nature. The biogenic sheens lack the creosote odor and appear brittle, in that the iridescent appearance on the surface of water cracks, breaks apart, or disaggregates upon disturbance (e.g., touching the sheen). Moreover, biogenic sheens at the Site generally appear to be more blue or bluish purple in color than sheens attributed to creosote.

In contrast, the creosote-related sheens produce a strong odor and are non-brittle, in that the iridescent appearance on the water surface rapidly coalesces upon disturbance. When disturbed, areas of creosote-impacted sediment imparted a visible sheen on the overlying surface water. Within areas of shallow water, field personnel walked across the submerged sediment to look for sheen "blossoms". A sheen "blossom" is the occurrence of a new sheen due to the migration of a droplet of NAPL (e.g., creosote) to the water surface overlying impacted sediment.

Along the shoreline below the OHWM, core samples and pothole samples were removed and investigated in place using visual and olfactory observations. Core samples were advanced to a maximum depth of approximately 18 inches and located using stakes and a hand-held Global Positioning System (GPS) device. DEQ participated in this inspection. The near-shore distribution of creosote was determined to be more heterogeneous and widespread than indicated during previous investigations.

3.2.2 2011

A low-water-level shoreline inspection and surface sediment sampling event was conducted on September 27 and October 6 to 7, 2011, along the east side of Milton Creek and along the Area 1 shoreline of Scappoose Bay (AMEC, 2012a). This field event was conducted to achieve two objectives:

- Compare/confirm 2011 shoreline conditions to conditions observed during the 2010 shoreline inspection at locations where creosote-impacted surface sediment was observed, and
- Collect surface sediment samples at areas of obvious or suspected impact to support the results of the HHRA and ERA.

The October 6 visit corresponded with the mean lower low water (MLLW) level, which is the average of the lowest tide recorded at a tidal station each day during the recording period. Surface water levels during the October 7 visit were 0.20 foot below MLLW. Potholes were advanced to depths of 12 to 18 inches below the sediment surface at locations with visual surface sheens, at locations previously staked (during the 2010 shoreline inspection), near previous seep locations, and near shoreline locations previously investigated during the Tar-specific Green Optical Screening Tool (TarGOST®) and sediment sampling events (**Section 3.3**).

Surface sediment samples were collected at areas of obvious or suspected creosote impact from four locations along the exposed shoreline in Milton Creek (SSED-MC-1 through SSED-MC-4) and nine locations along the exposed shoreline in Scappoose Bay (SSED-1 through SSED-9). Samples were generally collected within the upper 12 inches of sediment within the intertidal zone using a trowel.

Samples SSED-MC-2, SSED-1, SSED-3, and SSED-4 were archived in the laboratory freezer for potential future analysis. The remaining samples were analyzed for one or more of the following:

- TOC by SM 5310B MOD;
- Diesel-range hydrocarbons by Method NWTPH-Dx;
- PAHs by EPA Method 8270D SIM;
- VOCs by EPA Method 8260B;
- Extractable petroleum hydrocarbon (EPH) and volatile petroleum hydrocarbon (VPH) constituents by Method NWTPH-EPH and Method NWTPH-VPH; and
- Total metals (arsenic, cadmium, chromium, copper, lead, and zinc) by EPA Method 6020.

3.2.3 2012

A visual inspection of a focused segment of the Area 1 shoreline along Scappoose Bay was completed in October 2012 as part of the LSI (AMEC, 2013a). The LSI was designed to document observations and collect sufficient data to identify and delineate the extent of NAPL in near-surface sediment along an approximately 625-foot section of the Scappoose Bay shoreline adjacent to the former wood-treating operations, generally between the hog fuel dock and former transfer table (AMEC, 2012c).

During the Area 1 shoreline inspections in October 2010 and 2011, with oversight from the DEQ, surface and near-surface sediment within the intertidal zone exhibiting a creosote sheen was marked with wooden stakes, flagging, and georeferenced using a hand-held GPS receiver. During the 2012 LSI, exposed soil and sediment within the LSI Area between the bank and edge of surface water during low tide was visually inspected for evidence of creosote, paying particular attention to intact stakes, flagging, and existing georeferenced locations. Visible surface contaminants within the LSI Area were documented, and LSI sampling locations were recorded by GPS, photographed using a digital camera, and marked by a wooden stake and flagging.

Shallow hand borings were advanced to depths of 3.5 to 5 feet bgs if possible, and samples were selected for analysis based on similarity to proximal LSI locations, presence of wood debris, and/or observation of slight odor and moderate sheen.

Additional information on sediment sampling during the LSI is provided in **Section 3.5**.

3.3 TARGOST® NAPL DELINEATION, 2011

The supplemental RI activities included delineation of upland and offshore NAPL using TarGOST® to address DEQ's objectives 1 and 2, as outlined in **Section 1.2** (AMEC, 2011a). TarGOST® is a technology offered by Dakota Technologies, Inc. (Dakota), and is designed for the detection of NAPL-contaminated zones at wood-treating facilities using laser-induced fluorescence (LIF) technology. Details on the TarGOST® methodology are provided in **Appendix B**.

A total of 110 TarGOST® borings were completed at the Site between March 14 and March 23, 2011 (AMEC, 2011c). A total of 43 upland TarGOST® borings were completed within Area 1 and are designated as S0xx on **Figure 3-1**. The initial upland TarGOST® borings were completed near monitoring well MW-3A in order to calibrate the technology within a known source area. Two upland transects using TarGOST® were completed; one along Milton Creek and one along Scappoose Bay. TarGOST® borings were also completed in and around the inferred upland NAPL area to better define upland source areas requiring remedial action and to assist with effectively positioning new monitoring wells. Upland TarGOST® borings were generally spaced approximately 100 feet apart; however, additional borings were completed in areas of irregular contaminant distribution.

A total of 67 offshore TarGOST® borings were completed in Scappoose Bay and Milton Creek. These borings are designated SD0xx on **Figure 3-1** (AMEC, 2011c). The initial offshore TarGOST® borings were completed within the immediate vicinity of surface sediment that had exhibited creosote impact during the October 2010 shoreline inspection in an effort to calibrate the technology within the aquatic environment.

Periodically during these initial NAPL delineation efforts, soil macrocores were extracted and logged directly adjacent to (collocated with) select TarGOST® Geoprobe® borings. The purpose of the collocated Geoprobe® macrocores was to visually inspect soil or sediment at or near a TarGOST® boring location for comparison to the LIF response. TarGOST® sampling methodology is provided in **Appendix B**. Boring logs for the collocated Geoprobe® macrocores are provided in **Appendix C**.

3.4 OFFSHORE/UPLAND NAPL DELINEATION, 2011

The 2011 offshore/upland investigation was designed to collect information toward achieving DEQ's objectives 1 through 3 as outlined in **Section 1.2**.

The Addendum to the Supplemental Remedial Investigation Work Plan for Area 1 (Supplemental RI Work Plan Addendum) was submitted to the DEQ on May 24, 2011 (AMEC, 2011b). The Supplemental RI Work Plan Addendum included modifications to the scope of work presented in the Supplemental RI Work Plan (AMEC, 2011a). These modifications were based on observations made during the Phase 1 delineation of upland and offshore NAPL using TarGOST® (see **Section 3.3**) (AMEC, 2011c). The scope of work was also modified based on DEQ comments received on May 16, 2011 (DEQ, 2011a). The modifications presented in the Supplemental RI Work Plan Addendum were intended to provide a comprehensive and efficient data collection and analysis program designed to further characterize source-area NAPL and its potential migratory pathways to off-site locations. The modified scope of work was executed as described below. A discussion of deviations from the Supplemental RI Work Plan Addendum are provided in the 2nd Quarter 2011 Progress Report (AMEC, 2011d). Detailed field methodology is provided in **Appendix B**.

3.4.1 Delineation of Offshore NAPL—Depth-Discrete Sediment Sampling

The Delineation of Offshore NAPL—Depth-Discrete Sediment Sampling consisted of a focused sediment investigation based on the results of TarGOST® borings with the following specific objectives:

- To determine if the existing surface sediment dataset is representative of current conditions;
- To confirm the estimated lateral and vertical distribution of creosote NAPL based on TarGOST® results; and
- To further define the depth to the Basalt Bedrock surface and to visually assess whether creosote NAPL was present within the upper surface (i.e., 10 feet) of the Basalt Bedrock matrix.

The Phase 2 offshore borings were completed between July 12 and July 21, 2011. Thirty-one offshore borings were advanced in Scappoose Bay (SB-01 through SB-28 plus borings SB-08A, SB-08B, and SB-08C). Four borings were advanced in, or angled beneath, Milton Creek (MC-01, MC-02, MC-03, and MC-04), plus two angled borings approximately collocated with MC-01 and MC-02 (MC-01A and MC-02A, respectively). Boring locations are shown on **Figure 3-1**. Borings were advanced using a combination of vibracore and sonic drilling / sampling methods. A clamshell Van Veen sampler was used to collect surface sediment samples at selected locations. The borings ranged in depth from 6.1 to 26.5 feet below the mudline (bml; "mudline" generally refers to the surface water/sediment interface).

Soil/sediment samples were collected from the borings at three or more depth intervals:

- Generally, from a near-surface interval at depths of 0 to 0.3 foot bgs (surface samples);
- From just above the Basalt Bedrock contact; and
- Either from the mid-level in the boring or an area of suspected impact.

Suspected areas of creosote impact, determined either by visual or olfactory observations, were subjected to a sheen test. For sheen testing, a small portion of the soil/sediment was placed in a jar and covered with deionized water to see if a petroleum-related sheen formed on the water surface. Photoionization detector (PID) readings were collected at sampled intervals, and soil / sediment samples were field analyzed by ultraviolet fluorescence as a screening tool for creosote NAPL. Field screening of total PAHs, targeted PAHs, and extended diesel-range organics (EDRO) was performed using a siteLAB® portable ultraviolet fluorometer.

All sediment and soil samples from the July 2011 sampling event were analyzed, at a minimum, for the following constituents:

- Diesel-range hydrocarbons by Method NWTPH-Dx; and
- PAHs by EPA Method 8270D SIM.

The vast majority of surface sediment samples (i.e., collected at depths of 0 to 0.3 foot bml) from Scappoose Bay and Milton Creek were also analyzed for the following constituents:

- TOC by EPA Method 415.1/5310B; and
- Grain size.

Twenty sediment samples, including the majority of surface sediment samples collected in Scappoose Bay and Milton Creek, were analyzed for the full suite of 34 PAH homologues by EPA Method 8270D SIM Modified to assist in calculating equilibrium partitioning-based sediment toxic units, as discussed further in **Section 10.2**.

As requested by DEQ, two surface sediment samples collected near the historical transfer table and dock (SB-17 and SB-18) were also analyzed for the following constituents:

- Metals (arsenic, cadmium, chromium, iron, lead) by EPA Method 6020; and
- VOCs by EPA Method 8260B.

A total of three sediment samples collected in the man-made cove area. Two samples (SB-10 and SB-11, located just west of the peninsula), and one depth-discrete sample, (SB-14, located just east of the peninsula) were analyzed for the following:

- VOCs by EPA Method 8260B; and
- EPH and VPH.

Boring logs are provided in **Appendix C**. The chemical analytical program, including data validation results, is summarized in **Appendix D**.

3.4.2 Delineation of Upland NAPL—Additional Groundwater Monitoring Well Installation

Upland delineation of NAPL and additional groundwater monitoring well installation was conducted July 18 through 25, 2011 (AMEC, 2011d). Eight additional groundwater monitoring wells were installed in Area 1 of the Site: MW-2A, MW-19, MW-20, MW-21, MW-22, MW-23, MW-24, and MW-25 to address the following specific objectives:

- Confirm the lateral upland extent of NAPL beneath Area 1 as defined in the 2000 RI Report and by the 2011 TarGOST® investigation;
- Further evaluate NAPL mobility in groundwater beneath Area 1;
- Further investigate potential NAPL or source material near Milton Creek; and

- Replace monitoring well MW-2 (due to collapse of the polyvinyl chloride [PVC] sump in 2007) with MW-2A to investigate the thickness of NAPL present within the former wood treating plant and ASTs.

The groundwater monitoring well borings were advanced through the dredge sand fill and native silt/clay soil units and were extended approximately 1 foot into the upper surface of Basalt Bedrock using sonic drilling techniques. Core samples from well installation boreholes were logged and screened for evidence of NAPL. The field screening methods used were: (1) visual examination, (2) water sheen screening, and (3) headspace vapor screening using a PID.

The supplemental RI monitoring wells were constructed in accordance with Oregon Water Resources Department (OWRD) monitoring well construction standards. The base of each well was equipped with a 12-inch-long vertical solid sump to collect mobile NAPL that potentially may be present. The NAPL collection sump was completed within the upper 1 foot of the Basalt Bedrock, and the top of the sump/bottom of the well screen was set at the same depth as the Native Soil/ Basalt Bedrock interface. A NAPL funnel was installed at the bottom of the screen interval in the sand pack to direct NAPL (if present) into the sump.

The new monitoring well locations are shown on **Figure 3-2**.

3.5 SHORELINE AND OFFSHORE TOXICITY ASSESSMENT, JULY AND OCTOBER 2012

After the Port completed the initial phases of the supplemental RI (mainly upland/offshore NAPL delineation), DEQ more clearly defined the objectives of the sediment characterization program in a letter dated July 6, 2011 (DEQ, 2011b), and in ongoing agency correspondence (meetings, phone calls, and e-mails). As stated in the Sediment Porewater Sampling Work Plan (AMEC, 2012b), the scope of the supplemental RI was refined to focus on the following objectives:

- Determine the bioavailable or bioaccessible concentrations of PAHs associated with creosote releases in sediment porewater occurring within and near the base of the benthic/ biologically active sediment environment.
- Determine a correlation factor or coefficient, if possible, to apply to sediment data for use in Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) modeling (EPA 2003, 2012).
- Evaluate potential temporal variability in bioaccessible PAH concentrations in porewater relative to different river stages and groundwater elevations.
- Delineate the boundary in sediment porewater riverward of NAPL-contaminated sediments for exceedances of the ambient water quality criteria (AWQC) and aquatic screening level values (SLVs) for pyrene and fluoranthene used in the HHRA and ERA.

The 2012 sediment porewater sampling and LSI were designed to collect information toward achieving DEQ's objectives 2 and 4, as outlined in (**Section 1.2**). To this end, the Port conducted a

high-water PWS sampling event in July 2012, and low-water PWS and LSI sampling events in October 2012 (AMEC, 2013a).

The 8- to 11-inch depth interval bml at each PWS sample location was targeted for porewater and bulk sediment subsample collection (i.e., within and near the base of the benthic/biologically active sediment environment). A subset of sediment from shallower depth intervals or strata bml (e.g., 1 to 4 inches and 4 to 7 inches) at each sample location was field screened for creosote-related compounds and held for potential chemical analytical testing. In some instances, the decision to analyze the shallower depth intervals was made during the field event.

Consistent with the PWS task, the biologically active zone (the uppermost foot of sediment) was considered to be the more critical interval for observation during the LSI. During the LSI event, borings generally were advanced by hand auger to 3.5 to 5 feet bgs where possible, whether or not evidence of impact was observed within the uppermost foot. The rationale for having visual observations of soil and creosote conditions within the upper 3.5 to 5 feet of each LSI boring was to evaluate the irregular distribution of NAPL in overlying surface sediment from the western side of the peninsula eastward just past the existing transfer table dock.

Whole or bulk sediment samples were collected for laboratory analysis from 26 locations during the July (high water) and October (low water) PWS events, and from 6 sampling locations during LSI event. Sediment samples were analyzed for the following constituents:

- TPH (LSI samples only) by Method NWTPH-Dx;
- PAHs by EPA Method 8270D SIM; and
- TOC/black carbon by EPA Method 415.1/5310B.

Sediment porewater samples were collected for laboratory analysis (through collection of bulk sediment and laboratory extraction of porewater; see **Appendix D**) from 24 locations during the July high-water event, from 26 locations during the October low-water event, and from 6 locations during the LSI event. Sediment porewater samples were analyzed for 18 parent PAH compounds and 16 groups of alkylated PAH homologues (i.e., 34 total PAH concentrations) using SPME followed by gas chromatography/mass spectrometry (GC/MS) according to ASTM Standard D7363 and procedures developed based on research completed at the University of North Dakota (Hawthorne et al., 2005a/b). Sediment porewater samples were also analyzed for dissolved organic carbon (DOC) using Standard Method (SM) 5310C.

In addition to the planned analyses, the following bulk sediment samples were analyzed for PAHs in January 2013, outside of standard holding times, to confirm unexpected PAH results in the primary October 2012 sample from PWS-13:

- Additional volume from the October PWS-13 sediment sample (effectively duplicate and triplicate samples); and
- Sediment from locations PWS-22 and PWS-24 (near PWS-13) collected in July 2012.

Figures 3-1 and **3-3** show the July and October 2012 PWS and LSI sampling locations. Detailed field methodology is provided in **Appendix B**. The chemical analytical program, including data validation results, is summarized in **Appendix D**.

3.6 DOCK AREA INVESTIGATION, 2013

The DAI focused on an area, primarily beneath the former transfer table dock, that was previously inaccessible for investigation purposes due to the presence of the dilapidated wooden deck. Removal of the overhead dock structure, required for safe investigation of the soil and sediment below, was completed in August 2013.

As mandated by DEQ and described in a September 2013 work plan (AMEC, 2013b), the objective of the DAI was to delineate the lateral and vertical extent of creosote-related contamination in nearshore soil and sediment beneath the former transfer table dock; in particular, to determine the source of creosote NAPL observed in surface soils and sediment beneath the dock (i.e., contaminated wood debris versus subsurface connections with upland NAPL). For the purpose of classifying samples for analysis and in data tables, samples collected from locations below the OHWM were designated as sediment, and samples collected from locations above the OHWM were designated as soil.

The DAI was completed between October 14 and 17, 2013, generally within the approximately 275-foot-long portion of the Scappoose Bay Area 1 shoreline below the former transfer table dock. Access to sampling locations within the DAI sampling area was complicated by water levels, tidal cycles, existing pilings, saturated sediment, and existing wood and metal debris sitting on and just below the sediment surface. Mud mats and plywood were used to extend access into softer sediments for the drilling rig and field personnel. Surficial wood and metal debris were removed, and pilings were cut to provide access to specific sampling locations and reduce safety hazards to the field crew.

In total, 6 sonic borings, 15 direct-push borings, 20 potholes, and 3 hand-auger borings were completed as part of the DAI.

- Sonic borings were completed using a track-mounted, mini-sonic drilling rig. In addition to the four sonic borings completed beneath the former transfer table dock (DAI-SB-01 through DAI-SB-04), two sonic borings (DAI-SB-20 and DAI-SB-21) were completed as requested by DEQ between the Former Operations Area and Scappoose Bay (in the vicinity of monitoring well MW-7) to evaluate potential subsurface migration of NAPL in that area of the Site. Sonic borings were utilized to determine the character of underlying Basalt Bedrock and the presence or absence of contaminant migration along the Native Soil/Basalt

Bedrock (nearshore) contact. Each sonic boring penetrated the underlying Basalt Bedrock by a depth ranging from 0.5 foot in boring DAI-SB-20 to 4 feet in boring DAI-SB-01.

- Direct-push borings were completed using a track-mounted Geoprobe® drilling rig. Nine direct-push borings were completed beneath the former transfer table (DAI-SB-05, -06, -07, -08, -09, -10, -15, -16, and -17), and a transect of six upland borings were advanced directly northwest of the former dock near monitoring well MW-10 (DAI-SB-11, -12, -13, -14, -18, and -19).
- Shallow hand tool excavations (potholes and hand-auger borings) were completed generally within the upper 30 inches of sediment using shovels or hand augers. Deeper hand auger borings were conducted at locations DAI-HA-02 and DAI-HA-03 to depths of 6.5 and 4 feet bgs, respectively.
- Soil, sediment, and bedrock cores obtained from borings were field screened for visual evidence of NAPL, photographed, and logged according to the Unified Soil Classification System (USCS) prior to sample collection. Soil and sediment samples from varying depths (dependent upon field observations) were collected from each sonic and direct-push boring. Sediment samples were also collected from two of the three hand-auger borings. Each sample was analyzed for the following constituents:
  - TPH by Method NWTPH-Dx; and
  - PAHs by EPA Method 8270 SIM.

Direct-push borings were completed in areas inaccessible to the sonic rig and in the DEQ-requested upland transect located at the top of the grade to the northwest of the former transfer table dock. The upland transect was completed in an attempt to define potential NAPL migration pathways between upland sources and nearshore sediment and included six borings (DAI-SB-11, DAI-SB-12, DAI-SB-13, DAI-SB-14, DAI-SB-18, DAI-SB-19). In addition to the transect, direct-push borings DAI SB-07, DAI-SB-10, DAI-SB-15, DAI-SB-16, and DAI-SB-17 were completed on the graded slope above the shoreline. These borings were all noted to contain subsurface NAPL. Samples were not collected if the matrix contained a significant amount of wood debris.

Detailed field methods from the DAI are provided in **Appendix B**. Boring logs and potholing and hand-auger observations are included in **Appendix C**. All DAI sample/observation locations are depicted on **Figures 3-1** and **3-3**.

3.7 OFFSHORE DATA GAP INVESTIGATION, 2017/2018

A phased offshore data gap investigation was completed between April 2017 and November 2018, to further assess the risks that bioavailable fractions of PAHs and TPH pose to aquatic invertebrate receptors outside the inferred NAPL areas in Scappoose Bay and Milton Creek. The data obtained during this investigation were intended to supplement previous RI data, and ultimately, to more

clearly define the offshore sediment areas that are sources of potentially significant ecological toxicity and surface water impacts (i.e., priority action areas). This information was deemed critical for selecting and designing an appropriate remedy for the Site and consisted of the following activities:

Phase 1

- A high-accuracy bathymetric survey of the Scappoose Bay river bottom was completed in April 2017;
- Installation of a stilling well in Scappoose Bay and monitoring of surface water conditions (i.e., water level and temperature) relative to an upland groundwater monitoring wells MW-6A and/or MW-25 between May and August 2017; and
- An offshore groundwater discharge survey was completed in June and July 2017.

Phase 2

- Map the occurrence and type of sheen in surface sediment adjacent to Site Area 1 in July 2017.

Phase 3

- Supplemental sediment porewater and surface water sampling using *in-situ* passive sampling devices (PSDs) containing low-density polyethylene (LDPE) outside offshore areas of creosote NAPL and sheen in surface sediment in September 2017.

Phase 4

- Map the occurrence and type of sheen in surface sediment adjacent to Site Area 2 in October and November 2018.

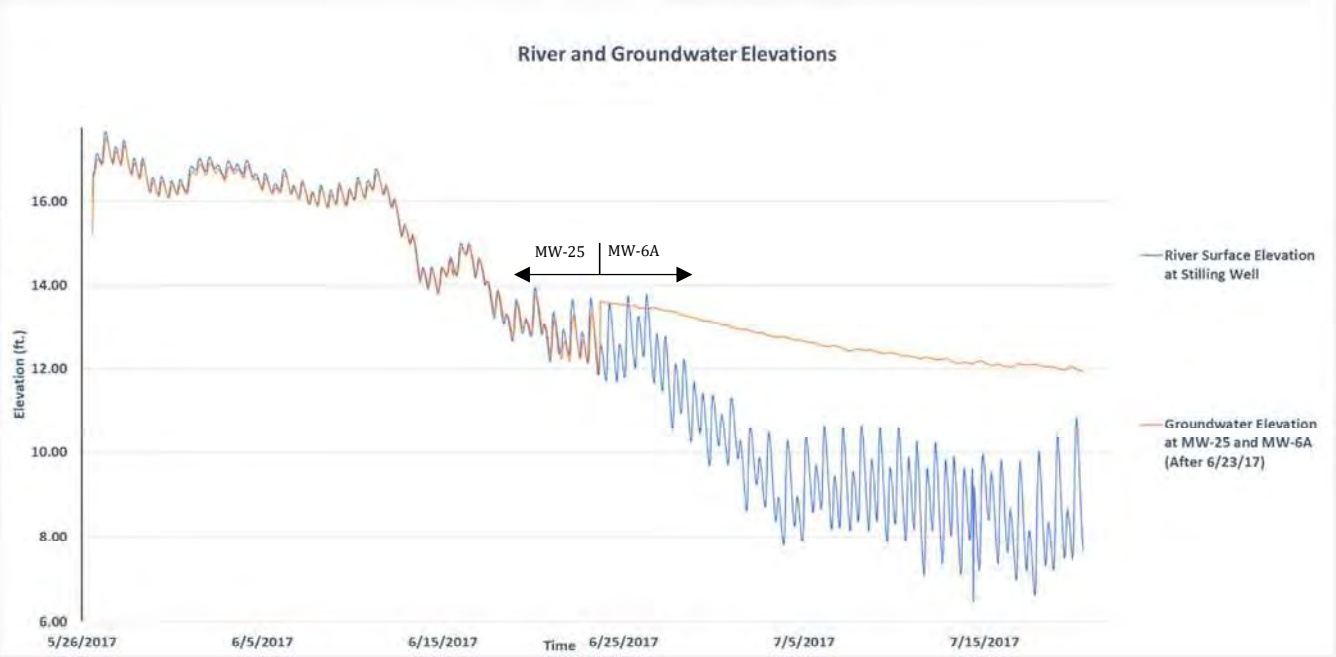
As described in the April 26, 2017 work plan (Cascadia, 2017a), the purpose of the Phase 1 and 2 investigations were to assess and map groundwater discharge areas and to better define and differentiate offshore areas exhibiting biogenic (e.g., decomposition of organic matter and/or reducing bacteria) versus petroleum (i.e., creosote-related) sheens in surface sediment adjacent to the Site. The results of the Phase 1 groundwater discharge study were used to target Phase 3 *in-situ* porewater and surface water sampling locations. Similarly, the results of the Phase 2 sheen study were used to guide the number and location of Phase 3 PSDs. The work conducted for the Phase 3 offshore data gap investigation was described in the August 29, 2017 work plan (Cascadia, 2017c) and incorporated the September 1, 2017 comments from DEQ (DEQ, 2017c). The Phase 4 creosote sheen mapping along the Area 2 shoreline was requested by DEQ in a September 27, 2018 email, and represents the final task of the offshore data gap investigation prior to finalizing the supplemental RI and initiating the FS.

3.7.1 High-Accuracy, High Resolution Bathymetric Survey, April 2017

On April 5, 2017, a high accuracy, high resolution bathymetric survey was completed by Solmar Hydro, Inc. of Portland, Oregon. The river bottom soundings are within 5.2 cm (mean error) of their true elevations. A map of sediment bathymetry relative to the Site is presented on **Figure 3-2.** In an effort to compare the river bottom mosaic with the Phase 1 and 2 investigation results, the color-coded bathymetry imagery was incorporated in subsequent **Figures 3-5** through **3-8** as referenced below.

3.7.2 Stilling Well Installation—River and Groundwater Elevation Monitoring, May - August 2017

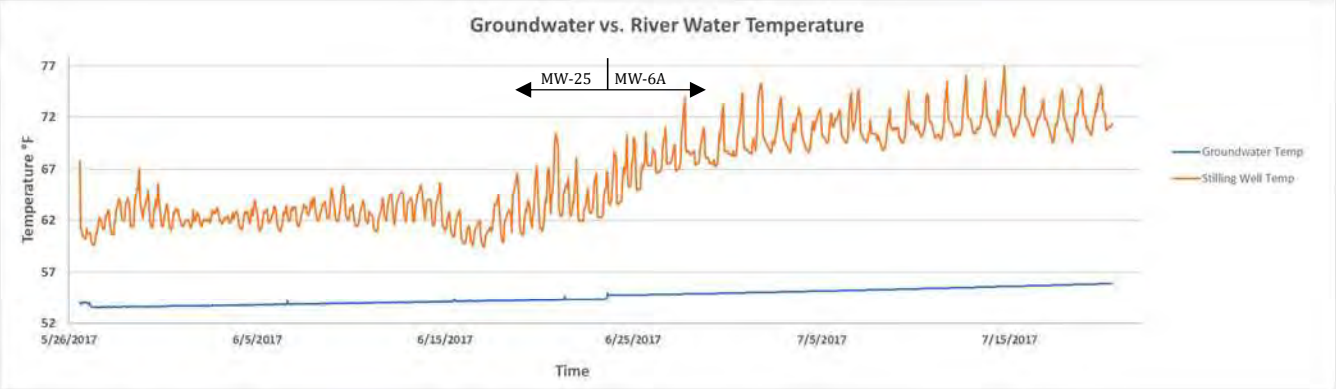
On May 26, 2017, as requested in DEQ's May 19 comment letter, Cascadia installed a surface water stilling well (i.e., 2-inch diameter PVC pipe casing attached to a timber pile) in Scappoose Bay adjacent to the Site, at the location shown on **Figure 3-2**. The vertical elevation of the stilling well top of casing was measured relative to the previously surveyed monitoring well MW-25 top of casing using an engineer's level and survey rod. Additionally, a pressure transducer (LevelSCOUT® water level and temperature sensor) with an integrated datalogger was placed inside both the stilling well and monitoring well MW-25. Water level and temperature measurements were contemporaneously logged in the upland monitoring and stilling wells on an hourly basis. Graphical representations of both water level and temperature contrast are presented below.



As indicated by initial water level data, monitoring well MW-25 was too close to Scappoose Bay and its screened interval was too long to evaluate groundwater responses to fluctuations in river stage. Specifically, water elevations in MW-25 between May 26 and June 23, 2017, were nearly identical to surface water stage in Scappoose Bay. For this reason, on June 23, 2017, Cascadia moved the

LevelSCOUT® transducer from MW-25 to monitoring well MW-6A, which is located approximately 100 feet farther inland. Monitoring well MW-6A was identified because the well is screened entirely within the Native Soil zone and was therefore expected to exhibit little to no response to the tidal cycles. As indicated by the water level graph presented above, groundwater levels in MW-6A indicate a significantly lower degree of hydraulic connection with surface water. Still, overall water level trends in MW-6A and the river stage are similar.

As indicated by the graph below, temperature contrasts between groundwater in MW-25 and MW-6A (after June 23, 2017) and surface water in the stilling well gradually increased from approximately 6-8 degrees Fahrenheit (°F) in late May 2017 to 13-15° F in mid- to late-July 2017.



Groundwater levels were measured in upland monitoring wells on July 21, 2017, following completion of the in-water groundwater discharge and sheen mapping activities described below. Depths to groundwater in monitoring wells were measured using an electric oil-water interface probe. At each well, the groundwater elevation was gauged within 0.01 foot of precision relative to the top of the well casing, which had been previously surveyed relative to the Site's vertical datum. Each monitoring well was checked for the presence of NAPL by carefully lowering the interface probe through the entire section of submerged casing. Consistent with prior groundwater monitoring events, approximately 6 inches of NAPL was detected in the base of monitoring well MW-3A. None of the other upland monitoring wells contained measurable NAPL. In general, groundwater elevations were similar to gauging events previously completed at the Site and indicate a generally flat groundwater gradient that gently slopes towards the Scappoose Bay and Milton Creek. The measured and inferred July 2017 groundwater elevations are presented on **Figure 3-4**.

3.7.3 Offshore Groundwater Discharge Survey, June – July 2017

The Phase 1 activities include the coordination and collection of paired water quality measurements (i.e., temperature, specific conductance, and/or dissolved oxygen [DO]) in surface water and porewater at various locations shown on **Figure 3-5**. Before undertaking a groundwater discharge study of 90 stations, as initially recommended (DEQ, February 24, 2017 email), Cascadia conducted a 10-station pilot test in June 2017. After discussing the results of the June 2017 pilot

test with DEQ, Cascadia returned to the Site in July 2017 to conduct and complete the groundwater discharge survey.

Pilot Test

On June 13 and 14, 2017, Cascadia conducted a 10-station groundwater discharge survey pilot test at the approximate offshore locations/stations (GWPS-1 through GWPS-10) shown on **Figure 3-5**. The purpose of the pilot test was to evaluate the effectiveness of the approach and technology proposed for evaluating groundwater discharge to sediment in Scappoose Bay. The approach and technology are described in the April 26, 2017 work plan (Cascadia, 2017a).

Utilizing a peristaltic pump and stainless-steel tooling with a slotted, 5-cm screen (PushPoint Sampler), Cascadia attempted to collect sediment porewater from 10 discrete locations within Scappoose adjacent to Area 1. The intent of the porewater collection effort was: (1) to measure the potentiometric surface of the porewater in comparison to the river stage; and (2) to compare porewater parameters (pH, specific conductance, temperature, and DO) to those of surface water. These measurements would indicate if the target location was in a state of "gain" or "loss" with regards to porewater/groundwater. The pilot test had limited success. At most pilot test locations, the PushPoint Sampler plugged with fine-grained sediment before a continuous column of porewater could be established inside the tubing. Several unsuccessful attempts and adjustments to the depth of the sampling screen, filter media (polypropylene ScreenSok, air stone) covering screen, and pumping rate (50 to 200 milliliters per minute [mL/min]) were made in an effort to improve the extraction of the sediment porewater. As a result of these physical challenges, with approval from DEQ, Cascadia suspended efforts to measure the potentiometric difference between porewater and surface water.

While efforts to measure potentiometric differences were unsuccessful, at several pilot test locations, with the PushPoint Sampler inserted 8 to 12 inches below the sediment surface, Cascadia managed to collect enough sediment water to measure water quality parameters. Given the difficulties associated with sediment porewater extraction, it is unclear if the water extracted from the PushPoint Sampler was truly sediment porewater or a combination of porewater and surface water. Either way, the water was pumped from the sampler to the surface and through a flow cell connected to a YSI Multiparameter Meter (YSI). In general, specific conductance (conductivity) and DO levels exhibited noticeable differences between surface water and water extracted from the PushPoint Sampler. However, conductivity was determined to be directly correlated to the number of suspended particulates in a given water column, and therefore was deemed not viable in differentiating a contrast between porewater and surface water. Additionally, due to the inability to maintain a sustained porewater column for the measurement of parameters, DO was also not a viable parameter for comparison of surface water to porewater. Measured temperature differences between surface water and porewater were relatively small compared to the temperature contrasts referenced above in the stilling well and groundwater in MW-25. The lower than anticipated porewater/surface water temperature differential may have resulted from temperature equilibration as porewater was pumped through the surface water column (in tubing). For the

reasons cited above, the porewater quality measurements, including temperature, using the YSI flow cell are considered unreliable. Concurrent with the YSI flow cell measurements, porewater and surface temperature were measured using a thermocouple. The thermocouple was deployed in surface water, approximately 1 foot above the mudline, and 8 inches below the sediment-water interface. The thermocouple indicated that the temperature of surface water was 2 to 7 °F warmer than sediment porewater at all target areas. Based on the apparent effectiveness of the thermocouple, and with approval from DEQ, subsequent porewater/surface water temperature measurements were limited to direct thermocouple readings in sediment and surface water.

Full-Scale Implementation

Between July 18 and 20, 2017, Cascadia returned to the Site to complete the groundwater discharge survey. Using the thermocouple and methods described above, porewater and surface water temperatures were measured at 32 locations in Scappoose Bay and 12 locations in Milton Creek (labeled GWS-11 through GWS-53). Surface water temperature was warmer than porewater by an average of 8 °F in Scappoose Bay and 4 °F in Milton Creek. In general, the greatest temperature contrasts were observed closest to the shoreline within the intertidal zone where the surface sediment substrate predominately consists of fine to medium sand with varying amounts of silt. Review of previous offshore remedial investigations (e.g., boring/sampling logs), indicates that the surface sediment substrate beyond the intertidal zone riverward predominately consists of fine-grained material (e.g., silt with varying amounts of fine, clay and organic debris). The temperature contrasts recorded at each Phase 1 location are illustrated on **Figure 3-6**. Copies of the field forms and photos taken to record observations and temperature measurements collected during the June and July 2017 groundwater discharge survey were provided in the August 15, 2017 Technical Memorandum (Cascadia, 2017b).

3.7.4 Surface Sediment Sheen Mapping – Area 1, July 2017

At each of the 53 Phase 1 and 2 offshore data gap investigation locations, Cascadia utilized a "poling" technique to disturb surface sediment for the purpose of identifying whether a sheen was produced on the overlying water surface offshore of Area 1 within Scappoose Bay and Milton Creek. The objective of poling was to map areas of sheen occurrence and to differentiate petroleum sheen related to creosote from biogenic sheens attributed to the decomposition of organic material and/or iron/manganese reducing bacteria. Observed sheens were classified as biogenic, slight petroleum, or moderate to heavy petroleum. In accordance with the April 26, 2017 work plan (Cascadia, 2017a), if a sheen was observed, the "Stick Test" was utilized to determine if the sheen was of a biogenic or petroleum nature. The "Jar Shake Test" described in the work plan was abandoned during pilot testing with DEQ concurrence. Sheen observations are documented in the field forms included in the August 15, 2017 Technical Memorandum (Cascadia, 2017b).

Moderate to heavy petroleum sheens were produced in previously identified areas of surficial sediment containing wood debris with creosote. The lateral extent of surface sediment and/or wood debris capable of producing a creosote-related sheen on the overlying water surface when

disturbed (poling) appears to be confined to within close proximity of the former P&T in-water structures (e.g., former transfer table dock). Specifically, moderate to heavy petroleum sheens were only encountered within 10 feet of the former transfer table dock; while sediment poling beyond this distance, towards the channel, did not produce a visible sheen.

Localized/intermittent, slight petroleum sheens were observed near the channel side of the small island located near the confluence of Milton Creek and Scappoose Bay. Additionally, slight petroleum sheens were observed near previously identified creosote seeps within Milton Creek. Target locations and classification of sheen are documented on **Figure 3-7.** Specific field conditions such as location, water depth, temperature, thickness of soft sediment surface, and a qualitative determination of sheen coverage over a specified surface area were recorded on the field forms in the August 15, 2017 Technical Memorandum (Cascadia, 2017b). Many of the July 2017 field forms contain photos of the surface water immediately following sediment agitation.

3.7.5 Offshore Toxicity Assessment, September 2017

This section presents the scope and methods for implementing the Phase 3 offshore data gap investigation, which was designed to further assess freely dissolved concentrations of PAHs and TPH in sediment porewater adjacent to and outside offshore areas of creosote NAPL, inclusive of moderate to heavy petroleum sheen, in surface sediment. The results of the Phase 1 and 2 data gap investigations and a review of previously detected concentrations of PAHs in bulk sediment samples guided placement of the Phase 3 *in-situ* PSDs[2]. A summary of total PAHs (i.e., detected concentrations greater than Probable Effects Level) detected in select bulk sediment samples adjacent to Site Area 1 relative to the Phase 3 sampling locations is provided on **Figure 3-8**.

This phase of the offshore toxicity assessment was conducted in general accordance with the Phase 3 Data Gap Investigation Work Plan (Phase 3 Work Plan) (Cascadia, 2017c). Based on DEQ's September 1, 2017 comment letter, field conditions/observations, and subsequent correspondence with DEQ, the following modifications to the Phase 3 Work Plan were implemented:

- Phase 3 porewater sampling location #1 was moved from Milton Creek to the Scappoose Bay location to improve spatial coverage in the offshore area of interest.
- Following additional qualitative assessment of sheen occurrence in surface sediment, Phase 3 sampling location #5 was moved near historical investigation locations SB02, SD067, and SD021 (between the island and peninsula) to assess risk associated with slight to moderate sheens observed during the Phase 2 poling/sheen study completed in July 2017.

[2] PSD is used in this report to refer to the sampling hardware (either sediment probes or surface water cages) containing the passive sampling media (LDPE). These *in-situ* PSDs are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in sediment porewater or surface water.

- Phase 3 sampling locations #6, #7, #8, #9, #10, #11, and #13 were slightly adjusted to coincide with areas previously characterized (e.g., SB04, SB03, SB08, SB09, SB13, SB27, and PWS-25, respectively).
- Phase 3 sampling location #14 was moved from the former transfer table dock area to coincide with historical investigation location PWS-6.
- Phase 3 sampling location #15 was moved from the former transfer table dock area to the Scappoose Bay location to improve spatial coverage in this offshore area.
- Preparation of one of the triplicate LDPE surface water samples (rep 2), as well as the deeper sediment porewater LDPE sample at Phase 3 sampling location #10 did not follow analytical protocol and their analytical results were omitted from the final laboratory report.
- The upper 30 inches of sediment at each Phase 3 sampling location was to be targeted for bulk sediment examination, field screening, and chemical analysis using clear Teflon® tubes. Due to limited recovery, only the upper 12 inches of sediment were obtained for field screening and chemical analysis at each Phase 3 sampling location, as discussed with DEQ.
- In addition to "volatile" aliphatic and aromatic petroleum hydrocarbons (VPH), select Phase 3 bulk sediment samples[3] were tested for "extractable" aliphatic and aromatic petroleum hydrocarbons (EPH), as requested by DEQ.

On September 5 and 6, 2017, Cascadia in conjunction with personnel with the Food Safety and Environmental Stewardship (FSES) program at Oregon State University (OSU) implemented the Phase 3 offshore data gap investigation with assistance from Cascade Dive Co. of Vancouver, Washington. A total of 15 *in-situ* PSDs were deployed at the above-referenced locations illustrated on **Figure 3-8**. Surface water LDPE passive samplers were deployed at 8 of the 15 Phase 3 sampling locations. Additionally, each Phase 3 sampling location included a separate *in-situ* passive diffusive bag (PDB) sampler[4] for assessing freely dissolved concentrations of TPH.

[3] DEQ's request to add EPH analysis was received on September 26, 2017, approximately 21 days after collecting the bulk sediment samples. Due to an error by the laboratory, EPH was not performed on approximately 1/3 of the bulk sediment samples (PWS-01, PWS-02, PWS-12, PWS-13, and PWS-15).

[4] As requested by DEQ, the Phase 3 investigation of sediment porewater also included deployment of PDB samplers in separate adjacent sediment probes (passive samplers) to accumulate dissolved TPH in a controlled manner. Measurements of dissolved TPH concentrations in sediment porewater water were extracted from ASTM Type 1 Deionizer water inside the PDBs. The Equilibrator™ PDBs manufactured by Eon Products, Inc., are designed for deployment into sediment and consist of low-density polyethylene bags filled with relatively de-oxygenated distilled water. When placed in water or sediment containing water, dissolved phase organic compounds diffuse through the wall of the bag in response to the concentration gradient between the porewater in the sediment and the distilled water in the bag.

Bulk Sediment Collection

At each Phase 3 sampling location, the upper 12 inches of sediment were collected using clear Teflon® sampling tubes for visual examination, field screening, and chemical analysis. Immediately upon retrieval and prior to deploying the PSDs, the Teflon® tubes were cut open and the sediment conditions examined and logged for grain size, debris, odors, visible sheen, and biological activity. Observations were recorded on the field sampling sheets provided in **Appendix C**. A homogenized sample of the upper 12 inches of sediment was placed in laboratory-prepared sampling containers and submitted to Apex Laboratories, LLC (Apex Labs) under chain-of-custody protocol for chemical analytical testing. The sediment samples were submitted for chemical analysis of the following:

- 34 PAHs (measurement of 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives) by EPA Method 8270D Modified;
- VPH using the Washington Department of Ecology (Ecology) method where volatile aliphatic and aromatic hydrocarbons are collectively quantified within the following equivalent carbon ranges by gas chromatography (GC) using a PID and flame ionization detector (FID) in series;
  - Volatile aliphatics - C_5 through C_6, $C_{>6}$ through C_8, $C_{>8}$ through C_{10}, and $C_{>10}$ through C_{12} ranges; and
  - Volatile aromatics - C_8 through C_{10}, $C_{>10}$ through C_{12}, and $C_{>12}$ through C_{13} ranges;
- VOCs using GC/MS by EPA Method 5035/8260C;
- EPH using the Ecology method where extractable aliphatic and aromatic hydrocarbons are collectively quantified within the following ranges by GC using an FID;
  - C_8 through C_{10}, $C_{>10}$ through C_{12}, $C_{>12}$ through C_{16}, $C_{>16}$ through C_{21}, and $C_{>21}$ through C_{34} ranges;
- TOC by Standard Method 5310B-Modified; and
- Black Carbon (a.k.a., % soot) in accordance with Environmental Science and Technology (ES&T) American Chemical Society (ACE) publications by Accardi-Dey and Gschwend, 2002 and Gustafsson (et al.), 2004.

Apex Labs subcontracted analytical testing of bulk sediment samples for Black Carbon to Alpha Analytical, Inc. in Mansfield, Maine, and the Ecology VPH/EPH to Analytical Resources, Inc. (ARI) in Tukwila, Washington. As noted above, bulk samples collected on September 6, 2017 (i.e., PWS-090617-1, -2, -12, -13, -15) were not analyzed for EPH because Apex Labs failed to list it on its ARI work order. Cascadia was not aware of the situation nor given an opportunity to review the laboratory work orders until Apex Labs started issuing draft reports in December 2017.

Based on a review of the Apex Labs reports, the remaining field samples were analyzed for all methods with quality assurance/quality control (QA/QC) that met applicable data quality objectives (DQOs). As requested by DEQ, a sample of the certified reference material National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) 2779 Gulf of Mexico Crude Oil was analyzed for PAHs by Apex Labs and included in its final report. In addition to SRM 2779, Apex Labs purchased SRM 1191, SRM 149, and SRM 2260, and analyzed theses oil samples select parent and/or alky PAH derivatives. For a particular analyte and/or alkylated group, the performance on the reference material is deemed acceptable if the laboratory result is within 30 percent of the assigned value listed in the Certificate of Analysis for SRM 2779. The results of the SRM PAH analyses are provided the February 14, 2018 Apex Labs report A7K0243, as well as a brief discussion of the results in the Data Quality Review in **Appendix D**.

Surface Water and Sediment Porewater Collection

As described in the Phase 3 Work Plan, the PSDs prepared and provided by FSES consisted of LDPE sheets applied with performance reference compounds (PRCs) housed inside sealed stainless-steel probes. The LDPE average membrane thickness is 75 to 95 micrometers (µm), average width of each sheet is 2.7 cm, the average transient polymer cavity size is 10 angstrom (Å), and each LDPE is nominally 100 cm long (FSES, 2017). The stainless-steel probes consisted of two separate slotted intervals, each containing LDPE sampling media. The slotted intervals were separated by blank sections of the stainless-steel probe so that the slotted interval/LDPE sampling media targeted separate and discrete sediment intervals. Each LDPE sediment probe was manually inserted approximately 32 inches into the sediment, with slotted sampling intervals and media targeting the intervals between 3 and 8 inches bml and 24 and 29 inches bml. Also, FSES prepared and provided stainless steel cages containing LDPE for surface water sampling approximately 12 inches (1 foot) above the mudline at 8 of the 15 Phase 3 sampling locations and included triplicate water cages at PWS-090517-10. The PDBs were prepared and provided by EON Products, Inc. were deployed inside PVC probes manually inserted 12 inches into the sediment with a slotted sampling interval between 4 and 10 inches bml.

The predetermined Phase 3 sampling locations were identified in the field using a high-resolution differential global positioning system (DGPS) with pre-loaded target sample location coordinates using the following horizontal datum: North American Datum of 1983 (NAD83); State Plane Coordinate System; Oregon North Zone; and International Feet. Cascadia and FSES field staff deployed 5 of the 15 passive sampling devices from shore (i.e., PWS-090517-6, PWS-090517-7, PWS-090517-8, PWS-090517-9 and PWS-090517-11). The remaining ten PSDs (PWS-090617-1 through PWS-090517-5, PWS-090517-10, PWS-090617-12 through PWS-090617-15) were deployed from a boat using a diver. Boat and diver operations were conducted by Cascade Dive Company, under subcontract to Cascadia. Each Phase 3 sampling location was established to within 25 feet of the pre-determined location, based on field conditions.

The passive samplers were then left in the sediment and/or overlying water for approximately 21 days and allowed to approach equilibrium. At the time of retrieval on September 26, 2017, the

divers removed the passive samplers and passed them to FSES and Cascadia personnel on the sample vessel for sample handling and transport to the appropriate laboratory for chemical analysis of freely dissolved PAHs and TPH. Specifically, FSES personnel removed the passive LDPE sampling media from the protective housing, rinsed them with water from the Site to remove sediment or biofouling, as necessary, before packaging for transport to the FSES laboratory at OSU. Upon retrieval of the PDBs, Cascadia field staff removed the Equilibrator™ PDB from the PVC casing and immediately punctured the LDPE bag with a discharge straw to fill standard water sampling containers provided by Apex Labs.

Post-deployment preparation of all LDPE samples was performed at the FSES laboratory on October 12, 2017. Batches of samples were extracted as per FSES standard operating procedure (SOP) 406.02 between October 17 and 26, 2017. Chemical analysis of surface water and sediment porewater LDPE PSDs was completed by the OSU FSES Program as described in the following SOPs.

- SOP 407.01 – Calculation of Freely Dissolved Water Concentrations (C_{free}) of Organic Compounds Derived from polyethylene (PE) PSDs;
- SOP 418.00 – Determination of Parent and Alkyl Substituted PAHs (a total of 63 PAHs) using Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS);
- SOP 414.00 – Determination of Oxygenated PAHs (OPAHs) (a total of 22 analytes) using GC/MS;
- SOP 416.10 – Determination of Hopane and Cholestane Compounds (a total of 11 analytes) by SIM GC/MS; and
- SOP 427.00 – Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS. The primary standard for this method was NIST SRM 1991 Mix Coal Tar/Petroleum Extract in Methylene Chloride.

Problems occurred during the preparation of one of the triplicate surface water samples (rep 2), as well as the deeper sediment porewater sample, at Phase 3 sampling location #10 and subsequently the analytical results for these Phase 3 samples have been omitted from the FSES Final Report (FSES, 2018). According to FSES, the remaining field samples were analyzed for all methods with QA/QC that met applicable DQOs. As requested by DEQ, a sample of the certified reference material NIST SRM 2779 Gulf of Mexico Crude Oil was analyzed for alkyl PAHs by FSES and was included in its Final Report along with measures of instrument precision.

Upon retrieval and transfer of the water from the PDBs into standard water sampling containers, the sediment porewater samples slated for chemical analysis of TPH fractions were submitted to Apex Labs for quantification of aromatic and aliphatic hydrocarbons between equivalent carbon numbers C_5 through C_{13} using the Ecology VPH test. Apex Labs subcontracted the VPH analysis to ARI, a Washington certified laboratory. Also, an aliquot of the PDB water samples were analyzed for

select VOCs by EPA 8260C using multiple-ion monitoring (MIM) techniques by Apex Labs. MIM techniques were used to search for aromatic and aliphatic hydrocarbons below the VPH method reporting limit of 50 micrograms per liter (µg/L).

3.7.6 Surface Sediment Sheen Mapping – Area 2, October – November 2018

In October 2017, DEQ staff inspected the Area 2 shoreline and observed creosote-impacted surface sediment near the terminus of the former creosote pipeline and residual pilings associated with a historical dock. According to historical maps and photos, this dock was formerly used to offload creosote from river barges between 1919 and 1959.

In response to the September 2018 DEQ email (DEQ, 2018a) and subsequent telephone conversations, Cascadia prepared a work plan (Cascadia, 2018b) to visually map creosote sheen occurrence along the approximately 900-foot-long portion of the Scappoose Bay Area 2 shown on **Figure 3-9**. The work plan was approved by DEQ on October 11, 2018 (DEQ, 2018b).

Cascadia, with DEQ oversight, completed a low-tide, low-water shoreline inspection on October 22, 2018. Cascadia and DEQ returned to this Site area on November 29, 2018, with a small boat to map offshore sheen occurrence amongst the piling and throughout the footprint of the former creosote offloading dock. The details and findings of these Area 2 shoreline inspections are presented below.

October 2018 Shoreline Inspection

On October 22, 2018, Cascadia and DEQ visually inspected exposed soil and sediment along approximately 1,000 linear feet of Area 2 shoreline between the riverbank and edge of surface water during low tide for evidence of creosote-related sheen. The low-tide water level on October 22, 2018, at 11 AM was approximately -1.4 feet below the MLLW or 0.65 feet relative to the Columbia River Datum (CRD). Cascadia personnel walked the shoreline and potholed 18 to 24 inches below grade using hand tools at a total of 23 locations shown on **Figure 3-9**. Initially, Cascadia staked out the predetermined locations based on proximity to prior upland investigations (e.g., GB-8, GP-09, and MW-14), historical site features (e.g., former creosote pipeline, oil aboveground storage tank, dock, oil pipe trestle), and general spatial coverage along shoreline within previous composite sediment sample transects (SHI01B, SHI01S, and SHI02B). The exact boring location and the number of borings was adjusted/increased as necessary to define the extent of visible contamination.

Surface sediment conditions generally consisted of silty fine to medium sand with varying amounts of wood debris (combination of dimensional lumber and/or wood fragments). The source of petroleum sheens in surface sediment was determined to be attributed to creosote-treated dimensional lumber and/or wood fragments partially buried within the upper 12 inches of sediment at 11 of the 23 shoreline borings. The vertical extent of creosote contamination did not exceed 12 inches bml and its lateral extent was confined to the intertidal zone (i.e., did not extend to the uplands). The creosote-treated wood debris appears to be associated with deterioration of the former dock and support pilings and is predominately located within the red dashed area shown on

Figure 3-9. NAPL blebs independent of wood debris were not observed in the surface sediment. As discussed below, NAPL (inclusive of moderate to heavy petroleum sheen) were not generated by disturbing sediment around the remaining log pilings outside the red dashed area. Highly localized/ intermittent areas of creosote contaminated wood debris were observed at shoreline borings #3 and #21, located approximately 150 to 200 feet upriver and downriver of the primary accumulation area, respectively. Sheen observations are documented on the field forms provided in the January 17, 2019 Technical Memorandum (Cascadia, 2019b).

A relatively steep downward slope in sediment bathymetry precluded a full delineation of the offshore extent of creosote-treated wood debris in surface sediment during the October 2018 shoreline inspection.

November 2018 Offshore Inspection

On November 29, 2018, Cascadia and DEQ delineated the lateral extent of sheen occurrence in surface sediment offshore of Area 2. As shown on **Figure 3-9**, a total of 60 offshore locations were investigated for submerged creosote-treated wood debris using the "poling" technique described above in **Section 3.7.4** to disturb surface sediment. Most of the poling occurred between high tide at 10 AM (3.75 feet MLLW or 5.78 feet CRD) and low tide at 4 PM (1.65 feet MLLW and 3.67 feet CRD). The objective of poling was to map areas of sheen occurrence on the overlying surface water and to differentiate creosote-related (petroleum) sheen from biogenic sheens attributed to the decomposition of organic material and/or iron/manganese reducing bacteria. Observed sheens were classified as either "No Sheen or Biogenic" or "Petroleum - Moderate to Heavy Sheen" (indicative of creosote). In the accordance with the work plan, if a sheen was observed, the "Stick Test" was utilized to determine if the sheen was of a biogenic or petroleum nature. As discussed above in **Section 3.7.4**, the "Jar Shake Test" described in the work plan was abandoned during pilot testing with DEQ concurrence.

NAPL, including moderate to heavy petroleum sheens, were noted in 5 of the 60 offshore locations within close proximity of the shoreline borings that encountered creosote contaminated wood debris within the upper 12 inches of sediment. The lateral extent of surface sediment and/or wood debris capable of producing a moderate to heavy petroleum sheens on the overlying water surface when disturbed (poling) appears to cover an approximately 200-foot-long by 50-foot-wide section of the Area 2 shoreline beneath and immediately downriver of the former P&T dock and creosote AST. Specifically, moderate to heavy sheens were only encountered amongst the pilings near the shoreline; while sediment poling beyond 50 feet of the shoreline (even amongst the pilings), did not produce a visible petroleum sheen. Specific field conditions such as location, water depth, thickness of soft sediment surface, and a qualitative determination of sheen coverage over a specified surface area were recorded on the field forms provided in the January 2019 Technical Memorandum (Cascadia, 2019b).

4.0 UPDATED SITE SETTING

The supplemental RI data collection efforts have allowed a more detailed evaluation of the Site physical setting. Topographic and bathymetric information for the Site is presented on **Figure 2-1**, and geologic and hydrogeologic information is presented on **Figure 2-2**. Eight detailed cross sections were developed for the locations shown on **Figure 4-1** using stratigraphic data obtained from boring logs. The cross sections are presented on **Figures 4-2** through **4-9**. A contour map showing the elevation at the top of the Basalt Bedrock unit is presented on **Figure 4-10**.

4.1 GEOLOGY

Subsurface soil conditions beneath the upland portions of the Site are largely consistent with the description presented earlier in **Section 2.3.1**. Information gathered during the supplemental RI activities allowed for a more detailed understanding of the fill material (i.e., "Fill Zone" unit) and Native Soil units, as well as the underlying Basalt Bedrock.

For the purposes of this report, fill is used as a generic term for imported soil or reworked native soil placed at the Site after initial development in the early 1900s. The thickness of the Fill Zone unit across Area 1 generally ranges from 5 to 10 feet. The fill material is fairly uniform in thickness across most of the upland area, but tends to be thickest along Milton Creek and along the Scappoose Bay shoreline near the Former Operations Area, where the pre-fill land surface sloped toward these surface water features, and in the northwestern portion of the property near the railroad bridge crossing Milton Creek. The fill tends to be thinnest where the Basalt Bedrock elevation is locally high.

The Native Soil unit beneath the Fill Zone unit consists predominantly of silt with varying amounts of fine sand, clay, and organic matter. Silty gravel with varying amounts of sand was encountered immediately above the Basalt Bedrock in localized areas. The thickness of the Native Soil unit above the Basalt Bedrock beneath this portion of the Site varies between approximately 5 and 23 feet. The Native Soil is thickest above dips in the Basalt Bedrock elevation (local troughs), and thinnest where the Basalt Bedrock elevation is locally high, including the northwestern portion of the property near the railroad bridge crossing Milton Creek. The Native Soil was not present in an area along the basalt ridge near Milton Creek. Although not visible at the scale shown on the cross sections, thin layers of fine sand with varying amounts of silt (typically less than 2 inches thick) were observed intermittently within the fine-grained sequences of Native Soil.

The Basalt Bedrock unit was encountered in nearly all RI borings completed with machine drilling equipment (e.g., hollow-stem auger, direct-push, sonic). The contact with the Basalt Bedrock was generally distinct and encountered beneath 6 to 35 feet of soil within the upland portion of Area 1. At offshore locations, the contact with the Basalt Bedrock was encountered beneath 2 to 26 feet of river sediment. The thickness of river sediment in the nearshore area appears to vary depending on the elevation of the underlying Basalt Bedrock. As illustrated by the cross sections, the basalt surface beneath the Site (both upland and offshore) is highly variable with numerous peaks and

valleys over relatively short distances. An updated contour map of the top of the Basalt Bedrock is provided on **Figure 4-10**. Most likely, the irregularity of the basalt topography beneath the Site is related to erosion and not faults within the units (GeoEngineers, 2000).

Varying degrees of weathering and fracturing were encountered in each exploration. Visual examination of core samples obtained from the explorations indicates that the basalt is generally dense with relatively impermeable fractures, which is consistent with prior RI findings.

4.2 HYDROGEOLOGY

Hydrogeological conditions beneath the upland portions of the Site are largely consistent with the description in **Section 2.3.2**. Information gathered during the supplemental RI activities allowed for a more detailed understanding of groundwater occurrence and flow within the Fill Zone and Native Soil units, as well as interaction with surface water bodies.

Groundwater elevation contours are plotted on **Figure 4-11** for both high-water and low-water conditions, and the measured groundwater and surface water elevations are presented in **Table 4-1**. Regional groundwater flow in the area of the Site reflects discharge to the Scappoose Bay and Columbia River Systems (including Multnomah Channel). This means that groundwater generally flows toward the river in both the horizontal and vertical directions. The shallow water table beneath the Site exhibits a divergent flow pattern with groundwater beneath its north and west margins flowing towards Milton Creek, and groundwater beneath its south and east margins flowing towards Scappoose Bay. The local, or near-surface, flow regime (shallow groundwater) is present within both the Fill Zone and the Native Soil beneath the Site. RI and supplemental RI monitoring wells were constructed to evaluate shallow groundwater conditions separately within the upper dredge sand fill and the lower native silt. *In-situ* tests (slug tests) conducted as part of the 1996 RI determined that the hydraulic conductivity within the Fill Zone is approximately 1 to 2 orders of magnitude greater than Native Soil hydraulic conductivity. Based on the hydraulic conductivity, wells in the Fill Zone are expected to exhibit a higher level of hydraulic connection with surface water than wells that are screened in Native Soil. These variable levels of hydraulic connection are exhibited by wells MW-25 (Screened within the Fill Zone) and MW-6A (Screened within the Native Soil) during the May – July 2017 Phase 1 data gap investigation. Specifically, groundwater levels in MW-25 exhibit a nearly instantaneous response to changes in river stage, whereas well MW-6A exhibited no significant response to tidal stage and only a low gradual response to seasonal river stage.

The area of Scappoose Bay and Multnomah Channel adjacent to the former P&T site is a regional discharge area for groundwater. Relative shallow groundwater elevations in paired monitoring wells located away from surface waters (interior upland areas) typically exhibit a downward vertical hydraulic gradient from the Fill Zone to the underlying Native Soil. Groundwater elevations in paired monitoring wells located immediately adjacent to the shoreline of Scappoose Bay/ Multnomah Channel typically exhibit a slight upward vertical gradient from the Native Soil to the overlying Fill Zone. These observed vertical gradients within the local, or near-surface, flow regime

indicates that shallow groundwater joins with the regional flow system near the Site along the Scappoose Bay/Multnomah Channel shoreline. This flow regime is shown schematically on **Figure 4-12**.

The rates and timing of groundwater discharge to surface water are strongly influenced by seasonal rainfall and fluctuating river stage. These dynamic conditions can result in significant temporal variability in the advective driven impacts to surface water and sediment porewater quality. **Figures 4-13** and **4-14** present the annual hydrographs for the Columbia River in 2012 and 2017, respectively, and identify the sampling periods for porewater and surface water (2017 only).

The July 2017 offshore temperature contrast study was conducted during a period of rapid surface water decline, and much like the heterogenic nature of sediment, its results were highly variable. A comparison of temperature contrasts to grain size descriptions of nearby sediment samples, confirms that shallow groundwater discharges into Scappoose Bay primarily through the sandier bank and sediment stratum generally located along the Site shoreline. Some of the highest temperature contrasts were observed within the poorly sorted beach sand and/or silty sand areas depicted on **Figure 3-6**.

During the late summer and early fall (August, September, and October) when surface water elevations drop and reach seasonally low levels, localized groundwater seeps along the Site's banks have been observed intermittently along the Scappoose Bay and Milton Creek shorelines adjacent to Area 1 (**Figure 4-11**). These groundwater seeps appear to be confined to relatively thin soil layers (2 to 4 inches thick) where the near-surface flow regime is discharging through a lens of sand within the native silt matrix and/or along the Fill Zone/Native Soil contact.

The intermittent groundwater seeps observed along Scappoose Bay within the man-made cove were generally found near the bottom of the shoreline embankment between Area 1 monitoring wells MW-19 and MW-25. The groundwater seeps observed along the banks of Milton Creek were generally found between sediment porewater sample locations PWS-17 and PWS-30. **Figure 3-3** shows the groundwater seep locations identified from the Area 1 shoreline inspection events.

4.3 FLUVIAL GEOMORPHOLOGY

The Site is situated along the northwestern shore of Scappoose Bay adjacent to the confluence between Scappoose Bay and the Multnomah Channel of the Willamette River. This lower reach of Scappoose Bay is characterized as a lowland floodplain of the Columbia River estuary (DEA, 2000). The confluence of the Multnomah Channel and the Columbia River is approximately 1.3 miles northeast (downriver) from the Site. Milton Creek is a perennial stream that borders the western Site boundary and discharges to Scappoose Bay at the southwest corner of the Site. The main channel of Scappoose Bay is located just offshore of the former P&T facility (**Figure 2-1**) and borders the Area 1 shoreline. The Area 2 shoreline is located just downstream of Scappoose Bay and borders Multnomah Channel.

A review of bathymetric maps generated adjacent to Area 1 in 2010 and 2017 indicates the main channel of Scappoose Bay is a stable feature adjacent to the Site. Tidal fluctuations of water levels occur daily in Scappoose Bay and Multnomah Channel, in addition to seasonal fluctuations in water levels as a result of runoff events in the watershed. The Site's Scappoose Bay shoreline is routinely inundated above the OHWM (14 feet NAVD88) during high tides when Columbia River surface water elevations are sufficiently high (typically between April and July). During much of the year, mudflats are visible along the Site's shoreline between approximately 5 to 10 feet NAVD88. Depending on shoreline conditions, basalt topography, and channel dimensions, portions of the Site's shoreline experience sediment deposition (e.g., flat, soft bottom cove areas), while riverbank areas closer to the main channel appear to exhibit localized erosion of sediment from large storm events and/or tidal cycles.

The Site's shoreline, including riverbank and mudflats, differs by location. Therefore, the offshore areas exhibiting creosote contamination are described separately below and are termed, the "Cove Area" (on either side of the peninsula), "Area 1 Dock", "Lower Milton Creek", "Upper Milton Creek", and "Area 2 Dock". These offshore areas are illustrated on **Figure 4-15.**

4.3.1 Upper Milton Creek

The sediment profile within Upper Milton Creek consists of 0 to 1 foot of silty organic-rich fluff overlying a 1- to 6-foot hardpan layer of gray stiff clayey-sandy silt with gravel and cobbles. Scouring of the creek channel by seasonal runoff and diurnal tidal cycles appears to limit the accumulation of sediment in this portion of the creek. The Site shoreline with Milton Creek is generally characterized by relatively steep embankment covered with vegetation. Prior to development of the wood treating facility, the upland area of the Site immediately east and northeast of the Upper Milton Creek was part of the Milton Creek floodplain. Between 1929 and 1939, this upland area appears to have been filled and brought to grade with the rest of the Site.

4.3.2 Lower Milton Creek

The Lower Milton Creek in-water area generally covers the portion of Milton Creek downstream of the Railroad Avenue vehicle bridge and the confluence of Milton Creek with Scappoose Bay (riverward of the island). Downstream of the vehicle bridge, the depth to Basalt Bedrock increases and the sediment profile thickens. In the Lower Milton Creek area, the sediment profile consists of 3 to 10 feet of silt with varying amounts of sand and clay overlying Basalt Bedrock.

Riverward of the island and immediately downstream of the mouth of Milton Creek is an approximately 1-acre area of sediment deposition with river bottom elevations between 0 and 5 feet NAVD88. The bottom elevationof the main channel of Scappoose Bay adjacent to this portion of Lower Milton Creek ranges between -7 and -5 feet NAVD88 and is between 50 and 100 feet wide.

4.3.3 Cove Area

The Area 1 Scappoose Bay shoreline and in-water area immediately downgradient of the former wood treating facility, inside the island and around the peninsula, is referred to herein as the Cove Area. Prior to development, the Cove Area consisted of a partially vegetated slough (historical aerial photographs were included in the 2000 RI Report). This southwestern portion of the Area 1 shoreline was created between 1948 and 1953 through extensive dredging and filling of historical lowlands.

The elevation of the river bottom within the manmade cove and shallow inlet immediately downriver of the peninsula ranges between approximately 0 and 10 feet NAVD88 within approximately 100 to 300 feet of the shoreline before sloping steeply towards the main channel of Scappoose Bay. The main channel of Scappoose Bay adjacent to the Cove Area widens to approximately 150 feet with bottom elevations between -7 and -5 feet NAVD88.

Since the Cove Area is protected from the erosional effects of large storm and tidal surge, it is a sediment depositional area. In 1960, wood treating plant operations ceased, and presumably dredging, which appears to have led to the deposition and burial of the old operational sediment surface throughout the Cove Area. A sediment deposition rate of 0.2 to 1.4 inches per year (in/yr) is implied based on the presence of 1 to 7 feet of relatively clean fine textured sediment above the old contaminated operational sediment surface. The nature and extent of offshore contamination is discussed in **Section 5.3.2**.

4.3.4 Area 1 Dock

The approximately 700-foot section of shoreline and in-water area between the former hog fuel dock and northeastern (downriver) terminus of the former transfer table dock is referred herein as the "Area 1 Dock." In 2013, the creosote-treated wood decking and lateral bracing was removed from both dock structures and only the creosote-treated timber pilings remain. This portion of the Site's shoreline is closer to the main channel of Scappoose Bay and is subjected to stronger river current, as evidenced by the coarser sandy sediments encountered within the intertidal zone.

The main channel of Scappoose Bay widens and deepens adjacent to and within the Area 1 Dock. Specifically, the bottom of the main channel ranges between 200 and 250 feet NAVD88 wide and between -10 and -5 feet NAVD88 deep adjacent to Area 1 Dock. Within this offshore area the river bottom slopes steeply downward within 50 to 100 feet of the shoreline. The results of the supplemental RI suggest that this portion of the Site's shoreline is relatively stable to eroding, generally preventing the deposition of newer clean sediments and the burial of historical contamination.

4.3.5 Area 2 Dock

The approximately 600-foot section of Site shoreline near the downriver margins of Area 2 and in-water area at the terminus of the former creosote pipeline and historical offloading dock (circa

1919 to 1959) is referred to herein as the "Area 2 Dock." This portion of the Site's shoreline is adjacent to Multnomah Channel and since it was not originally part of the supplemental RI, high resolution bathymetry data are not currently available. Based on the presence of contamination in surface sediment, hard compact nature of the mudflats with relatively steep slopes towards the channel, this portion of the Site's shoreline appears to be relatively stable to eroding.

The Area 2 Dock boundary is approximately 600 feet long and 150 feet wide (eastward from the riverbank). Its approximately 2-acre dimensions within Multnomah Channel were determined by the outer extent of timber piling associated with the former pipeline and dock structures. According to the FS Tech Memo prepared for the Boise Mill shoreline (AECOM, 2016), the main stem of the Multnomah Channel is 100 to 150 offshore with a bottom elevation of approximately - 15 feet NAVD88 immediately downstream of the Site.

5.0 NATURE AND EXTENT OF CONTAMINATION

The 2000 RI Report presented data collected at the Site through 1998. The initial phases of the RI were focused on the upland portions of the Site, with only limited characterization of surface water and surface sediment (i.e., top 4 inches) along its 4,500 linear feet of shoreline of Milton Creek and Scappoose Bay / Multnomah Channel. Since submittal of the 2000 RI Report, an additional 670 samples of soil, groundwater, NAPL, sediment, porewater, and surface water have been collected and analyzed. The supplemental RI activities described in **Section 3.0** were conducted in phases, and the resulting information was used to fill the RI data gaps and address the objectives listed in **Section 1.2**. Unlike the site-wide assessment described in the 2000 RI Report, the supplemental RI findings are focused on the upland portion of Area 1, offshore areas adjacent to Area 1 within Milton Creek and Scappoose Bay, and the offshore area adjacent to Area 2 within Multnomah Channel near the terminus of the former creosote pipeline and residual pilings associated with a historical dock ("Area 2 Dock").

The development of the nature and extent of contamination discussion presented in this section is based on the field observations and analytical data collected during RI and supplemental RI activities. This discussion is presented by Site media below.

5.1 OVERVIEW

The results of the RI demonstrate that the majority of the soil, groundwater, and sediment contamination at the Site is related to the former wood-treatment activities conducted between 1912 and 1960. Creosote has been identified as the primary wood-treating contaminant in soil, groundwater, and sediment samples collected in the vicinity of the former wood-treating facilities (primarily Area 1). Creosote is a TPH mixture of predominantly diesel- and oil-range hydrocarbons and contains substantial amounts of PAHs (about 85% by weight). Consequently, the presence and quantity of TPH and PAHs (or lack thereof) in subsurface soil, groundwater, sediment (bulk and porewater), and surface water collected from the Site and locality were used to evaluate the extent of creosote impacts at the Site.

Based on the results of the supplemental RI, the lateral upland extent of creosote related NAPL extends over a larger portion of Area 1 than had been established in the 2000 RI. Data obtained from conventional characterization techniques (e.g., borings and direct examination of retrieved soil samples at pre-selected depths) suggest that the majority of NAPL beneath upland soil is pooled on top of the basalt surface. Detailed vertical profiling of NAPL architecture using LIF identified much thinner layers of NAPL than were originally believed to be present and indicated that NAPL is generally confined to the fine-grained Native Soil above the basalt surface. Some RI and supplemental RI borings completed near the former wood treating operations did encounter NAPL at the Native Soil/Basalt Bedrock contact, but not consistently enough to support the previous conclusion that significant amounts of creosote NAPL pooled and spread laterally across the basalt surface as was described in the 2000 RI. The majority of creosote NAPL appears to have been

trapped by capillary forces within the overlying Native Soil (fine-grained alluvium) before reaching the Basalt Bedrock.

The lateral and vertical extent of contamination associated with the former wood-treating operations appears to be sufficiently defined beneath the Site and adjacent portions of Scappoose Bay and Milton Creek to assess risk and establish remedial action objectives. Data completeness is further discussed in **Section 8.0.**

5.2 SOIL

Results from most upland soil samples collected at the Site were presented in the 2000 RI Report (Section 7.2.1, Figure 21). A limited number of soil samples were collected as part of the supplemental RI (**Table 5-1**). The supplemental RI soil sample results support the conclusions regarding nature and extent of soil impact from the 2000 RI Report. Upland soil at the Site is adequately characterized for the purposes of the RI/FS.

The Fill Zone/Native Soil contact generally represents the original ground surface at the time the wood-treating facility operated. Consequently, creosote-impacted soil in the vicinity of the former wood-treating facilities is generally limited to the Native Soil unit, located beneath 5 to 10 feet of dredge sand fill and gravel (Fill Zone). In explorations completed in close proximity to the former wood-treating plant and former aboveground creosote storage tanks to the west of the plant, varying degrees of creosote impact have been observed throughout the entire thickness of the Native Soil unit (depths ranging between about 5 feet bgs to approximately 23 feet bgs at the Native Soil/Basalt Bedrock contact). In general, creosote-impacted soil decreases in vertical thickness and is encountered at deeper intervals within the Native Soil stratum (i.e., closer to but not necessarily directly at the Native Soil/Basalt Bedrock contact exclusively) as distance increases from the former wood-treating operations.

A summary of the analytical results for soil samples is provided below and in **Table 5-1**.

- Creosote-related hydrocarbons (diesel and oil ranges) were detected in soil samples collected from 19 of 28 explorations completed in Area 1, with a maximum concentration of 6,320 mg/kg (sum of diesel- and oil-range hydrocarbons) in the MW-24 boring.
- Concentrations of total PAHs in soil ranged from not detected to a maximum of 3,410 mg/kg in boring MW-24.

5.3 NAPL

Creosote NAPL has been encountered in soil, groundwater, groundwater seeps, and sediment at the Site. The nature of NAPL has been investigated, and the results provided in the 2000 RI Report (2000 RI Report Appendix C, Tables C-17 through C-23) indicate a NAPL composition consistent with recent analytical results for creosote-related constituents from the supplemental RI activities (**Table 5-2**). The extent of NAPL at the Site has been inferred based on field observations of

creosote sheens in soil samples collected during the multiple investigation events conducted during the supplemental RI. The extent is shown on **Figure 5-1**.

The composition of NAPL at the Site is dominated by diesel- and oil-range hydrocarbons (although chromatograms do not match a diesel or oil fingerprint) and PAHs (naphthalene, phenanthrene, 2-methylnaphthalene, and others).

5.3.1 Upland

The presence of NAPL has been identified in uplands soil in close proximity to the former operations area (i.e., retorts, pump house, storage tanks) and at distances of up to approximately 300 feet northwest, west, southwest, and south toward Milton Creek and Scappoose Bay. The upland extent of NAPL, although not continuous throughout, has been generally defined within an approximately 4-acre area. The distribution of NAPL beneath the former operations area appears to be a function of subsurface migration from the former creosote storage tanks, plant, and retorts as well as direct releases from other ancillary operations (e.g., the transfer table).

As indicated by TarGOST® logs (SO14, SO15, SO16, SO18, SO20, and SO21) completed within the upland NAPL footprint, potentially mobile creosote is present in the Native Soil at various depths within distinct stratigraphic layers less than 18 inches thick. The total thickness of creosote impacted varies from 1 to 8 feet, and the impacted intervals typically occur at depths greater than 10 feet bgs (below Fill Zone). In general, this vertical layering or profile of NAPL becomes thinner and deeper within the Native Soil with distance from the former operations area at depths greater than 10 feet bgs.

The inferred extent of NAPL indicates that topographical highs on the basalt surface, such as the ridge to the east of the former operations area along the Scappoose Bay shoreline, appear to influence the subsurface distribution of NAPL. The bedrock appears to be a barrier to downward vertical migration of the NAPL, based on the physical properties of creosote samples and *in-situ* hydrogeologic data gathered from RI rock core borings (see **Section 6.0**).

A sheen and/or olfactory evidence of creosote impact were noted in the upper surface of basalt in only 4 of the 45 NAPL delineation borings completed in 2011 (SB10, SB11, MW-24, and MW-25; **Section 3.4.2**). These four borings correspond to Site areas where creosote NAPL was found near the Native Soil/Basalt Bedrock contact. The results of the 2011 NAPL delineation are consistent with the conceptual model presented in the 2000 RI, in that only minor amounts of creosote-related contamination (i.e., dissolved phase) appear to have penetrated and/or migrated through the top of the Basalt Bedrock.

During the 2000 RI, the presence of NAPL was identified in monitoring wells MW 2, MW-3A, and MW-3B. Eight new Area 1 monitoring wells were installed in 2011 (**Section 3.4.2**) to confirm the lateral extent of NAPL inferred from the TarGOST® LIF investigation, direct examination of the subsurface soil samples, and groundwater monitoring of existing wells. Pooled NAPL was not detected in the base of any of the new Area 1 monitoring wells, despite the fact that the wells were

equipped with "DNAPL funnels" set entirely within the upper surface of the basalt, were situated within the former operations area, and were screened across soil intervals containing heavy creosote impact (see **Section 3.4.2**). With the exception of monitoring well MW-3A, NAPL was not observed in any of the Site's monitoring wells during gauging conducted as part of the supplemental RI. Consistent with the 2000 RI, measured NAPL thicknesses in the base of monitoring well MW-3A ranged from 1.25 to 2.56 feet. Prior measurements of the specific gravity of NAPL collected from monitoring well MW-3A ranged from 1.01 to 1.04. Because the density of creosote NAPL is similar to the density of water, accurate measurements of NAPL thickness in monitoring well MW-3A are problematic and considered qualitative.

5.3.2 In-Water

The presence of offshore creosote NAPL differs by source, depth bml, thickness, and fate depending on location. Therefore, the offshore areas defined above in **Section 4.3** are described below separately.

Upper Milton Creek

Groundwater seepage with a creosote-related sheen has been observed along a 200-foot section of the east bank of the Upper Milton Creek and chemical concentrations in related bank samples indicate contact with NAPL (**Figure 5-1**). However, the Upper Milton Creek in-water area is located over 350 feet west of any known historical wood-treating features and/or operations. Field evidence of NAPL was generally not observed in supplemental RI borings completed between the upland inferred NAPL area and the Upper Milton Creek area. As mentioned above, this portion of the Site was filled between 1929 and 1939. The composition of fill material placed in this portion of the Site between 1920 and 1939 is unknown and could be a source of the metal and wood debris observed in the bank. In later aerial photographs, it is evident that this upland area adjacent to Upper Milton Creek was used for storage of untreated peeled logs.

Currently, the primary sources of contamination to the Upper Milton Creek in-water area are heavy petroleum sheens seeping from a relatively thin (1-foot-thick or less) sand layer situated at an approximate depth of 19 to 20 feet below the top of the bank. Biogenic sheens also seep from the eastern bank of Milton Creek and are intermingled with petroleum sheens. The platy relatively odorless biogenic sheens, which are easily distinguished from the fluid, odoriferous creosote-related petroleum sheens, likely emanate from areas where upland creosote contamination and wood debris is more completely degraded.

It is important to note that NAPL was generally not observed in borings completed directly within the Milton Creek stream bed, and that creosote-impacted soil and groundwater were not encountered in borings along the top of the Milton Creek shoreline. Only TarGOST® boring S002 exhibited a narrow zone of creosote impact between 19 and 20 feet bgs. Measurable NAPL has not been detected in monitoring wells MW-20 and MW-21 installed between the upland inferred NAPL area and Upper Milton Creek.

Contaminated sediments in the channel of Upper Milton Creek primarily occur within the reach of active petroleum seeps.

Lower Milton Creek

Field evidence of NAPL was generally not observed in supplemental RI borings and samples collected within the Lower Milton Creek area. Rather, lesser discrete creosote impacts were encountered in sediment between the surface (e.g., SD-MC-D, PWS-090617-2) and an approximate depth of 5 feet bml (SD009, SD010) downstream of the vehicle bridge near the confluence with Scappoose Bay. Riverward of the island and immediately downstream of the mouth of Milton Creek is a 15-acre area of surface sediment in Scappoose Bay that exhibits light petroleum sheen (e.g., GWS-11, GWS-12, and GW-13) and measurable PAHs in bulk sediment and/or sediment porewater (PWS-13, PWS-22, PWS-23, and PWS-24). The surficial nature of the contamination and its distribution and proximity to the mouth of Milton Creek suggest intermittent discharge from Milton Creek because the sediment impacts are not laterally contiguous.

Cove Area

Immediately upland of the Cove Area, ASTs stored creosote and fuel oil while a hog fuel boiler and pole peeling station operated along the shoreline. Based on historical photographs and information on plant operations and its subsequent demolition, it appears that significant amounts of creosote contaminated hog fuel, tree bark, and dimensional lumber accumulated in the Cove Area. I

The results of the supplemental RI indicate that NAPL has migrated from these upland source areas into approximately 0.8 acre of the Cove Area as shown by the solid red line on **Figure 5-1**. Heavy petroleum sheens are visible in seasonal groundwater seeps along a 300-foot section of bank seepage west of the peninsula. Near-shore Cove Area borings typically encountered 6 to 8 feet of NAPL impacted sediment, with a maximum thickness of 12 feet observed in SB-11. The near-shore presence of moderate to heavy petroleum sheens in surface sediment appears to be related to the NAPL/groundwater seeps, the presence of creosote-treated wood debris, and gas ebullition resulting from biodegradation of organic matter in deeper sediments.

Moderate to heavy petroleum sheens has been detected in subsurface sediment up to 220 feet offshore beneath the Cove Area (borings SB-04 and SB-09). In general, creosote-impacted sediment decreases in thickness and is encountered at deeper intervals within the Cove Area as distance increases from the shoreline. Outside the inferred extent of upland NAPL, the vertical mobilization of sheen via ebullition has not been observed in the Cove Area.

Riverward of the solid red NAPL boundary depicted on **Figure 5-1**, the source of subsurface sediment contamination transitions to creosote contaminated wood debris. This buried layer of creosote wood debris is interpreted to be the old in-water operational surface while the plant was active and during its demolition. Creosote-impacted wood debris ranges from 1 to 7 feet bml beneath much of the Cove Area (e.g., SB-03, SB-04, SB-06, SB-08, SB-09, and TarGOST® borings TGSD26 and TGSD32), and progressively thins and diminishes in magnitude outward from the

shoreline. Vertically, contaminant levels attenuate rapidly within the sediment stratigraphic layers. Sediment within the western portion of the Cove Area is generally unimpacted by upland NAPL migration and/or creosote contaminated wood debris.

Light or slight petroleum sheens have been intermittently observed in the relatively clean, more recently deposited surface sediment beyond the solid NAPL boundary depicted on **Figure 5-1**. Based on the results of bulk sediment and depth-discrete porewater sampling, these slight surficial sheens appear to be attributed to localized particles of creosote-treated wood debris in the surface sediment and do not appear to be attributed to NAPL migration from the underlying sediment. **Figure 5-2** depicts general areas where sheens have been observed in surface sediment at various times during the supplemental RI activities. **Figure 5-3** depicts general areas where sheens have been observed in subsurface sediment during the supplemental RI activities.

Area 1 Dock

Between the former hog fuel dock and northeastern (downriver) terminus of the former transfer table dock (Area 1 Dock), discontinuous, isolated pockets of creosote NAPL have been observed in many locations at or near the sediment surface, as depicted by the red dashed lines on **Figure 5-1**.

The source of sediment contamination in this portion of the Site is creosote contaminated and/or treated wood debris, although differing in character from that described above in the Cove Area. In this portion of the Site, much of the wood debris is finer textured and is described as "pulverized wood" in sediment sampling logs. The pulverized wood is interpreted to be hog fuel (e.g., wood shavings/chips) likely spilled from the hog fuel conveyor and during over-water transfers from ships/barges to the hog fuel hopper and conveyor system. Some of this material appears to have become saturated with creosote and accumulated along the shoreline and in sediment surrounding, and downstream of, the former hog fuel dock. Additionally, some of the contaminated wood debris appears to be related to deterioration of the creosote-treated dock structures (i.e., timber piles, lateral bracing, decking) that existed along this portion of the Area 1 shoreline. The distribution and thickness of the woody debris is highly variable in this portion of the Site, ranging from completely absent to more than 11 feet thick (sediment boring SB-16). The lateral extent of surface sediment and/or wood debris capable of producing a creosote-related sheen on the overlying water surface when disturbed extends approximately 75 feet offshore (i.e., riverward of the OHWM) between the former hog fuel dock and transfer table dock structure.

Within western half of the primary wood dock structure of the former transfer table, thick sequences of contaminated wood debris are intermingled with dimensional lumber, logs, metals ties, and other debris. Heavy sheens are easily generated by disturbing the surface sediment around many of the remaining log pilings. During the DAI, creosote NAPL associated with wood debris was primarily observed in the upper 24 inches of sediment within the central and western portions of the former transfer table dock area. Deposited wood and creosote-related contamination were observed from the surface to approximately 9 feet bml in the far western portion of the former transfer table dock. In general, the thickness of the wood mass decreased to the northeast away from the southwest area

of the former transfer table dock and is not present in significant thickness to the north of hand-auger boring DAI-HA-02 or to the east of location DAI-PH-11 (**Figure 3-3**). The lateral extent of surface sediment creosote contaminated wood debris extends approximately 200 feet offshore (i.e., riverward of the OHWM) within the footprint of the former transfer table dock.

As shown by a solid red outline on **Figure 5-1**, an upland and slightly in-water area of subsurface creosote staining and isolated blebs of NAPL were encountered in the Native Soil (i.e., fine-grained silt only, no sand lenses) beneath the northwest corner of the former transfer table dock. Creosote-impacted soil with residual NAPL decreases in thickness and is encountered at deeper intervals within the Native Soil (i.e., closer to but not necessarily directly at the Native Soil/Basalt Bedrock contact exclusively) as distance increases in all directions from the northwest corner of the former transfer table dock. This corner of the former transfer table dock is covered by recently deposited sand (natural deposition) and there is no visible surface evidence of impacted groundwater seeps from this upland area of NAPL.

Area 2 Dock

In October 2017, DEQ staff inspected the Area 2 shoreline and observed creosote-impacted surface sediment near the terminus of the former creosote pipeline and residual piling associated with a historical dock (a.k.a., Area 2 Dock). According to historical maps and photos, the Area 2 Dock was formerly used to offload creosote from river barges between 1919 and 1959.

In response to the September 2018 DEQ email and subsequent telephone conversations, creosote sheen occurrence was mapped in surface sediment along the approximately 900-foot-long portion of the Scappoose Bay shoreline shown on **Figure 3-9**. Moderate to heavy petroleum sheens were noted only in borings amongst the pilings near the shoreline that encountered creosote-contaminated wood debris within the upper 12 inches of sediment. Sediment poling beyond 50 feet of the shoreline (even amongst the pilings), did not produce a visible sheen. As shown on **Figure 3-9** and **Figure 5-1**, the lateral extent of creosote contaminated wood debris covers an approximately 200-foot-long by 50-foot-wide section (0.2 acre) of the Area 2 shoreline beneath and immediately downriver of the former P&T dock and creosote AST.

5.4 GROUNDWATER

Groundwater sampling results were presented in the 2000 RI Report (Section 7.2.2, Figures 23, 24, and 25), and groundwater samples were also collected in 1999, 2000, 2001, 2003, 2004, 2005, and 2006 (**Section 2.2**). Seep sampling results were presented in the 2000 RI Report (Section 7.2.4, Appendix C Figures C-24 and C-25). This Supplemental RI Report includes discussion of groundwater samples collected in September 2010, August 2011, and February, May, and August 2012 (**Tables 5-3**, **5-4**, and **5-5**) as representative of current Site conditions.

Residual NAPL continues to be a source for dissolved-phase creosote-related constituents in shallow groundwater beneath the Site. Based on the 2010, 2011, and 2012 groundwater monitoring

results, groundwater beneath Area 1 is adequately characterized for the purposes of the RI/FS. The occurrence of NAPL in groundwater is discussed in **Section 5.3.1**. The extent of PAHs and TPH in groundwater impacted by creosote is presented on **Figures 5-4** and **5-5**, respectively.

Consistent with previous groundwater analytical data, the highest concentrations of PAHs and TPH in groundwater were generally detected in monitoring wells MW 22, MW-2A, and MW-3A, within the inferred NAPL area, followed by detections in wells at the southeastern and northeastern edges (MW-23, MW-24, and MW-25) of the former wood treating operations area. Detections of PAHs were generally lower in wells to the west of, and outside of, the inferred upland NAPL area and in wells at the far eastern edge of Area 1.

A summary of the analytical results for groundwater samples collected for the supplemental RI is provided below.

- Total PAHs were detected in groundwater samples collected within or near the former operations area, with a similar distribution of relative concentrations as TPH (**Figure 5-4**). Total PAHs detected in groundwater ranged in concentration from 0.35 µg/L at well MW-18 to a maximum of approximately 26,800 µg/L at well MW-3A in 2010; NAPL was also detected at MW-3A during the 2010 monitoring event. The maximum Total PAHs in groundwater in 2011/2012 was approximately 22,500 µg/L in well MW-22.
- Petroleum hydrocarbons indicative of creosote were detected in groundwater samples collected within or near the former operations area (**Figure 5-5**; **Table 5-4**). TPH detections were primarily in the diesel range, presumptively identified.
  - The maximum diesel-range hydrocarbon concentration was detected in well MW-3A at 374 mg/L in 2010; NAPL was also detected at MW-3A and sampled during the 2010 monitoring event. This sample also had elevated BTEX concentrations relative to other sampling events. The maximum diesel-range hydrocarbon concentration in 2011/2012 was 116 mg/L at MW-3A.
  - The maximum concentration of TPH in the oil range was 103 mg/L at MW-3A in 2010; the maximum oil-range hydrocarbon concentration in 2011/2012 was 3.81 mg/L at MW-2A.
- Metals detected in groundwater were arsenic, chromium, copper, lead, and zinc (**Table 5 5**). The distribution of metals detections does not generally correlate with NAPL or the former wood treating operations area.
  - Arsenic was detected in every well sampled during the supplemental RI.
  - Chromium was detected infrequently just above reporting limits in MW-3B and MW-5, and at slightly higher concentrations (maximum of 5.83 µg/L) at MW-2A.

- Copper was detected at MW-5 at a maximum concentration of 18.5 µg/L; the only other detection of copper was just above the reporting limit at MW-4B.
- Lead was detected infrequently in wells MW-3B, MW-5, and MW-9, at a maximum of 3.49 µg/L.
- The maximum zinc detection, 683 µg/L, was at MW-20 in 2011; other detections at MW-20 were below 10 µg/L. Well MW-5, located near the northern property boundary, has had consistent detections above 200 µg/L. All other zinc concentrations were below 200 µg/L, with most below 10 µg/L.

Effect of Turbidity on Groundwater PAH Results

Results from the August 2012 SPME analysis (ASTM Standard Test Method D 7363-11) of groundwater at monitoring wells MW-3A, MW-21, and MW-24 (**Section 3.1.3**) were compared with results for the standard PAH analytical method (EPA Method 8270D SIM) in the same wells for the PAH constituents common to both methods. Analyte concentrations were similar or lower, and detection limits were considerably lower, using the SPME analysis. For samples from MW-3A, results for many analytes were an order of magnitude lower, in some cases as much as three orders of magnitude lower, when using SPME. The PAH concentrations detected using the ASTM SPME analysis method represent dissolved PAHs; therefore, the lower detected concentrations are related to the exclusion of PAH compounds adsorbed to suspended solids and colloids, which are removed from the groundwater samples as part of the extraction process.

The August 2012 groundwater samples from MW-3A were significantly more turbid than samples obtained from MW-21 and MW-24. Monitoring well MW-3A is screened entirely within the clayey silt immediately above the Basalt Bedrock, and the 20-40 sand pack and 0.10-inch slot well screen are not sufficient to filter out suspended solids and colloids during sample collection. Groundwater results from these three wells, including turbidity measurements (in nephelometric turbidity units [NTU]), are presented below for comparison.

Sample ID	Total PAHs (EPA Method 8270 SIM)	Freely Dissolved PAHs (ASTM SPME Method)	Turbidity
MW-3A	16,631 µg/L	7,005 µg/L	67 NTU
MW-21	186 µg/L	146 µg/L	12 NTU
MW-24	3,426 µg/L	3,285 µg/L	9 NTU

The data indicate that the alum flocculation (floc) step used by the ASTM SPME method effectively removed the majority of particulate-bound PAHs in the MW-3A sample. Because significantly less solids were present in samples from MW-21 and MW-24, aqueous PAH levels as measured by SPME versus conventional methodology were more consistent.

5.5 SEDIMENT

Sediment sampling results were presented in the 2000 RI Report (Section 9.0, Figure 30) and in the 2006 ERA (Bridgewater Group, Inc., and Kennedy/Jenks Consultants, 2006). This updated supplemental RI Report includes discussion of sediment samples collected in July and October 2011, July and October 2012, October 2013, and September 2017 as representative of current Site conditions. The analytical results for sediment samples are presented in **Table 5-6** and summarized below.

- Petroleum hydrocarbons were detected in sediment samples collected along the Scappoose Bay shoreline. These were primarily diesel-range hydrocarbons with some oil-range hydrocarbon detections. A maximum of 14,000 mg/kg of diesel-range hydrocarbons was detected in sample SB-11 at 4 feet bml; SB-11 was located within the estimated NAPL extent just west of the peninsula (**Figure 3 1**).

- Total PAHs in the 2011 to 2013 surface sediment samples ranged from not detected to a maximum of approximately 4,800 mg/kg in SSED-6 located east of the former hog fuel dock within an area of creosote wood debris. Total PAHs in the 2017 surface sediment samples, all obtained outside inferred NAPL areas, ranged from 1.58 mg/kg (PWS-090517-6) to 53.54 mg/kg (PWS-090517-9). As stated above, the highest relative total PAH concentrations were found within the old buried operational surface and/or within the inferred areas of offshore NAPL.

- As part of the 2017 supplemental RI, surface sediment samples were submitted for VOCs. VOCs were not detected in the Phase 3 bulk sediment samples, except for naphthalene (0.133 mg/kg) in the surface sediment sample obtained at PWS-090517-14.

- As part of the 2017 supplemental RI, surface sediment samples were submitted for VPH/EPH. None of the volatile aliphatic and aromatic hydrocarbons quantified by the Ecology VPH method were detected in the Phase 3 sediment samples (all 15 Phase 3 sampling locations). High molecular weight aliphatics and aromatics (C_{16}-C_{21} and C_{21}-C_{34}) were detected at concentrations ranging between 4.84 mg/kg (PWS-090517-5, C_{16}-C_{21} Aromatics) and 236 mg/kg (PWS-090517-9, C_{16}-C_{21} Aromatics) in all 10 of the 2017 surface sediment samples submitted for the Ecology EPH analysis. It is important to note that the laboratory's EPH reporting limits are 6 to 10 times lower than VPH method reporting limits for comparable TPH fractions. Approximately two-thirds of the sediment samples tested for EPH (i.e., 10 of the 15 Phase 3 sampling locations) detected aliphatics and aromatics between C_{12}-C_{16}. The highest concentrations of aliphatic and aromatic fractions were detected in the surface sediment sample obtained at PWS-090517-9; which also produced the largest total PAHs value and was the only bulk surface sediment sample to contain measurable C_{10}-C_{12} aliphatics (12.90 mg/kg).

- In the 2011/2012, surface sediment samples analyzed for TOC, concentrations ranged from 520 mg/kg at SB-23 to 150,000 mg/kg at SSED-6; these locations were east of the former hog fuel dock and within 25 feet of each other. The average TOC concentration was approximately 21,000 mg/kg. The average TOC concentration from 0 to 4 inches bml was 28,000 mg/kg, and the average from 8 to 12 inches bml was 16,000 mg/kg. TOC content in the 2017 surface sediment samples ranged from 10,000 mg/kg (PWS-090617-12) to 29,000 mg/kg (PWS-090617-1, -2, and -3), with an average of approximately 22,200 mg/kg across all 15 Phase 3 sampling locations. TOC content varied across the investigated area, and there does not appear to be a discernable pattern of high or low concentrations by locality. In general, samples with higher TOC were observed to contain wood debris, including wood chips, sticks, and roots.
- In the 2012 surface sediment samples analyzed for black carbon, the percentage of black carbon ranged from 0.10 to 0.34 (with the exception of one location at which black carbon was not detected), with an average of 0.18% black carbon. The average black carbon concentration from 0 to 4 inches bml was 0.16%, and the average from 8 to 12 inches bml was 0.19%. Black carbon measurements in the 2017 surface sediment samples ranged from 0.067 to 0.36% (presented as % soot), with an average of 0.17% across all 15 Phase 3 sampling locations. Similar to TOC, black carbon content varied across the investigated area with no discernable pattern of high or low concentrations by locality.

Since the 2000 RI, over three hundred (305) additional sediment samples from the Scappoose Bay and Milton Creek shorelines along Area 1 (including duplicates and reference/background samples) have been analyzed for PAHs, TPH, VPH/EPH, VOCs, TOC, and/or black carbon. Additionally, subsurface information was obtained via the 67 TarGOST® borings and depth-discrete sampling, various sediment sampling events, and multiple shoreline inspections.

PAH concentrations measured in surface sediment during the 2011 to 2017 supplemental RI were generally consistent with the concentrations measured in the historical surface samples, although variations were noted in specific samples collected within close proximity of one another. These variations in sediment bulk chemistry appear to be a function of sediment heterogeneity (e.g., presence of treated wood debris, varying grain size distribution, and varying amounts of organic material) and not attributed to temporal or spatial changes in contaminant mass flux from upland source areas. However, the potential for contaminant concentrations in sediment to be affected by temporal changes in contaminant mass flux from upland source areas cannot be ruled out and should be further evaluated as part of the FS.

As expected, the highest concentrations of PAHs in sediment occurred within the area of the inferred extent of NAPL, although NAPL was not observed in all samples collected within this area. Although TPH was not tested in sediment as frequently as PAHs, the highest TPH detections (primarily diesel-range hydrocarbons) were also observed within the inferred extent of offshore NAPL.

As mentioned above, the current sediment surface outside the inferred NAPL areas is significantly less contaminated than the old buried operational surface. For instance, TPH levels in bulk sediment collected between 3 and 7 feet beneath the Cove Area ranged from 500 to 2,000 mg/kg with total PAHs (including homologues) up to an estimated 800 mg/kg. Over the majority of the Cove Area, sediment contamination is capped by a more recently deposited and relatively clean fine-textured sediment of varying thickness.

5.6 SEDIMENT POREWATER

Sediment porewater was not sampled separately as an independent medium as part of the RI (e.g., porewater and sediment were sampled and analyzed together). During the supplemental RI, shallow sediment porewater samples were collected in July and October 2012, and shallow/deep sediment porewater samples were collected in September 2017. The majority of the thirty 2012 porewater samples (PWS-01 through PWS-30) were collected outside inferred NAPL areas. Nine of the 2012 PWS and five of the LSI porewater samples were collected within inferred NAPL areas. The locations of the July and October 2012 sediment porewater sampling location are illustrated on **Figure 5-6**. All fifteen 2017 sediment porewater sampling locations (PWS-0905017-1 through PWS-090617-15) were situated outside inferred NAPL areas. The locations of the September 2017 sediment porewater sampling locations are illustrated on **Figure 5-7**

As mentioned above, the 2012 shallow porewater samples were collected as bulk sediment samples and porewater was extracted in the analytical laboratory (*ex-situ*). The extracted porewater was analyzed for 18 parent PAH compounds and 16 groups of prominent C1 to C4 alkylated PAH homologues (i.e., 34 PAHs) using SPME followed by GC/MS according to ASTM Standard D7363 and procedures developed based on research completed at the University of North Dakota (Hawthorne et al., 2005a/b). The 2012 sediment porewater samples were also analyzed for DOC using SM 5310C.

During the 2017 supplemental RI activities, creosote constituents were measured in shallow (0 to 12 inches bml) and deeper (24 to 29 inches bml) sediment porewater at the Site (*in-situ*) using LDPE PSDs followed by GC-MS/MS or SIM GC/MS for the following parameters:

- Parent and alkyl substituted PAHs (63 compounds) by FSES SOP 418.00;
- 34 PAHs by ASTM D7363 and FSES SOP 427.00;
- Oxygenated PAHs (22 OPAHs) by FSES SOP 414.00; and
- Hopanes/cholestanes by FSES SOP 416.00.

In addition, VPH and select VOCs were analyzed in water samples obtained from *in-situ* PDB PSDs buried between 0 to 12 inches bml adjacent to the LDPE PSDs.

All sediment porewater concentrations reported from the *ex-situ* SPME and *in-situ* LDPE PSD samples, are freely dissolved water concentrations (C_{free}), except hopane and cholestanes values which represent instrument concentrations. For *in-situ* C_{free} calculations, no assumptions were

necessary with regards to the sampling kinetics for any compound because the full kinetic model incorporating PRCs was used when calculating PAH porewater concentrations (Fernandez L.A., C.F. Harvey, and P.M. Gschwend. 2009). For a complete and detailed description of the C_{free} calculation see FSES SOP 407.01. Copies of the laboratory SOPs are included in **Appendix D**.

The analytical results for porewater samples are presented in **Table 5-7** and summarized below.

2012

- Total PAHs (summed 34 PAHs) measured in sediment porewater using the *ex-situ* approach ranged from not detected to a maximum concentration of 1,720 µg/L at PWS-02 near the former transfer table dock. Naphthalene, a key component of PAHs in upland groundwater, was only detected in 4 out of 59 porewater samples; these were located near groundwater seeps in Milton Creek and along Scappoose Bay, and near the former transfer table dock.
- DOC in porewater ranged from not detected to 112 mg/L. The highest concentrations were generally found in samples within or on the margins of the man-made cove, but DOC concentrations were variable throughout the investigation area.

Sediment porewater results for Milton Creek and Scappoose Bay were evaluated using partitioning models developed by EPA to further assess potential risk of PAHs to aquatic invertebrate receptors in and around creosote-impacted Site sediment. The EPA has developed multiple approaches for evaluating risk to invertebrates. These methods involve either using equilibrium partitioning theory to estimate porewater concentrations from bulk sediment concentrations or directly measuring porewater extracted from bulk sediment samples. The 2012 PWS investigation was designed to collect data in support of this assessment. Sediment and porewater results were used to calculate summed Equilibrium Partitioning Sediment Benchmark Toxic Unit (∑ESBTU) values for sediment results, and the summed Interstitial Water Toxic Units (∑IWTU) values for porewater results, in accordance with EPA guidance.

In accordance with EPA guidelines and described in **Appendix G**, the direct measurements of the freely dissolved 34 PAH concentrations in sediment porewater or interstitial water (IW) are used along with their expected final chronic value (FCV) water/lipid partitioning behavior to calculate a hazard quotient, referred to as a toxic unit (TU). The narcosis based TUs are considered additive, and evaluation of the sum of the TUs requires that all 34 PAH analytes be included in the sum (ΣIWTU). Calculations of ΣIWTU have been used on this project as a benchmark for predicting the toxicity of PAHs to benthic invertebrates with a potential for risk when the ΣIWTU greater than 1.

Calculated ΣIWTU values are summarized in **Table 5-8** and illustrated on **Figure 5-6**. The 2012 sediment porewater locations with high C_{free} PAH levels (i.e., IWTU greater than 1) occurred only in the presence of NAPL. This finding indicates that when NAPL is present, it plays a dominant role in the solid-to-water PAH partitioning (Hong et al., 2003). Alternatively, in sediment porewater samples without NAPL, organic carbon seemed to dominate PAH aqueous partitioning. Black carbon (e.g., soot, and other anthropogenic carbon created by pyrogenic processes) is widely

recognized to have stronger affinity for PAHs (i.e., binds more tightly) relative to other forms of organic carbon. The role of black carbon in inhibiting migration of PAHs to porewater and surface water is further discussed in **Section 6.2**.

2017

- The total sum of all detected PAHs in sediment porewater using the *in-situ* LDPE PSDs ranged from 0.0055 µg/L (Shallow PWS-090517-3) to 6.780 µg/L (Deep PWS-090617-15). These total PAH values represent the sum of all 63 freely dissolved concentrations (i.e., C_{free} Σ63) measured on the LDPE media. In general, higher dissolved PAH concentrations were encountered in the deeper porewater samples (24 to 29 inches bml). Only at sampling locations PWS-090617-2 and PWS-090617-12 were dissolved PAHs detected at markedly higher concentrations in the shallow porewater (3 to 8 inches bml) relative to the deeper sample. Of the 16 prominent alkyl groups, the highest concentrations were reported for the C_3- and C_4-naphthalenes.

Because the hydrocarbon narcosis risk model requires the quantitation of 34 PAHs, the results of the FSES forensic alkyl PAH analyses are summarized in **Table 5-7**, rather than the 63 individual analytes.

Only one of the fifteen 2017 sediment porewater locations produced an ΣIWTU greater than 1 (PWS-090617-2) within the biologically active zone (0 to 12 inches bml). This location happens to be in the mouth of Milton Creek and a significant distance downstream from the inferred NAPL area mapped along the east bank of Milton Creek and upstream of the NAPL area mapped in Scappoose Bay. Calculated ΣIWTU values for sediment porewater samples collected in 2017 are summarized in **Table 5-8** and illustrated on **Figure 5-7** (biologically active zone only).

In addition to PAH alkylation group concentration determination, the FSES SOP 427 includes diagnostic ratios between PAHs which can aid in distinguishing between petrogenic (petroleum), pyrogenic (combustion and pyrolytic), and biogenic sources, as well as among multiple pyrogenic sources. As part of evaluating sediment porewater quality in Scappoose Bay upstream and adjacent to the Site, Cascadia reviewed the diagnostic ratios provided by FSES to better differentiate Site-related contamination (i.e., pyrogenic PAHs attributed to creosote) from urban non-point discharges like storm runoff from nearby roadways; fall-out of combustion particles from burning biomass, coal, and petroleum; and incidental discharges or spills of unburned petroleum from boat traffic. Consistent with prior evaluations, the ratio of 4-ringed PAHs fluoranthene/pyrene (Fl/Py) provided the sharpest distinctions and subsequently has been included in the **Table 5-7**.

A comparison of the ratio of select stable PAH isomers (e.g., C_{free} fluoranthene and pyrene) in PSW-090617-2 is markedly lower (0.29) than ratios of fluoranthene to pyrene (Fl/Py ratio) typically found in creosote (1.36 to 1.75) (Stouta et al., 2001) (Zemo, 2009). The Fl/Py ratios calculated in the other 2017 porewater sampling locations situated much closer to the Site's creosote source areas, ranged from 0.9 to 1.6. For perspective, the Fl/Py ratio was 1.9 in the C_{free}

groundwater sample obtained from upland monitoring well MW-3A (i.e., source area well containing creosote NAPL). Prior forensic evaluations of Fl/Py ratios to attribute PAH sources within this offshore area have largely relied on bulk sediment data derived by EPA Method 8270. For reference, Fl/Py ratios between 1.2 and 1.6 were noted in bulk sediment samples obtained near creosote seeps or creosote-affected areas. Whereas bulk sediment samples collected near the confluence of Milton Creek and Scappoose Bay have Fl/Py ratios less than 1.2. Fortunately, the resolving power of the Fl/Py ratio to attribute PAH sources in sediment is enhanced by the improved analytical precision of the FSES quantitation of C_{free} PAHs in sediment porewater. The Fl/Py ratio and other diagnostic ratios (e.g., Pyrogenic Index) provided in Appendix 6 of the FSES report support field observations (i.e., no creosote NAPL noted) that elevated concentrations of the C_3- and C_4-naphthalenes in PWS-090617-2 are not Site related.

The spatial distribution of surface and subsurface porewater toxic units, along with the distribution of sheen and bulk sediment PAH concentrations, is shown on **Figure 5-8**.

- The results of VPH, BTEX, and naphthalene analyses for the 15 sediment porewater samples collected in 2017 are presented in **Table 5-9**. None of the volatile aliphatic and aromatic hydrocarbons quantified by the Ecology VPH method were detected in the Phase 3 *in-situ* porewater samples. As mentioned above, the volatiles GC/MS data for each PDB sample analyzed by EPA Method 8260C underwent additional evaluation using MIM. Specifically, MIM techniques were used to search for aliphatic hydrocarbons between C_{10}-$C_{>12}$ below VPH detection limit (50 µg/L). According to Apex Labs, the PDB water samples were free of interference and the absence of select VOCs (BTEX and naphthalene) suggests that VPH fractions are not present at significant freely dissolved concentrations in the sediment porewater at the 2017 sampling locations.
- Twenty-one of the thirty 2017 sediment porewater samples contained detectable levels of dissolved OPAHs (**Table 5-10**). The total sum of all detected OPAHs (i.e., Σ22) in the Phase 3 sampling locations ranged from 0.0001 µg/L (Deep PWS-090517-15) to 0.630 µg/L (Shallow PWS-090617-12). All but three of the sediment porewater samples (Shallow PWS-090617-1, Shallow PWS-090617-12, and Deep PWS-090617-12) had relatively few and/or low detections of OPAHs. Of the 22 OPAHs, chromone was detected at the largest concentrations in samples Shallow PWS-090617-1, Shallow PWS-090617-12, and Deep PWS-090617-12.

5.7 SURFACE WATER

Cascadia has summarized the results of the following Phase 3 surface water chemical analytical testing:

- 34 PAHs (**Table 5-11**)
- ΣSWTU (**Table 5-12**)
- OPAHs (**Table 5-13**)

The corresponding FSES laboratory reports (OSU Final Report, and Appendices 3 and 5) are included in **Appendix D**. The remaining surface water chemical analytical data (e.g., 63 PAHs, hopanes/cholestanes, NIST SRM 2279) have also been included in **Appendix D**; however, they have not been summarized in tables.

5.7.1 PAHs

Low levels of freely dissolved PAHs were detected in all eight 2017 surface water samples. Total PAHs measured on the *in-situ* LDPE PSDs after 21 days in surface water ranged from 0.0192 µg/L (Surface Water Site 3) to 0.0797 µg/L (Surface Water 10). These total PAH values represent the sum of all 63 freely dissolved concentrations (i.e., C_{free} Σ63) measured on the LDPE media. Detected concentrations of select parent PAHs were compared to the surface water SLVs to evaluate potential risk to fish. As shown in **Table 5-11**, all detected PAHs were below their corresponding SLV.

To be consistent with the sediment porewater PAHs data, the 18 parent and 16 alkyl (34 PAHs) results are summarized in **Table 5-11** rather than the 63 individual analytes. Like the sediment porewater data, the highest alkyl PAH reported was C_4-naphthalene. In general, 34 PAH levels in the 2017 surface water samples were either consistent or slightly higher than detected concentrations in co-located shallow sediment porewater. The two notable exceptions to this data trend are PWS-090617-2 and PWS-090617-12, where detected concentrations of PAHs in shallow porewater are higher than levels measured in the overlying surface water samples.

Like porewater, surface water toxic units relative to the FCVs were calculated and summed (ΣSWTU) as summarized in **Table 5-12** and **Figure 5-7**. As discussed in **Section 10.2**, samples PWS-090917-9, PWS-090517-10, PWS-090617-12, and PWS-090617-13 produced a ΣSWTU greater than 1.

5.7.2 OPAHs

Low levels of freely dissolved OPAHs were detected in all but one of the eight Phase 3 surface water samples (**Table 5-13**). The total sum of all detected OPAHs (i.e., Σ22) in the 2017 surface water samples ranged from 0.0001 µg/L (Surface Water Site #2) to 0.438 µg/L (Surface Water Site #10). Of the 22 OPAHs, chromone was detected at the largest concentrations in surface water samples deployed at Phase 3 sampling locations #10, #12, and #13. OPAHs were largely not detected in the sediment porewater.

6.0 CONTAMINANT FATE AND TRANSPORT

This section presents a discussion of contaminant fate and transport based on field and laboratory data collected as part of the supplemental RI as presented in **Section 5.0.** Contaminant transport is discussed in Section 11 of the 2000 RI Report. Data collected as part of the supplemental RI generally support conclusions regarding contaminant transport from the 2000 RI Report and further enhances the understanding of Site conditions.

6.1 GENERAL

A schematic diagram of contaminant transport at the Site is provided in plan view **Figure 6-1**. This section provides a general overview of the mechanisms for transport of contamination from source areas within the source media (e.g., historical surface soil) and to other media (e.g., surface water).

Operations/Source Area

- During approximately 40 years of wood-treating operations at the Site from 1919 to 1959, creosote spills and/or releases to upland soil and adjacent portions of Scappoose Bay appear to have occurred.
- Historical dredging and filling activities appear to have altered the Site's shoreline along Scappoose Bay over time. In effect, the upland area increased, and the shoreline appears to have moved 100 to 200 feet south and southwest from the former wood treatment operations.
- The former treatment plant, storage tanks, and product transfer tables appear to have been developed on timber piles and suspended above the historical ground surface because the Site was prone to flooding.
- The wood-treating facilities were dismantled in the 1960s, and the Site's historical ground surface was covered with 5 to 10 feet of clean imported fill in the 1970s.
- Site uses since the 1970s do not appear to have caused significant contamination.

NAPL

- Creosote, in the form of NAPL, has migrated vertically through the layered fine-grained Native Soil to the shallow water table and spread somewhat laterally through thin sand layers and along the top of basalt beneath approximately 4 acres of the upland as illustrated by the solid red line on **Figure 6-1**.
- The Site's underlying dense Basalt Bedrock appears to be an effective barrier to downward DNAPL migration in those Site areas where creosote impact was observed at the Native Soil/Basalt Bedrock contact.

- Creosote is a multi-component NAPL that contains many hydrocarbons, primarily PAHs, phenolic compounds, and carrier fluids such as diesel. Over the approximately 60 years between plant closure and completion of the RI, subsurface creosote (either as free phase NAPL, sorbed on solids, or dissolved in water) likely underwent compositional changes due to weathering (e.g., loss of more soluble or biodegradable components). Residual Site contamination consists predominantly of creosote-derived PAHs (i.e., no light nonaqueous-phase liquid or evidence of carrier fluids).

Groundwater/NAPL Shoreline Seeps

- Once the creosote reached groundwater, PAHs from the creosote migrated vertically and horizontally with groundwater flow as dissolved-phase constituents; however, diffusive and advective migration has been largely inhibited by limited solubility and the tendency for PAHs to adsorb to soil.
- Dissolved PAHs and NAPL have migrated from the upland former operations area to the southwest bank of Scappoose Bay within the Cove Area, presumably along narrow, thin stratigraphic soil layers, and are visible along a 300-foot section of the riverbank as visible petroleum sheen seeps during late summer when surface water levels are low. This upland derived NAPL source extends approximately 100 feet beneath the offshore Cove Area where sediment contamination is largely capped by more recently deposited and relatively clean sediment.
- Dissolved PAHs and limited amounts of NAPL appear to have migrated from the upland former operations area to the east bank of Upper Milton Creek, presumably along narrow, thin stratigraphic soil layers. Although the supplemental RI did not confirm a direct connection between the former operations area and Milton Creek. In late summer, groundwater seeps with a petroleum sheen are visible along a 200-foot section of the bank. Contaminated sediments in the channel of Upper Milton Creek primarily occur within the reach of active groundwater/NAPL seeps. They appear to be limited to the soft unconsolidated surface sediments and have not been observed in the underlying stiff gray clayey silt.
- Detected concentrations of PAHs and TPH in groundwater monitoring wells located beyond observed areas of direct NAPL seepage along the Area 1 shoreline exceed aquatic water quality standards (**Figures 5-4** and **5-5**). While PAH and TPH data obtained from upland groundwater monitoring wells are not representative of freely dissolved-phase concentrations (i.e., bioavailable fraction) in the groundwater/surface water transition zone, DEQ believes the contamination in groundwater has the potential to discharge to the aquatic environment at concentrations that could cause adverse effects to the environment.

Sediment/Porewater/Surface Water

- Moderate to heavy petroleum sheens have been encountered in subsurface sediment (>1 foot) beneath approximately 1.9 acres of the Cove Area. Riverward of the red shaded area on **Figure 6-1**, sediment contamination is covered by new relatively clean sediment. Based on the existing RI data, subsurface sediment containing NAPL present in the Cove Area is considered contained by the overlying relatively clean sediment that has been deposited in the Cove Area because operations at the Facility ceased.

- Creosote was also released directly to the surface of Scappoose Bay sediment from historical nearshore and/or overwater operations within the Cove Area, Area 1 Dock, and Area 2 Dock offshore areas. Much of the old in-water operational sediment surface contains wood debris with significant amounts of creosote. Unlike the Cove Area, the old operational sediment surface within the Area 1 and 2 Dock offshore areas has not been covered by new relatively clean sediment. Approximately 2.2 acres of surficial wood-related NAPL are present within Area 1 Dock and approximately 0.3 acre within Area 2 Dock. These areas of significant creosote contaminated wood debris are illustrated by the dashed red lines on **Figure 6-1**.

- Porewater sampling conducted beyond the delineated areas of NAPL indicate that creosote constituents attenuate rapidly in the sediment pore space. The results of depth-discrete porewater sampling were used to evaluate dissolved-phased mass flux from deeper impacted sediment. In general, detected concentrations of dissolved PAHs in "deep" sediment porewater beneath the biologically active zone (i.e., 24 to 29 inches bml) were higher than those measured in the overlying "shallow" sediment and surface water. As summarized in **Table 5-8**, 4 of 15 deep porewater sampling locations exhibited ΣIWTUs greater than 1 (i.e., PWS-090617-1, PWS-090617-2, PWS-090517-5, and PWS-090517-14). However, the overlying sediment exhibited no toxicity (ΣIWTUs < 1) at three of the same four sampling locations (except PWS-090617-2).

- Like sediment porewater, surface water sample with a ΣSWTU greater than 1 are designated as toxic to aquatic receptors, and include samples PWS-9, PWS-10, PWS-12 and PWS-13 (**Table 5-12** and **Figure 5-7**).

6.2 GROUNDWATER DISCHARGE TO SEDIMENT AND SURFACE WATER

The Site's wood-treating operations ceased approximately 60 years ago, and the residual creosote-related contaminants are highly weathered and tightly bound to the soil matrix (i.e., unable to desorb from the soil or organic carbon within the soil matrix). Residual NAPL present in upland Site soil contributes to, and remains a long-term source of, dissolved-phase contamination. Dissolved-phase constituents (mainly PAHs) in groundwater, as well as constituents adsorbed to mobile colloids, migrate with groundwater flow from upland source areas to the surface water bodies. Detected concentrations of PAHs and TPH in groundwater monitoring wells located along the Area 1 shoreline exceed aquatic water quality standards. However, these dissolved-phase

constituents are not expected to reach sediment porewater within the biologically active zone (i.e., upper 12 inches) or surface water at concentration levels equivalent to those in upland monitoring wells. Migration of both dissolved-phase and adsorbed Site-related constituents is mitigated by the affinity of PAHs to adsorb to soil and the limited solubility of PAHs. Furthermore, dissolved PAHs in groundwater entering Scappoose Bay and Milton Creek surface water are subject to significant dilution and are expected to strongly partition onto the natural organic carbon in the soft sediment adjacent to the Site. Specifically, PAHs were detected at much lower concentrations, or were not detected at all in sediment porewater samples obtained outside delineated areas of NAPL. This conclusion is demonstrated by the naphthalene concentrations in groundwater and porewater shown on **Figure 6-2.**

While PAH and TPH data obtained from upland groundwater monitoring wells are not representative of freely dissolved-phase concentrations (i.e., bioavailable fraction) in the groundwater/surface water transition zone, contamination in groundwater has the potential to discharge to the aquatic environment at concentrations that could cause adverse effects to the environment. Therefore, the feasibility study will consider upland or riverbank actions that address contaminated groundwater discharge to the aquatic environment.

6.3 NAPL TRANSPORT

The movement of creosote NAPL through the subsurface is complex and highly non-uniform due to the fact that it is acted upon by three forces: (1) gravitational forces (pressure due to gravity), (2) capillary forces (capillary pressure), and (3) hydraulic force (also known as advection or hydrodynamic pressure). In general, capillary forces tend to trap creosote, while gravitational and hydraulic forces tend to mobilize creosote. Creosote NAPL will be mobilized when the vector sum of the gravitational and hydraulic forces exceeds the capillary forces.

NAPL trapping due to capillary forces occurs in two ways: (1) creosote is trapped within the pores at residual saturation; and (2) creosote is trapped as pools (above residual saturation) on top of less permeable layers (due to insufficient NAPL entry pressure to displace water in a fine-grained, low-permeability layer). Consequently, once the surface source is eliminated, NAPL will migrate until a flow equilibrium is reached whereby the mobile creosote is trapped by capillary forces at residual saturation within pores and/or as pools on top of stratigraphic traps (low-permeability, capillary pressure barriers). The volume of NAPL that is mobile at the Site depends on several factors, including: (1) residual saturation trapped by capillary forces, (2) heterogeneity of the fine-grained Native Soil, and (3) site-specific properties of the weathered creosote NAPL. NAPL properties that affect mobility are discussed below.

Based on the physical properties of creosote (i.e., density, high water/NAPL interfacial tension, and high viscosity), Site conditions, and the results of NAPL delineation completed around the former wood-treating facilities (both upland and offshore), the lateral and vertical extent of NAPL appears to be defined and relatively stable. However, evidence of ongoing lateral NAPL migration is evident within the former operations area (via thin sand layers in the Native Soil). Based on the

accumulation of NAPL in MW-3A, it can be inferred that: (1) NAPL in the vicinity of monitoring well MW-3A exceeds the residual saturation limit of the soil and thus is free to migrate; and (2) NAPL transport occurs through these thin, more permeable soil layers under steep hydraulic gradients (i.e., during low-water conditions).

As discussed in Section 5.3.1, NAPL was not identified in supplemental RI monitoring wells installed within or along the edges of the former wood treating operations area (MW-2A, MW-22, MW-23, MW-24, and MW-25) even though the wells are screened across stratigraphic soil layers containing NAPL and equipped with "DNAPL funnels" and collection sumps. This finding demonstrates that the majority of the residual upland NAPL is trapped by capillary forces within the Native Soil macropores and not within the more permeable sand lenses; except for the localized creosote seep areas (discussed below) along the banks of Milton Creek and Scappoose Bay.

6.3.1 Vertical Transport

Evidence of NAPL observed near the Native Soil/Basalt Bedrock interface indicates some component of downward vertical migration of NAPL at the Site. However, capillary forces significantly inhibit migration of NAPL, both laterally and vertically. Additionally, the Basalt Bedrock is a barrier to downward vertical migration of the NAPL, based on the physical properties of creosote samples (as described above), *in-situ* hydrogeologic data gathered from RI rock core borings, and limited field observations of NAPL in basalt cores. Vertical migration calculations based on site-specific NAPL density, viscosity, and interfacial tension were presented in the 2000 RI Report, Section 11.3.1; these calculations indicated that vertical migration of creosote into the fractured basalt beneath the Site is not occurring and supports the field observations.

In addition to upland borings, offshore borings completed along Scappoose Bay within the inferred offshore extent of NAPL did not identify appreciable quantities of creosote NAPL at depth within the upper surface of Basalt Bedrock.

6.3.2 Lateral Transport

Evidence of NAPL in groundwater seeps along the banks of Milton Creek and Scappoose Bay during low-water conditions demonstrates some lateral NAPL migration beneath the Site. The supplemental RI did not confirm a direct connection between the former operations area and Milton Creek. However, the presence of discontinuous pockets of groundwater/NAPL seepage along 200 feet of Milton Creek's east embankment indicates that NAPL has spread laterally toward Milton Creek, potentially influenced by a topographic low in the Basalt Bedrock surface. One TarGOST® boring, S002, completed along the top of the east bank of Milton Creek approximately 75 feet north (upriver) of the groundwater/NAPL seepage, detected NAPL near the Native Soil/Basalt Bedrock contact. However, the magnitude of groundwater concentrations at monitoring wells and Geoprobe borings completed between Milton Creek and the former wood treating operations area are not indicative of NAPL. Therefore, investigation results suggest that NAPL has reached Milton Creek along narrow, thin (1 to 2 inches thick) stratigraphic layers within the Native Soil near the contact

with Basalt Bedrock. Sediment impacts in the Upper and Lower Milton Creek stream channel are limited and do not appear to be laterally contiguous.

The supplemental RI did confirm a direct connection between the former wood treating plant and ASTs and Scappoose Bay in the vicinity of the man-made cove and peninsula. Presence of discontinuous pockets of groundwater/NAPL seepage along 300 feet of Scappoose Bay indicates that upland NAPL has spread laterally into approximately 0.4 acre of the Cove Area, as shown by the solid red line on **Figure 6-1**. NAPL was encountered in upland borings completed along the Scappoose Bay shoreline immediately downgradient from the former wood treating plant and ASTs near the Fill Zone/Native Soil contact, indicating that historical releases likely occurred near the original ground surface. Borings completed within the intertidal zone of the man-made cove and western side of the peninsula encountered NAPL near the sediment surface as well as within Native Soil / sediment layers (i.e., macropores of silt and thin sand lenses) to depths of 12 feet below the current mudline. This offshore extent of residual NAPL appears to be a function of lateral spreading within the thin, more permeable soil/sediment layers up to 100 feet offshore beneath the Cove Area (borings SB-10, SB-11, and SB-14). The near-shore presence of moderate to heavy petroleum sheens in surface sediment appears to be related to the NAPL/groundwater seeps, the presence of creosote-treated wood debris, and gas ebullition resulting from biodegradation of organic matter in deeper sediments.

Moderate to heavy petroleum sheens have been detected in subsurface sediment up to 220 feet offshore beneath the Cove Area (borings SB-04 and SB-09). Beyond/riverward the solid red line indicative of upland NAPL, subsurface sediment contamination appears to be related to the former in-water operational surface (buried contaminated wood debris) and is covered by new clean sediment. In general, creosote-impacted sediment decreases in thickness and is encountered at deeper intervals within the Cove Area as distance increases from the shoreline. Beyond the solid red line, the vertical mobilization of sheen via ebullition has not been observed in the Cove Area.

The vast majority of offshore NAPL encountered along the Scappoose Bay shoreline appears to be relatively localized (i.e., discrete oil blebs) and stable (i.e., insufficient creosote mass to migrate further). Most of contaminated sediment beneath the Cove Area is buried by 1 to 7 feet of relatively clean recently deposited sediment. Offshore borings completed within the man-made coves and at the edges of the peninsula (i.e., within the inferred offshore extent of NAPL) did not identify appreciable quantities of creosote NAPL at depth within the upper surface of Basalt Bedrock.

6.4 OFFSHORE EXTENT OF CREOSOTE-CONTAMINATED WOOD DEBRIS

Discontinuous, isolated areas of creosote sheen were observed in surface sediment in the intertidal zone along the 700-foot section of Scappoose Bay between the former hog fuel dock and northeastern (downriver) terminus of the former transfer table dock (Area 1 Dock Area). Moderate to heavy petroleum sheens were observed in surface sediment in many areas throughout the footprint of the former transfer table dock, extending several feet beyond the southern limits (riverward) of the former dock structure. The source of these creosote sheens is directly related to

creosote contaminated and/or treated wood debris. The wood debris is generally observed within the upper 1 to 2 feet of sediment beneath and between these historical dock features, as discussed in **Section 5.3.2**. However, thickness and depth of wood waste with creosote was observed as deep as 14 feet bml beneath the far western portion of the former transfer table dock. The accumulation of wood debris in these areas appears to be a function of historical upland and overwater operations, its subsequent demolition, log rafts, deterioration of the remnant dock structures, and material deposition from river currents. In general, the thickness of the wood mass decreases to the northeast away from the southwest area of the former transfer table dock and is not present in significant thickness to the north of hand-auger boring DAI-HA-02 or to the east of location DAI-PH-11 (**Figure 3-3**). Close inspection of exposed surface sediment during periods of low water, low tide between the former hog fuel dock and transfer table dock indicates that the near-shore sediment environment is relatively stable, preventing the net deposition of newer clean sediment and burial of the historical operational surface throughout the Area 1 Dock.

As shown on **Figure 6-3**, the lateral extent of surface sediment and/or wood debris capable of producing a moderate to heavy petroleum sheen on the overlying water surface when disturbed extends approximately 75 feet offshore (i.e., riverward of the OHWM) between the former hog fuel dock and transfer table dock structure. The lateral extent of surface sediment creosote contaminated wood debris extends approximately 200 feet offshore (i.e., riverward of the OHWM) within the footprint of the former transfer table dock.

In addition to the Area 1 Dock shoreline, moderate to heavy petroleum sheens associated with wood debris were identified in the upper 12 inches of sediment over an approximately 200-foot-long by 50-foot-wide section of the Area 2 shoreline beneath and immediately downriver of a former P&T dock and creosote AST. This portion of the Site shoreline is referred to as the Area 2 Dock. The 2018 low-water inspection suggests the Area 2 Dock shoreline is a higher energy environment and that appears to prevent new sediment deposition and burial of this historical operational surface.

6.5 AIR TRANSPORT (DUST)

Airborne dust transport is not a likely significant contaminant migration pathway. The original ground surface at the time the former wood-treating facility operated is currently located beneath 5 to 10 feet of non-contaminated dredge sand fill. Consequently, soil contamination related to former wood-treating activities generally is not encountered at depths less than 5 feet below current ground surface (2000 RI Report, Section 7.2.11) and is not exposed to wind erosion.

Gravel roads built atop the clean fill (at current ground surface) reportedly had oil applied to them between 1974 and 1991 for dust suppression. PCBs were detected in surface soil samples collected from former oiled gravel roadbeds at the Site (2000 RI Report, Section 10.0). Potential risk to on-site industrial workers and recreational trespassers from inhalation of airborne particulates from surface soil contaminants was evaluated in the updated HHRA discussed below in **Section 10**.

6.6 PRIORITY ACTION AREAS

Using the results from the 2017 and 2018 offshore data gap investigation activities as the primary line of evidence, combined with historical analytical sediment and porewater analytical data obtained during the RI activities, PAAs have been established for the Site. The PAAs are identified as areas in which the concentration of contaminants of concern (COCs) represent an unacceptable risk and require implementation of an active remedy in order to address:

- Areas where contaminant concentrations clearly result in unacceptable risk to human health and/or environment; and
- Areas where creosote NAPL are present in the surface sediment and riverbank seeps.

While Cfree 34 PAHs have been detected outside of the proposed PAAs at concentrations exceeding PRGs (e.g., ΣIWTU > 1 and ΣSWTU > 1), the elimination of creosote NAPL in surface sediment and riverbank seeps is expected to, over time, allow concentrations of COCs in other matrices and/or less impacted areas outside of the PAAs to naturally attenuate.

6.6.1 Upland

Much of the Site's upland area was covered with 5 to 10 feet of imported granular fill in the years after P&T ceased operating the creosote facility. The Fill Zone effectively caps upland creosote contamination and prevents access to the deeper NAPL impacted (hot spot) soils and dissolved-phase constituents in groundwater. Evidence of NAPL in groundwater seeps along the banks of Milton Creek and Scappoose Bay during low-water conditions demonstrates some lateral NAPL migration beneath the Site. Defined riverbank NAPL seeps clearly represent a PAA because of the potential for recontamination of the adjacent in-water PAAs.

Detected concentrations of TPH and PAHs in groundwater monitoring wells located beyond observed areas of direct NAPL seepage along the Area 1 shoreline exceed aquatic water quality standards. While TPH and PAH data obtained from upland groundwater monitoring wells are not representative of freely dissolved-phase concentrations (i.e., bioavailable fraction) in the groundwater/surface water transition zone, DEQ believes the contamination in groundwater has the potential to discharge to the aquatic environment at concentrations that could cause adverse effects to the environment. The upland PAA includes groundwater discharge zones potentially exceeding aquatic standards. The upland PAA is illustrated on **Figure 6-3**.

6.6.2 Offshore

The offshore PAAs are characterized by (1) NAPL and moderate to heavy sheens in surface sediment, and/or (2) contaminant concentrations that result in unacceptable ecological risk with high degree of certainty, as discussed in **Section 10.2**. The presence of NAPL is an exceedance of the Oregon narrative water quality standard (340-041-0007[12]), is an unacceptable direct contact risk to human health and ecological receptors, is considered a highly mobile hot spot, and serves as

ongoing source of contamination to sediment, porewater, and surface water. Further, elimination of the ongoing release of creosote NAPL in shoreline seeps and near-shore surface sediment is expected to, over time, allow concentrations of creosote constitutes in other matrices (e.g., surface water) to attenuate. Offshore PAAs are included on **Figure 6-3**.

7.0 BENEFICIAL WATER USE DETERMINATION

A BWUD was included as Appendix E of the 2000 RI Report. The 2000 BWUD included a detailed discussion of the Site hydrogeological conditions and contaminant distribution and migration. Findings from the 2000 BWUD were updated using current information pertaining to OWRD records for supply wells and surface water rights, Port and City of St. Helens land-use and zoning ordinances, and information regarding available habitat and recreational uses in the vicinity of the Site. Updated information was obtained through desktop review of publicly available records from the OWRD, Port, City of St. Helens, and U.S. Fish and Wildlife Service (USFWS).

DEQ lists general categories of water use in the Guidance for Conducting Beneficial Water Use Determinations at Environmental Cleanup Sites (DEQ, 1998). With respect to groundwater, these general categories can be described as "direct" or "indirect" uses. Direct uses of groundwater include drinking water, irrigation, livestock, and industrial uses. Indirect uses of groundwater are uses involving discharge to surface water and include aquatic habitat, recreation, and aesthetic quality.

7.1 GENERAL

The findings of the 2000 BWUD indicated that beneficial water uses were limited to aquatic habitat, recreation, and aesthetic quality. No direct beneficial uses of groundwater occurred at or adjacent to the Site. No on-site surface water uses were identified; however, the Boise Cascade facility downstream of the Site was identified in the 2000 RI as using surface water for facility processes (industrial use). Reasonably likely future beneficial water uses were determined to include industrial, recreational and habitat.

Contaminant distribution and migration were discussed in the 2000 BWUD, and updated discussions are presented in **Section 5** and **Section 6** of this report. Surface water quality data indicate that adverse impacts to surface water from groundwater discharge have not occurred.

Current analytical results, land-use information, and water rights information obtained for this update indicate that the findings of the 2000 BWUD remain applicable to current conditions. The updated information is discussed in the following sections.

7.2 LOCALITY OF THE FACILITY

The LOF is defined as the area where a human or ecological receptor contacts or is reasonably likely to contact facility-related hazardous substances (Oregon Administrative Rules 340-122-115[35]). The 2000 BWUD considered the LOF to be delineated by the Site's property boundary to the north and east, and Milton Creek and Scappoose Bay to the south and west, and limited to the shallow water-bearing zone above the Basalt Bedrock (Section 12.2 of the 2000 RI Report).

For the purposes of this updated BWUD, the LOF has been revised to include in-water areas within Milton Creek west of the Site and Scappoose Bay south-southeast of the Site. The extent of the LOF

was determined using: (1) analytical results for each sampled media (e.g., soil, groundwater, sediment, sediment porewater, and surface water); (2) observations of petroleum sheens or creosote NAPL in media assessed as part of the RI (e.g., soil, groundwater, sediment, sediment porewater, and surface water); (3) geographic barriers (property and Area 1 boundaries); and (4) physical barriers (Basalt Bedrock, railroad berm north of Area 1). The LOF coincides with exposure units used for the ERA and HHRA (**Section 10.0**). The areal extent of the LOF is shown on **Figure 7-1**, along with reference (background) sample locations that help to define the LOF extent. The LOF is limited to the soil and shallow water-bearing zone above Basalt Bedrock within the outlined area in the upland, and to sediment and surface water in Milton Creek and Scappoose Bay in the outlined offshore area.

7.3 CURRENT BENEFICIAL WATER USES

As concluded in the 2000 BWUD, the current indirect beneficial use of shallow groundwater within the LOF is discharge to surface water. No direct use of groundwater occurs within the LOF. Current beneficial uses of surface water within the LOF consist of associated aquatic and terrestrial habitat, recreation, and aesthetic quality.

7.3.1 Groundwater Use

Current beneficial uses of groundwater in the Site vicinity were evaluated by reviewing well logs recorded since the 2000 RI within a radius of approximate 1 mile of the Site. No new beneficial groundwater uses applicable to the Site were identified.

The OWRD database was queried for new water supply well records completed since the submittal of the 2000 RI (April 2000). According to the OWRD database, five domestic wells have been constructed or deepened since 2000 within 1 mile of the Site, none of which are located within the LOF. These wells are all installed with screened intervals at a minimum depth of 100 feet bgs within Basalt Bedrock, well below the shallow water-bearing zone within the LOF. The nearest wells are located approximately 0.5 mile cross-gradient from the Site. Well logs reviewed as part of the BWUD update are included in **Appendix E**, and pertinent information is summarized in the table below.

Summary of OWRD Well Records

OWRD Record ID	Depth (feet)	Screened Interval Depth(s) (feet)	Use and Type of Work	Distance from Site
COLU52376	280	220 – 280	Domestic; existing well was deepened	0.6 mile west (cross-gradient)
COLU53905	160	100 – 120 140 – 160	Domestic; new well	0.9 mile northwest (upgradient)
COLU54599	160	140 – 160	Domestic; new well	0.9 mile northwest (upgradient)
COLU55360	305	265 - 305	Domestic, new well	0.5 mile northwest (upgradient)
COLU55412	200	160 - 200	Domestic, new well	0.5 mile northwest (upgradient)

7.3.2 Surface Water Use

Current beneficial uses of surface water in the Site vicinity were evaluated by reviewing available information on land uses and recreational opportunities, habitat information, and surface water rights within an approximate 1-mile radius of the Site. Surface water in the LOF is currently used for the following purposes:

- **Recreation.** Recreational uses include water-based activities, such as kayaking, canoeing, fishing, and boating, near and within the LOF. Current property controls (i.e., fencing) are expected to discourage land-based recreation, such as shoreline fishing and hiking, within the LOF. In addition, the Heavy Industrial land-use designation (**Section 2.1**) limits non-industrial uses within or adjacent to the LOF. A detailed discussion of potential human health impacts is included in the HHRA (**Section 10.1** and **Appendix F**).
- **Aesthetic Quality.** Milton Creek and Scappoose Bay provide aesthetic quality for water-based and land-based recreational activities in or near the LOF. Local aesthetics reflect the land-use designation of Heavy Industrial; opportunities for land-based recreation within the LOF are therefore expected to be limited.
- **Aquatic and Terrestrial Habitat.** Scappoose Bay is a freshwater tidal estuary that supports populations of aquatic and terrestrial plant and wildlife species. In addition to aquatic habitat, habitats dependent on surface water (riparian and wetland) also are available within the LOF. The USFWS National Wetlands Inventory identifies freshwater forested/ shrub and freshwater emergent wetlands within the LOF (USFWS, 2010). A discussion of potential ecological impacts is included in the Supplemental ERA (**Section 10.2** and **Appendix G**).

In addition to the identified surface water uses within the LOF, the Boise Cascade facility located downstream (northeast) of the LOF historically used surface water from Multnomah Channel for industrial purposes (2000 RI Report, Section 12.3) per a Surface Water Registration Statement Pre-1909 Vested Water Right Claim that allowed the use of up to 45 million gallons per day for industrial use (**Appendix E**). Since closure of the mill in 2015 and the purchase of the land by the City of St. Helens, the status of this surface water right is unknown.

7.4 REASONABLY LIKELY FUTURE BENEFICIAL WATER USES

The Port prepared a Strategic Business Plan (SBP) to guide its next 20 years of facilities management and project development (Port, 2012). According to the SBP, land use at the Site will continue to consist of commercial / industrial uses, consistent with the City of St. Helens zoning designation. Water supply at the Site is provided by the City of St. Helens (Port, 2012). Based on the poor yield of the shallow aquifer (less than 0.5 gallon per minute [GeoEngineers, 2000]) and the availability of municipal water supply, future direct beneficial uses of groundwater within the LOF are not expected.

The Heavy Industrial zoning designation may allow for water-intensive land uses (e.g., plant nursery or greenhouses) to occur at the Site or in the immediate vicinity. Additionally, according to a December 2016 EPA Area-Wide Planning Project (Resolution 1765), the 205 acres northeast of the Site will be redeveloped for mixed uses (industrial, retail, and residential) to encourage water-related uses and preserve adequate public space while allowing for private enterprise. Therefore, reasonably likely future beneficial surface water uses may include industrial facility uses and will continue to include recreational uses and aquatic and terrestrial habitat support.

8.0 DATA COMPLETENESS EVALUATION

The RI and supplemental RI activities conducted at the Site have generated field data, field observations, and laboratory analytical data toward completion of the RI process for the Site. The data collected are of sufficient quantity and quality to meet RI and supplemental RI objectives, and to support the subsequent FS process.

Over 1,100 samples have been collected at the Site and its immediate vicinity from the following media: soil, surface water, groundwater, sediment, sediment porewater, seep water, and NAPL. Results from approximately 3,000 analytical tests are in the project RI database for the following analyte groups: PAHs, SVOCs, VOCs, petroleum hydrocarbons, metals, herbicides, dioxins/furans, field screening, and wet chemistry. A summary of data collected during the RI and supplemental RI is provided in **Table 8-1**.

EPA's November 1989 Directive 9355.3-01FS2 specifies that available data should be evaluated to determine if: (1) project DQOs have been met, (2) the risks posed by the site have been adequately defined, (3) the need (or lack of need) for remedial action is documented, and (4) the data necessary for development and evaluation of remedial action alternatives have been obtained. These evaluations are each addressed under the subheadings below.

DQOs Have Been Met

The supplemental RI objectives were defined in **Section 1.2** and addressed as follows.

1. Mapping the lateral and vertical extent of NAPL in offshore sediment adjacent to the Site. Additional sediment investigation offshore was required to determine the source(s) of contamination in shallow sediments. The extent of NAPL in offshore sediment has been defined based on extensive sediment sampling and field observations, both within and bounding the estimated NAPL extent shown on **Figure 5-1**.

2. Confirming the vertical and lateral extent of upland NAPL and/or contaminated soil areas potentially contributing to offshore contamination. The extent of upland NAPL has been defined based on installation of additional monitoring wells, TarGOST® borings, direct-push borings, and sonic borings in the upland area, most of which extended to or into the surface of the Basalt Bedrock, as shown on plan view **Figure 5-1** and cross-section **Figures 4-2** through **4-9**.

3. Further assess groundwater conditions beneath Area 1 and the quality of groundwater discharging into the adjacent surface water bodies (Scappoose Bay and Milton Creek). Current groundwater conditions, including NAPL occurrence, were investigated during four quarterly groundwater monitoring events in 2011 and 2012. The quality of groundwater discharge to surface water was investigated through the quarterly monitoring of wells near the shorelines and through analysis of sediment porewater along the shorelines.

4. Further evaluate risk to aquatic receptors near but outside the offshore extent of NAPL. The supplemental RI provided sufficient data to refine the CSM to better account for the nature and extent of offshore contamination, upland NAPL migration, and dissolved-phase contaminant transport and discussed in **Section 5.0** and **Section 6.0**.

Risks Have Been Adequately Defined

The supplemental HHRA and ERA have been completed using data collected since the 2006 HHRA (Kennedy Jenks Consultants, 2006) and ERA (Bridgewater Group, Inc., and Kennedy/Jenks Consultants, 2006), as described in the respective supplemental documents. Potential risk to both human and ecological receptors has been adequately evaluated using the available data. A summary of the supplemental HHRA and Supplemental ERA results is provided in **Section 10.0**.

Need for Remedial Action Has Been Documented

The Site will require remedial action to mitigate unacceptable risk. This conclusion is based on the results of the RI and supplemental RI data evaluation, specifically the supplemental HHRA and ERA, and the results of a Hot Spot evaluation (**Section 11.0**). The next steps in the RI/FS process are discussed in **Section 12.0**.

Necessary Data to Assess Remedial Alternatives Have Been Collected

The RI and supplemental RI data provide sufficient basis to allow evaluation of remedial alternatives, as will be further discussed in the FS. Additional data may be required for remedial design once a remedy has been selected. The next steps in the RI/FS process are discussed in **Section 12.0**.

9.0 CONCEPTUAL SITE MODEL

The Site CSM has been updated based on information collected and evaluated during the supplemental RI. The updated CSM is shown schematically on **Figure 9-1**.

Key components of the CSM have been presented in this report as follows:

- **Section 2.4.1** identifies contaminants of potential concern related to the Site, and **Section 2.4.2** summarizes contaminant source (release) areas at the Site.
- **Section 4.0** presents the current understanding of the Site physical setting.
- **Section 5.0** presents the nature and extent of contaminants at the Site based on investigation results, including field observations and laboratory analytical data.
- **Section 6.0** presents a description of pathways of transport of contaminants from source areas within source media and into other media.

The CSM considers potential mechanisms of contaminant transport from source areas to potential and/or hypothetical receptors, both human and ecological. Contaminant transport at the Site has occurred as free-phase NAPL or as dissolved-phase constituents in groundwater. As discussed in **Section 6.0**, NAPL at the Site has migrated from the historical ground surface (release area) to deeper soil and groundwater, and dissolved-phase contaminants have migrated to groundwater seeps and porewater, affecting offshore sediment, porewater, and surface water. In addition, direct overwater release of creosote and creosote-treated wood has released contamination to surface sediment and/or subsurface sediment (former operational sediment surface).

The illustration provided as **Figure 9-1** presents a schematic summary of transport mechanisms at the Site. Potential/hypothetical receptors evaluated in the supplemental HHRA and supplemental ERA are included on the figure.

10.0 SUPPLEMENTAL RISK ASSESSMENTS

As part of the supplemental RI Report, previous human health and ecological risk assessments were reevaluated in consideration of new data and DEQ guidance. The supplemental HHRA is provided in **Appendix F**, and the supplemental ERA is provided in **Appendix G**. Each of these risk assessments is summarized in the following sections.

10.1 HUMAN HEALTH

An updated supplemental HHRA was prepared for the Site to evaluate the new sediment and groundwater quality data generated during the supplemental RI. The supplemental HHRA also incorporates the results of the 2006 HHRA for soil because no new data for this media were generated during the supplemental RI. The updated supplemental HHRA evaluated potential exposures through direct and/or indirect contact to Site media for five potential receptors: (1) an industrial worker, (2) an excavation worker, (3) a construction worker, (4) a child trespasser; (5) an adult transient trespasser, and (6) an adult and child sport fisher (assuming both general and subsistence consumption of fish). The supplemental HHRA is summarized here.

A summary of the exposure pathways and media considered for the HHRA is presented on **Figure 10-1**.

10.1.1 Data Set and Exposure Units

The groundwater data evaluated in the supplemental HHRA are those generated since 2005, because the 2006 HHRA evaluated groundwater results between 1996 and 2004. All groundwater results between 2005 and 2012 were included in a single exposure unit covering Area 1 of the Site. The groundwater data set includes results for PAHs, petroleum hydrocarbons, BTEX, and selected metals (arsenic, cadmium, chromium, copper, lead, and zinc).

The soil data evaluated in the supplemental HHRA are those collected in 1998, at the request of DEQ, and includes samples covering Areas 1 and 2 of the Site. The surface soil data set analyzed includes the results for PCBs; the subsurface soil data set analyzed includes results for selected VOCs, SVOCs, and metals.

The sediment data evaluated in the supplemental HHRA is comprehensive, at the request of DEQ, and includes the results from all discrete samples located outside of areas of inferred NAPL that were collected in the upper 12 inches of sediment in 1996, 2003 through 2005, and 2010 through 2017. Samples collected from inside the areas of inferred NAPL are presumed to have unacceptable risk and thus were excluded from the analysis. The sediment data sets were segregated into two exposure units, one representing Scappoose Bay and the other representing Milton Creek. Sediment samples were analyzed for PAHs, petroleum hydrocarbons, selected VOCs, selected metals, and dioxins/furans. VOCs in sediment were not quantitatively evaluated in the supplemental HHRA because only one sediment sample outside the areas of inferred NAPL was analyzed for VOCs, and

no VOCs were detected. Metals were not quantitatively evaluated in the supplemental HHRA because all detected metals concentrations in sediment are consistent with the site-specific background levels established during the RI.

10.1.2 Risk Assessment Methodologies

The estimated risks for complete exposure pathways were calculated by determining the ratio of the exposure point concentration (EPC) for each COPC to its risk-based screening level, and then multiplying that ratio by 1×10^{-6} for carcinogenic compounds and by 1 for noncarcinogenic compounds. Cumulative risks were estimated by summing the individual risks for each compound in each exposure pathway, and then by summing the risks from all complete exposure pathways for each receptor to estimate a total risk.

Exposure point concentrations were developed through the use of ProUCL software (version 5.0) (EPA, 2013) to evaluate the reasonable maximum exposure (RME) as well as the central tendency exposure (CTE). The RME EPC is the 90% upper confidence limit (UCL) of the mean detected concentrations for each data set, though in some cases ProUCL recommended a higher confidence level to ensure adequate confidence in the UCL. The CTE EPC is the arithmetic mean of the detected concentrations for each data set. In cases where the data set was small, or where the compound was detected only a few times, the maximum concentration was used as the RME EPC, and the minimum concentration was used as the CTE EPC. In cases where there was only a single detection, the detected concentration was used to evaluate both the RME and CTE.

Risk-based screening levels used in the supplemental HHRA come from five sources: (1) Risk-Based Concentrations (RBCs) published by DEQ in May 2018; (2) DEQ SLVs published in 2007 (and modified using current subsistence fish consumption rates); (3) site-specific RBCs developed for the recreational trespasser using the DEQ HHRA Guidance (DEQ, 2010b); (4) site-specific TPH RBCs developed to evaluate exposure to petroleum hydrocarbons in sediment, and (5) site-specific exposure assumptions used to develop preliminary remediation goals (PRGs) for the adjacent Armstrong site. The RBCs, SLVs, and PRGs used in the updated supplemental HHRA are provided as appendices to that document and can be found in **Appendix F**.

10.1.3 Risk Assessment Results and Uncertainty Analysis

The results of the quantitative evaluation for each receptor are summarized below. These results include the evaluation prepared for the supplemental HHRA and the results for soil that were presented in the 2006 HHRA.

- Industrial workers – No unacceptable risks were estimated for direct exposure to buried creosote-impacted soil, or from indirect exposure to creosote constituents (TPH and PAHs) in soil through inhalation pathways of indoor or outdoor air. Unacceptable risk to industrial workers potentially exists from direct contact with residual PCBs in surface soil (i.e., gravel roadbed samples SS-08, SS-10, SS-19, and SS-24). Detected concentrations of naphthalene in

groundwater monitoring wells MW-3A and MW-22 indicate unacceptable risk to industrial workers inside buildings overlying NAPL (e.g., vapor intrusion to indoor air).

- Excavation/construction workers – No unacceptable risks were estimated for direct exposure to soil, or for indirect exposure to contaminants in soil from inhalation outside the inferred upland NAPL area, with the exception of an exceedance of risk calculated due to the localized high concentration of arsenic in one deep soil sample (MW-10) collected historically. The potential risks from exposure to groundwater in an excavation were not quantified because the COPCs are semi-volatiles and DEQ does not recommend a quantitative assessment of dermal exposures to SVOCs because their dermal permeability coefficients are outside of the effective predictive domain used to model this exposure factor. Instead, a qualitative discussion is provided in the uncertainty section and concludes that:
  - It is reasonable to assume there are unacceptable risks or hazards from dermal contact with groundwater where NAPL is present.
  - It is not possible to accurately quantify the magnitude of the risk from dermal contact with water containing appreciable levels of PAHs (e.g., >100 µg/L) or other semi-volatile compounds (such as weathered creosote related TPH > 1 mg/L) in areas where NAPL is not present.
  - Thus, it is reasonable to consider that an administrative or engineering control should be applied to Area 1 excavation workers to control future exposures to groundwater with NAPL. Administrative and engineering controls have already been established for Area 2, and similar controls could easily be applied to Area 1 of the Site.
- Potentially complete current and reasonably likely future exposure pathways to contamination in the offshore area include direct contact with sediment and consuming fish that accumulated site-related contamination. These exposure pathways are discussed below:
  - Direct Contact with Sediment – People on the Site may directly contact beach sediment. At this Site, four different exposure scenarios were evaluated: adult anglers contacting sediment while fishing, child anglers, child trespasser, and adult transients trespassing on the Site. No unacceptable risks were estimated for direct exposures by anglers and trespassers to sediments outside of NAPL areas.
  - Fish Consumption – Screening values protective of people consuming fish that have accumulated site-related chemicals were derived for both water and sediment. Of the limited number of sediment samples analyzed for dioxins and furans, there was found to be unacceptable risk for the sport fisher from the consumption of fish exposed to site-related dioxins and furans in the Scappoose Bay area; however, exceedances were mostly limited to detected concentrations in the sample collected within the offshore

PAA. Freely dissolved concentrations of PAHs in sediment porewater and surface water beyond the offshore PAA indicate a low level of concern for bioaccumulation of cPAHs into fish tissue consumed by humans. However, detected concentrations of PAHs in some bulk sediment samples obtained out the PAA exceed bioaccumulation sediment screening values.

10.1.4 Conclusions from Human Health Risk Assessment

Based on the results of the updated supplemental HHRA, the following conclusions can be drawn:

- The estimated risk levels were below the target risk level of 1 for noncarcinogenic compounds for all receptors and exposure pathways outside the inferred NAPL areas, with the exception of exceedances based on isolated detections of PCBs and/or arsenic from historical (1998) soil samples.
- The estimated risk levels were below the target individual risk level of 1×10^{-6} and the cumulative risk level of 1×10^{-5} for carcinogenic compounds for all receptors and exposure pathways outside the inferred NAPL areas, with the exception of an exceedance of risk from subsistence fish consumption based on one sample collected within the offshore PAA.
- The risks from dermal exposure to PAHs and TPH in groundwater were not quantified but are assumed to be unacceptable in locations where NAPL is present. Because it is not possible to accurately quantify the magnitude of potential risks from dermal contact with water containing appreciable levels of PAHs or other semi-volatile compounds in areas where NAPL is not present, it is reasonable to consider use of administrative or engineering controls for Area 1 groundwater similar to those currently in place for Area 2 groundwater.
- Areas of creosote NAPL in surface sediment represent unacceptable risk from contact by anglers and transients. Based on available data, it appears there is acceptable risk associated with current and likely future exposure pathways to chemical constituents in sediment outside of the NAPL areas.
- Directly measured surface water concentrations of PAHs indicate a low level of concern for bioaccumulation of creosote-related constituents in fish tissue consumed by humans.
- Detected concentrations of total PCBs in 5 of 24 discrete surface soil samples (gravel roadbed material) exceed direct contact RBCs for industrial workers. The 1970s practice of applying used oil to gravel roadways for dust control is the alleged source of PCBs.
- Subsurface soil (3 to 6 feet bgs) was evaluated for risks to the on-site excavation and construction worker from direct exposure to subsurface soils impacted by select VOCs, PAHs, and metals. For purposes of the exposure assessment, subsurface soil is from 3 feet to the depth of the shallow groundwater underlying the Site (approximately 6 feet bgs). The only risk exceedance was for arsenic exposure based on the RME scenario, which was

elevated due to a single sample (MW-10-5.5). The RME calculated excluding this outlier showed no risk exceedance. No exceedances were calculated in the central tendency exposure (CTE) scenario.

10.2 ECOLOGICAL

The collection of additional PAH data for sediment and porewater with direct exposure pathways to ecological receptors and the progress that has been made in recent years in the science of evaluating the potential for adverse effects to these receptors has necessitated a supplement to the ERA process that has been in progress at the Site since 2003. The updated supplemental ERA is presented in **Appendix G** of this report, which is summarized here.

The updated supplemental ERA focuses on application of new methods and research in evaluating the recently collected 34 PAH data from the aquatic habitats of the Site (Scappoose Bay and Milton Creek) as additional lines of evidence (LOE) to the overall assessment of ecological risk at this Site. Therefore, the scope of this updated supplemental ERA is limited to new data (collected since 2005) and exposure pathways and receptors associated with the sampled media (sediment, porewater, surface water, and groundwater).

A summary of the exposure pathways and media considered for the ERA is presented on **Figure 10-2**.

10.2.1 Data Set and Exposure Units

The data included in this supplemental ERA are limited to analytical results for sediment, porewater samples from the upper 1 foot of sediment (0 to 12 inches bml), and surface water outside delineated areas of inferred NAPL presence where unacceptable risk to ecological receptors is presumed to occur. Receptors addressed in this supplemental ERA are benthic invertebrates that may be exposed to dissolved-phase PAHs in the interstitial water of the Site sediments and fish (resident and anadromous) exposed through direct contact with these waters (released to surface water) and through bioaccumulation. This supplemental ERA also includes an examination of analytical results from groundwater, pre DEQ's request, to determine potential risks to aquatic receptors from dissolved phase constituents after discharge of groundwater to Scappoose Bay. Other receptors identified on **Figure 10-2** were previously addressed in the 2006 ERA and no revision to that assessment is needed for these receptors. For the purposes of this assessment, the Site was segregated into two ecological exposure areas: the Milton Creek exposure area and the Scappoose Bay exposure area.

The basis of this supplemental ERA is sediment data collected in July 2011, July 2012, October 2012, and September 2017. (Note that no samples from October 2011 or the DAI were evaluated in the Supplemental ERA because none of the samples were collected from the upper 1 foot of sediment outside of the inferred NAPL areas.) The July 2012 samples represent high-water conditions of the Columbia River, and the September 2017 and October 2012 samples represent declining and/or low-water conditions. These bulk sediment samples were analyzed for PAH and

TPH, as summarized in **Section 3.4** and **Section 3.5**. Most of the 2011 samples were only analyzed for the 16 priority PAHs (plus 1- and 2-methylnaphthalene), although some samples were analyzed for the full suite of 34 PAH analytes (18 parent PAHs and 16 groups of alkylated PAHs). All of the 2012 and 2017 sediment samples were analyzed for the 34 PAH analytes. All of these samples (2011, 2012, and 2017) were analyzed for TOC. The 2012 and 2017 samples were also analyzed for black carbon. The 2017 sediment samples were analyzed for VPH/EPH.

Sediment samples collected in 2012 (both rounds) were centrifuged to extract porewater for PAH analysis in accordance with the SPME methodology. The 2017 sediment porewater and surface water LDPE PSDs were left at the Site over a 21-day period, which generally corresponds to a chronic exposure scenario for aquatic organisms (**Appendix D**). These surface water and porewater samples were analyzed for the full suite of PAH analytes as well as VPH.

10.2.2 Risk Assessment Methodologies

Multiple LOE were used to identify probable ecological toxicity or impacts to aquatic receptors including: (1) the presence of NAPL and/or moderate to heavy petroleum sheen within the upper 12 inches of sediment and/or surface water; (2) sediment toxicity by comparing total PAHs and TPH in surface sediment to screening level values (e.g., threshold/probable effects concentrations; TEC/PEC); (3) porewater toxicity by comparing the C_{free} 34 PAHs in surface sediment to FCVs and summing the individual ratios to determine if the resulting TU (ΣIWTU) is greater than 1; (4) surface water toxicity by comparing detected C_{free} 34 PAHs in surface water PSDs suspended 1 foot above the mudline to FCVs (ΣSWTU) and SLVs based on toxic responses to individual chemical constituents; and (5) other porewater and surface water toxicity indicators (e.g., OPAHs, total of 63 C_{free} PAHs, hopanes and cholestanes).

Results from these approaches were used to produce primary and secondary possible indicators of aquatic ecological risk:

Primary

- Observations of moderate to heavy petroleum sheen in surface sediment (1 foot bml).
- Surface water concentrations representing a summed surface water toxic unit (ΣSWTU) ≥ 1 based on the direct measurement of 34 PAHs.
- Surface sediment porewater concentrations representing a summed interstitial water toxic unit (ΣIWTU) ≥ 1 based on the direct measurement of 34 PAHs.

Secondary

- Bulk sediment total 34 PAH concentrations ≥ probable effect concentration (PEC) of 22.8 mg/kg.
- Significant concentrations of total TPH in bulk sediment relative to fraction specific SLVs.

- Bulk sediment total 34 PAH concentrations >10 mg/kg, representing the mid-point between the threshold effect concentration (TEC) of 1.6 mg/kg and the PEC of 22.8 mg/kg.
- Total TPH concentrations greater than fraction specific SLVs.
- Porewater concentrations in surface sediment representing 1/2 of a TU.
- Relative magnitude of C_{free} 63 PAHs > 0.5 µg/L (not risk based).
- Relative magnitude of C_{free} total OPAHs concentrations > 0.5 µg/L (not risk based).

Previous sampling (2012 and earlier) included:

- Bulk sediment chemistry of PAHs, total organic carbon, and black carbon. Some samples were analyzed for the complete 34 PAH parent and alkylated compounds, and others were only analyzed for 18 parent compounds.
- Porewater C_{free} PAH concentrations were determined *ex-situ* using laboratory SPME. In the laboratory, SPME fibers were exposed to porewater taken from centrifuged sediment samples. Porewater concentrations are estimated using established chemical partitioning relationships for PAHs. Samples were collected during high water (July) and low water (October) conditions and were co-located with bulk sediment samples analyzed for 34 PAHs. Detection limits were elevated, particularly for the high molecular weight PAHs, and therefore TUs for low molecular weight PAHs were examined as a separate line of evidence. The 2017 *in-situ* methodology for the analysis of C_{free} achieved adequate detection limits to evaluate TUs for all PAHs.
- Groundwater samples from the upland area were analyzed for concentrations of PAHs and TPH.

The 2017 sediment porewater and surface water characterization provided time-integrated samples over a 21-day period that generally corresponds to a chronic exposure for aquatic organisms. The quantitation of chemicals in sediment porewater using the LDPE passive samplers developed by the FSES program at OSU appears to be significantly more robust and precise than the 2012 *ex-situ* measurements of freely dissolved PAHs in sediment porewater. The 2017 supplemental RI activities were instrumental in DEQ's January 15, 2019 LOE discussion and presented below.

NAPL/Sheen

Presence of creosote NAPL and moderate-to-heavy petroleum sheen presents unacceptable risk to ecological receptors where it is observed in surface sediment and surface water. The offshore areas exhibiting moderate to heavy petroleum sheens in surface sediment is illustrated on **Figure 5-2**.

Sediment Toxicity

Total PAHs

Bulk sediment was either analyzed for 18 parent compounds, or for 34 PAHs, consisting of 18 parent compound and 16 groups of alkylated homologues. DEQ requested the comparison of the total 34 PAHs to Total PAH criteria (TEC and PEC) to estimate toxicity. This approach incorporates toxicity related to the larger range of environmentally relevant PAHs as an alternative to relying on comparisons to the sediment TPH fraction SLVs as a primary LOE (EPA, 2012). According to DEQ, samples where the sum of 34 PAHs in bulk sediment are greater than the TEC of 1.7 mg/kg may be toxic, and samples above the PEC of 22.8 mg/kg have a higher probability of toxicity.

Risk to fish from bioaccumulation was based on comparisons of sediment PAH concentrations (as the 90% UCLs) to PAH-specific screening levels from the DEQ guidance for bioaccumulative chemicals in sediment (DEQ, 2007a). These, however, are limited to only two PAHs—fluoranthene and pyrene. EPCs for this evaluation were based on all available sediment datasets including both recent datasets (2011, 2012, and 2017) as well as the historical (1996 to 2005) data for the two exposure areas (0- to 12-inch sampling interval only).

TPH

Bulk sediment was analyzed for VPH, and a subset of samples were analyzed for EPH. It is important to note that laboratories report the results in equivalent carbons. The equivalent carbon number is related to the boiling point of a chemical or its retention time in a boiling point gas chromatographic column.

Porewater Toxicity

34-PAH C_{free} and TUs

The 2017 *in-situ* sampling methodology improves the relevancy of measured dissolved water concentrations by time-integrating exposure concentrations representative of site-specific environmental factors that control the bioavailable free dissolved concentrations. This improves the confidence in risk estimates of chronic exposure and toxicity. Directly measuring the C_{free} in surface sediment and surface water appropriately integrates site-specific factors such as diffusion, advection, bioturbation, and resuspension in addition to particle-bound and colloid-bound partitioning. This is an improvement on the 2012 *ex-situ* methodology that measured C_{free} in sediments in the laboratory, separate of the site-specific environment.

The C_{free} 34 PAHs were compared individually to their FCV. The ratio of the measured concentration to the chronic values of each PAH is a TU, which shows site concentrations relative to acceptable levels for each PAH. The sum of individual PAH specific TUs are totaled to calculate the ΣIWTU for each sample. Samples are designated toxic where ΣIWTU is equal to or greater than (≥) 1 (see **Figures 5-6 and 5-7**). This analysis can be applied to both surface sediment porewater and surface water to estimate toxicity to aquatic life.

VPH and Select Constituents

The volatile fraction of TPH and select constituents (benzene, toluene, ethylbenzene, total xylenes, and naphthalene) were sampled in surface sediment using PBDs to evaluate any risk associated with TPH fractions not captured by the PAH analysis.

Surface Water Toxicity

Surface water samples were collected as part of the Phase 3 offshore data gap investigation. The same LDPE PSDs were used in surface water and installed in eight Scappoose Bay locations offshore of Area 1 beyond delineated areas of NAPL in surface sediment, inclusive of moderate to heavy petroleum sheens. The risk drivers in the surface water samples were similar to those in porewater, with samples collected within the LOF boundary exhibiting greater concentrations than upstream and downstream locations.

Other Porewater and Surface Water Toxicity Indicators

OPAHs

OPAHs may achieve greater dissolved concentrations than parent hydrocarbons due to their greater polarity. This can result in metabolite concentrations as high as one to two orders of magnitude greater than hydrocarbon-only concentrations under baseline conditions (Steenson et al., 2016). Toxicity of metabolites has been found to be comparable to the parent compounds and may induce synergetic effects that may result in greater effects than additivity (Jonker et al., 2016).

Total of 63 C_{free} PAHs

In addition to the 34 PAHs, porewater and surface water samples were analyzed for 63 PAHs by GC/MS/MS, providing C_{free} for a specific group of individual PAHs. These data provide concentrations for a wider range of parent and alkyl substituted PAHs. However, these individual PAHs are a subset of the 34 PAH homologue groups described above.

The potential for risk to fish from direct exposure to porewater and/or affected, near-bottom surface water was evaluated based on the concentrations of freely dissolved PAHs calculated from the measured surface water concentrations in 2017. The SLVs used to evaluate detected concentrations of PAHs in the surface water samples were fish-specific, when possible; however, several of the SLVs were based on Tier II secondary chronic values presented by Suter and Tsao (1996) and EPA regional screening levels for surface water.

Hopanes and Cholestanes

Concentrations of hopanes and cholestanes were measured in porewater and surface water as biomarkers for petroleum. These were presented as instrument concentrations and were not freely dissolved concentrations.

Groundwater Toxicity Indicators

Historical (2010 to 2012) groundwater data from nearshore monitoring wells were used to assess the potential risk to aquatic receptors following discharge of upland groundwater to surface water. Concentrations of select PAHs and TPH were compared to surface water SLVs as a conservative estimate of risk.

PAHs

As with porewater and surface water, concentrations of PAHs in groundwater were converted to TUs using FCV values. Groundwater was only analyzed for either 14 or 16 PAHs; the sum of TUs (ΣGWTUs) calculated from these individual PAHs may be biased low as a result. ΣGWTUs greater than 1 indicate the potential for toxicity to benthic organisms.

Concentrations of select individual PAHs in nearshore groundwater samples were also screened against DEQ Level II SLVs for surface water as an evaluation of potential risk after upland groundwater migration to Scappoose Bay

TPH

Concentrations of diesel- and gasoline-range hydrocarbons were compared to Freshwater Ecotox Aquatic Habitat Goal Levels from San Francisco Bay Regional Water Quality Control Board (SFBRWQCB, 2019). As described above, this approach was used as a conservative analysis of potential risk to Scappoose Bay from upland groundwater migration.

10.2.3 Risk Assessment Results and Uncertainty Analysis

NAPL/Sheen

Observations of NAPL and moderate to heavy petroleum sheen in surface sediment represent unacceptable ecological risk based on this indicator alone. Sample locations and areas with observations of moderate to heavy petroleum sheen in surface sediment on **Figure 5-2**.

Sediment Toxicity

Total PAHs

All surface samples locations had total PAH bulk chemistry concentrations above TECs, and nine samples located well beyond delineated offshore areas of moderate to heavy petroleum sheen had total PAHs levels above the PEC, including PWS-05, PWS-06, PWS-08, SB-09, PWS-090517-9, PWS-13, PWS-090617-13, PWS-16, and PWS-25.

TPH

The highest detections of TPH fractions in sediment included the EPH ranges $C_{>21}$ – $C_{>34}$ aliphatics and aromatics, followed by $C_{>16}$ – C_{21}, and then $C_{>12}$-C_{16}. Locations PWS-090517-9 and PW-090517-10 had the highest detections of sediment TPH.

Sediment concentrations were compared to criteria developed as a part of the Portland Harbor Superfund Site ecological risk assessment. No VPH ranges were detected; however, the detection limits of the VPH analysis were elevated above criteria. EPH fraction concentrations were detected above criteria at all sample locations for the $C_{>16}$ – C_{21} and the $C_{>21}$ – C_{34} aromatics, with the highest magnitude exceedance at PWS-090517-9 (236 mg/kg). Aliphatic fractions $C_{>16}$ – C_{21} and $C_{>21}$ – C_{34} were detected at a maximum of 71.7 mg/kg and 191 mg/kg, respectively; criteria are above the solubility limit.

Porewater Toxicity

34-PAH C_{free} and TUs

As mentioned above, the 2017 *in-situ* shallow sediment porewater data carries a higher degree of confidence than the 2012 *ex-situ* shallow sediment porewater data in estimating toxicity aquatic life. Therefore, the following summary focuses on the shallow sediment porewater data only. A summation of the 34 PAH specific toxic units (ΣIWTU) using full detection limits for non-detected analytes is presented in **Table 5-8**. The 2017 porewater data demonstrate an overall lack of potential narcosis risk to benthic organisms outside of delineated offshore NAPL areas. Specifically, the ΣIWTU exceeded 1 in only 1 of the 15 Phase 3 locations (i.e., PWS-2) based on porewater measurements obtained within the biologically active zone (i.e., upper 12 inches of sediment). The ΣIWTU > 1 risk prediction is primarily driven by the alkyl PAHs grouped as C_3-naphthalene and C_4-naphthalene.

It is important to note, that while most parent PAHs (and many of their perdeuterated analogs) are available as pure standards, few alkyl PAHs are available, so their response must be estimated rather than measured in many cases. The calibration and quantitation of the more highly alkylated PAHs is increasingly complicated by the fact that a single group can have multiple (even hundreds of C_3- and C_4-alkyl PAHs) alkylated isomers that are listed as a single PAH in the total 34 PAH list. Care must be taken to avoid including non-target compounds in the integration of a group of alkyl PAHs. For example, dibenzothiophene elutes at the end of the C_4-naphthalene cluster and frequently has a higher concentration than the total C_4-naphthalene group. Since both dibenzothiophene and C_4-naphthalenes have *m/z* 184 as their molecular ion, care must be taken not to include the peak area of dibenzothiophene in the C_4-naphthalene peak area. Similarly, the deuterated internal standard, fluorene-d10, elutes in the middle of the C_3-naphthalene cluster and has an approximately 15% ion at *m/z* 170, which is the same mass as monitored to determine the C_3-naphthalene compounds. This interfering peak from fluorene-d10 was substantially larger than the total alkyl C_3-naphthalene peaks, and therefore, care is needed to remove its peak area to avoid grossly overestimating the alkyl C_3-naphthalene concentrations (Hawthorne, et al., 2005a/b). OSU FSES was asked to provide non-background corrected 34 PAHs. Given the above-mentioned concerns with co-eluting non-target compounds, the background corrected 34 PAH data were used in the ecological risk assessment.

The results of the 2017 shallow sediment ΣIWTU calculations based on the LDPE 34 PAHs analyses are illustrated on **Figure 5-7**. The spatial distribution of surface sediment ΣIWTU, along with the distribution of sheen and bulk sediment total PAHs, is shown on **Figure 5-8**. Toxicity predicted in the 2017 sediment porewater locations are generally consistent with the 2012 sediment porewater results, where available.

Based on data reported by McDonough et al. (2010), ΣIWTU values from direct porewater measurement are likely conservative predictors of potential narcotic risk. These authors used laboratory toxicity test results to determine the optimal benchmark value of ΣIWTU for both sensitivity (the ability to predict toxic sediment) and specificity (the ability to discriminate between nontoxic and toxic sediments). For direct porewater measurements, the optimal ΣIWTU value was 7.0, which also had a sensitivity of 95% or greater and a specificity of 94%. Nonetheless, given the uncertainty associated with quantifying the alkyl PAHs, porewater within the upper 12 inches sediment is considered unacceptable where the total ΣIWTU ≥ 1.

VPH and Select VOCs

None of the volatile aliphatic and aromatic hydrocarbons quantified by the Ecology VPH method were detected in the 2017 shallow sediment porewater. According to Apex Labs, the PDB water samples were free of interference and the absence of select VOCs (BTEX and naphthalene) suggests that VPH fractions are not present at significant freely dissolved concentrations in the sediment porewater at the 2017 PSD/PDB sampling locations.

Surface Water Toxicity

Like porewater, surface water samples with a ΣSWTU ≥ 1 are considered unacceptable, and include sample PWS-090917-9, PWS-090517-10, PWS-090617-12, and PWS-090617-13 (**Table 5-12**). PAHs driving surface water ΣSWTU > 1 include the same alkyl PAHs to those driving risk in porewater (mainly C_4-naphthalene).

For potential risk to fish in Scappoose Bay from direct exposure to dissolved PAHs, it was found that none of the surface water PAHs exceeded their corresponding SLVs, indicating that no unacceptable risk exists to fish for these cases. However, it should be noted that SLVs were found only for the 18 priority PAHs (including 1- and 2-methylnaphthalene) typically evaluated in environmental samples; therefore (with the exception of C_1–naphthalene, for which 1-methylnaphthalene was used as a surrogate), risk to fish could not be evaluated for the alkylated PAHs, benzo(e)pyrene, and perylene (the latter two, and six of the alkylated PAH analytes, were not detected in the porewater samples).

Other Porewater and Surface Water Toxicity Indicators

OPAHs

Detections of OPAHs in porewater and surface water vary at the Site. Although several individual OPAHs were detected, chromone at surface water locations PWS-090517-10, PWS-090617-12, and

PWS-09061713. Sediment porewater samples PWS-090617-1 and PWS-090617-12 had similar chromone concentrations to surface water at approximately 0.5 µg/L.

Total of 63 C_{free} PAHs

The highest concentrations of the sum of the 63 freely dissolved PAHs was detected at porewater location PWS-090617-1 at 5 µg/L and PWS-090617-2 at 1.3 µg/L.

Hopanes and Cholestanes

The results are presented in Appendix B of the Phase 3 Offshore Data Gap Progress Report (Cascadia, 2018a). The highest concentrations were found at surface water location PWS-090517-9, and porewater locations PWS-090517-14 and PWS-090617-15.

Groundwater Toxicity Indicators

PAHs

Concentrations of PAHs in the upland nearshore groundwater were screened against DEQ Level II SLVs. Monitoring wells MW-5, MW-7, and MW-18 had no exceedances; all other monitoring wells had one or more exceedance. Exceedances in one or more sample were found for all PAHs with a DEQ Level II SLV (acenaphthene, anthracene, benzo[a]anthracene, benzo[a]pyrene, fluoranthene, fluorene, naphthalene, and phenanthrene). Nearshore monitoring wells with ΣGWTUs greater than 1 in one or more sample included MW-3A, MW-3B, MW-6A, MW-10, MW-19, and MW-25. Total PAHs and ΣGWTUs in groundwater are shown on **Figure 5-4**.

As mentioned in **Section 10.2.2**, this approach of analyzing potential risk to benthic organisms from groundwater is highly conservative, as there is no exposure at the source, and it does not account for any changes in concentration as water migrates from upland to Scappoose Bay.

TPH

Concentrations of gasoline- and diesel-range hydrocarbons in upland groundwater samples were compared to Freshwater Ecotox Aquatic Habitat Goal Levels (HGLs), as shown on **Figure 5-5**. There were exceedances of diesel-range hydrocarbon HGLs in one or more groundwater sample from nearshore monitoring wells MW-3A, MW-3B, MW-6A, MW-10, MW-19, and MW-25. There were exceedances of gasoline-range hydrocarbon HGLs in one or more sample from nearshore monitoring wells MW-3A, MW-3B, and MW-6A; all other monitoring wells had no exceedances detected in samples. No HGLs exist for oil-range hydrocarbons. As discussed above, screening groundwater analytical results against surface water screening levels is a conservative approach that includes a large degree of uncertainty, as there is no direct exposure and does not account for any mitigating factors that may be occurring as water migrates to Scappoose Bay.

10.2.4 Conclusions from Ecological Risk Assessment

Based on the Supplemental ERA, the following conclusions can be drawn:

- Presence of creosote NAPL and moderate-heavy petroleum sheen present unacceptable risk to ecological receptors where it is observed in surface sediment porewater and surface water. The offshore areas exhibiting moderate to heavy petroleum sheen in surface sediment are illustrated on **Figure 6-3**.

- Issues with the 2012 measurement of freely dissolved PAHs in sediment porewater centered around elevated detection limits, particularly high molecular weight PAHs, and a perceived low bias for detecting select low molecular weight PAHs (e.g., naphthalene and its alkylated isomers). This uncertainty to confidently assess porewater toxicity led DEQ to consider other lines of evidence. Subsequently, in 2017, *in-situ* passive samplers were deployed within offshore areas where prior efforts to assess porewater toxicity and habitat impairment posed by Site-related contamination had been inconclusive. Compared to whole sediment and *ex-situ* porewater sampling and analysis, the 2017 quantitation of C_{free} 34 PAHs in sediment porewater and surface water using a time-integrated passive sampling approach appears to better quantify the potential risk to aquatic organisms when considering the heterogeneous conditions and assessing the chronic exposure of aquatic organisms.

- The 2017 porewater data demonstrate the low or nonexistent potential narcosis risk to benthic organisms outside of delineated offshore NAPL areas. Specifically, only 1 of the 15 sediment porewater sampling locations obtained within the biologically active zone (i.e., upper 12 inches of sediment) produced a ΣIWTU ≥ 1, PWS-090617-2. It is important to note that the 2017 PWS-090617-2 sediment porewater sample was obtained in Milton Creek near the confluence with Scappoose Bay. The diagnostic ratios of select stable PAH isomers (such as the ratio of Fl/Py) in PWS-090617-2 relative to samples obtained within the inferred creosote NAPL areas are consistent with field observations (i.e., no creosote sheen or odor noted at PWS-090617-2) and suggest that the elevated concentrations of the alkylated homologues C_3- and C_4-naphthalene at passive sampling site PWS-090617-2 may not be Site related. Nonetheless, this offshore area is part of the LOF because Site-related constituents detected in Upper Milton Creek could migrate and settle out within this depositional sediment area.

- Similar to sediment porewater, surface water samples with a ΣSWTU ≥ 1 are considered unacceptable. Four of the eight 2017 surface water passive sampling sites (PWS-090917-9, PWS-090517-10, PWS-090617-12, and PWS-090617-13) resulted in a ΣSWTU slightly above 1.

- The quantitation of chemicals in sediment porewater and surface water using the passive samplers developed by the FSES program at OSU is significantly more robust and precise than bulk sediment analysis of PAHs and TPH. After reviewing the 2017 LDPE PDS data, there appears to be little to no correlation of total PAHs detected in bulk sediment samples to freely dissolved concentrations in porewater and overlying surface water. Extraction and

analysis of bulk sediment samples combine both the C_{free} fraction and the contaminant fraction that is bound to particulate materials and carbon in the matrix that is sampled. The standard screening benchmarks used to evaluate the potential toxicity of PAHs in bulk sediment (e.g., TEC, PEC, TPH SLVs) appear to overestimate the toxicity of creosote-derived PAH to benthic invertebrates.

- A comparison of the 2017 surface water concentrations of C_{free} PAHs to published SLVs for individual PAHs, where available, indicates that risk to fish outside of delineated offshore NAPL areas is negligible from direct exposure to surface water. A comparison of the 2017 sediment concentrations of C_{free} PAHs to published SLVs for the bioaccumulation of individual PAHs (fluoranthene or pyrene) also indicated negligible risk outside of delineated offshore NAPL areas. As described above, the assessment of narcosis risk was conducted as a separate evaluation.
- A screening of analytical results from monitoring wells along Scappoose Bay indicate dissolved phase constituents may pose a risk to aquatic receptors from discharge of upland groundwater to surface water based on exceedances of select SLVs for PAHs and TPH and ΣGWTU values greater than 1. There is still large degree of uncertainty associated with this pathway, and further evaluation is needed as part of the feasibility study and/or remedial design.

11.0 HOT SPOTS AND PRIORITY ACTION AREAS

As required by DEQ Environmental Cleanup Rules, a "hot spot" evaluation was performed in accordance with the DEQ "Guidance for Identification of Hot Spots" (DEQ, 1998). The definition of hot spots depends upon the medium that is contaminated. Generally, for water, a hot spot exists if contamination results in a significant adverse effect on the beneficial use of that resource, and if restoration or protection of the beneficial use can occur within a reasonable amount of time. For media other than water, a hot spot exists if the site presents an unacceptable risk and if the contamination is highly concentrated, highly mobile, or cannot be reliably contained.

Using the results from the 2017 and 2018 offshore data gap investigation activities as the primary line of evidence, combined with historical analytical sediment and porewater analytical data obtained during the RI activities, PAAs have been established for the Site. The PAAs were identified as areas in which the concentration of COCs represent an unacceptable risk and require implementation of an active remedy. While C_{free} 34 PAHs have been detected outside of the proposed PAAs at concentrations exceeding PRGs (e.g., ΣIWTU > 1 and ΣSWTU > 1), the elimination of creosote NAPL in surface sediment and riverbank seeps is expected to, over time, allow concentrations of COCs in other matrices or less impacted areas outside of the PAAs to naturally attenuate.

11.1 NAPL

The hot spot guidance generally assumes that the presence of NAPL will produce "highly concentrated" and "not reliably containable" hot spots. Creosote NAPL is present in the subsurface soil and groundwater beneath the former wood treatment operations area and represents a hot spot. Downward contaminant migration is not a current transport of concern, based on the expected increasing hydraulic head with depth and the presence of very dense Basalt Bedrock beneath the Site. Historically, creosote NAPL at the Site has migrated from the former operational ground surface (release area) to deeper soil and groundwater, affecting riverbanks, near-shore sediment, porewater, and surface water adjacent to Area 1. The presence of NAPL in riverbank seeps and surface sediment is an unacceptable direct contact risk to human health and ecological receptors, is considered a highly mobile hot spot, and serves as an ongoing source of contamination to sediment, porewater, and surface water. In summary, the presence of NAPL is an unacceptable risk and is considered a hot spot in all media where the NAPL is accessible and not reliably contained, including subsurface sediment if exposed.

In upland areas, subsurface NAPL was typically encountered within thin discontinuous lenses and layers present in the native fine-grained stratum (Native Soil) at various depths above the basalt surface. In general, Basalt Bedrock acts as a barrier to downward vertical migration of the NAPL (**Section 6.3.1**). The results of the RI soil sampling, groundwater quality monitoring, and sediment investigations indicate that the lateral mobility of NAPL within these media is limited, except for the

intermittent groundwater with creosote sheen seepage observed along the banks of Milton Creek and Scappoose Bay (**Section 6.3.2**).

Historical wood treatment operations are believed to be the primary reason for creosote NAPL to be present in offshore sediment versus advective contaminant transport from upland areas. As illustrated by the solid red outline on **Figure 5-1**, approximately 4.3 acres of Native Soil and offshore sediment contains residual creosote NAPL beneath and immediately downgradient of the former operations area. Beyond the solid red outline of inferred creosote DNAPL, contaminated sediment beneath the Cove Area is buried by 1 to 7 feet of relatively clean recently deposited sediment.

According to DEQ, the elimination of creosote NAPL in surface sediment along the Site's shoreline and riverbanks is paramount to success of the aquatic remedy (DEQ, 2019a). The upland and in-water extent of NAPL (i.e., hot spots) and the PAAs are illustrated on **Figure 6-3**.

The Cove Area with surface sediment NAPL (hot spot) generally includes the following:

- Hot Spot Area – ~0.8 acre;
- Hot Spot Depth – mudline to 1 foot bml (biologically active zone); and
- Hot Spot Volume – ~1,300 cubic yards.

The Cove Area riverbank exhibiting NAPL seeps (hot spot) generally includes the following:

- Hot Spot Length – ~300 feet; and
- Hot Spot Depth/Thickness – mobile NAPL exists within relatively thin (1-foot-thick or less) sand layers intermittently situated between depths of 11 and 25 feet bgs.

The Cove Area with NAPL in subsurface sediment[5] generally includes the following:

- Subsurface Sediment Area – ~1.9 acre;
- Subsurface Sediment Depth – Varies; >1 foot bml up to 12 feet bml (an average thickness of 4 feet was used in the volume calculation); and
- Subsurface Sediment Volume – ~12,500 cubic yards

The Upper Milton Creek riverbank exhibiting NAPL seeps (hot spot) generally includes the following:

- Hot Spot Length – ~200 feet; and
- Hot Spot Thickness/Depth – mobile NAPL exists within a relatively thin (1-foot-thick or less) sand layer situated at an approximate depth of 19 feet bgs.

[5] Considered a hot spot if not reliably contained/containable

Discontinuous pockets of surficial wood related creosote NAPL have been observed within the Area 1 Dock offshore area as shown by the dashed red lines on **Figure 6-3**. The lateral extent of surface sediment and/or wood debris capable of producing a creosote-related sheen on the overlying water surface when disturbed extends approximately 75 feet offshore (i.e., riverward of the OHWM) between the former hog fuel dock and transfer table dock structure, and approximately 200 feet offshore (i.e., riverward of the OHWM) within the footprint of the former transfer table dock.

The portion of Area 1 Dock with wood related creosote NAPL in surface sediment (hot spot) generally includes the following:

- Surface Sediment Area – ~2.2 acres;
- Surface Sediment Depth – mudline to 1 foot bml (biologically active zone); and
- Surface Sediment Volume – ~3,600 cubic yards.

The portion of Area 1 Dock with NAPL in subsurface sediment[6] (hot spot) generally includes the following:

- Subsurface Sediment Area – ~2.2 acres;
- Subsurface Sediment Depth – Varies, >1 foot bml up to 14 feet bml (an average thickness of 5 feet was used in the volume calculation); and
- Subsurface Sediment Volume – ~18,100 cubic yards.

Discontinuous pockets of surficial wood related creosote NAPL have been observed within the Area 2 Dock offshore area as shown by the dashed red line on **Figure 6-3**.

The Area 2 Dock with wood related creosote NAPL in surface sediment (hot spot) generally includes the following:

- Hot Spot Area – ~0.3 acre;
- Hot Spot Depth – mudline to 1 foot bml (biologically active zone); and
- Hot Spot Volume – ~560 cubic yards.

11.2 SOIL/SEDIMENT

The DEQ cleanup rules define hot spots in "media other than water" (including soil and sediment) as:

[6] NAPL in the subsurface sediment is considered a hot spot if not reliably contained/containable.

> *OAR 340-122-0115(32)(b): For media other than groundwater or surface water (e.g., contaminated soil, debris, sediments, and sludges; drummed waste; 'pools' of DNAPL submerged beneath groundwater or in fractured bedrock; and NAPL floating on groundwater), if hazardous substances present a risk to human health or the environment exceeding the acceptable risk level, the extent to which the hazardous substances:*
>
> *Are present in concentrations exceeding risk-based concentrations corresponding to:*
>
> > *100 times the acceptable risk level for human exposure to each individual carcinogen;*
> >
> > *10 times the acceptable risk level for human exposure to each individual non-carcinogen;*
> >
> > *10 times the acceptable risk level for individual or populations of ecological receptors to each individual hazardous substance;*
>
> *Are reasonably like to migrate to such an extent that the conditions specified in subsection (a)1 or paragraphs (b)(A) or (b)(C) would be created; or*
>
> *Area not reliably containable, as determined in the FS.*

No contaminant concentration in soil outside of the inferred NAPL areas resulted in a human health risk level corresponding to soil hot spots. In particular, none of the carcinogenic COCs had a concentration in soil causing an excess cancer risk greater than 1×10^{-4}. None of the non-carcinogenic COCs have a concentration in soil causing a Hazard Quotient greater than 10. NAPL in subsurface soil represent unacceptable risk to construction/excavation workers. NAPL in riverbank seeps and surface sediment represent unacceptable risk to human health (e.g., anglers and transients) and ecological (benthic and fish) receptors. Outside of offshore areas with NAPL, concentrations of dissolved-phase constituents above human health and ecological criteria are the most certain line of evidence used to assess toxicity.

Contaminated subsurface soil present on the Site is easily contained. The Site's topography is relatively flat and PCB-impacted roadbed material is easily contained. Contaminated riverbank and surface sediment along the Site's shoreline are prone to erosion and are not currently reliably contained. Therefore, the FS will consider technologies that would reliably contain these areas.

Soil contamination leaching potential is addressed through the assessment of groundwater contamination and the associated identification of the groundwater hot spot as discussed below in **Section 11.3**.

11.3 WATER

The DEQ cleanup rules define hot spots in groundwater (includes sediment porewater) and surface water as:

> *OAR 340-122-0115(32)(a): For groundwater or surface water, hazardous substances having a significant adverse effect on beneficial uses of water or waters to which the hazardous substances would be reasonably like to migrate and for which treatment is reasonably likely to restore or protect such beneficial uses within a reasonable time, as determined in a feasibility study.*

As noted in **Section 7.3.1**, the beneficial use of shallow groundwater beneath the Site is limited to discharge to Milton Creek and Scappoose Bay. The current and reasonably likely future beneficial surface water uses within the Site's LOF include aquatic habitat, recreation, and aesthetic quality. The risk assessments concluded that direct contact with creosote NAPL in groundwater (e.g., excavation water, riverbank groundwater seeps) and sediment porewater represents unacceptable risk to human and ecological receptors. Based on available data, the risk to human and ecological receptors from exposure to chemical constituents in groundwater discharge is low outside of the inferred NAPL areas. However, contaminated groundwater with the potential to discharge to the near-shore aquatic environment remains a data gap that needs to be further evaluated in either the FS or remedial design.

The presence of NAPL in riverbank seeps and surface sediment is an unacceptable direct contact risk to human health and ecological receptors, is considered a highly mobile hot spot, and serves as an ongoing source of contamination to sediment, porewater, and surface water. Dissolved-phase creosote constituents in porewater and surface water that cause unacceptable risk to benthos and fish are also potential hot spots. Therefore, the upland PAA includes groundwater discharge zones potentially exceeding aquatic standards. It is anticipated that removal or containment of contamination in the PAAs will allow the lesser impacted offshore areas to recover (e.g., ΣSWTU > 1 in surface water).

12.0 CONCLUSIONS

EPA's November 1989 Directive 9355.3-01FS2 specifies that available data should be evaluated to determine if: (1) DQOs have been met, (2) the risks posed by the site have been adequately defined, (3) the need (or lack of need) for remedial action is documented, and (4) the data necessary for development and evaluation of remedial action alternatives have been obtained. As documented in **Section 8.0**, each of these criteria has been met. These criteria are each addressed under the subheadings below.

1. DQOs have been met: The supplemental RI DQOs were defined in **Section 1.2**, and each has been met through field observations, investigation, analysis, and data evaluation. Each of these is addressed in more detail below.
2. Risks have been adequately defined: Potential risk to both human and ecological receptors have been adequately evaluated using the available data.
3. Need for Remedial Action has been documented: The Site will require remedial action to mitigate unacceptable risk.
4. Necessary data to assess remedial alternatives have been collected: The RI and supplemental RI data provide sufficient basis to allow evaluation of remedial alternatives, as will be further discussed in the FS. Additional data may be required for remedial design once a remedy has been selected.

Supplemental RI objectives have been met and, the results from the supplemental RI are summarized below.

1. The lateral and vertical extent of NAPL in offshore sediment adjacent to the Site has been defined. Upland NAPL near the former operations area extends a maximum of approximately 100 feet offshore (riverward of OHWM) beneath 0.8 acre of Scappoose Bay (solid red line beneath the Cove Area). Moderate and heavy petroleum sheens have been observed in subsurface sediment up to 220 feet from the shoreline near the former operations area beneath 1.9 acres of Scappoose Bay (orange shading beyond the Cove Area in-water PAA). The supplemental RI work revealed that wood debris in surface sediment along 700 feet of the Area 1 shoreline is a source of NAPL beneath the former hog fuel dock and transfer table dock structures (referred to as the Area 1 Dock) and extends approximately 75 feet offshore. The creosote contaminated wood debris beneath the former transfer table dock extends approximately 200 feet offshore (riverward of OHWM). In addition, moderate to heavy petroleum sheens have been identified in surface sediment along a 50- by 200-foot portion of the Area 2 shoreline beneath a former creosote offloading dock structure (referred to as the Area 2 Dock). The estimated extent of offshore NAPL in surface sediment is illustrated on multiple figures.

2. The vertical and lateral extent of upland NAPL and/or contaminated soil areas potentially contributing to offshore contamination has been defined. The area of upland NAPL is similar to the area presented in the 2000 RI Report, with some expansion of the inferred area based on installation of additional monitoring wells and various investigation techniques, most of which extended to or into the surface of the Basalt Bedrock. The estimated extent of upland NAPL is shown on **Figure 5-1**, and NAPL observations are presented on cross-section **Figures 4-2** through **4-9**.

3. Based on the physical properties of creosote (i.e., density, high water/NAPL interfacial tension, and high viscosity), Site conditions, and the results of NAPL delineation completed around the former wood-treating facilities (both upland and offshore), the lateral and vertical extent of NAPL appears to be defined and relatively stable, except for the localized creosote seep areas identified in the various report figures along the banks of Milton Creek and Scappoose Bay. As documented in DEQ's January 15, 2019 RI Summary, the highest goal of the in-water remedial action should be to eliminate the presence of NAPL and petroleum sheen in surface sediment, seeps, and surface water. The elimination of the ongoing release of creosote constituents is expected to, over time, allow concentrations of creosote constituents in other matrices to attenuate.

4. Current groundwater conditions beneath Area 1, NAPL occurrence, and the quality of groundwater discharging from Area 1 uplands to the adjacent surface water bodies (Scappoose Bay and Milton Creek) have been investigated. Four quarterly groundwater monitoring events in 2011 and 2012 and analysis of sediment porewater along the shorelines indicate the presence of PAHs in upland groundwater; however, PAHs were detected at much lower concentrations in sediment porewater and surface water samples. Although upland groundwater discharges to sediment porewater and surface water within Milton Creek and Scappoose Bay, the risk to human health and ecological receptors from dissolved-phase constituents transported via groundwater appears to be low outside the observed areas of direct NAPL seepage.

5. The CSM has been refined to better account for offshore sediment contamination (particularly NAPL along the Site's shorelines), as well as upland NAPL migration and dissolved-phase contaminant transport. Upland NAPL has migrated, to a limited extent, via sand lenses and seeps to offshore sediment; however, overwater operations, including deposition of treated wood waste, are also a source of NAPL in surface sediment. The shoreline and offshore extent of creosote NAPL and petroleum sheens have been adequately defined for the FS. The upland and offshore PAAs have been identified as shown on **Figure 6-3**. The updated CSM is summarized in **Section 9.0** and is shown schematically on **Figure 6-1** and **Figure 9-1**.

6. The updated supplemental HHRA indicates low potential risk to human receptors other than direct contact with NAPL and Area 1 groundwater by excavation workers and direct contact with NAPL by shoreline anglers/transients. Detected concentrations of total PCBs in

5 of 24 discrete surface soil samples (gravel roadbed material) exceed direct contact RBCs for industrial workers. The updated supplemental HHRA is summarized in **Section 10.1**, and the updated supplemental HHRA report is provided in **Appendix F**.

7. The updated supplemental ERA indicates that the presence of creosote NAPL (inclusive of moderate to heavy petroleum sheen) present unacceptable ecological risk to benthic invertebrates and fish where it is observed in surface sediment (**Figure 5-2**). Beyond the delineated NAPL areas, concentrations of freely dissolved-phase constituents above ecological criteria represent the most certain line of evidence used for assessing risk to ecological receptors. In general, the 2017 surface sediment porewater sampling indicates that dissolved-phase constituents in deeper sediment and/or upland groundwater do not adversely impact benthic invertebrates outside the prior remedial action areas. Specifically, only one of the fifteen 2017 *in-situ* surface sediment porewater PSDs deployed outside the inferred NAPL areas indicates unacceptable risk to benthic invertebrates (PWS-090617-2 in Lower Milton Creek), although the source of this contamination is uncertain. Surface water PAH toxic units indicate there may be unacceptable risk to fish near the priority remedial areas. The updated ERA is summarized in **Section 10.2**, and the updated supplemental ERA report is provided in **Appendix G**.

8. The hot spot evaluation indicates that groundwater and sediment within the delineated extent of NAPL, and NAPL-affected groundwater seeps, are hot spots in accordance with DEQ guidance. Presence of NAPL is a violation of the Oregon narrative water quality standard (340-041-007(12)), is an unacceptable direct contact risk to human health and ecological receptors, is considered a highly mobile hot spot, and serves as an ongoing source of contamination to sediment, porewater, and surface water. Dissolved-phase creosote constituents in porewater and surface water that cause unacceptable risk to benthos and fish are also potential hot spots. The hot spot evaluation and discussion of upland and in-water PAAs is provided in **Section 11.0**.

Subsequent to DEQ approval of the Supplemental RI Report, the Port will begin development of the Site FS to address media impacted by upland and offshore NAPL. The RI and supplemental RI data provide sufficient basis to allow development and evaluation of remedial alternatives, as will be further discussed in the FS. Additional data may be required for remedial design once a remedy has been selected.

13.0 REFERENCES

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TABLES

Table 3-1
Supplemental RI Sampling Summary
Updated Supplemental RI Report
Former Pope Talbot Wood-Treating Site
St. Helens, Oregon

Sampling Location	Sample ID	Sample Type	Sample Matrix	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Data Group	Analytical Suite				
								Fuels	Metals	PAHs	VOCs[1]	Other
Groundwater												
MW-1	MW-1-BTM-20100908-N	P	GW	9/8/2010	N/A	N/A	A10I112	X	X	X	X	
MW-1	MW-1-MID-20100908-N	P	GW	9/8/2010	N/A	N/A	A10I112	X	X	X	X	
MW-1	MW-1	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-1	MW-1_022012	P	GW	2/20/2012	N/A	N/A	A12B287	X	X	X		
MW-1	MW-1_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-1	MW-1_081412	P	GW	8/14/2012	N/A	N/A	A12H291	X	X	X		
MW-2A	MW-2A	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-2A	MW-2A_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-2A	MW-2A_050312	P	GW	5/3/2012	N/A	N/A	A12E118	X	X	X		
MW-2A	MW-2A_081512	P	GW	8/15/2012	N/A	N/A	A12H291	X	X	X		
MW-3A	MW-3A-20100908-N	P	GW	9/8/2010	N/A	N/A	A10I112	X	X	X	X	
MW-3A	MW-3A	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-3A	MW-3A_022112	P	GW	2/21/2012	N/A	N/A	A12B310	X	X	X		
MW-3A	MW-3A_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-3A	MW-3A_081512	P	GW	8/15/2012	N/A	N/A	A12H291	X	X	X		
MW-3A	MW-3A_081512	P	GW	8/15/2012	N/A	N/A	A12H309			X		
MW-3B	MW-3B-20100908-N	P	GW	9/8/2010	N/A	N/A	A10I112	X	X	X	X	
MW-3B	MW-3B	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-3B	MW-3B_022112	P	GW	2/21/2012	N/A	N/A	A12B310	X	X	X		
MW-3B	MW-3B_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-3B	MW-3B_081512	P	GW	8/15/2012	N/A	N/A	A12H291	X	X	X		
MW-4A	MW-4A-20100907-N	P	GW	9/7/2010	N/A	N/A	A10I079	X	X	X	X	
MW-4A	MW-4A-20100907-ED	FD	GW	9/7/2010	N/A	N/A	A10I079	X	X	X	X	
MW-4A	MW-4A	P	GW	8/8/2011	N/A	N/A	A11H101	X	X	X		
MW-4A	MW-4A_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-4A	MW-4A_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-4A	MW-4A_081512	P	GW	8/15/2012	N/A	N/A	A12H291	X	X	X		
MW-4B	MW-4B-20100907-N	P	GW	9/7/2010	N/A	N/A	A10I079	X	X	X	X	
MW-4B	MW-4B	P	GW	8/8/2011	N/A	N/A	A11H101	X	X	X		
MW-4B	MW-4B_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-4B	MW-4B_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-4B	MW-4B_081512	P	GW	8/15/2012	N/A	N/A	A12H291	X	X	X		
MW-5	MW-5-20100907-N	P	GW	9/7/2010	N/A	N/A	A10I079	X	X	X	X	
MW-5	MW-5	P	GW	8/8/2011	N/A	N/A	A11H101	X	X	X		
MW-5	MW-5_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-5	MW-5_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-5	MW-5_081512	P	GW	8/15/2012	N/A	N/A	A12H291	X	X	X		
MW-6A	MW-6A-20100908-N	P	GW	9/8/2010	N/A	N/A	A10I112	X	X	X	X	
MW-6A	MW-6A	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-6A	MW-6A_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-6A	MW-6A_050312	P	GW	5/3/2012	N/A	N/A	A12E100	X	X	X		
MW-6A	MW-6A_08142012	P	GW	8/14/2012	N/A	N/A	A12H256	X	X	X		
MW-7	MW-7_050312	P	GW	5/3/2012	N/A	N/A	A12E100	X	X	X		
MW-9	MW-9-20100907-N	P	GW	9/7/2010	N/A	N/A	A10I079	X	X	X	X	
MW-9	MW-9	P	GW	8/8/2011	N/A	N/A	A11H101	X	X	X		
MW-9	MW-9_022012	P	GW	2/20/2012	N/A	N/A	A12B273	X	X	X		
MW-9	MW-9_050312	P	GW	5/3/2012	N/A	N/A	A12E100	X	X	X		
MW-9	MW-9_08142012	P	GW	8/14/2012	N/A	N/A	A12H256	X	X	X		
MW-10	MW-10-20100907-N	P	GW	9/7/2010	N/A	N/A	A10I079	X	X	X	X	
MW-10	MW-10	P	GW	8/8/2011	N/A	N/A	A11H101	X	X	X		
MW-10	MW-10_022012	P	GW	2/20/2012	N/A	N/A	A12B273	X	X	X		
MW-10	MW-10_050312	P	GW	5/3/2012	N/A	N/A	A12E100	X	X	X		
MW-10	MW-10_08142012	P	GW	8/14/2012	N/A	N/A	A12H256	X	X	X		

Please refer to notes on last page of table.

Cascadia Associates, LLC

Table 3-1
Supplemental RI Sampling Summary
Updated Supplemental RI Report
Former Pope Talbot Wood-Treating Site
St. Helens, Oregon

Sampling Location	Sample ID	Sample Type	Sample Matrix	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Data Group	Analytical Suite				
								Fuels	Metals	PAHs	VOCs[1]	Other
MW-18	MW-18-20100907-N	P	GW	9/7/2010	N/A	N/A	A10I079	X	X	X	X	
MW-18	MW-18	P	GW	8/8/2011	N/A	N/A	A11H101	X	X	X		
MW-18	MW-18 DUP	FD	GW	8/8/2011	N/A	N/A	A11H101		X	X		
MW-18	MW-18_022012	P	GW	2/20/2012	N/A	N/A	A12B273	X	X	X		
MW-18	MW-18_050312	P	GW	5/3/2012	N/A	N/A	A12E100	X	X	X		
MW-18	MW-18_08142012	P	GW	8/14/2012	N/A	N/A	A12H256	X	X	X		
MW-19	MW-19	P	GW	8/8/2011	N/A	N/A	A11H101	X	X	X		
MW-19	MW-19_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-19	MW-19_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-19	MW-19_081412	P	GW	8/14/2012	N/A	N/A	A12H291	X	X	X		
MW-20	MW-20	P	GW	8/8/2011	N/A	N/A	A11H101	X	X	X		
MW-20	MW-20_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-20	MW-20_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-20	MW-20_081512	P	GW	8/15/2012	N/A	N/A	A12H291	X	X	X		
MW-21	MW-21	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-21	MW-21_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-21	MW-21_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-21	MW-21_081512	P	GW	8/15/2012	N/A	N/A	A12H291	X	X	X		
MW-21	MW-21_081512	P	GW	8/15/2012	N/A	N/A	A12H309			X		
MW-22	MW-22	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-22	MW-22_022012	P	GW	2/20/2012	N/A	N/A	A12B287	X	X	X		
MW-22	MW-22_050412	P	GW	5/4/2012	N/A	N/A	A12E118	X	X	X		
MW-22	MW-22_081512	P	GW	8/15/2012	N/A	N/A	A12H291	X	X	X		
MW-22	MW-22-DUP_022012	FD	GW	2/20/2012	N/A	N/A	A12B287		X	X		
MW-22	MW-22DUP_050412	FD	GW	5/4/2012	N/A	N/A	A12E118		X	X		
MW-22	MW-22DUP_081512	FD	GW	8/15/2012	N/A	N/A	A12H291		X	X		
MW-23	MW-23	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-23	MW-23 DUP	FD	GW	8/9/2011	N/A	N/A	A11H114		X	X		
MW-23	MW-23_022012	P	GW	2/20/2012	N/A	N/A	A12B273	X	X	X		
MW-23	MW-23_050312	P	GW	5/3/2012	N/A	N/A	A12E100	X	X	X		
MW-23	MW-23_08142012	P	GW	8/14/2012	N/A	N/A	A12H256	X	X	X		
MW-23	MW-23DUP_022012	FD	GW	2/20/2012	N/A	N/A	A12B273		X	X		
MW-23	MW-23DUP_050312	FD	GW	5/3/2012	N/A	N/A	A12E100		X	X		
MW-23	MW-23DUP_08142012	FD	GW	8/14/2012	N/A	N/A	A12H256		X	X		
MW-24	MW-24	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-24	MW-24_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-24	MW-24_050312	P	GW	5/3/2012	N/A	N/A	A12E100	X	X	X		
MW-24	MW-24_08142012	P	GW	8/14/2012	N/A	N/A	A12H256	X	X	X		
MW-24	MW-24_08142012	P	GW	8/14/2012	N/A	N/A	A12H309			X		
MW-25	MW-25	P	GW	8/9/2011	N/A	N/A	A11H114	X	X	X		
MW-25	MW-25_022112	P	GW	2/21/2012	N/A	N/A	A12B287	X	X	X		
MW-25	MW-25_050312	P	GW	5/3/2012	N/A	N/A	A12E118	X	X	X		
MW-25	MW-25_08142012	P	GW	8/14/2012	N/A	N/A	A12H256	X	X	X		
NAPL												
MW-3A	MW-3A-20100908-DNPL	P	NAPL	9/8/2010	N/A	N/A	A10I112	X				
MW-3A	MW-3A-DNAPL_20120815	P	NAPL	8/15/2012	N/A	N/A	A12H289			X		

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Sampling Location	Sample ID	Sample Type	Sample Matrix	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Data Group	Analytical Suite				
								Fuels	Metals	PAHs	VOCs[1]	Other
Sediment Porewater												
LSI-01	LSI-01_8-11	P	PW	10/16/2012	0.66	0.92	A12J450			X		
LSI-02	LSI-02_8-11	P	PW	10/9/2012	0.66	0.92	A12J257			X		
LSI-09	LSI-09_8-11	P	PW	10/9/2012	0.66	0.92	A12J257			X		
LSI-11	LSI-11_8-11	P	PW	10/10/2012	0.66	0.92	A12J331			X		
LSI-20	LSI-20_8-11	P	PW	10/10/2012	0.66	0.92	A12J331			X		
LSI-24	LSI-24-8-11	P	PW	10/12/2012	0.66	0.92	A12J365			X		
PWS-01	PWS-01_8-9	P	PW	7/10/2012	0.66	0.75	A12G149			X		X
PWS-01	PWS-1_8-10	P	PW	10/10/2012	0.66	0.83	A12J289			X		X
PWS-02	PWS-02_1-4	P	PW	7/10/2012	0.08	0.33	A12G149			X		X
PWS-02	PWS-02_8-10	P	PW	7/10/2012	0.66	0.83	A12G149			X		X
PWS-02	PWS-02_8-11	P	PW	10/11/2012	0.66	0.92	A12J356			X		
PWS-03	PWS-03_8-11	P	PW	7/12/2012	0.66	0.92	A12G193			X		X
PWS-03	PWS-3_8-11	P	PW	10/10/2012	0.66	0.92	A12J289			X		X
PWS-04	PWS-04_1-4	P	PW	7/10/2012	0.08	0.33	A12G149					X
PWS-04	PWS-04_8-11	P	PW	7/10/2012	0.66	0.92	A12G149			X		X
PWS-04	PWS-4_8-11	P	PW	10/10/2012	0.66	0.92	A12J289			X		X
PWS-05	PWS-05_8-11	P	PW	7/12/2012	0.66	0.92	A12G193			X		X
PWS-05	PWS-5_8-11	P	PW	10/10/2012	0.66	0.92	A12J289			X		X
PWS-06	PWS-06_8-11	P	PW	7/12/2012	0.66	0.92	A12G193			X		X
PWS-06	PWS-6_8-11	P	PW	10/10/2012	0.66	0.92	A12J289			X		X
PWS-07	PWS-07_8-11	P	PW	7/10/2012	0.66	0.92	A12G149			X		X
PWS-07	PWS-7_8-10 DUP	FD	PW	10/11/2012	0.66	0.83	A12J367			X		X
PWS-07	PWS-7_8-10	P	PW	10/11/2012	0.66	0.83	A12J367			X		X
PWS-08	PWS-08_8-11	P	PW	7/12/2012	0.66	0.92	A12G213			X		X
PWS-08	PWS-8_8-11	P	PW	10/9/2012	0.66	0.92	A12J289			X		X
PWS-09	PWS-09_8-11	P	PW	7/12/2012	0.66	0.92	A12G213			X		X
PWS-09	PWS-9_8-11	P	PW	10/9/2012	0.66	0.92	A12J289			X		X
PWS-10	PWS-10_8-11	P	PW	10/10/2012	0.66	0.92	A12J357			X		X
PWS-10	PWS-10_8-11	P	PW	7/11/2012	0.66	0.92	A12G170			X		X
PWS-11	PWS-11_8-11	P	PW	10/10/2012	0.66	0.92	A12J357			X		X
PWS-11	PWS-11_8-11	P	PW	7/9/2012	0.66	0.92	A12G119			X		X
PWS-11	PWS-11B_8-11	P	PW	7/13/2012	0.66	0.92	A12G214			X		X
PWS-12	PWS-12_8-11 DUP	FD	PW	7/12/2012	0.66	0.92	A12G213			X		X
PWS-12	PWS-12_8-11	P	PW	10/9/2012	0.66	0.92	A12J241			X		X
PWS-12	PWS-12_8-11	P	PW	7/12/2012	0.66	0.92	A12G213			X		X
PWS-13	PWS-13_1-4	P	PW	7/11/2012	0.08	0.33	A12G170			X		X
PWS-13	PWS-13_8-11	P	PW	10/9/2012	0.66	0.92	A12J241			X		X
PWS-13	PWS-13_8-11	P	PW	7/11/2012	0.66	0.92	A12G170			X		X
PWS-14	PWS-14_4-8	P	PW	10/11/2012	0.33	0.66	A12J367			X		X
PWS-15	PWS-15_8-11	P	PW	10/11/2012	0.66	0.92	A12J356			X		X
PWS-15	PWS-15_8-11	P	PW	7/12/2012	0.66	0.92	A12G169			X		X
PWS-16	PWS-16_8-11	P	PW	10/9/2012	0.66	0.92	A12J241			X		X
PWS-16	PWS-16_8-11	P	PW	7/9/2012	0.66	0.92	A12G119			X		X
PWS-16	PWS-16B_8-11	P	PW	7/13/2012	0.66	0.92	A12G214			X		X
PWS-17	PWS-17_4-7	P	PW	10/10/2012	0.33	0.58	A12J357			X		X
PWS-18	PWS-18_8-10	P	PW	10/11/2012	0.66	0.83	A12J367			X		X
PWS-18	PWS-18_8-11	P	PW	7/11/2012	0.66	0.92	A12G170			X		X
PWS-19	PWS-19_8-11	P	PW	10/11/2012	0.66	0.92	A12J367			X		X
PWS-19	PWS-19_8-11	P	PW	7/11/2012	0.66	0.92	A12G170			X		X

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								Fuels	Metals	PAHs	VOCs[1]	Other
PWS-20	PWS-20_8-11 DUP	FD	PW	7/11/2012	0.66	0.92	A12G170			X		X
PWS-20	PWS-20_8-11	P	PW	10/9/2012	0.66	0.92	A12J241			X		X
PWS-20	PWS-20_8-11	P	PW	7/11/2012	0.66	0.92	A12G170			X		X
PWS-22	PWS-22_8-11	P	PW	7/12/2012	0.66	0.92	A12G213					X
PWS-25	PWS-25_4-8	P	PW	10/11/2012	0.33	0.66	A12J367			X		X
PWS-25	PWS-25_8-11	P	PW	7/13/2012	0.66	0.92	A12G214			X		X
PWS-26	PWS-26_8-11	P	PW	10/11/2012	0.66	0.92	A12J356			X		X
PWS-26	PWS-26_8-11_DUP	FD	PW	10/11/2012	0.66	0.92	A12J356			X		X
PWS-26	PWS-26_8-11	P	PW	7/13/2012	0.66	0.92	A12G214			X		X
PWS-27	PWS-27_8-11	P	PW	10/9/2012	0.66	0.92	A12J241			X		X
PWS-27	PWS-27_8-11	P	PW	7/13/2012	0.66	0.92	A12G214			X		X
PWS-28	PWS-28_8-11	P	PW	10/10/2012	0.66	0.92	A12J357			X		X
PWS-29	PWS-29_8-11	P	PW	10/12/2012	0.66	0.92	A12J367			X		X
PWS-30	PWS-30_8-11	P	PW	10/12/2012	0.66	0.92	A12J367			X		X
PWS-090617-1	Shallow Porewater Site 1	P	PW	9/6-26/2017	0.08	1	A170724			X		X
	Deep Porewater Site 1	P	PW	9/6-26/2017	2	2.42	A170725			X		X
	PDB-92617-1	P	PW	9/6-26/2017	0.08	1	A7I0849				X	
PWS-090617-2	Shallow Porewater Site 2	P	PW	9/6-26/2017	0.08	1	A170726			X		X
	Deep Porewater Site 2	P	PW	9/6-26/2017	2	2.42	A170727			X		X
	PDB-092617-2	P	PW	9/6-26/2017	0.08	1	A7I0849				X	
PWS-090517-3	Shallow Porewater Site 3	P	PW	9/5-26/2017	0.08	1	A170730			X		X
	Deep Porewater Site 3	P	PW	9/5-26/2017	2	2.42	A170730			X		X
PWS-090517-4	Shallow Porewater Site 4	P	PW	9/5-26/2017	0.08	1	A170733			X		X
	Deep Porewater Site 4	P	PW	9/5-26/2017	2	2.42	A170734			X		X
	PDB-092617-4	P	PW	9/5-26/2017	0.08	1	A7I0849				X	
PWS-090517-5	Shallow Porewater Site 5	P	PW	9/5-26/2017	0.08	1	A170735			X		X
	Deep Porewater Site 5	P	PW	9/5-26/2017	2	2.42	A170736			X		X
	PDB-092617-5	P	PW	9/5-26/2017	0.08	1	A7I0849				X	
PWS-090517-6	Shallow Porewater Site 6	P	PW	9/5-26/2017	0.08	1	A170737			X		X
	Deep Porewater Site 6	P	PW	9/5-26/2017	2	2.42	A170738			X		X
	PDB-092617-6	P	PW	9/5-26/2017	0.08	1	A7I0849				X	
PWS-090517-7	Shallow Porewater Site 7	P	PW	9/5-26/2017	0.08	1	A170739			X		X
	Deep Porewater Site 7	P	PW	9/5-26/2017	2	2.42	A170740			X		X
	PDB-092617-7	P	PW	9/5-26/2017	0.08	1	A7I0849				X	
PWS-090517-8	Shallow Porewater Site 8	P	PW	9/5-26/2017	0.08	1	A170741			X		X
	Deep Porewater Site 8	P	PW	9/5-26/2017	2	2.42	A170742			X		X
	PDB-092617-8	P	PW	9/5-26/2017	0.08	1	A7I0849				X	
PWS-090517-9	Shallow Porewater Site 9	P	PW	9/5-26/2017	0.08	1	A170744			X		X
	Deep Porewater Site 9	P	PW	9/5-26/2017	2	2.42	A170745			X		X
	PDB-092617-9	P	PW	9/5-26/2017	0.08	1	A7I0849				X	
PWS-090517-10	Shallow Porewater 10	P	PW	9/5-26/2017	0.08	1	A170749			X		X
	PDB-092617-10	P	PW	9/5-26/2017	0.08	1						
	PDB-092617-10R	FD	PW	9/5-26/2017	0.08	1	A7I0849				X	
PWS-090517-11	Shallow Porewater 11	P	PW	9/5-26/2017	0.08	1	A170751			X		X
	Deep Porewater 11	P	PW	9/5-26/2017	2	2.42	A170752			X		X
	PDB-092617-11	P	PW	9/5-26/2017	0.08	1	A7I0849				X	
PWS-090617-12	Shallow Porewater 12	P	PW	9/6-26/2017	0.08	1	A170754			X		X
	Deep Porewater 12	P	PW	9/6-26/2017	2	2.42	A170755			X		X
	PDB-92617-12	P	PW	9/6-26/2017	0.08	1	A7I0849				X	

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								Fuels	Metals	PAHs	VOCs[1]	Other
PWS-090617-13	Shallow Porewater 13	P	PW	9/6-26/2017	0.08	1	A170756			X		X
	Deep Porewater 13	P	PW	9/6-26/2017	2	2.42	A170757			X		X
	PDB-92617-13	P	PW	9/6-26/2017	0.08	1	A7I0849				X	
PWS-090517-14	Shallow Porewater 14	P	PW	9/5-26/2017	0.08	1	A170760			X		X
	Deep Porewater 14	P	PW	9/5-26/2017	2	2.42	A170761			X		X
	PDB-92617-14	P	PW	9/5-26/2017	0.08	1	A7I0849				X	
PWS-090617-15	Shallow Porewater Site 15	P	PW	9/6-26/2017	0.08	1	A170762			X		X
	Deep Porewater Site 15	P	PW	9/6-26/2017	2	2.42	A170763			X		X
	PDB-92617-15	P	PW	9/6-26/2017	0.08	1	A7I0849				X	
Surface Water												
PWS-090617-2	Surface Water Site 2	P	SW	10/16/2012	0.66	0.92	A12J450			X		X
PWS-090517-3	Surface Water Site 3	P	SW	10/9/2012	0.66	0.92	A12J257			X		X
PWS-090517-4	Surface Water Site 4	P	SW	10/9/2012	0.66	0.92	A12J257			X		X
PWS-090517-9	Surface Water Site 9	P	SW	10/10/2012	0.66	0.92	A12J331			X		X
PWS-090517-10	Surface Water Site 10-1	P	SW	10/10/2012	0.66	0.92	A12J331			X		X
	Surface Water Site 10-3	FD	SW	10/12/2012	0.66	0.92	A12J365			X		X
PWS-090617-12	Surface Water Site 12	P	SW	7/10/2012	0.66	0.75	A12G149			X		X
PWS-090617-13	Surface Water Site 13	P	SW	10/10/2012	0.66	0.83	A12J289			X		X
PWS-090517-14	Surface Water Site 14	P	SW	10/10/2012	0.66	0.83	A12J289			X		X
Sediment												
DAI-PWS-01	DAI-PWS-01-8-11	P	SE	10/14/2013	0.66	0.92	A3J0564	X		X		
DAI-PWS-02	DAI-PWS-02-8-11	P	SE	10/14/2013	0.66	0.92	A3J0564	X		X		
LSI-01	LSI-01_8-11	P	SE	10/16/2012	0.66	0.92	A12J450	X		X		X
LSI-02	LSI-02_8-11	P	SE	10/9/2012	0.66	0.92	A12J257	X		X		X
LSI-09	LSI-09_8-11	P	SE	10/9/2012	0.66	0.92	A12J257	X		X		X
LSI-11	LSI-11_8-11	P	SE	10/10/2012	0.66	0.92	A12J331	X		X		X
LSI-20	LSI-20_8-11	P	SE	10/10/2012	0.66	0.92	A12J331	X		X		X
LSI-24	LSI-24_8-11	P	SE	10/12/2012	0.66	0.92	A12J365	X		X		X
MC-03	MCO3-0-0.3	P	SE	7/12/2011	0	0.3	A11G169	X		X		X
MC-03	MCO3-7.1	P	SE	7/12/2011	6.8	7.1	A11G169	X		X		
MC-03	MC03-12.8	P	SE	7/12/2011	12.5	12.8	A11G169	X		X		
MC-04	MC04-0-0.3	P	SE	7/12/2011	0	0.3	A11G169	X		X		X
MC-04	MC04-3.3	P	SE	7/12/2011	0	3.3	A11G169	X		X		
MC-04	MC04-9.5	P	SE	7/12/2011	9.2	9.5	A11G169	X		X		
PWS-01	PWS-01_8-9	P	SE	7/10/2012	0.66	0.75	A12G149			X		X
PWS-01	PWS-1_8-10	P	SE	10/10/2012	0.66	0.83	A12J289			X		X
PWS-01	PWS-1_8-10	P	SE	10/10/2012	0.66	0.83	A12J289					X
PWS-02	PWS-02_1-4	P	SE	7/10/2012	0.08	0.33	A12G149			X		X
PWS-02	PWS-02_8-10	P	SE	7/10/2012	0.66	0.83	A12G149			X		X
PWS-02	PWS-02_8-11	P	SE	10/11/2012	0.66	0.92	A12J356			X		X
PWS-02	PWS-02_8-11	P	SE	10/11/2012	0.66	0.92	A12J356					X
PWS-03	PWS-03_8-11	P	SE	7/12/2012	0.66	0.92	A12G193			X		X
PWS-03	PWS-3_8-11	P	SE	10/10/2012	0.66	0.92	A12J289			X		X
PWS-03	PWS-3_8-11	P	SE	10/10/2012	0.66	0.92	A12J289					X
PWS-04	PWS-04_1-4	P	SE	7/10/2012	0.08	0.33	A12G149			X		X
PWS-04	PWS-04_8-11	P	SE	7/10/2012	0.66	0.92	A12G149			X		X
PWS-04	PWS-4_8-11	P	SE	10/10/2012	0.66	0.92	A12J289			X		X
PWS-04	PWS-4_8-11	P	SE	10/10/2012	0.66	0.92	A12J289					X
PWS-05	PWS-05_8-11	P	SE	7/12/2012	0.66	0.92	A12G193			X		X
PWS-05	PWS-5_8-11	P	SE	10/10/2012	0.66	0.92	A12J289			X		X
PWS-05	PWS-5_8-11	P	SE	10/10/2012	0.66	0.92	A12J289					X
PWS-06	PWS-06_8-11	P	SE	7/12/2012	0.66	0.92	A12G193			X		X
PWS-06	PWS-6_8-11	P	SE	10/10/2012	0.66	0.92	A12J289			X		X
PWS-06	PWS-6_8-11	P	SE	10/10/2012	0.66	0.92	A12J289					X

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Sampling Location	Sample ID	Sample Type	Sample Matrix	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Data Group	Analytical Suite				
								Fuels	Metals	PAHs	VOCs[1]	Other
PWS-07	PWS-07_8-11	P	SE	7/10/2012	0.66	0.92	A12G149			X		X
PWS-07	PWS-7_8-10	P	SE	10/11/2012	0.66	0.83	A12J367			X		X
PWS-07	PWS-7_8-10 DUP	FD	SE	10/11/2012	0.66	0.83	A12J367			X		X
PWS-07	PWS-7_8-10	P	SE	10/11/2012	0.66	0.83	A12J367					X
PWS-08	PWS-08_8-11	P	SE	7/12/2012	0.66	0.92	A12G213			X		X
PWS-08	PWS-08_8-11	P	SE	10/9/2012	0.66	0.92	A12J289			X		X
PWS-08	PWS-08_8-11	P	SE	10/9/2012	0.66	0.92	A12J289					X
PWS-09	PWS-09_8-11	P	SE	7/12/2012	0.66	0.92	A12G213			X		X
PWS-09	PWS-09_8-11	P	SE	10/9/2012	0.66	0.92	A12J289			X		X
PWS-09	PWS-09_8-11	P	SE	10/9/2012	0.66	0.92	A12J289					X
PWS-10	PWS-10_8-11	P	SE	10/10/2012	0.66	0.92	A12J357			X		X
PWS-10	PWS-10_8-11	P	SE	10/10/2012	0.66	0.92	A12J357					X
PWS-10	PWS-10_8-11	P	SE	7/11/2012	0.66	0.92	A12G170			X		X
PWS-11	PWS-11_8-11	P	SE	10/10/2012	0.66	0.92	A12J357			X		X
PWS-11	PWS-11_8-11	P	SE	10/10/2012	0.66	0.92	A12J357					X
PWS-11	PWS-11_8-11	P	SE	7/9/2012	0.66	0.92	A12G119			X		X
PWS-11	PWS-11B_8-11	P	SE	7/13/2012	0.66	0.92	A12G214			X		X
PWS-12	PWS-12_8-11	P	SE	10/9/2012	0.66	0.92	A12J241			X		X
PWS-12	PWS-12_8-11 DUP	FD	SE	7/12/2012	0.66	0.92	A12G213			X		X
PWS-12	PWS-12_8-11	P	SE	10/9/2012	0.66	0.92	A12J241					X
PWS-12	PWS-12_8-11	P	SE	7/12/2012	0.66	0.92	A12G213			X		X
PWS-13	PWS-13_1-4	P	SE	7/11/2012	0.08	0.33	A12G170			X		X
PWS-13	PWS-13_8-11	P	SE	10/9/2012	0.66	0.92	A12J241			X		X
PWS-13	PWS-13_8-11	P	SE	10/9/2012	0.66	0.92	A12J241					X
PWS-13	PWS-13_8-11 DUP	FD	SE	10/9/2012	0.66	0.92	A12J241			X		
PWS-13	PWS-13_8-11	P	SE	7/11/2012	0.66	0.92	A12G170			X		X
PWS-14	PWS-14_4-8	P	SE	10/11/2012	0.33	0.66	A12J367			X		X
PWS-14	PWS-14_4-8	P	SE	10/11/2012	0.33	0.66	A12J367					X
PWS-15	PWS-15_8-11	P	SE	10/11/2012	0.66	0.92	A12J356			X		X
PWS-15	PWS-15_8-11	P	SE	10/11/2012	0.66	0.92	A12J356					X
PWS-15	PWS-15_8-11	P	SE	7/12/2012	0.66	0.92	A12G169			X		X
PWS-16	PWS-16_8-11	P	SE	10/9/2012	0.66	0.92	A12J241			X		X
PWS-16	PWS-16_8-11	P	SE	10/9/2012	0.66	0.92	A12J241					X
PWS-16	PWS-16_8-11	P	SE	7/9/2012	0.66	0.92	A12G119			X		X
PWS-16	PWS-16B_8-11	P	SE	7/13/2012	0.66	0.92	A12G214			X		X
PWS-17	PWS-17_4-7	P	SE	10/10/2012	0.33	0.58	A12J357			X		X
PWS-17	PWS-17_4-7	P	SE	10/10/2012	0.33	0.58	A12J357					X
PWS-18	PWS-18_8-10	P	SE	10/11/2012	0.66	0.83	A12J367			X		X
PWS-18	PWS-18_8-10	P	SE	10/11/2012	0.66	0.83	A12J367					X
PWS-18	PWS-18_8-11	P	SE	7/11/2012	0.66	0.92	A12G170			X		X
PWS-19	PWS-19_8-11	P	SE	10/11/2012	0.66	0.92	A12J367			X		X
PWS-19	PWS-19_8-11	P	SE	10/11/2012	0.66	0.92	A12J367					X
PWS-19	PWS-19_8-11	P	SE	7/11/2012	0.66	0.92	A12G170			X		X
PWS-20	PWS-20_8-11	P	SE	10/9/2012	0.66	0.92	A12J241			X		X
PWS-20	PWS-20_8-11 DUP	FD	SE	7/11/2012	0.66	0.92	A12G170			X		X
PWS-20	PWS-20_8-11	P	SE	10/9/2012	0.66	0.92	A12J241					X
PWS-20	PWS-20_8-11	P	SE	7/11/2012	0.66	0.92	A12G170			X		X
PWS-21	PWS-21_8-10	P	SE	7/11/2012	0.66	0.83	A12G148			X		X
PWS-22	PWS-22_8-11	P	SE	7/12/2012	0.66	0.92	A13A418			X		X
PWS-24	PWS-24_8-11	P	SE	7/12/2012	0.66	0.92	A13A418			X		X
PWS-25	PWS-25_4-8	P	SE	10/11/2012	0.33	0.66	A12J367			X		X
PWS-25	PWS-25_4-8	P	SE	10/11/2012	0.33	0.66	A12J367					X
PWS-25	PWS-25_8-11	P	SE	7/13/2012	0.66	0.92	A12G214			X		X

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								Fuels	Metals	PAHs	VOCs[1]	Other
PWS-26	PWS-26_8-11	P	SE	10/11/2012	0.66	0.92	A12J356			X		X
PWS-26	PWS-26_8-11	P	SE	10/11/2012	0.66	0.92	A12J356					X
PWS-26	PWS-26_8-11 DUP	FD	SE	10/11/2012	0.66	0.92	A12J356			X		X
PWS-26	PWS-26_8-11	P	SE	7/13/2012	0.66	0.92	A12G214			X		X
PWS-27	PWS-27_8-11	P	SE	10/9/2012	0.66	0.92	A12J241			X		X
PWS-27	PWS-27_8-11	P	SE	10/9/2012	0.66	0.92	A12J241					X
PWS-27	PWS-27_8-11	P	SE	7/13/2012	0.66	0.92	A12G214			X		X
PWS-28	PWS-28_8-11	P	SE	10/10/2012	0.66	0.92	A12J357			X		X
PWS-28	PWS-28_8-11	P	SE	10/10/2012	0.66	0.92	A12J357					X
PWS-29	PWS-29_8-11	P	SE	10/12/2012	0.66	0.92	A12J367			X		X
PWS-29	PWS-29_8-11	P	SE	10/12/2012	0.66	0.92	A12J367					X
PWS-30	PWS-30_8-11	P	SE	10/12/2012	0.66	0.92	A12J367			X		X
SB-01	SB01-0-0.3	P	SE	7/14/2011	0	0.3	A11G186	X		X		X
SB-01	SB01-5	P	SE	7/14/2011	4.7	5	A11G186	X		X		
SB-02	SB02-0.0.3	P	SE	7/14/2011	0	0.3	A11G186	X		X		X
SB-02	SB02-12.5	P	SE	7/14/2011	12.2	12.5	A11G186	X		X		
SB-03	SB03_0-0.3	P	SE	7/14/2011	0	0.3	A11G186	X		X		X
SB-03	SB03-11	P	SE	7/14/2011	10.7	11	A11G186	X		X		
SB-03	SB03-11 DUP	FD	SE	7/14/2011	10.7	11	A11G186	X		X		
SB-03	SB03-7	P	SE	7/14/2011	6.7	7	A11G186	X		X		
SB-04	SB04-0-0.3	P	SE	7/14/2011	0	0.3	A11G186	X		X		X
SB-04	SB04-3	P	SE	7/14/2011	2.7	3	A11G186	X		X		
SB-05	SB05-0-0.3	P	SE	7/14/2011	0	0.3	A11G186	X		X		X
SB-05	SB05-4	P	SE	7/14/2011	3.7	4	A11G186	X		X		
SB-05	SB05-8	P	SE	7/14/2011	7.7	8	A11G186	X		X		
SB-06	SB06-0-0.3	P	SE	7/14/2011	0	0.3	A11G186	X		X		X
SB-06	SB06-13.5	P	SE	7/14/2011	13.2	13.5	A11G186	X		X		
SB-06	SB06-13.5 DUP	FD	SE	7/14/2011	13.2	13.5	A11G186	X		X		
SB-06	SB06-5	P	SE	7/14/2011	4	5	A11G186	X		X		
SB-07	SB07-0-0.3	P	SE	7/13/2011	0	0.3	A11G167	X		X		X
SB-07	SB07-12.8	P	SE	7/13/2011	12.5	12.8	A11G167	X		X		
SB-08	SB08-0-0.3	P	SE	7/13/2011	0	0.3	A11G167	X		X		X
SB-08	SB08-4.5	P	SE	7/13/2011	4.2	4.5	A11G167	X		X		
SB-08	SB08-8	P	SE	7/13/2011	7.7	8	A11G167	X		X		
SB-08A	SB08A-0-0.3	P	SE	7/13/2011	0	0.3	A11G167	X		X		X
SB-08B	SB08B-0-0.3	P	SE	7/13/2011	0	0.3	A11G167	X		X		X
SB-08C	SB08C-0-0.3	P	SE	7/13/2011	0	0.3	A11G167	X		X		X
SB-09	SB09-0-0.3	P	SE	7/14/2011	0	0.3	A11G186	X		X		X
SB-09	SB09-5	P	SE	7/14/2011	4.7	5	A11G186	X		X		
SB-10	SB10-0-0.3	P	SE	7/13/2011	0	0.3	A11G167	X		X		X
SB-10	SB10-2	P	SE	7/13/2011	1.7	2	A11G167	X		X		
SB-10	SB10-3	P	SE	7/13/2011	2.7	3	A11G167	X		X	X	
SB-10	SB10-3	P	SE	7/13/2011	2.7	3	te39te42tj82	X		X		
SB-10	SB10-8	P	SE	7/13/2011	7.7	8	A11G167	X		X		
SB-11	SB11-0-0.3	P	SE	7/13/2011	0	0.3	A11G167	X		X		X
SB-11	SB11-15.5	P	SE	7/13/2011	15.2	15.5	A11G186	X		X		
SB-11	SB11-24	P	SE	7/13/2011	23.5	24	A11G186	X		X		
SB-11	SB11-4	P	SE	7/13/2011	3.7	4	A11G186	X		X	X	
SB-11	SB11-4	P	SE	7/13/2011	3.7	4	te39te42tj82	X		X		

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								Fuels	Metals	PAHs	VOCs[1]	Other
SB-12	SB12-0-0.3	P	SE	7/14/2011	0	0.3	A11G186	X		X		X
SB-12	SB12-3.9	P	SE	7/14/2011	3.6	3.9	A11G186	X		X		
SB-12	SB12-9	P	SE	7/14/2011	11.7	12	A11G186	X		X		
SB-13	SB13-0-0.3	P	SE	7/14/2011	0	0.3	A11G202	X		X		X
SB-13	SB13-2.5	P	SE	7/14/2011	2.2	2.5	A11G202	X		X		
SB-13	SB13-4.4	P	SE	7/14/2011	4.1	4.4	A11G202	X		X		
SB-14	SB14-0-0.3	P	SE	7/15/2011	0	0.3	A11G219	X		X		
SB-14	SB14-6-7	P	SE	7/15/2011	6	7	A11G219	X		X	X	
SB-14	SB14-6-7	P	SE	7/15/2011	6	7	te39te42tj82	X		X		
SB-15	SB15-0-0.3	P	SE	7/15/2011	0	0.3	A11G202	X		X		X
SB-15	SB15-4	P	SE	7/15/2011	3.7	4	A11G202	X		X		
SB-15	SB15-8.5	P	SE	7/15/2011	8.2	8.5	A11G202	X		X		
SB-16	SB16-0-0.3	P	SE	7/15/2011	0	0.3	A11G202	X		X		X
SB-16	SB16-10	P	SE	7/15/2011	9.7	10	A11G202	X		X		
SB-16	SB16-5-6	P	SE	7/15/2011	5	6	A11G202	X		X		
SB-17	SB17-0-0.3	P	SE	7/15/2011	0	0.3	A11G202	X	X	X	X	X
SB-17	SB17-5-6	P	SE	7/15/2011	5	6	A11G202	X		X		
SB-18	SB18-0-0.3	P	SE	7/15/2011	0	0.3	A11G202	X	X	X	X	X
SB-18	SB18-18	P	SE	7/15/2011	17.7	18	A11G202	X		X		
SB-18	SB18-4	P	SE	7/15/2011	3.7	4	A11G202	X		X		
SB-19	SB19-0-0.3	P	SE	7/15/2011	0	0.3	A11G202	X		X		X
SB-19	SB19-1.0	P	SE	7/15/2011	0.7	1	A11G202	X		X		
SB-19	SB19-10	P	SE	7/15/2011	9.7	10	A11G202	X		X		
SB-20	SB20-0-0.3	P	SE	7/15/2011	0	0.3	A11G202	X		X		X
SB-20	SB20-6-7	P	SE	7/15/2011	6	7	A11G202	X		X		
SB21	SB021-6-7	P	SE	7/15/2011	6	7	A11G202	X		X		
SB-21	SB21-0-0.3	P	SE	7/15/2011	0	0.3	A11G202	X		X		X
SB-22	SB22-7.5-8	P	SE	7/15/2011	7.5	8	A11G219	X		X		
SB-23	SB23-0-0.3	P	SE	7/15/2011	0	0.3	A11G219	X		X		X
SB-24	SB24-0-0.3	P	SE	7/16/2011	0	0.3	A11G219	X		X		X
SB-25	SB25-1.5	P	SE	7/16/2011	1.2	1.5	A11G219	X		X		
SB-25	SB25-6.5-7	P	SE	7/16/2011	6.5	7	A11G219					
SB-26	SB26-0-0.3	P	SE	7/16/2011	0	0.3	A11G219	X		X		X
SB-26	SB26-4-4.5	P	SE	7/16/2011	4	4.5	A11G219	X		X		
SB-27	SB27-0-0.3	P	SE	7/16/2011	0	0.3	A11G219	X		X		X
SB-28	SB28-0-0.3	P	SE	7/16/2011	0	0.3	A11G219	X		X		X
SB-28	SB28-2	P	SE	7/16/2011	1.7	2	A11G219	X		X		
SSED-2	SSED-2	P	SE	10/6/2011	0	0.3	A11J131	X		X		X
SSED-5	SSED-5	P	SE	10/6/2011	0	0.3	A11J131	X		X	X	X
SSED-6	SSED-6	P	SE	10/6/2011	0	0.3	A11J131	X		X		X
SSED-7	SSED-7	P	SE	10/7/2011	0	0.3	A11J131	X		X		X
SSED-8	SSED-8	P	SE	10/7/2011	0	0.3	A11J131		X			
SSED-9	SSED-9	P	SE	10/7/2011	0	0.3	A11J131	X		X		X
SSED-MC-1	SSED-MC-1	P	SE	10/6/2011	0	0.3	A11J131	X		X	X	X
SSED-MC-3	SSED-MC-3	P	SE	10/7/2011	0	0.3	A11J131	X		X		X
SSED-MC-4	SSED-MC-4	P	SE	10/7/2011	0	0.3	A11J131	X		X		X

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								Fuels	Metals	PAHs	VOCs[1]	Other
PWS-090617-1	PWS-090617-1	P	SE	09/06/2017	0	1	A7I0159			X		X
PWS-090617-2	PWS-090617-2	P	SE	09/06/2017	0	1	A7I0159			X		X
PWS-090517-3	PWS-090517-3	P	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090517-4	PWS-090517-4	P	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090517-5	PWS-090517-5	P	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090517-6	PWS-090517-6	P	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090517-7	PWS-090517-7	P	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090517-8	PWS-090517-8	P	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090517-9	PWS-090517-9	P	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090517-10	PWS-090517-10	P	SE	09/05/2017	0	1	A7I0159			X		X
	PWS-090517-DUP	FD	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090517-11	PWS-090517-11	P	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090617-12	PWS-090617-12	P	SE	09/06/2017	0	1	A7I0159			X		X
PWS-090617-13	PWS-090617-13	P	SE	09/06/2017	0	1	A7I0159			X		X
PWS-090517-14	PWS-090517-14	P	SE	09/05/2017	0	1	A7I0159			X		X
PWS-090617-15	PWS-090617-15	P	SE	09/06/2017	0	1	A7I0159			X		X
SRM 1491a	SRM 1491a	SRM	Liquid	N/A	--	--	A7I0570			X		
	SRM 1491a	SRM	Liquid	N/A	--	--	A7I0570			X		
SRM 2260a	SRM 2260a	SRM	Liquid	N/A	--	--	A7I0570			X		
	SRM 2260a	SRM	Liquid	N/A	--	--	A7I0570			X		
SRM 1991	SRM 1991	SRM	Liquid	N/A	--	--	A7I0570			X		
SRM 2779	Gulf of Mexico Crude	SRM	Liquid	N/A	--	--	A7K0243			X		
Soil												
DAI-SB-02	DAI-SB-02-2-3	P	SO	10/14/2013	2	3	A3J0564	X		X		
DAI-SB-03	DAI-SB-03-7-8	P	SO	10/14/2013	7	8	A3J0564	X		X		
DAI-SB-04	DAI-SB-04-4-5	P	SO	10/15/2013	4	5	A3J0564	X		X		
DAI-SB-05	DAI-SB-05-15-15.5	P	SO	10/16/2013	15	15.5	A3J0564	X		X		
DAI-SB-05	DAI-SB-05-22-23	P	SO	10/16/2013	22	23	A3J0564	X		X		
DAI-SB-06	DAI-SB-06-12-13	P	SO	10/16/2013	12	12	A3J0564	X		X		
DAI-SB-07	DAI-SB-07-9-10	P	SO	10/16/2013	10	10	A3J0564	X		X		
DAI-SB-08	DAI-SB-08-7-8	P	SO	10/16/2013	7	8	A3J0564	X		X		
DAI-SB-09	DAI-SB-09-7.5-8.0	P	SO	10/16/2013	7.5	8	A3J0564	X		X		
DAI-SB-10	DAI-SB-10-13.5-14	P	SO	10/16/2013	13.5	14	A3J0564	X		X		
DAI-SB-12	DAI-SB-12-14.5-15.5	P	SO	10/17/2013	14.5	15.5	A3J0564	X		X		
DAI-SB-12	DAI-SB-12-9-10	P	SO	10/17/2013	9	10	A3J0564	X		X		
DAI-SB-13	DAI-SB-13-13-14	P	SO	10/17/2013	12	14	A3J0564	X		X		
DAI-SB-14	DAI-SB-14-13-14	P	SO	10/17/2013	12	14	A3J0564	X		X		
DAI-SB-15	DAI-SB-15-10-11	P	SO	10/17/2013	10	11	A3J0564	X		X		
DAI-SB-15	DAI-SB-15-10-11 DUP	FD	SO	10/17/2013	10	11	A3J0564	X		X		
DAI-SB-16	DAI-SB-16-9-10	P	SO	10/17/2013	9	10	A3J0564	X		X		
DAI-SB-17	DAI-SB-17-11-12	P	SO	10/17/2013	11	12	A3J0564	X		X		
DAI-SB-18	DAI-SB-18-13-14	P	SO	10/17/2013	13	14	A3J0564	X		X		
DAI-SB-18	DAI-SB-18-9-10	P	SO	10/17/2013	9	10	A3J0564	X		X		
DAI-SB-19	DAI-SB-19-13-14	P	SO	10/17/2013	13	14	A3J0564	X		X		
DAI-SB-20	DAI-SB-20-8-8.5	P	SO	10/15/2013	8	8.5	A3J0564	X		X		
DAI-SB-21	DAI-SB-21-8.5-9.5	P	SO	10/15/2013	8.5	9.5	A3J0564	X		X		

Please refer to notes on last page of table.

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Table 3-1
Supplemental RI Sampling Summary
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Former Pope Talbot Wood-Treating Site
St. Helens, Oregon

Sampling Location	Sample ID	Sample Type	Sample Matrix	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Data Group	Analytical Suite				
								Fuels	Metals	PAHs	VOCs[1]	Other
MC-01	MC1-19.5	P	SO	7/21/2011	19.2	19.5	A11G294	X		X		
MC-02A	MC2A-12	P	SO	7/20/2011	5.8	6.11	A11G294	X		X		
MC-02A	MC2A-12 DUP	FD	SO	7/20/2011	5.8	6.11	A11G294	X		X		
MW-19	MW19-21	P	SO	7/19/2011	20.7	21	A11G244	X		X		
MW-19	MW19-29.5-30	P	SO	7/19/2011	29.5	30	A11G244	X		X		
MW-20	MW20-16-17	P	SO	7/21/2011	16	17	A11G294	X		X		
MW-20	MW20-16-17 DUP	FD	SO	7/21/2011	16	17	A11G294	X		X		
MW-21	MW21-21	P	SO	7/21/2011	20.7	21	A11G294	X		X		
MW-22	MW22-20.5	P	SO	7/22/2011	20.2	20.5	A11G294	X		X		
MW-23	MW23-13.5	P	SO	7/19/2011	13.2	13.5	A11G244	X		X		
MW-24	MW24-14.5-15	P	SO	7/19/2011	14.5	15	A11G244	X		X		
MW-25	MW25-19.5	P	SO	7/22/2011	19.2	19.5	A11G294	X		X		

Acronyms/Abbreviations

FD = field duplicate
ft bgs = feet below ground surface
GW = groundwater
N/A - not applicable
NAPL = nonaqueous-phase liquid
P = primary sample
PAHs = polycyclic aromatic hydrocarbons
PW = porewater
SE = sediment
SO = soil
SRM = standard reference material
SW = surface water
VOCs = volatile organic compounds
Other = Total Organic Carbon, Black Carbon, Dissolved Organic Carbon, Hopanes, Cholestanes, oxygenated PAHs, volatile petroleum hydrocarbons (VPH), grain size, and/or percent solids

Notes

[1] Sediment VOC results are not reported in tabular form in the Supplemental RI Report; results are reported in the Progress Report - 3rd/4th Quarter 2011 (AMEC 2012a).

Cascadia Associates, LLC

Table 4-1
Groundwater and Surface Water Elevations
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Former Pope Talbot Wood-Treating Site
St. Helens, Oregon

Location [1]	Date	Total Depth Measured (ft MP)	MP Elevation (ft MSL)	Depth to Water (ft MP)	Stickup Height (ft)	Water Level Elevation (ft MSL)	Depth of Water (ft MP)	Depth to NAPL (ft MP)	NAPL Thickness (ft)
MW-1	9/7/2010	22.75	22.68	12.52	2.61	10.16	10.23	NA	NA
MW-1	8/8/2011	22.80	26.64	11.93	2.57	14.71	10.87	NA	NA
MW-1	2/20/2012	22.80	26.64	10.91	2.57	15.73	11.89	NA	NA
MW-1	5/3/2012	22.66	26.64	5.80	2.57	20.84	16.86	NA	NA
MW-1	8/14/2012	22.66	26.64	12.05	2.57	14.59	10.61	NA	NA
MW-1	7/21/2017	22.80	26.64	11.64	2.57	15.00	11.16	ND	ND
MW-2	9/7/2010	21.26	23.15	8.94	2.47	14.21	12.32	NA	NA
MW-2A	8/8/2011	23.31	26.42	6.97	2.71	19.45	16.34	NA	NA
MW-2A	2/20/2012	23.30	26.42	6.49	2.71	19.93	16.81	NA	NA
MW-2A	5/3/2012	23.30	26.42	5.70	2.71	20.72	17.60	NA	NA
MW-2A	8/14/2012	23.29	26.42	6.99	2.71	19.43	16.30	NA	NA
MW-2A	7/21/2017	23.30	26.42	6.84	2.71	19.58	16.46	ND	ND
MW-3A	9/7/2010	22.89	20.43	13.37	2.46	7.06	9.52	20.49	2.40
MW-3A	8/8/2011	23.96	24.32	12.13	2.42	12.19	11.83	21.15	2.81
MW-3A	2/20/2012	23.96	24.32	11.32	2.42	13.00	12.64	22.08	1.88
MW-3A	5/3/2012	22.95	24.32	7.37	2.42	16.95	15.58	20.39	2.56
MW-3A	8/14/2012	22.95	24.32	12.28	2.42	12.04	10.67	21.7	1.25
MW-3A	7/21/2017	23.42	24.32	12.35	2.42	11.97	10.65	22.5	0.5
MW-3B	9/7/2010	14.94	20.52	13.55	2.36	6.97	1.39	NA	NA
MW-3B	8/8/2011	15.02	24.41	12.28	2.30	12.13	2.74	NA	NA
MW-3B	2/20/2012	15.02	24.41	11.37	2.30	13.04	3.65	NA	NA
MW-3B	5/3/2012	14.81	24.41	9.51	2.30	14.90	5.30	NA	NA
MW-3B	8/14/2012	14.81	24.41	12.45	2.30	11.96	2.36	NA	NA
MW-3B	7/21/2017	14.70	24.41	12.70	2.30	11.71	2.00	ND	ND
MW-4A	9/7/2010	24.50	23.70	11.48	2.54	12.22	13.02	NA	NA
MW-4A	8/8/2011	24.48	27.62	10.57	2.49	17.05	13.91	NA	NA
MW-4A	2/20/2012	24.48	27.62	9.30	2.49	18.32	15.18	NA	NA
MW-4A	5/3/2012	24.30	27.62	8.33	2.49	19.29	15.97	NA	NA
MW-4A	8/14/2012	24.30	27.62	10.70	2.49	16.92	13.60	NA	NA
MW-4A	7/21/2017	24.25	27.62	10.21	2.49	17.41	14.04	ND	ND
MW-4B	9/7/2010	18.20	23.36	11.41	2.81	11.95	6.79	NA	NA
MW-4B	8/8/2011	18.08	27.31	10.15	2.57	17.16	7.93	NA	NA
MW-4B	2/20/2012	18.08	27.31	8.66	2.57	18.65	9.42	NA	NA
MW-4B	5/3/2012	17.96	27.31	8.88	2.57	18.43	9.08	NA	NA
MW-4B	8/14/2012	17.96	27.31	10.34	2.57	16.97	7.62	NA	NA
MW-4B	7/21/2017	18.10	27.31	9.92	2.57	17.39	8.18	ND	ND
MW-5	9/7/2010	14.20	25.38	11.80	2.78	13.58	2.40	NA	NA
MW-5	8/8/2011	14.12	28.85	10.94	2.91	17.91	3.18	NA	NA
MW-5	2/20/2012	14.12	28.85	9.39	2.91	19.46	4.73	NA	NA
MW-5	5/3/2012	13.92	28.85	8.83	2.91	20.02	5.09	NA	NA
MW-5	8/14/2012	13.92	28.85	11.26	2.91	17.59	2.66	NA	NA
MW-5	7/21/2017	NM	28.85	NM	2.91	NM	NM	NM	NM
MW-6A	9/7/2010	14.80	19.60	12.02	2.41	7.58	2.78	NA	NA
MW-6A	8/8/2011	14.88	23.57	11.40	2.33	12.17	3.48	NA	NA
MW-6A	2/20/2012	14.90	23.57	10.84	2.33	12.73	4.06	NA	NA
MW-6A	5/3/2012	14.89	23.57	7.41	2.33	16.16	7.48	NA	NA
MW-6A	8/14/2012	14.89	23.57	11.44	2.33	12.13	3.45	NA	NA
MW-6A	7/21/2017	14.00	23.57	11.70	2.33	11.87	2.3	ND	ND
MW-7	9/7/2010	11.70	19.40	11.40	2.79	8.00	0.30	NA	NA
MW-7	8/8/2011	11.68	23.41	11.37	2.61	12.04	0.31	NA	NA
MW-7	2/20/2012	11.74	23.41	10.66	2.61	12.75	1.08	NA	NA
MW-7	5/3/2012	11.53	23.41	6.61	2.61	16.80	4.92	NA	NA
MW-7	8/14/2012	11.51	23.41	11.42	2.61	11.99	0.09	NA	NA
MW-7	7/21/2017	11.70	23.41	11.31	2.61	12.10	0.39	ND	ND

Please refer to notes at end of table

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Table 4-1
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Former Pope Talbot Wood-Treating Site
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Location [1]	Date	Total Depth Measured (ft MP)	MP Elevation (ft MSL)	Depth to Water (ft MP)	Stickup Height (ft)	Water Level Elevation (ft MSL)	Depth of Water (ft MP)	Depth to NAPL (ft MP)	NAPL Thickness (ft)
MW-8	9/7/2010	11.90	26.47	Dry	2.47	NA	NA	NA	NA
MW-8	8/8/2011	11.90	30.22	Dry	2.40	NA	NA	NA	NA
MW-8	2/20/2012	12.00	30.22	Dry	2.40	NA	NA	NA	NA
MW-8	5/3/2012	11.77	30.22	Dry	2.40	NA	NA	NA	NA
MW-8	8/14/2012	11.77	30.22	Dry	2.40	NA	11.77	NA	NA
MW-8	7/21/2017	12.00	30.22	Dry	2.40	NA	NA	ND	ND
MW-9	9/7/2010	16.90	24.61	10.60	2.98	14.01	6.30	NA	NA
MW-9	8/8/2011	15.72	28.39	10.18	3.83	18.21	5.54	NA	NA
MW-9	2/20/2012	15.70	28.39	8.90	3.83	19.49	6.80	NA	NA
MW-9	5/3/2012	15.52	28.39	8.46	3.83	19.93	7.06	NA	NA
MW-9	8/14/2012	15.52	28.39	10.38	3.83	18.01	5.14	NA	NA
MW-9	7/21/2017	15.75	28.39	9.95	3.83	18.44	5.8	ND	ND
MW-10	9/7/2010	15.30	21.16	9.62	2.73	11.54	5.68	NA	NA
MW-10	8/8/2011	15.30	24.99	NA	2.89	NA	NA	NA	NA
MW-10	2/20/2012	21.42	24.99	8.69	2.89	16.30	12.73	NA	NA
MW-10	5/3/2012	14.91	24.99	7.82	2.89	17.17	7.09	NA	NA
MW-10	8/14/2012	14.91	24.99	9.50	2.89	15.49	5.41	NA	NA
MW-10	7/21/2017	15.00	24.99	NM	2.89	NM	NM	NM	NM
MW-11	9/7/2010	21.30	24.67	10.00	2.70	14.67	11.30	NA	NA
MW-11	8/8/2011	21.38	28.45	9.67	2.73	18.78	11.71	NA	NA
MW-11	2/20/2012	21.38	28.45	8.48	2.73	19.97	12.90	NA	NA
MW-11	5/3/2012	21.31	28.45	8.35	2.73	20.10	12.96	NA	NA
MW-11	8/14/2012	21.31	28.45	10.07	2.73	18.38	11.24	NA	NA
MW-11	7/21/2017	21.40	28.45	9.91	2.73	18.54	11.49	ND	ND
MW-12A	9/7/2010	16.00	18.13	NA	2.60	NA	NA	NA	NA
MW-12A	8/8/2011	15.96	21.89	8.04	2.68	13.85	7.92	NA	NA
MW-12A	2/20/2012	15.96	21.89	7.09	2.68	14.80	8.87	NA	NA
MW-12A	5/3/2012	15.80	21.89	4.80	2.68	17.09	11.00	NA	NA
MW-12A	8/14/2012	15.80	21.89	8.28	2.68	13.61	7.52	NA	NA
MW-12A	7/21/2017	15.70	21.89	8.68	2.68	13.21	7.02	ND	ND
MW-12B	9/7/2010	10.10	18.03	NA	2.56	NA	NA	NA	NA
MW-12B	8/8/2011	12.30	21.72	8.84	2.38	12.88	3.46	NA	NA
MW-12B	2/20/2012	10.30	21.72	8.18	2.38	13.54	2.12	NA	NA
MW-12B	5/3/2012	10.09	21.72	5.06	2.38	16.66	5.03	NA	NA
MW-12B	8/14/2012	10.09	21.72	8.96	2.38	12.76	1.13	NA	NA
MW-12B	7/21/2017	10.30	21.72	9.10	2.38	12.62	1.2	ND	ND
MW-13A	9/7/2010	20.32	20.23	7.47	2.62	12.76	12.85	NA	NA
MW-13A	8/8/2011	20.40	23.89	7.53	2.53	16.36	12.87	NA	NA
MW-13A	2/20/2012	20.45	23.89	6.04	2.53	17.85	14.41	NA	NA
MW-13A	5/3/2012	20.63	23.89	5.32	2.53	18.57	15.31	NA	NA
MW-13A	8/14/2012	20.23	23.89	7.83	2.53	16.06	12.40	NA	NA
MW-13A	7/21/2017	20.20	23.89	7.70	2.53	16.19	12.5	ND	ND
MW-13B	9/7/2010	10.30	19.96	7.09	2.40	12.87	3.21	NA	NA
MW-13B	8/8/2011	10.38	23.62	6.38	2.29	17.24	4.00	NA	NA
MW-13B [2]	2/20/2012	10.48	23.62	3.98	2.29	19.64	6.50	NA	NA
MW-13B	5/3/2012	10.82	23.62	3.19	2.29	20.43	7.63	NA	NA
MW-13B	8/14/2012	10.82	23.62	6.67	2.29	16.95	4.15	NA	NA
MW-13B	7/21/2017	10.00	23.62	6.61	2.29	17.01	3.39	ND	ND
MW-14	9/7/2010	19.22	20.43	12.76	2.77	7.67	6.46	NA	NA
MW-14	8/8/2011	19.31	24.08	12.23	2.75	11.85	7.08	NA	NA
MW-14	2/20/2012	19.31	24.08	9.44	2.75	14.64	9.87	NA	NA
MW-14	5/3/2012	19.12	24.08	7.00	2.75	17.08	12.12	NA	NA
MW-14	8/14/2012	19.12	24.08	12.57	2.75	11.51	6.55	NA	NA
MW-14	7/21/2017	19.00	24.08	12.19	2.75	11.89	6.81	ND	ND

Please refer to notes at end of table

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Location [1]	Date	Total Depth Measured (ft MP)	MP Elevation (ft MSL)	Depth to Water (ft MP)	Stickup Height (ft)	Water Level Elevation (ft MSL)	Depth of Water (ft MP)	Depth to NAPL (ft MP)	NAPL Thickness (ft)
MW-15	9/7/2010	14.55	20.58	9.95	2.41	10.63	4.60	NA	NA
MW-15	8/8/2011	14.65	24.20	9.50	2.40	14.70	5.15	NA	NA
MW-15	2/20/2012	14.65	24.20	5.37	2.40	18.83	9.28	NA	NA
MW-15	5/3/2012	14.49	24.20	4.39	2.40	19.81	10.10	NA	NA
MW-15	8/14/2012	14.49	24.20	9.82	2.40	14.38	4.67	NA	NA
MW-15	7/21/2017	14.70	24.20	9.50	2.40	14.7	5.2	ND	ND
MW-16	9/7/2010	12.50	21.60	NA	2.46	NA	NA	NA	NA
MW-16	7/21/2017	NM	NM	NM	NM	NM	NM	NM	NM
MW-17A	9/7/2010	24.82	19.98	12.14	3.17	7.84	12.68	NA	NA
MW-17A	8/8/2011	24.89	23.63	11.07	3.21	12.56	13.82	NA	NA
MW-17A	2/20/2012	24.89	23.63	10.24	3.21	13.39	14.65	NA	NA
MW-17A	5/3/2012	24.67	23.63	6.18	3.21	17.45	18.49	NA	NA
MW-17A	8/14/2012	24.67	23.63	11.27	3.21	12.36	13.40	NA	NA
MW-17A	7/21/2017	24.80	23.63	11.31	3.21	12.32	13.49	ND	ND
MW-18	9/7/2010	21.47	23.11	9.17	2.97	13.94	12.30	NA	NA
MW-18	8/8/2011	20.52	27.25	9.03	3.13	18.22	11.49	NA	NA
MW-18	2/20/2012	20.52	27.25	7.56	3.13	19.69	12.96	NA	NA
MW-18	5/3/2012	20.32	27.25	7.31	3.13	19.94	13.01	NA	NA
MW-18	8/14/2012	20.32	27.25	9.13	3.13	18.12	11.19	NA	NA
MW-18	7/21/2017	20.50	27.25	8.78	3.13	18.47	11.72	ND	ND
MW-19	8/8/2011	30.75	26.97	16.70	3.30	10.27	14.05	NA	NA
MW-19	2/20/2012	30.74	26.97	16.74	3.30	10.23	14.00	NA	NA
MW-19	5/3/2012	30.57	26.97	10.07	3.30	16.90	20.50	NA	NA
MW-19	8/14/2012	30.57	26.97	16.83	3.30	10.14	13.74	NA	NA
MW-19	7/21/2017	29.95	26.97	16.95	3.30	10.02	13	ND	ND
MW-20	8/8/2011	19.25	26.44	9.49	2.67	16.95	9.76	NA	NA
MW-20	2/20/2012	19.74	26.44	10.63	2.67	15.81	9.11	NA	NA
MW-20	5/3/2012	19.55	26.44	7.29	2.67	19.15	12.26	NA	NA
MW-20	8/14/2012	19.55	26.44	9.64	2.67	16.80	9.91	NA	NA
MW-20	7/21/2017	19.33	26.44	9.21	2.67	17.23	10.12	ND	ND
MW-21	8/8/2011	24.20	25.78	9.92	3.42	15.86	14.28	NA	NA
MW-21 [3]	2/20/2012	24.70	25.78	10.90	3.42	14.88	13.80	NA	NA
MW-21	5/3/2012	24.41	25.78	6.43	3.42	19.35	17.98	NA	NA
MW-21	8/14/2012	24.41	25.78	10.15	3.42	15.63	14.26	NA	NA
MW-21	7/21/2017	23.92	25.78	9.97	3.42	15.81	13.95	ND	ND
MW-22	8/8/2011	23.25	28.10	10.20	2.44	17.90	13.05	NA	NA
MW-22	2/20/2012	23.25	28.10	11.72	2.44	16.38	11.53	NA	NA
MW-22	5/3/2012	22.55	28.10	8.21	2.44	19.89	14.34	NA	NA
MW-22	8/14/2012	23.40	28.10	10.66	2.44	17.44	12.74	NA	NA
MW-22	7/21/2017	23.50	28.10	10.39	2.44	17.71	13.11	ND	ND
MW-23	8/8/2011	18.47	26.91	8.28	2.37	18.63	10.19	NA	NA
MW-23	2/20/2012	18.47	26.91	6.94	2.37	19.97	11.53	NA	NA
MW-23	5/3/2012	17.98	26.91	6.68	2.37	20.23	11.30	NA	NA
MW-23	8/14/2012	17.98	26.91	8.34	2.37	18.57	9.64	NA	NA
MW-23	7/21/2017	18.25	26.91	8.00	2.37	18.91	10.25	ND	ND
MW-24	8/8/2011	17.81	25.25	11.37	2.87	13.88	6.44	NA	NA
MW-24	2/20/2012	17.81	25.25	7.85	2.87	17.40	9.96	NA	NA
MW-24	5/3/2012	17.37	25.25	6.77	2.87	18.48	10.60	NA	NA
MW-24	8/14/2012	17.60	25.25	9.69	2.87	15.56	7.91	NA	NA
MW-24	7/21/2017	17.42	25.25	9.80	2.87	15.45	7.62	ND	ND
MW-25	8/8/2011	23.92	20.99	12.36	2.90	8.63	11.56	NA	NA
MW-25	2/20/2012	23.91	20.99	12.68	2.90	8.31	11.23	NA	NA
MW-25	5/3/2012	23.81	20.99	4.42	2.90	16.57	19.39	NA	NA
MW-25	8/14/2012	23.81	20.99	12.57	2.90	8.42	11.24	NA	NA
MW-25	7/21/2017	24.00	20.99	12.73	2.90	8.26	11.27	ND	ND

Please refer to notes at end of table

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Table 4-1
Groundwater and Surface Water Elevations
Updated Supplemental RI Report
Former Pope Talbot Wood-Treating Site
St. Helens, Oregon

Location [1]	Date	Total Depth Measured (ft MP)	MP Elevation (ft MSL)	Depth to Water (ft MP)	Stickup Height (ft)	Water Level Elevation (ft MSL)	Depth of Water (ft MP)	Depth to NAPL (ft MP)	NAPL Thickness (ft)
S-1C	9/7/2010	NA	14.72	11.85	NA	2.87	NA	NA	NA
S-1C	8/8/2011	NA	18.36	9.78	NA	8.58	NA	NA	NA
S-1C	2/20/2012	NA	18.36	10.68	NA	7.68	NA	NA	NA
S-1C	5/3/2012	NA	18.36	2.00	NA	16.36	NA	NA	NA
S-1C	8/14/2012	NA	18.36	10.65	NA	7.71	NA	NA	NA
S-2	9/7/2010	NA	20.44	17.60	NA	2.84	NA	NA	NA
S-2	8/8/2011	NA	24.33	15.98	NA	8.35	NA	NA	NA
S-2	2/20/2012	NA	24.33	16.48	NA	7.85	NA	NA	NA
S-2	5/3/2012	NA	24.33	7.61	NA	16.72	NA	NA	NA
S-2	8/14/2012	NA	24.33	16.51	NA	7.82	NA	NA	NA
SBSW	7/21/2017	NA	14.08	4.96	NA	9.12	NA	NA	NA

Acronyms/Abbreviations
Dry = dry well
ft = feet
MP = measuring point; for wells, this is top of casing, for surface water it is the surveyed top of the gauge
MSL = mean sea level
NA = not applicable
ND = not detected
NM = not measured
NAPL = nonaqueous-phase liquid
SBSW=Scappoose Bay Stilling Well

Notes:
[1] For well pairs with both "A" and "B" suffixes, "A" indicates the deeper well and "B" indicates the shallower well in the pair. Elevations from wells with "B" designation were not used on groundwater elevation contour figures.

[2] Water was observed in monument at well MW-13B during February 2012 event; water elevation at this location is, therefore, suspect.

[3] Groundwater level may not have been in equilibrium with atmospheric conditions, based on the observation of pressure when well cap was opened. However, elevation was not found to be anomalous and was used on groundwater elevation contour figures.

Table 5-1
Soil Analytical Results Summary
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs																	TPH			NWTPH-HCID		
						Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)Anthracene	Benzo(a)Pyrene	Benzo(b)Fluoranthene	Benzo(g,h,i)Perylene	Benzo(k)Fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)Pyrene	Naphthalene	Phenanthrene	Pyrene	Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Gasoline-Range Hydrocarbons	Diesel-Range Hydrocarbons	Gasoline-Range Hydrocarbons	Oil-Range Hydrocarbons
						Concentration in mg/kg																						
MC-01	MC1-19.5	7/21/2011	P	19	19.5	**2.06**	**0.141**	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	NR	0.0142 U	0.0142 U	0.0142 U	**0.0510**	0.0142 U	**1.78**	0.0142 U	0.0142 U	35.4 U	70.7 U	NT	NT	NT	NT
MC-02A	MC2A-12	7/20/2011	P	11.5	12	**61.7**	**6.94**	**0.162**	**3.29**	**1.37**	**0.462**	NR	**0.167**	NR	NR	**1.35**	0.0622 U	**9.54**	**6.94**	**0.216**	**3.53**	**20.9**	**5.71**	**196 N**	**68.2 N**	NT	NT	NT	NT
MC-02A	MC2A-12 DUP	7/20/2011	FD	11.5	12	**42.0**	**4.37**	**0.124**	**2.22**	**0.981**	**0.370**	NR	**0.144**	NR	NR	**0.982**	0.0683 U	**6.57**	**4.66**	**0.185**	**2.02**	**14.5**	**3.99**	**191 N**	**75.4 N**	NT	NT	NT	NT
MW-19	MW19-21	7/19/2011	P	20.5	21	**65.5**	**6.44**	**0.148**	**4.30**	**1.77**	**0.439**	NR	**0.159**	NR	**1.16**	**1.91**	0.137 U	**10.9**	**8.24**	**0.203**	**1.51**	**22.3**	**5.99**	**145 N**	131 U	NT	NT	NT	NT
MW-19	MW19-29.5-30	7/19/2011	P	29.5	30	**368**	**13.3**	**0.778**	**8.30**	**2.28**	**0.401**	NR	0.122 U	NR	**1.02**	**2.13**	0.122 U	**18.3**	**16.3**	0.122 U	**241**	**54.9**	**9.55**	**813 N**	**67.0 N**	**1,290 N**	**69.2**	**27.7**	138 U
MW-20	MW20-16-17	7/21/2011	P	16	17	**859**	**22.4 J**	**0.568 J**	**8.59 J**	**2.65 J**	**0.497 J**	NR	**0.0914 J**	NR	**1.23 J**	**2.37 J**	**0.0541 J**	**23.1 J**	**26.6 J**	**0.132 J**	**109 J**	**65.7 J**	**12.3 J**	**2,600 N**	**231 N**	NT	NT	NT	NT
MW-21	MW21-21	7/21/2011	P	20.5	21	**11.2**	**2.99**	**0.0183 J**	**0.300**	**0.154**	**0.0305**	NR	0.0155 U	NR	**0.0807**	**0.0989**	0.0155 U	**1.13**	**2.54**	0.0155 U	**0.0248 J**	**3.19**	**0.594**	**49.8 N**	64.3 U	NT	NT	NT	NT
MW-22	MW22-20.5	7/22/2011	P	20	20.5	**527**	**39.3 J**	**0.844 J**	**14.4 J**	**4.37 J**	**0.988 J**	NR	**0.203 J**	NR	**2.36 J**	**4.11 J**	**0.0975 J**	**32.9 J**	**37.3 J**	**0.296 J**	**285 J**	**86.8 J**	**18.3 J**	**3,540 N**	**324 N**	NT	NT	NT	NT
MW-23	MW23-13.5	7/19/2011	P	13	13.5	**27.3**	**2.00**	**0.0511**	**1.56**	**0.854**	**0.257**	NR	**0.0632**	NR	**0.548**	**0.701**	0.0276 U	**5.38**	**3.19**	**0.0828**	**0.339**	**8.88**	**3.36**	**303 N**	153 U	NT	NT	NT	NT
MW-24	MW24-14.5-15	7/19/2011	P	14.5	15	**3,410**	**306 J**	**4.05**	**103**	**60.6**	**26.7**	NR	**8.03 J**	NR	**53.6**	**59.8 J**	**2.64**	**360 J**	**256 J**	**9.77**	**1,170 J**	**758 J**	**228**	**5,240 N**	**1,090 N**	NT	NT	NT	NT
MW-25	MW25-19.5	7/22/2011	P	19	19.5	**480**	**41.5**	**0.749**	**33.4**	**16.4**	**7.42**	NR	**2.36**	NR	**15.5**	**20.5**	**0.823**	**88.0**	**41.6 J**	**2.88 J**	**11.3 J**	**138**	**59.3**	**3,060 N**	**1,630**	NT	NT	NT	NT
DAI-SB-02	DAI-SB-02-2-3	10/14/2013	P	2	3	**0.271**	**0.0451**	0.0141 U	0.0141 U	**0.0175**	0.0141 U	NR	0.0141 U	NR	**0.0314**	**0.0270**	0.0141 U	**0.0359**	0.0141 U	0.0141 U	**0.0158**	**0.0180**	**0.0312**	26.9 U	53.8 U	NT	NT	NT	NT
DAI-SB-03	DAI-SB-03-7-8	10/14/2013	P	7	8	**293**	**33.4**	**0.659**	**10.9**	**8.43**	**1.88**	NR	**0.357**	NR	**4.62**	**8.08**	**0.177**	**41.6**	**37.0**	**0.494**	**19.2**	**104**	**22.5**	**553 N**	**78.2 N**	NT	NT	NT	NT
DAI-SB-04	DAI-SB-04-4-5	10/15/2013	P	4	5	**1.02**	**0.0480**	0.0112 U	**0.0641**	**0.0422**	**0.0118**	NR	0.0112 U	NR	**0.0370**	**0.0586**	0.0112 U	**0.217**	**0.0629**	0.0112 U	**0.0316**	**0.291**	**0.135**	25.0 U	50.0 U	NT	NT	NT	NT
DAI-SB-05	DAI-SB-05-15-15.5	10/16/2013	P	15	15.5	**14.3**	**1.85**	**0.0230**	**0.599**	**0.310**	**0.0885**	NR	**0.0235**	NR	**0.212**	**0.304**	0.0131 U	**2.01**	**1.65**	**0.0307**	**1.43**	**4.54**	**1.25**	26.8 U	53.5 U	NT	NT	NT	NT
DAI-SB-05	DAI-SB-05-22-23	10/16/2013	P	22	23	**0.232**	**0.0189**	0.0137 U	**0.0144**	0.0137 U	0.0137 U	0.0137 U	0.0137 U	0.0137 U	NR	0.0137 U	0.0137 U	**0.0273**	**0.0178**	0.0137 U	**0.0169**	**0.0568**	**0.0179**	26.0 U	52.0 U	NT	NT	NT	NT
DAI-SB-06	DAI-SB-06-12-13	10/16/2013	P	12	12	0.114	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	NR	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	0.0142 U	27.8 U	55.6 U	NT	NT	NT	NT
DAI-SB-07	DAI-SB-07-9-10	10/16/2013	P	10	10	**0.765**	**0.280**	0.0121 U	**0.0152**	0.0121 U	0.0121 U	0.0121 U	0.0121 U	0.0121 U	NR	0.0121 U	0.0121 U	**0.0190**	**0.171**	0.0121 U	**0.0546**	**0.165**	0.0121 U	25.0 U	50.0 U	NT	NT	NT	NT
DAI-SB-08	DAI-SB-08-7-8	10/16/2013	P	7	8	0.0992	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.0124 U	NR	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.0124 U	0.0124 U	25.0 U	50.0 U	NT	NT	NT	NT
DAI-SB-09	DAI-SB-09-7.5-8.0	10/16/2013	P	7.5	8	**0.112**	**0.0187**	0.0125 U	0.0125 U	0.0125 U	0.0125 U	0.0125 U	0.0125 U	0.0125 U	NR	0.0125 U	0.0125 U	0.0125 U	0.0125 U	0.0125 U	0.0125 U	0.0125 U	0.0125 U	26.6 U	53.2 U	NT	NT	NT	NT
DAI-SB-10	DAI-SB-10-13.5-14	10/16/2013	P	13.5	14	**1,650**	**168**	**2.17**	**60.2**	**25.8**	**9.40**	NR	**2.02**	NR	**19.4**	**23.1**	**0.737**	**157**	**145**	**2.64**	**548**	**391**	**95.6**	**2,630 N**	**358 N**	NT	NT	NT	NT
DAI-SB-12	DAI-SB-12-14.5-15.5	10/17/2013	P	14.5	15.5	**255**	**28.8**	**0.432**	**10.6**	**4.43**	**1.25**	NR	**0.278**	NR	**2.70**	**4.04**	**0.106**	**29.7**	**26.7**	**0.374**	**53.0**	**74.3**	**18.7**	**326 N**	258 U	NT	NT	NT	NT
DAI-SB-12	DAI-SB-12-9-10	10/17/2013	P	9	10	**2.13**	**0.0611**	**0.0205**	**0.0538**	**0.178**	**0.215**	NR	**0.102**	NR	**0.630**	**0.411**	**0.0273**	**0.0772**	**0.0182**	**0.128**	**0.0566**	**0.0522**	**0.0961**	25.0 U	50.0 U	NT	NT	NT	NT
DAI-SB-13	DAI-SB-13-13-14	10/17/2013	P	12	14	**109**	**11.5**	**0.212**	**5.80**	**4.13**	**1.22**	NR	**0.273**	NR	**2.66**	**4.04**	**0.103**	**20.6**	**11.5**	**0.367**	**0.0688**	**34.1**	**12.9**	**353 N**	237 U	NT	NT	NT	NT
DAI-SB-14	DAI-SB-14-13-14	10/17/2013	P	12	14	**23.2**	**3.25**	**0.0515**	**1.37**	**0.628**	**0.184**	NR	**0.0433**	NR	**0.428**	**0.524**	**0.0157**	**3.94**	**1.85**	**0.0579**	**0.0697**	**8.32**	**2.51**	25.0 U	50.0 U	NT	NT	NT	NT
DAI-SB-15	DAI-SB-15-10-11	10/17/2013	P	10	11	**665**	**78.7**	**0.736**	**23.9**	**11.6**	**3.23**	NR	NR	**6.80**	**0.656**	**10.9**	**0.263**	**76.0**	**69.9**	**0.908**	**140**	**193**	**48.0**	**492 NJ**	248 U	NT	NT	NT	NT
DAI-SB-15	DAI-SB-15-10-11 DUP	10/17/2013	FD	10	11	**949**	**113**	**1.10**	**36.3**	**16.6**	**4.84**	NR	**0.944**	NR	**10.1**	**15.4**	**0.375**	**107**	**101**	**1.30**	**200**	**274**	**67.5**	**472 NJ**	274 U	NT	NT	NT	NT
DAI-SB-16	DAI-SB-16-9-10	10/17/2013	P	9	10	**457**	**46.1**	**0.428**	**15.4**	**6.31**	**1.90**	NR	**0.370**	NR	**4.06**	**6.52**	**0.142**	**44.2**	**40.9**	**0.497**	**147**	**115**	**28.0**	**694 N**	**97.9 N**	NT	NT	NT	NT
DAI-SB-17	DAI-SB-17-11-12	10/17/2013	P	11	12	**475**	**48.6**	**0.465**	**12.4**	**7.02**	**2.03**	NR	**0.444**	NR	**4.50**	**6.02**	**0.166**	**47.4**	**44.0**	**0.599**	**151**	**123**	**27.3**	**1,550 N**	**246 N**	NT	NT	NT	NT
DAI-SB-18	DAI-SB-18-13-14	10/17/2013	P	13	14	**31.9**	**2.90**	**0.0772**	**1.02**	**0.382**	**0.101**	NR	**0.0205**	NR	**0.236**	**0.336**	0.0130 U	**2.71**	**3.04**	**0.0290**	**10.4**	**8.89**	**1.71**	**115 N**	56.5 U	NT	NT	NT	NT
DAI-SB-18	DAI-SB-18-9-10	10/17/2013	P	9	10	**0.246**	**0.0663**	0.0130 U	0.0130 U	0.0130 U	0.0130 U	0.0130 U	0.0130 U	0.0130 U	NR	0.0130 U	0.0130 U	**0.0194**	**0.0404**	0.0130 U	**0.0171**	**0.0244**	**0.0131**	28.7 U	57.3 U	NT	NT	NT	NT
DAI-SB-19	DAI-SB-19-13-14	10/17/2013	P	13	14	**424**	**44.9**	**0.634**	**41.8**	**7.11**	**1.84**	NR	**0.363**	NR	**4.16**	**6.60**	**0.136**	**43.7**	**45.5**	**0.494**	**78.0**	**121**	**27.9**	**1,840 NJ**	**249 NJ**	NT	NT	NT	NT
DAI-SB-20	DAI-SB-20-8-8.5	10/15/2013	P	8	8.5	**11.0**	**0.615**	**0.538**	**0.843**	**0.365**	**0.937**	NR	**0.999**	NR	**1.36**	**1.18**	**0.227**	**1.22**	**0.423**	**1.25**	**0.0322**	**0.102**	**0.926**	44.1 U	**223**	NT	NT	NT	NT
DAI-SB-21	DAI-SB-21-8.5-9.5	10/15/2013	P	8.5	9.5	**0.907**	0.0539 U	0.0539 U	0.0539 U	**0.100**	**0.0543**	**0.0541**	0.0539 U	**0.0577**	NR	**0.107**	0.0539 U	**0.0825**	0.0539 U	0.0539 U	0.0539 U	0.0539 U	**0.208**	529 U	**6,020**	NT	NT	NT	NT

Notes:
BOLD indicates analyte was detected at or above the reporting limit
Results have been validated
Data reported to reporting detection limit
Total PAHs were calculated by summing the detected concentrations.
If an analyte was not detected, 1/2 the reporting limit was included in the sum.
PAHs were analyzed using method 8270D-SIM
TPH were analyzed using methods NWTPH-Dx, NWTPH-Gx, and NWTPH-HCID

Acronyms/Abbreviations
FD = field duplicate
ft bgs = feet below ground surface
J = estimated result
mg/kg = milligrams per kilogram
N = presumptively identified result
NJ = presumptively identified and estimated result
NR = not reported
NT = not tested
P = primary sample
PAHs = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons
U = not detected at or above the stated level

Cascadia Associates, LLC

Table 5-2
NAPL Analytical Results Summary
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	TPH		
				Diesel-Range Hydrocarbons	Gasoline-Range Hydrocarbons	Oil-Range Hydrocarbons
				mg/kg		
MW-3A	MW-3A-20100908-DNAPL	9/8/2010	P	**90,900**	**36,400**	182,000 U

Sample Location	Sample ID	Sample Date	Sample Type	PAHs																	
				Total PAHs	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)Anthracene	Benzo(a)Pyrene	Benzo(b)Fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)Perylene	Benzo(k)Fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes
				mg/kg																	
MW-3A	MW-3A-DNAPL	8/15/2012	P	**418,000**	**17,100**	**38,000**	**25,400**	**379**	**7,630**	**3,300**	**855**	**1,500**	**616**	**188**	**597**	**1,150**	**5,810**	**3,870**	**15,000**	**395**	**1,210**

Sample Location	Sample ID	Sample Date	Sample Type	PAHs																	
				C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(A,H)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)Pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene
				mg/kg																	
MW-3A	MW-3A-DNAPL	8/15/2012	P	**22,000**	**4,880**	**284**	**590**	**9,470**	**1,590**	398 U	**2,790**	**418**	**2,700**	**63**	**24,000**	**21,500**	**226**	**130,000**	**185**	**58,700**	**15,000**

Notes:
Bold indicates analyte was detected at or above the reporting limit
Results have been validated (excluding TPH results)
Data reported to reporting limit
Total PAHs were calculated by summing the detected concentrations. If an analyte was not detected, 1/2 the reporting limit was included in the sum.
PAHs were analyzed using EPA Method 8270D
TPHs were analyzed using NWTPH-HCID method
C-n PAHs indicate groups of alkyl-substituted PAH constituents with n carbon atoms in attached alkyl groups.

Acronyms/Abbreviations:
DNAPL = Dense Nonaqueous-Phase Liquid
EPA = United States Environmental Protection Agency
ID = identification
mg/kg = milligrams per kilogram
P = primary sample
PAHs = polycyclic aromatic hydrocarbons
U = not detected at or above the stated level

Cascadia Associates, LLC

Table 5-3
Groundwater Analytical Results Summary - PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Total PAH	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
				Concentrations in µg/L																	
MW-1	MW-1-MID-20100908-N	9/8/2010	P	**429**	**160**	1.23 U	**8.94**	**0.126**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	**0.102**	0.0377 U	**9.88**	**97.7**	0.0377 U	**41.9**	**105**	**4.42**
MW-1	MW-1-BTM-20100908-N	9/8/2010	P	**469**	**163**	1.24 U	**9.73**	**0.179**	0.0383 U	NR	0.0383 U	NR	0.0766 U	**0.140**	0.0383 U	**11.0**	**101**	0.0383 U	**65.8**	**112**	**4.98**
MW-1	MW-1	8/9/2011	P	**438**	**141**	**1.16**	**10.1**	**0.218**	0.0404 U	NR	0.0404 U	NR	0.0808 U	**0.161**	0.0404 U	**12.0**	**92.8**	0.0404 U	**62.1**	**113**	**5.13**
MW-1	MW-1_022012	2/20/2012	P	**459**	**167**	1.87 U	**10.7**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**11.5**	**98.3**	1.87 U	**30.7 J**	**127**	**5.27**
MW-1	MW-1_050412	5/4/2012	P	**635**	**199**	1.89 U	**12.2**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**12**	**124**	1.89 U	**131**	**143**	**5.41**
MW-1	MW-1_081412	8/14/2012	P	**567**	**168**	1.87 U	**9.45**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**9.7**	**99**	1.87 U	**158**	**110**	**4.42**
MW-2A	MW-2A	8/9/2011	P	**6,438**	**254**	**5.32**	**14.1**	18.7 U	**0.367**	NR	0.187 U	NR	**0.714**	18.7 U	0.187 U	**19.6**	**170**	0.187 U	**5770**	**176**	**9.10**
MW-2A	MW-2A_022112	2/21/2012	P	**11,401**	**309**	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	NR	37.4 U	37.4 U	37.4 U	**175**	37.4 U	**10500 J**	**193**	37.4 U
MW-2A	MW-2A_050312	5/3/2012	P	**6,894**	**179**	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	NR	37.4 U	37.4 U	37.4 U	**108**	37.4 U	**6260**	**123**	37.4 U
MW-2A	MW-2A_081512	8/15/2012	P	**6,672**	**198**	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	NR	37.7 U	37.7 U	37.7 U	**120**	37.7 U	**6000**	**127**	37.7 U
MW-3A	MW-3A-20100908-N	9/8/2010	P	**26,816**	**740**	19.5 U	**207**	**78.0**	19.5 U	NR	19.5 U	NR	**44.6**	**68.7**	19.5 U	**565**	**601**	19.5 U	**22800**	**1340**	**323**
MW-3A[1]	MW-3A	8/9/2011	P	**12,264**	**560**	**10.7**	**113**	**56.8**	**14.4**	NR	**3.10**	NR	**31.3**	**45.0**	**1.14**	**422**	**417**	**3.97**	**9470**	**898**	**218**
MW-3A	MW-3A_022112	2/21/2012	P	**15,895**	**661**	37.4 U	**127**	**56.2**	37.4 U	NR	37.4 U	NR	74.8 U	**41.6**	37.4 U	**332**	**431**	37.4 U	**13000 J**	**916**	**199**
MW-3A	MW-3A_050412	5/4/2012	P	**20,411**	**972**	**19.3**	**276**	**118**	**32.4**	NR	**7.42**	NR	**72.2**	**102**	**2.96**	**820**	**799**	**9.55**	**14700**	**1990**	**490**
MW-3A	MW-3A_081512	8/15/2012	P	**16,763**	**804**	37.7 U	**204**	**91**	37.7 U	NR	37.7 U	NR	75.5 U	**73.1**	37.7 U	**591**	**621**	37.7 U	**12400**	**1500**	**347**
MW-3B	MW-3B-20100908-N	9/8/2010	P	**79.3**	**0.974**	0.777 U	**0.898**	**0.828**	**0.284**	NR	**0.0851**	NR	**0.526**	**0.735**	0.0388 U	**2.76**	0.777 U	**0.114**	**67.2**	**2.24**	**1.84**
MW-3B	MW-3B	8/9/2011	P	**9.21**	**0.247 J**	0.0377 UJ	**0.422 J**	**0.111 J**	**0.0473 J**	NR	0.0377 UJ	NR	**0.0819 J**	**0.0900 J**	0.0377 UJ	**0.422 J**	**0.178 J**	0.0377 UJ	**6.83 J**	**0.436 J**	**0.268 J**
MW-3B	MW-3B_022112	2/21/2012	P	**16.3**	**0.344**	0.189 U	**0.715**	**0.242**	0.189 U	NR	0.189 U	NR	0.377 U	0.189 U	0.189 U	**1.34**	**0.273**	0.189 U	**10.5 J**	**1.37**	**0.789**
MW-3B	MW-3B_050412	5/4/2012	P	**11.3**	**1.37**	0.187 U	**0.567**	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	NR	0.187 U	0.187 U	**1.13**	**1.09**	0.187 U	**2.99**	**2.59**	**0.766**
MW-3B	MW-3B_081512	8/15/2012	P	**1.92**	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	NR	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	**0.515**	0.187 U	0.187 U
MW-4A	MW-4A-20100907-N	9/7/2010	P	**18.2**	**7.73**	0.0381 U	**0.0900**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	**0.403**	**3.27**	0.0381 U	**0.0850**	**0.0542**	**0.194**
MW-4A	MW-4A-20100907-ED	9/7/2010	FD	**12.0**	**12.0**	0.0571 U	**0.170**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	**0.501**	**4.87**	0.0381 U	**0.133**	**0.100**	**0.240**
MW-4A	MW-4A	8/8/2011	P	**9.12**	**4.91**	0.0377 U	**0.141**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	0.0377 U	0.0377 U	**0.269**	**1.77**	0.0377 U	**1.60**	**0.111**	**0.145**
MW-4A	MW-4A_022112	2/21/2012	P	**24.3**	**12.7**	0.377 U	0.377 U	0.377 U	0.377 U	0.377 U	0.377 U	0.377 U	NR	0.377 U	0.377 U	**0.412**	**4.46**	0.377 U	**4.26 J**	**0.423**	0.377 U
MW-4A	MW-4A_050412	5/4/2012	P	**16.6**	**9.65**	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	NR	0.374 U	0.374 U	0.374 U	**3.68**	0.374 U	**0.82**	0.374 U	0.374 U
MW-4A	MW-4A_081512	8/15/2012	P	**15.1**	**8.27**	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	NR	0.374 U	0.374 U	0.374 U	**3.32**	0.374 U	**1.05**	0.374 U	0.374 U
MW-4B	MW-4B-20100907-N	9/7/2010	P	**0.934**	**0.250**	0.0381 U	**0.0783**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	**0.0895**	**0.131**	0.0381 U	**0.0979**	**0.0644**	**0.0513**
MW-4B	MW-4B	8/8/2011	P	**1.73**	**0.230 J**	0.0374 UJ	**0.160 J**	**0.0454 J**	0.0374 UJ	0.0374 UJ	0.0374 UJ	0.0374 UJ	NR	0.0374 UJ	0.0374 UJ	**0.317 J**	**0.145 J**	0.0374 UJ	**0.301 J**	**0.195 J**	**0.182 J**
MW-4B	MW-4B_022112	2/21/2012	P	**2.21**	**0.0478**	0.0377 U	**0.0435**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	**1.85 J**	**0.0379**	0.0377 U
MW-4B	MW-4B_050412	5/4/2012	P	**0.617**	0.0374 U	0.0374 U	**0.0396**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	**0.316**	0.0374 U	0.0374 U
MW-4B	MW-4B_081512	8/15/2012	P	**1.64**	**0.0905**	0.0392 U	**0.0657**	0.0392 U	0.0392 U	0.0392 U	0.0392 U	0.0392 U	NR	0.0392 U	0.0392 U	0.0392 U	**0.0564**	0.0392 U	**1.17**	**0.0443**	0.0392 U
MW-5	MW-5-20100907-N	9/7/2010	P	**0.785**	**0.134**	0.0374 U	**0.0605**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	**0.0580**	**0.0850**	0.0374 U	**0.122**	**0.0816**	**0.0753**
MW-5	MW-5	8/8/2011	P	**0.493**	0.0374 U	0.0374 U	**0.101**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	**0.130**	0.0374 U	0.0374 U
MW-5	MW-5_022112	2/21/2012	P	**2.34**	**0.179**	0.0374 U	**0.136**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	**0.0405**	**0.132**	0.0374 U	**1.45 J**	**0.218**	0.0374 U
MW-5	MW-5_050412	5/4/2012	P	**3.96**	**0.0864**	0.0381 U	**0.0535**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	**3.57**	0.0381 U	0.0381 U
MW-5	MW-5_081512	8/15/2012	P	**2.51**	**0.0541**	0.0374 U	**0.0803**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	**2.13**	0.0374 U	0.0374 U
MW-6A	MW-6A-20100908-N	9/8/2010	P	**220**	**90.2**	**1.00**	**3.59**	**0.228**	**0.0621**	NR	0.0421 U	NR	0.0947 U	**0.173**	0.0421 U	**4.24**	**43.7**	0.0421 U	**46.1**	**28.9**	**2.10**
MW-6A	MW-6A	8/9/2011	P	**456**	**114 J**	**1.05 J**	**6.71 J**	**0.115 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	NR	**0.116 J**	0.0400 UJ	**4.92 J**	**69.8 J**	0.0400 UJ	**194 J**	**62.3 J**	**2.65 J**
MW-6A	MW-6A_022112	2/21/2012	P	**786**	**244**	3.77 U	**8.63**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	**5.18**	**106**	3.77 U	**331 J**	**72.3**	3.77 U
MW-6A	MW-6A_050312	5/3/2012	P	**671**	**195**	3.74 U	**6.63**	3.74 U	3.74 U	3.74 U	3.74 U	3.74 U	NR	3.74 U	3.74 U	**4.16**	**88**	3.74 U	**305**	**53.1**	3.74 U
MW-6A	MW-6A_08142012	8/14/2012	P	**508**	**158**	3.77 U	**7.01**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	**5.3**	**84.5**	3.77 U	**175**	**59.2**	3.77 U
MW-7	MW-7_050312	5/3/2012	P	**3.14**	**0.548**	0.0381 U	**0.312**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	0.0381 U	**0.1**	0.0381 U	**1.95**	0.0381 U	0.0381 U

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-3
Groundwater Analytical Results Summary - PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Total PAH	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
				Concentrations in µg/L																	
MW-9	MW-9-20100907-N	9/7/2010	P	**160**	**56.4 J**	0.374 UJ	**4.01 J**	0.374 UJ	0.374 UJ	0.374 UJ	0.374 UJ	0.374 UJ	NR	0.374 UJ	0.374 UJ	**6.64 J**	**29.4 J**	0.374 UJ	**40.7 J**	**18.0 J**	**2.87 J**
MW-9	MW-9	8/8/2011	P	**245**	**87.3**	**0.488**	**6.42**	**0.131**	0.0377 U	NR	0.0377 U	NR	0.0755 U	**0.0805**	0.0377 U	**8.10**	**47.7**	0.0377 U	**63.6**	**27.4**	**3.18**
MW-9	MW-9_022012	2/20/2012	P	**300**	**131**	**0.801**	**7.6**	**0.136**	0.0374 U	NR	0.0374 U	NR	0.0748 U	**0.0907**	0.0374 U	**8.66**	**62.3**	0.0374 U	**53.3**	**32.8**	**3.48**
MW-9	MW-9_050312	5/3/2012	P	**233**	**109**	1.87 U	**6.55**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**7.74**	**55.4**	1.87 U	**14.5**	**28.6**	**3.08**
MW-9	MW-9_08142012	8/14/2012	P	**222**	**109**	0.589 U	**6.66**	**0.121**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	**0.0884**	0.0374 U	**8.35**	**60**	0.0374 U	**3.44**	**30.5**	**3.55**
MW-10	MW-10-20100907-N	9/7/2010	P	**49.1**	**10.0**	**0.121**	**2.11**	**1.73**	**0.350**	NR	**0.0942**	NR	**0.683**	**1.27**	0.0377 U	**13.5**	**5.52**	**0.113**	**0.0773 J**	**4.60**	**8.96**
MW-10	MW-10	8/8/2011	P	**129**	**66.7**	**0.375**	**2.77**	**0.308**	**0.0492**	NR	0.0374 U	NR	**0.0930**	**0.214**	0.0374 U	**5.79**	**32.7**	0.0374 U	**0.444**	**16.8**	**3.19**
MW-10	MW-10_022012	2/20/2012	P	**120**	**65.7**	0.374 U	**2.88**	**0.427**	0.374 U	0.374 U	0.374 U	0.374 U	NR	0.374 U	0.374 U	**7.09**	**27**	0.374 U	**0.906 J**	**10.9**	**4.07**
MW-10	MW-10_050312	5/3/2012	P	**277**	**146**	**1.06**	**4.51**	0.762 U	0.762 U	0.762 U	0.762 U	0.762 U	NR	0.762 U	0.762 U	**9.35**	**72.4**	0.762 U	1.52 U	**34.8**	**5.15**
MW-10	MW-10_08142012	8/14/2012	P	**184**	**86.8**	0.755 U	**4.25**	0.755 U	0.755 U	0.755 U	0.755 U	0.755 U	NR	0.755 U	0.755 U	**9.13**	**47**	0.755 U	**2.38**	**25.3**	**5.26**
MW-18	MW-18-20100907-N	9/7/2010	P	**0.351**	0.0381 U	0.0381 U	**0.0451**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0762 U	0.0381 U	0.0381 U
MW-18	MW-18	8/8/2011	P	**0.541**	**0.0617**	0.0377 U	**0.196**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0755 U	0.0377 U	0.0377 U
MW-18	MW-18 DUP	8/8/2011	FD	**0.508**	0.0374 U	0.0374 U	**0.209**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0748 U	0.0374 U	0.0374 U
MW-18	MW-18_022012	2/20/2012	P	**0.528**	0.0377 U	0.0377 U	**0.226**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0755 U	0.0377 U	0.0377 U
MW-18	MW-18_050312	5/3/2012	P	**0.460**	0.0374 U	0.0374 U	**0.161**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0748 U	0.0374 U	0.0374 U
MW-18	MW-18_08142012	8/14/2012	P	**0.532**	0.0374 U	0.0374 U	**0.233**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0748 U	0.0374 U	0.0374 U
MW-19	MW-19	8/8/2011	P	**5,064**	**128 J**	**2.95 J**	**8.51 J**	**2.07 J**	**0.447 J**	NR	**0.0906 J**	NR	**1.00 J**	**1.69 J**	0.0408 UJ	**16.0 J**	**83.1 J**	**0.119 J**	**4710 J**	**102 J**	**7.58 J**
MW-19	MW-19_022112	2/21/2012	P	**1,158**	**108**	**2.21**	**8.22**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**9.55**	**71.1**	1.89 U	**864 J**	**82.3**	**4.77**
MW-19	MW-19_050412	5/4/2012	P	**2,718**	**166**	7.84 U	**9.68**	7.84 U	7.84 U	7.84 U	7.84 U	7.84 U	NR	7.84 U	7.84 U	**8.69**	**96.6**	7.84 U	**2300**	**98.1**	7.84 U
MW-19	MW-19_081412	8/14/2012	P	**2,135**	**175**	7.48 U	**11.5**	7.48 U	7.48 U	7.48 U	7.48 U	7.48 U	NR	7.48 U	7.48 U	**7.95**	**105**	7.48 U	**1710**	**88.6**	7.48 U
MW-20	MW-20	8/8/2011	P	**84.2**	**24.8 J**	**0.403 J**	**3.10 J**	**0.125 J**	0.0421 UJ	NR	0.0421 UJ	NR	0.0842 UJ	**0.124 J**	0.0421 UJ	**2.54 J**	**19.2 J**	0.0421 UJ	**7.84 J**	**24.7 J**	**1.25 J**
MW-20	MW-20_022112	2/21/2012	P	**144**	**11.2**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	3.77 U	**4.78**	3.77 U	**95 J**	**10.2**	3.77 U
MW-20	MW-20_050412	5/4/2012	P	**266**	**19.1**	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	NR	1.9 U	1.9 U	1.9 U	**7.75**	1.9 U	**217**	**11.2**	1.9 U
MW-20	MW-20_081512	8/15/2012	P	**31.1**	**7.34**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	1.89 U	**2.8**	1.89 U	**6.53**	**3.07**	1.89 U
MW-21[1]	MW-21	8/9/2011	P	**289**	**89.0 J**	**0.471 J**	**2.59 J**	**0.447 J**	**0.106 J**	NR	0.0374 UJ	NR	**0.229 J**	**0.372 J**	0.0374 UJ	**4.06 J**	**50.5 J**	0.0374 UJ	**109 J**	**30.6 J**	**1.88 J**
MW-21	MW-21_022112	2/21/2012	P	**294**	**89.2**	1.89 U	**7.77**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**7.61**	**64.1**	1.89 U	**26.7 J**	**87.1**	**2.94**
MW-21	MW-21_050412	5/4/2012	P	**356**	**110**	1.87 U	**10.3**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**9.06**	**82.9**	1.87 U	**28.3**	**104**	**3.52**
MW-21	MW-21_081512	8/15/2012	P	**195**	**56.1**	1.96 U	**7.53**	1.96 U	1.96 U	1.96 U	1.96 U	1.96 U	NR	1.96 U	1.96 U	**8.57**	**41.7**	1.96 U	**13.4**	**55.1**	**3.55**
MW-22	MW-22	8/9/2011	P	**9,924**	**127**	**5.59**	**7.85**	**0.590**	0.189 U	NR	0.189 U	NR	0.377 U	**0.433**	0.189 U	**5.44**	**58.9**	0.189 U	**9670**	**44.6**	**2.76**
MW-22	MW-22_022012	2/20/2012	P	**21,872**	**294**	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	NR	37.7 U	37.7 U	37.7 U	**125**	37.7 U	**21100 J**	**126**	37.7 U
MW-22	MW-22-DUP_022012	2/20/2012	FD	**22,544**	**340**	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	NR	37.7 U	37.7 U	37.7 U	**141**	37.7 U	**21700 J**	**136**	37.7 U
MW-22	MW-22_050412	5/4/2012	P	**12,401**	**214**	76.2 U	76.2 U	76.2 U	76.2 U	76.2 U	76.2 U	76.2 U	NR	76.2 U	76.2 U	76.2 U	**92.1**	76.2 U	**11600**	76.2 U	76.2 U
MW-22	MW-22DUP_050412	5/4/2012	FD	**13,682**	**239**	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	NR	75.5 U	75.5 U	75.5 U	**102**	75.5 U	**12800**	**87.5**	75.5 U
MW-22	MW-22_081512	8/15/2012	P	**10,280**	**285 J**	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	NR	75.5 U	75.5 U	**88.7**	**163**	75.5 U	**9020**	**307 J**	75.5 U
MW-22	MW-22DUP_081512	8/15/2012	FD	**9,023**	**202 J**	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	NR	75.5 U	75.5 U	75.5 U	**110**	75.5 U	**8060**	**197 J**	75.5 U
MW-23	MW-23	8/9/2011	P	**265**	**81.3**	**0.470**	**9.70**	**0.618**	**0.0917 J**	NR	0.0374 U	NR	**0.179 J**	**0.457**	0.0374 U	**15.7**	**57.0**	0.0374 U	**0.894 J**	**89.3**	**9.26**
MW-23	MW-23 DUP	8/9/2011	FD	**267**	**83.5**	**0.483**	**9.54**	**0.734**	**0.130 J**	NR	0.0374 U	NR	**0.261 J**	**0.538**	0.0374 U	**15.6**	**57.5**	0.0374 U	**2.25 J**	**87.2**	**9.48**
MW-23	MW-23_022012	2/20/2012	P	**334**	**109**	1.87 U	**10.8**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**17.1**	**73.4**	1.87 U	3.74 U	**104**	**9.12**
MW-23	MW-23DUP_022012	2/20/2012	FD	**303**	**97.5**	1.87 U	**9.82**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**16.7**	**67.2**	1.87 U	3.74 U	**92.4**	**8.92**
MW-23	MW-23_050312	5/3/2012	P	**255**	**75.5**	1.87 U	**10.1**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**14.5**	**55.2**	1.87 U	3.74 U	**81.8 J**	**7.45**
MW-23	MW-23DUP_050312	5/3/2012	FD	**200**	**63.9**	1.89 U	**8.34**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**12.7**	**46.6**	1.89 U	3.77 U	**51.6 J**	**6.56**
MW-23	MW-23_08142012	8/14/2012	P	**243**	**85.7**	0.523 U	**7.76**	**0.479**	**0.0379**	NR	0.0374 U	NR	**0.0947**	**0.385**	0.0374 U	**13**	**61.2**	0.0374 U	**0.446**	**66.8**	**7.01**
MW-23	MW-23DUP_08142012	8/14/2012	FD	**265**	**85.6**	1.87 U	**10.8**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**14.5**	**64.2**	1.87 U	3.74 U	**72.3**	**7.66**

Please refer to notes at end of table.

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Table 5-3
Groundwater Analytical Results Summary - PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Total PAH	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
				Concentrations in µg/L																	
MW-24[1]	MW-24	8/9/2011	P	**5,745**	**205**	**2.63**	**10.3**	**2.63**	**1.04**	NR	**0.266**	NR	**1.97**	**2.32**	**0.0932**	38.5 U	**93.8**	**0.324**	**5280**	**113**	**12.4**
MW-24	MW-24_022112	2/21/2012	P	**9,520**	**318**	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	NR	37.4 U	37.4 U	37.4 U	**125**	37.4 U	**8710 J**	**143**	37.4 U
MW-24	MW-24_050312	5/3/2012	P	**4,628**	**149**	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	NR	37.4 U	37.4 U	37.4 U	**60.1**	37.4 U	**4140**	**54.7**	37.4 U
MW-24	MW-24_08142012	8/14/2012	P	**3,659**	**138**	38.8 U	38.8 U	38.8 U	38.8 U	38.8 U	38.8 U	38.8 U	NR	38.8 U	38.8 U	38.8 U	**61.6**	38.8 U	**3180**	**46.2**	38.8 U
MW-25	MW-25	8/9/2011	P	**928**	**92.5 J**	**1.38 J**	**8.09 J**	**0.417 J**	**0.112 J**	NR	0.0404 UJ	NR	**0.208 J**	**0.353 J**	0.0404 UJ	**8.52 J**	**66.4 J**	0.0404 UJ	**651 J**	**95.2 J**	**4.10 J**
MW-25	MW-25_022112	2/21/2012	P	**1,749**	**188**	**10.3**	**13.8**	3.88 U	3.88 U	3.88 U	3.88 U	3.88 U	NR	3.88 U	3.88 U	**28.7**	**114**	3.88 U	**1220 J**	**143**	**15.5**
MW-25	MW-25_050312	5/3/2012	P	**1,191**	**96.3**	7.77 U	**9.96**	**8.44**	7.77 U	7.77 U	7.77 U	7.77 U	NR	7.77 U	7.77 U	**53.7**	**61**	7.77 U	**811**	**87.8**	**31.2**
MW-25	MW-25_08142012	8/14/2012	P	**1,607**	**79.4**	7.55 U	**7.61**	7.55 U	7.55 U	7.55 U	7.55 U	7.55 U	NR	7.55 U	7.55 U	**20.2**	**51.6**	7.55 U	**1350**	**52.9**	**11.7**

Notes:
BOLD indicates analyte was detected at or above the reporting limit
Results have been validated
Data reported to reporting limit
Total PAHs were calculated by summing the detected concentrations.
If an analyte was not detected, 1/2 the reporting limit was included in the sum.
PAHs were analyzed using EPA Method 8270C-SIM or 8270D-SIM.
1. Sample was also analyzed by solid-phase microextraction (SPME) for freely dissolved PAHs. The SPME analysis reports 34 analytes, which are not all presented on this table. The full SPME results can be found in the laboratory reports in Appendix B of the 2012 Progress Report (AMEC 2013a).

Acronyms/Abbreviations
µg/L = micrograms per liter
EPA = United States Environmental Protection Agency
FD = field duplicate
J = estimated result
NR = not reported
P = primary sample
PAHs = polycyclic aromatic hydrocarbons
U = not detected at or above the stated level
UJ = not detected at or above the stated level, which is an approximate value

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Table 5-4
Groundwater Analytical Results Summary - TPH and BTEX
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	TPH			BTEX				
				Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Gasoline-Range Hydrocarbons	Benzene	Ethylbenzene	m,p-Xylene	o-Xylene	Toluene
				mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-1	MW-1-MID-20100908-N	9/8/2010	P	**4.08 N**	4.67 U	**3.64 N**	**3.80**	**50.0**	**5.00**	**11.2**	5.00 U
MW-1	MW-1-BTM-20100908-N	9/8/2010	P	**5.45 N**	0.467 U	**3.87 N**	**4.10**	**54.4**	**5.65**	**11.4**	5.00 U
MW-1	MW-1	8/9/2011	P	**4.48 N**	0.472 U	NT	NT	NT	NT	NT	NT
MW-1	MW-1_022012	2/20/2012	P	**4.56 N**	**0.519 N**	NT	NT	NT	NT	NT	NT
MW-1	MW-1_050412	5/4/2012	P	**5.37 N**	0.755 U	NT	NT	NT	NT	NT	NT
MW-1	MW-1_081412	8/14/2012	P	**8.49 N**	**0.503 N**	NT	NT	NT	NT	NT	NT
MW-2A	MW-2A	8/9/2011	P	**26.1 N**	9.90 U	NT	NT	NT	NT	NT	NT
MW-2A	MW-2A_022112	2/21/2012	P	**76.3 N**	2.99 U	NT	NT	NT	NT	NT	NT
MW-2A	MW-2A_050312	5/3/2012	P	**81.1 N**	**3.81 N**	NT	NT	NT	NT	NT	NT
MW-2A	MW-2A_081512	8/15/2012	P	**89.9 N**	1.51 U	NT	NT	NT	NT	NT	NT
MW-3A	MW-3A-20100908-N	9/8/2010	P	**374 N**	**103 N**	**28.5 N**	**48.0**	**146**	**178**	**97.5**	**132**
MW-3A	MW-3A	8/9/2011	P	**57.1 N**	10.1 U	NT	NT	NT	NT	NT	NT
MW-3A	MW-3A_022112	2/21/2012	P	**49.1 N**	**3.26 N**	NT	NT	NT	NT	NT	NT
MW-3A	MW-3A_050412	5/4/2012	P	**113 N**	15 U	NT	NT	NT	NT	NT	NT
MW-3A	MW-3A_081512	8/15/2012	P	**116 N**	3.02 U	NT	NT	NT	NT	NT	NT
MW-3B	MW-3B-20100908-N	9/8/2010	P	**1.72 N**	0.467 U	**0.789 N**	**3.76**	**6.58**	**5.36**	**4.58**	**3.10**
MW-3B	MW-3B	8/9/2011	P	0.236 U	0.472 U	NT	NT	NT	NT	NT	NT
MW-3B	MW-3B_022112	2/21/2012	P	**0.349 N**	0.377 U	NT	NT	NT	NT	NT	NT
MW-3B	MW-3B_050412	5/4/2012	P	0.187 U	**0.394**	NT	NT	NT	NT	NT	NT
MW-3B	MW-3B_081512	8/15/2012	P	**0.732**	0.374 U	NT	NT	NT	NT	NT	NT
MW-4A	MW-4A-20100907-N	9/7/2010	P	0.239 U	0.478 U	0.100 U	0.250 U	0.500 U	1.00 U	0.500 U	1.00 U
MW-4A	MW-4A-20100907-ED	9/7/2010	FD	0.239 U	0.478 U	0.100 U	0.250 U	0.500 U	1.00 U	0.500 U	1.00 U
MW-4A	MW-4A	8/8/2011	P	0.236 U	0.472 U	NT	NT	NT	NT	NT	NT
MW-4A	MW-4A_022112	2/21/2012	P	**0.287 N**	**0.391 N**	NT	NT	NT	NT	NT	NT
MW-4A	MW-4A_050412	5/4/2012	P	**0.238 N**	**0.53**	NT	NT	NT	NT	NT	NT
MW-4A	MW-4A_081512	8/15/2012	P	**0.191 N**	0.374 U	NT	NT	NT	NT	NT	NT
MW-4B	MW-4B-20100907-N	9/7/2010	P	0.239 U	0.478 U	0.100 U	0.250 U	0.500 U	1.00 U	0.500 U	1.00 U
MW-4B	MW-4B	8/8/2011	P	0.236 U	0.472 U	NT	NT	NT	NT	NT	NT
MW-4B	MW-4B_022112	2/21/2012	P	0.189 U	0.377 U	NT	NT	NT	NT	NT	NT
MW-4B	MW-4B_050412	5/4/2012	P	0.187 U	0.374 U	NT	NT	NT	NT	NT	NT
MW-4B	MW-4B_081512	8/15/2012	P	0.196 U	0.392 U	NT	NT	NT	NT	NT	NT
MW-5	MW-5-20100907-N	9/7/2010	P	0.236 U	0.472 U	0.100 U	0.250 U	0.500 U	1.00 U	0.500 U	1.00 U
MW-5	MW-5	8/8/2011	P	0.238 U	0.476 U	NT	NT	NT	NT	NT	NT
MW-5	MW-5_022112	2/21/2012	P	0.187 U	0.374 U	NT	NT	NT	NT	NT	NT
MW-5	MW-5_050412	5/4/2012	P	0.19 U	**0.477**	NT	NT	NT	NT	NT	NT
MW-5	MW-5_081512	8/15/2012	P	0.187 U	0.374 U	NT	NT	NT	NT	NT	NT
MW-6A	MW-6A-20100908-N	9/8/2010	P	**4.11 N**	4.67 U	**4.79 N**	**3.20**	**78.8**	**9.85**	**32.2**	5.00 U
MW-6A	MW-6A	8/9/2011	P	**4.28 N**	2.55 U	NT	NT	NT	NT	NT	NT
MW-6A	MW-6A_022112	2/21/2012	P	**7.69 N**	0.755 U	NT	NT	NT	NT	NT	NT
MW-6A	MW-6A_050312	5/3/2012	P	**8.3 N**	**0.723 NJ**	NT	NT	NT	NT	NT	NT
MW-6A	MW-6A_08142012	8/14/2012	P	**8.45 N**	**0.868 N**	NT	NT	NT	NT	NT	NT
MW-7	MW-7_050312	5/3/2012	P	0.19 U	0.381 U	NT	NT	NT	NT	NT	NT
MW-9	MW-9-20100907-N	9/7/2010	P	**2.25 N**	0.467 U	**2.10**	**0.360**	**29.5**	**22.8**	**15.0**	**4.93**
MW-9	MW-9	8/8/2011	P	**1.52 N**	0.467 U	NT	NT	NT	NT	NT	NT
MW-9	MW-9_022012	2/20/2012	P	**2.55 N**	0.755 U	NT	NT	NT	NT	NT	NT
MW-9	MW-9_050312	5/3/2012	P	**2.18 N**	0.374 U	NT	NT	NT	NT	NT	NT
MW-9	MW-9_08142012	8/14/2012	P	**2.34 N**	0.374 U	NT	NT	NT	NT	NT	NT
MW-10	MW-10-20100907-N	9/7/2010	P	**0.288 N**	0.476 U	0.100 U	0.250 U	0.500 U	1.00 U	0.500 U	1.00 U
MW-10	MW-10	8/8/2011	P	**0.730 N**	0.467 U	NT	NT	NT	NT	NT	NT
MW-10	MW-10_022012	2/20/2012	P	**0.771 N**	0.374 U	NT	NT	NT	NT	NT	NT
MW-10	MW-10_050312	5/3/2012	P	**1.45 N**	0.381 U	NT	NT	NT	NT	NT	NT
MW-10	MW-10_08142012	8/14/2012	P	**1.03 N**	0.385 U	NT	NT	NT	NT	NT	NT

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-4
Groundwater Analytical Results Summary - TPH and BTEX
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	TPH			BTEX				
				Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Gasoline-Range Hydrocarbons	Benzene	Ethylbenzene	m,p-Xylene	o-Xylene	Toluene
				mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-18	MW-18-20100907-N	9/7/2010	P	0.238 U	0.476 U	0.100 U	0.250 U	0.500 U	1.00 U	0.500 U	1.00 U
MW-18	MW-18	8/8/2011	P	0.234 U	0.467 U	NT	NT	NT	NT	NT	NT
MW-18	MW-18_022012	2/20/2012	P	0.187 U	0.374 U	NT	NT	NT	NT	NT	NT
MW-18	MW-18_050312	5/3/2012	P	0.187 U	0.374 U	NT	NT	NT	NT	NT	NT
MW-18	MW-18_08142012	8/14/2012	P	0.187 U	0.374 U	NT	NT	NT	NT	NT	NT
MW-19	MW-19	8/8/2011	P	**12.5 N**	10.1 U	NT	NT	NT	NT	NT	NT
MW-19	MW-19_022112	2/21/2012	P	**3.66 N**	0.755 U	NT	NT	NT	NT	NT	NT
MW-19	MW-19_050412	5/4/2012	P	**7.64 N**	0.784 U	NT	NT	NT	NT	NT	NT
MW-19	MW-19_081412	8/14/2012	P	**7.49 N**	0.377 U	NT	NT	NT	NT	NT	NT
MW-20	MW-20	8/8/2011	P	**0.870 N**	0.495 U	NT	NT	NT	NT	NT	NT
MW-20	MW-20_022112	2/21/2012	P	**0.657 N**	0.377 U	NT	NT	NT	NT	NT	NT
MW-20	MW-20_050412	5/4/2012	P	**1.18 N**	0.762 U	NT	NT	NT	NT	NT	NT
MW-20	MW-20_081512	8/15/2012	P	**0.385 N**	0.377 U	NT	NT	NT	NT	NT	NT
MW-21	MW-21	8/9/2011	P	**3.65 N**	0.467 U	NT	NT	NT	NT	NT	NT
MW-21	MW-21_022112	2/21/2012	P	**1.38 N**	0.377 U	NT	NT	NT	NT	NT	NT
MW-21	MW-21_050412	5/4/2012	P	**1.69 N**	0.374 U	NT	NT	NT	NT	NT	NT
MW-21	MW-21_081512	8/15/2012	P	**3.03 N**	0.377 U	NT	NT	NT	NT	NT	NT
MW-22	MW-22	8/9/2011	P	**23.8 N**	9.35 U	NT	NT	NT	NT	NT	NT
MW-22	MW-22_022012	2/20/2012	P	**40.9 N**	1.51 U	NT	NT	NT	NT	NT	NT
MW-22	MW-22_050412	5/4/2012	P	**44.6 N**	3.05 U	NT	NT	NT	NT	NT	NT
MW-22	MW-22_081512	8/15/2012	P	**41.1 N**	1.51 U	NT	NT	NT	NT	NT	NT
MW-23	MW-23	8/9/2011	P	**0.949 N**	0.472 U	NT	NT	NT	NT	NT	NT
MW-23	MW-23_022012	2/20/2012	P	**1.1 N**	0.748 U	NT	NT	NT	NT	NT	NT
MW-23	MW-23_050312	5/3/2012	P	**1.19 N**	**0.459 NJ**	NT	NT	NT	NT	NT	NT
MW-23	MW-23_08142012	8/14/2012	P	**1.15**	0.374 U	NT	NT	NT	NT	NT	NT
MW-24	MW-24	8/9/2011	P	**11.5 N**	2.34 U	NT	NT	NT	NT	NT	NT
MW-24	MW-24_022112	2/21/2012	P	**12.4 N**	1.5 U	NT	NT	NT	NT	NT	NT
MW-24	MW-24_050312	5/3/2012	P	**10.8 N**	**0.673 NJ**	NT	NT	NT	NT	NT	NT
MW-24	MW-24_08142012	8/14/2012	P	**10.9**	**0.902**	NT	NT	NT	NT	NT	NT
MW-25	MW-25	8/9/2011	P	**4.04 N**	0.510 U	NT	NT	NT	NT	NT	NT
MW-25	MW-25_022112	2/21/2012	P	**10.1 N**	1.55 U	NT	NT	NT	NT	NT	NT
MW-25	MW-25_050312	5/3/2012	P	**7.91 N**	**0.907 NJ**	NT	NT	NT	NT	NT	NT
MW-25	MW-25_08142012	8/14/2012	P	**9.51**	**0.554**	NT	NT	NT	NT	NT	NT

Notes:
BOLD indicates analyte was detected at or above the reporting limit
Results have been validated
Data reported to reporting limit
TPH was analyzed using methods NWTPH-Dx and NWTPH-Gx
BTEX was analyzed using EPA Method 8260

Acronyms/Abbreviations:
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, and xylenes
EPA = United States Environmental Protection Agency
mg/L = milligrams per liter
N = presumptively identified result
NJ = presumptively identified and estimated result
NT = not tested
P = primary sample
TPH = total petroleum hydrocarbons
U = not detected at or above the stated level

Cascadia Associates, LLC

Table 5-5
Groundwater Analytical Results Summary - Metals
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Arsenic	Cadmium	Chromium	Copper	Lead	Zinc
				Concentrations in µg/L					
MW-1	MW-1-BTM-20100908-N	9/8/2010	P	**11.8**	1 U	2 U	4 U	1 U	4 U
MW-1	MW-1-MID-20100908-N	9/8/2010	P	**11.8**	1 U	2 U	4 U	1 U	4 U
MW-1	MW-1	8/9/2011	P	**11.5**	1 U	2 U	4 U	1 U	4 U
MW-1	MW-1_022012	2/20/2012	P	**13.1**	1 U	2 U	4 U	1 U	4 U
MW-1	MW-1_050412	5/4/2012	P	**11.8**	1 U	2 U	2 U	1 U	4 U
MW-1	MW-1_081412	8/14/2012	P	**13.2**	1 U	2 U	2 U	1 U	4 U
MW-2A	MW-2A	8/9/2011	P	**3.06**	1 U	**3.94**	4 U	1 U	**20.8**
MW-2A	MW-2A_022112	2/21/2012	P	**11.3**	1 U	**5.83**	4 U	1 U	4 U
MW-2A	MW-2A_050312	5/3/2012	P	**10.9**	1 U	**5.4**	2 U	1 U	4 U
MW-2A	MW-2A_081512	8/15/2012	P	**12.7**	1 U	**5.46**	2 U	1 U	**9.83**
MW-3A	MW-3A-20100908-N	9/8/2010	P	**5.16**	1 U	2 U	4 U	1 U	4 U
MW-3A	MW-3A	8/9/2011	P	**5.67**	1 U	2 U	4 U	1 U	4 U
MW-3A	MW-3A_022112	2/21/2012	P	**4.97**	1 U	2 U	4 U	1 U	**5.19**
MW-3A	MW-3A_050412	5/4/2012	P	**7.78**	1 U	2 U	2 U	1 U	4 U
MW-3A	MW-3A_081512	8/15/2012	P	**6.07**	1 U	2 U	2 U	1 U	4 U
MW-3B	MW-3B-20100908-N	9/8/2010	P	**39.1**	1 U	2 U	4 U	1 U	4 U
MW-3B	MW-3B	8/9/2011	P	**25.7**	1 U	**2.76**	4 U	1 U	4 U
MW-3B	MW-3B_022112	2/21/2012	P	**23.9**	1 U	2 U	4 U	1 U	4 U
MW-3B	MW-3B_050412	5/4/2012	P	**5.1**	1 U	2 U	2 U	**3.49**	**10.1**
MW-3B	MW-3B_081512	8/15/2012	P	**27.4**	1 U	2 U	2 U	1 U	4 U
MW-4A	MW-4A-20100907-N	9/7/2010	P	**4.41**	1 U	2 U	4 U	1 U	4 U
MW-4A	MW-4A-20100907-ED	9/7/2010	FD	**4.74**	1 U	2 U	4 U	1 U	4 U
MW-4A	MW-4A	8/8/2011	P	**4.28**	1 U	2 U	4 U	1 U	4 U
MW-4A	MW-4A_022112	2/21/2012	P	**3.4**	1 U	2 U	4 U	1 U	4 U
MW-4A	MW-4A_050412	5/4/2012	P	**4.03**	1 U	2 U	2 U	1 U	4 U
MW-4A	MW-4A_081512	8/15/2012	P	**4**	1 U	2 U	2 U	1 U	4 U
MW-4B	MW-4B-20100907-N	9/7/2010	P	**5.01**	1 U	2 U	4 U	1 U	4 U
MW-4B	MW-4B	8/8/2011	P	**3.01**	1 U	2 U	4 U	1 U	4 U
MW-4B	MW-4B_022112	2/21/2012	P	2 U	1 U	2 U	4 U	1 U	4 U
MW-4B	MW-4B_050412	5/4/2012	P	2 U	1 U	2 U	**4.86**	1 U	4 U
MW-4B	MW-4B_081512	8/15/2012	P	**4.02**	1 U	2 U	2 U	1 U	**5.41**
MW-5	MW-5-20100907-N	9/7/2010	P	**2.28**	1 U	2 U	4 U	1 U	**243**
MW-5	MW-5	8/8/2011	P	2 U	1 U	2 U	**12.0**	1 U	**248**
MW-5	MW-5_022112	2/21/2012	P	2 U	1 U	2 U	**8.76**	**1.16**	**244**
MW-5	MW-5_050412	5/4/2012	P	**2.1**	1 U	**3.34**	**18.5**	**2.99**	**221**
MW-5	MW-5_081512	8/15/2012	P	2 U	1 U	2 U	**5.67**	1 U	**235**
MW-6A	MW-6A-20100908-N	9/8/2010	P	**3.56**	1 U	2 U	4 U	1 U	4 U
MW-6A	MW-6A	8/9/2011	P	**2.50**	1 U	2 U	4 U	1 U	4 U
MW-6A	MW-6A_022112	2/21/2012	P	**2.94**	1 U	2 U	4 U	1 U	4 U
MW-6A	MW-6A_050312	5/3/2012	P	**2.66**	1 U	2 U	2 U	1 U	4 U
MW-6A	MW-6A_08142012	8/14/2012	P	**3.19**	1 U	2 U	2 U	1 U	4 U

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-5
Groundwater Analytical Results Summary - Metals
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Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Arsenic	Cadmium	Chromium	Copper	Lead	Zinc
				Concentrations in µg/L					
MW-7	MW-7_050312	5/3/2012	P	2 U	1 U	2 U	2 U	1 U	4 U
MW-9	MW-9-20100907-N	9/7/2010	P	**2.17**	1 U	2 U	4 U	1 U	4 U
MW-9	MW-9	8/8/2011	P	**3.16**	1 U	2 U	4 U	1 U	4 U
MW-9	MW-9_022012	2/20/2012	P	**4.21**	1 U	2 U	4 U	**1.09**	4 U
MW-9	MW-9_050312	5/3/2012	P	**4.12**	1 U	2 U	2 U	1 U	4 U
MW-9	MW-9_08142012	8/14/2012	P	**4.29**	1 U	2 U	2 U	1 U	4 U
MW-10	MW-10-20100907-N	9/7/2010	P	**12.4**	1 U	2 U	4 U	1 U	4 U
MW-10	MW-10	8/8/2011	P	**8.88**	1 U	2 U	4 U	1 U	4 U
MW-10	MW-10_022012	2/20/2012	P	**9.22**	1 U	2 U	4 U	1 U	4 U
MW-10	MW-10_050312	5/3/2012	P	**7.89**	1 U	2 U	2 U	1 U	4 U
MW-10	MW-10_08142012	8/14/2012	P	**10.8**	1 U	2 U	2 U	1 U	4 U
MW-18	MW-18-20100907-N	9/7/2010	P	**7.76**	1 U	2 U	4 U	1 U	4 U
MW-18	MW-18	8/8/2011	P	**6.18**	1 U	2 U	4 U	1 U	4 U
MW-18	MW-18 DUP	8/8/2011	FD	**6.67**	1 U	2 U	4 U	1 U	4 U
MW-18	MW-18_022012	2/20/2012	P	**6.14**	1 U	2 U	4 U	1 U	4 U
MW-18	MW-18_050312	5/3/2012	P	**6.23**	1 U	2 U	2 U	1 U	4 U
MW-18	MW-18_08142012	8/14/2012	P	**7.7**	1 U	2 U	2 U	1 U	4 U
MW-19	MW-19	8/8/2011	P	**2.02**	1 U	2 U	4 U	1 U	**148**
MW-19	MW-19_022112	2/21/2012	P	**8.33**	1 U	2 U	4 U	1 U	**4.27**
MW-19	MW-19_050412	5/4/2012	P	**7.91**	1 U	2 U	2 U	1 U	4 U
MW-19	MW-19_081412	8/14/2012	P	**5.5**	1 U	2 U	2 U	1 U	4 U
MW-20	MW-20	8/8/2011	P	**2.54**	1 U	2 U	4 U	1 U	**683**
MW-20	MW-20_022112	2/21/2012	P	**73.2**	1 U	2 U	4 U	1 U	**6.12**
MW-20	MW-20_050412	5/4/2012	P	**57.5**	1 U	2 U	2 U	1 U	**5.04**
MW-20	MW-20_081512	8/15/2012	P	**80.7**	1 U	2 U	2 U	1 U	**5.6**
MW-21	MW-21	8/9/2011	P	2.00 U	1 U	2 U	4 U	1 U	**10.5**
MW-21	MW-21_022112	2/21/2012	P	**8.71**	1 U	2 U	4 U	1 U	**9.02**
MW-21	MW-21_050412	5/4/2012	P	**9.57**	1 U	2 U	2 U	1 U	**4.91**
MW-21	MW-21_081512	8/15/2012	P	**5.82**	1 U	2 U	2 U	1 U	**4.7**
MW-22	MW-22	8/9/2011	P	**7.70**	1 U	2 U	4 U	1 U	**154**
MW-22	MW-22_022012	2/20/2012	P	**12.2**	1 U	2 U	4 U	1 U	**10.1 J**
MW-22	MW-22-DUP_022012	2/20/2012	FD	**11.9**	1 U	2 U	4 U	1 U	**5.99 J**
MW-22	MW-22_050412	5/4/2012	P	**12.7**	1 U	2 U	2 U	1 U	**4.48**
MW-22	MW-22DUP_050412	5/4/2012	FD	**12.9**	1 U	2 U	2 U	1 U	4 U
MW-22	MW-22_081512	8/15/2012	P	**13.4**	1 U	2 U	2 U	1 U	4 U
MW-22	MW-22DUP_081512	8/15/2012	FD	**13.2**	1 U	2 U	2 U	1 U	4 U

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-5
Groundwater Analytical Results Summary - Metals
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Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Arsenic	Cadmium	Chromium	Copper	Lead	Zinc
				Concentrations in µg/L					
MW-23	MW-23	8/9/2011	P	**9.18**	1 U	2 U	4 U	1 U	**80.8**
MW-23	MW-23 DUP	8/9/2011	FD	**9.58**	1 U	2 U	4 U	1 U	**64.9**
MW-23	MW-23_022012	2/20/2012	P	**10**	1 U	2 U	4 U	1 U	**4.03 J**
MW-23	MW-23DUP_022012	2/20/2012	FD	**9.93**	1 U	2 U	4 U	1 U	4 U
MW-23	MW-23_050312	5/3/2012	P	**11.5**	1 U	2 U	2 U	1 U	4 U
MW-23	MW-23DUP_050312	5/3/2012	FD	**11.3**	1 U	2 U	2 U	1 U	4 U
MW-23	MW-23_08142012	8/14/2012	P	**17.5**	1 U	2 U	2 U	1 U	4 U
MW-23	MW-23DUP_08142012	8/14/2012	FD	**17.4**	1 U	2 U	2 U	1 U	4 U
MW-24	MW-24	8/9/2011	P	**5.89**	1 U	2 U	4 U	1 U	**414**
MW-24	MW-24_022112	2/21/2012	P	**9.91**	1 U	2 U	4 U	1 U	**18.4**
MW-24	MW-24_050312	5/3/2012	P	**9.77**	1 U	2 U	2 U	1 U	4 U
MW-24	MW-24_08142012	8/14/2012	P	**10.1**	1 U	2 U	2 U	1 U	**8.16**
MW-25	MW-25	8/9/2011	P	**2.36**	1 U	2 U	4 U	1 U	**15.8**
MW-25	MW-25_022112	2/21/2012	P	**5.41**	1 U	2 U	4 U	1 U	4 U
MW-25	MW-25_050312	5/3/2012	P	**5.92**	1 U	2 U	2 U	1 U	4 U
MW-25	MW-25_08142012	8/14/2012	P	**5.94**	1 U	2 U	2 U	1 U	**4.49**

Notes:
BOLD indicates analyte was detected at or above the reporting limit
Results have been validated
Data reported to reporting limit
Metals were analyzed using EPA Method 6020

Acronyms/Abbreviations
µg/L = micrograms per liter
EPA = United States Environmental Protection Agency
FD = field duplicate
J = estimated result
P = primary sample
U = not detected at or above the stated level
UJ = not detected at or above the stated level, which is an approximate value

Cascadia Associates, LLC

Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	TPH		TOC	Black Carbon	PAHs												
						Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Total Organic Carbon	Black Carbon	Total PAHs[1]	Total PAHs including Homologues	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
						Concentrations in mg/kg			%	Concentrations in mg/kg												
DAI-PWS 01	DAI-PWS-01-8-11	10/14/2013	P	0.66	0.92	26.8 U	53.6 U	NT	NT	**26.7**	NA	NT	NT	**2.55 J**	**0.0758 J**	**1.02**	**0.354 J**	**0.11 J**	NT	NT	**0.0400**	NT
DAI-PWS 02	DAI-PWS-02-8-11	10/14/2013	P	0.66	0.92	26.4 U	52.8 UJ	NT	NT	**1.17**	NA	NT	NT	0.0129 U	**0.0307**	**0.125**	**0.0677**	**0.084**	NT	NT	**0.0801**	NT
LSI-01	LSI-01_8-11	10/16/2012	P	0.66	0.92	25.0 U	50.0 U	**1,900**	NT	**0.96**	**1.61**	**0.0212**	**0.0549**	**0.034**	**0.00667 J**	**0.0478**	**0.0384**	**0.0296**	**0.0497 J**	**0.0301**	**0.0243**	**0.0150 J**
LSI-02	LSI-02_8-11	10/9/2012	P	0.66	0.92	36.8 U	**77.0 N**	**16,000**	NT	**2.14**	**3.28**	**0.0164**	**0.0406**	**0.0613**	**0.0182**	**0.131**	**0.112**	**0.0946**	**0.21 J**	**0.116**	**0.0641**	**0.0699 J**
LSI-09	LSI-09_8-11	10/9/2012	P	0.66	0.92	**139 N**	**254 N**	**7,100**	NT	**61.8**	**84.9**	**0.21**	**0.436**	**0.781**	**0.174**	**1.2**	**4.56**	**2.41**	**4.37 J**	**2.17**	**0.674**	**1.63 J**
LSI-11	LSI-11_8-11	10/10/2012	P	0.66	0.92	**326 NJ**	**462 N**	**9,600**	NT	**64.8**	**103**	**1.27**	**2.25**	**4.14**	**0.214**	**2.5**	**2.81**	**1.23**	**2.59 J**	**1.12**	**0.311**	**0.775 J**
LSI-20	LSI-20_8-11	10/10/2012	P	0.66	0.92	**33.5 N**	**70.6 N**	**3,300**	NT	**6.52**	**9.7**	**0.0304**	**0.0808**	**0.127**	**0.0373**	**0.19**	**0.436**	**0.318**	**0.649**	**0.319**	**0.144**	**0.216**
LSI-24	LSI-24_8-11	10/12/2012	P	0.66	0.92	30.3 U	**147**	**9,100**	NT	**2.46**	**3.79**	**0.014**	**0.0307**	**0.114**	**0.0345**	**0.0381**	**0.165**	**0.234**	**0.273**	**0.163**	**0.173**	**0.102**
MC-03	MCO3-0-0.3	7/12/2011	P	0	0.3	71.1 U	142 U	**8,800**	NT	**0.298**	**1.54**	NT	NT	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U
MC-03	MCO3-7.1	7/12/2011	P	6.8	7.1	25.0 U	50.0 U	NT	NT	0.084	NA	NT	NT	0.0105 U	0.0105 U	0.0105 U	0.0105 U	0.0105 U	0.0105 U	NT	0.0105 U	0.0105 U
MC-03	MC03-12.8	7/12/2011	P	12.5	12.8	26.9 U	53.8 U	NT	NT	**0.170**	NA	NT	NT	0.0127 U	0.0127 U	0.0127 U	0.0127 U	0.0127 U	0.0127 U	NT	0.0127 U	0.0127 U
MC-04	MC04-3.3	7/12/2011	P	0	3.3	84.1 U	168 U	NT	NT	**0.351**	NA	NT	NT	**0.0173**	0.0158 U	0.0158 U	0.0158 U	0.0158 U	0.0158 U	NT	0.0158 U	0.0158 U
MC-04	MC04-0-0.3	7/12/2011	P	0	0.3	77.1 U	154 U	**14,000**	NT	**0.890**	NA	NT	NT	**0.268**	0.0135 U	**0.0303**	0.0135 U	0.0135 U	0.0135 U	NT	0.0135 U	0.0135 U
MC-04	MC04-9.5	7/12/2011	P	9.2	9.5	53.6 U	107 U	NT	NT	**0.184**	NA	NT	NT	0.0105 U	0.0105 U	0.0105 U	0.0105 U	0.0105 U	0.0105 U	NT	0.0105 U	0.0105 U
PWS-01	PWS-01_8-9_SE	7/10/2012	P	0.66	0.75	NT	NT	**6,300**	**0.10%**	**3.32**	**4.93**	**0.14**	**0.0336**	**0.755**	**0.0133 J**	**0.114**	**0.0895**	**0.0666**	**0.145**	**0.071**	**0.0329**	**0.0461**
PWS-01	PWS-1_8-10	10/10/2012	P	0.66	0.83	NT	NT	**5,600**	0.10 U	**0.86**	**2.56**	0.00625 U	0.00625 U	**0.0736**	0.00625 U	**0.0190**	**0.0802**	**0.0485**	**0.0757**	**0.0423**	**0.0272**	**0.0286**
PWS-02	PWS-02_1-4_SE	7/10/2012	P	0.08	0.33	NT	NT	**18,000**	**0.19%**	**13.3**	**19.8**	**0.237 J**	**0.554 J**	**0.6 J**	**0.0834 J**	**0.829 J**	**0.594 J**	**0.453 J**	**0.858 J**	**0.454 J**	**0.288 J**	**0.296 J**
PWS-02	PWS-02_8-10_SE	7/10/2012	P	0.66	0.83	NT	NT	**31,000**	**0.26%**	**527**	**786**	**9.2**	**10.3**	**53.5**	0.543 U	**48.2**	**12.8**	**3.7 J**	**6.24 J**	**2.66 J**	**0.985 J**	**2.36 J**
PWS-02	PWS-02_8-11	10/11/2012	P	0.66	0.92	NT	NT	**21,000**	**0.34%**	**82.9**	**132**	**2.18**	**2.32**	**7.36**	0.114 U	**4.47**	**2.76**	**0.815**	**1.42**	**0.587**	**0.24**	**0.535**
PWS-03	PWS-03_8-11_SE	7/12/2012	P	0.66	0.92	NT	NT	**28,000**	**0.17%**	**85.8**	**122**	**0.661**	**1.94**	**1.37**	**0.49**	**2.69**	**5.57**	**3.49**	**7.6**	**3.8**	**1.75**	**2.65**
PWS-03	PWS-3_8-11	10/10/2012	P	0.66	0.92	NT	NT	**26,000**	**0.28%**	**35.3**	**51.3**	**0.208**	**0.483**	**0.461**	**0.29**	**1.16**	**2.63**	**1.98**	**4.36**	**2.05**	**0.739**	**1.46**
PWS-04	PWS-04_1-4_SE	7/10/2012	P	0.08	0.33	NT	NT	**12,000**	**0.13%**	**7.93**	**11.4**	**0.0865**	**0.226**	**0.161**	**0.0514**	**0.277 J**	**0.461**	**0.372**	**0.75**	**0.384**	**0.207**	**0.248**
PWS-04	PWS-04_8-11_SE	7/10/2012	P	0.66	0.92	NT	NT	**10,000**	**0.10%**	**14.1**	**20.8**	**0.216**	**0.499**	**0.521**	**0.0769**	**0.559**	**0.668**	**0.472**	**0.944**	**0.507**	**0.252**	**0.284**
PWS-04	PWS-4_8-11	10/10/2012	P	0.66	0.92	NT	NT	**6,900**	**0.12%**	**13.5**	**18.5**	**0.0375**	**0.0970**	**0.102**	**0.0787**	**0.868**	**0.765**	**1.46**	**1.99 J**	**1.26**	**0.63**	**0.562 J**
PWS-05	PWS-05_8-11_SE	7/12/2012	P	0.66	0.92	NT	NT	**18,000**	**0.14%**	**24.5**	**36.6**	**0.302**	**0.785**	**0.84**	**0.139**	**0.971**	**1.52**	**1.03**	**1.93**	**1.01**	**0.489**	**0.604**
PWS-05	PWS-5_8-11	10/10/2012	P	0.66	0.92	NT	NT	**12,000**	**0.19%**	**8.4**	**12.5**	**0.0992**	**0.21**	**0.283**	**0.0563**	**0.274**	**0.513**	**0.456**	**0.862**	**0.408**	**0.205**	**0.294**
PWS-06	PWS-06_8-11_SE	7/12/2012	P	0.66	0.92	NT	NT	**23,000**	**0.23%**	**81.6**	**123**	**2.11**	**4.89**	**3.89**	**0.235**	**3.4**	**2.43**	**0.975**	**2.46**	**1.1**	**0.35**	**0.739**
PWS-06	PWS-6_8-11	10/10/2012	P	0.66	0.92	NT	NT	**15,000**	**0.26%**	**14.9**	**24.4**	**0.4**	**0.84**	**0.977**	**0.0670**	**0.872**	**0.606**	**0.371**	**0.735**	**0.36**	**0.159**	**0.266**
PWS-07	PWS-07_8-11_SE	7/10/2012	P	0.66	0.92	NT	NT	**28,000**	**0.17%**	**35.9**	**51.2**	**0.604**	**1.63**	**1.32**	**0.216**	**1.48**	**1.7**	**1.36**	**2.69**	**1.41**	**0.707**	**0.832**
PWS-07	PWS-7_8-10	10/11/2012	P	0.66	0.83	NT	NT	**17,000**	**0.22%**	**28.3**	**42.7**	**0.307**	**0.689 J**	**0.878**	**0.175**	**2.69 J**	**1.78**	**1.49**	**2.68**	**1.28**	**0.45**	**0.873**
PWS-07	PWS-7_8-10 DUP	10/11/2012	FD	0.66	0.83	NT	NT	**17,000**	**0.23%**	**24.8**	**37.4**	**0.381**	**0.932 J**	**0.859**	**0.184**	**0.981 J**	**1.38**	**1.62**	**2.69 J**	**1.43**	**0.588**	**0.828 J**
PWS-08	PWS-08_8-11_SE	7/12/2012	P	0.66	0.92	NT	NT	**21,000**	**0.20%**	**18.9**	**29.0**	**0.471**	**0.982**	**1.05**	**0.0713**	**0.831**	**0.708**	**0.372**	**0.727**	**0.353**	**0.167**	**0.22**
PWS-08	PWS-8_8-11	10/9/2012	P	0.66	0.92	NT	NT	**15,000**	**0.25%**	**7.34**	**12.0**	**0.12**	**0.265**	**0.261**	**0.0523**	**0.344**	**0.414**	**0.366**	**0.747**	**0.363**	**0.18**	**0.274**
PWS-09	PWS-09_8-11_SE	7/12/2012	P	0.66	0.92	NT	NT	**20,000**	**0.17%**	**7.92**	**11.9**	**0.133**	**0.259**	**0.333**	**0.0385**	**0.302**	**0.361**	**0.251**	**0.415**	**0.216**	**0.11**	**0.134**
PWS-09	PWS-9_8-11	10/9/2012	P	0.66	0.92	NT	NT	**18,000**	**0.23%**	**1.40**	**2.48**	**0.0193**	**0.0402**	**0.0494**	0.00942 U	**0.0689**	**0.0836**	**0.0548**	**0.0932**	**0.0474**	**0.0329**	**0.0373**
PWS-10	PWS-10_8-11_SE	7/11/2012	P	0.66	0.92	NT	NT	**15,000**	**0.18%**	**25.0**	**37.6**	**0.537**	**1.32**	**1.33**	**0.0783**	**1.22**	**0.883**	**0.337**	**0.71**	**0.334**	**0.169 J**	**0.203**
PWS-10	PWS-10_8-11	10/10/2012	P	0.66	0.92	NT	NT	**14,000**	**0.26%**	**4.90**	**8.13**	**0.106**	**0.251**	**0.273**	**0.0252**	**0.237**	**0.226**	**0.105**	**0.192**	**0.0937**	**0.0572**	**0.0746**
PWS-11	PWS-11_8-11_SE	7/9/2012	P	0.66	0.92	NT	NT	**24,000 J**	**0.20%**	**46.2**	**70.5**	**2.02**	**4.73**	**3.61**	**0.191**	**3.53**	**1.15**	**0.441**	**0.969**	**0.542**	**0.258**	**0.3**
PWS-11	PWS-11B_8-11_SE	7/13/2012	P	0.66	0.92	NT	NT	**39,000**	**0.28%**	**37.5**	**60.2**	**1.21**	**2.92**	**1.98**	**0.168**	**1.94**	**1.07**	**0.491**	**1.04**	**0.57**	**0.294**	**0.341**
PWS-11	PWS-11_8-11	10/10/2012	P	0.66	0.92	NT	NT	**20,000**	**0.31%**	**4.85**	**7.66**	**0.107 J**	**0.253 J**	**0.182 J**	**0.0432**	**0.266**	**0.206**	**0.188**	**0.311 J**	**0.221**	**0.108**	**0.1 J**
PWS-12	PWS-12_8-11_SE	7/12/2012	P	0.66	0.92	NT	NT	**18,000**	**0.16%**	**3.74**	**5.47**	**0.0222**	**0.0617**	**0.0793 J**	**0.0268**	**0.111**	**0.23**	**0.241 J**	**0.405**	**0.222 J**	**0.153 J**	**0.144 J**
PWS-12	PWS-12_8-11 DUP_SE	7/12/2012	FD	0.66	0.92	NT	NT	**18,000**	**0.15%**	**2.47**	**3.80**	**0.0168 J**	**0.0509**	**0.043 J**	**0.0197**	**0.0848**	**0.147**	**0.142 J**	**0.244**	**0.129 J**	**0.0792 J**	**0.0742 J**
PWS-12	PWS-12_8-11	10/9/2012	P	0.66	0.92	NT	NT	**15,000**	**0.20%**	**0.289**	**1.00**	0.00804 U	0.00804 U	0.00804 U	0.00804 U	0.00804 U	**0.0198**	**0.0183**	**0.0303 J**	**0.0183**	**0.0165**	**0.0105 J**

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs																	
						Benzofluoranthenes	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(a,h)anthracene
						Concentrations in mg/kg																	
DAI-PWS 01	DAI-PWS-01-8-11	10/14/2013	P	0.66	0.92	**0.287 J**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.475 J**	0.0145 U
DAI-PWS 02	DAI-PWS-02-8-11	10/14/2013	P	0.66	0.92	**0.182**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.115**	0.0129 U
LSI-01	LSI-01_8-11	10/16/2012	P	0.66	0.92	**0.0635**	0.0640 U	0.0640 U	0.0640 U	NT	0.0640 U	0.0640 U	0.0640 U	0.0640 U	0.0640 U	0.0640 U	0.0640 U	0.0640 U	0.0640 U	0.128 U	0.0640 U	0.128 U	**0.0467**	0.00640 U
LSI-02	LSI-02_8-11	10/9/2012	P	0.66	0.92	**0.268**	**0.0834**	**0.137**	0.0805 U	NT	**0.136**	0.0805 U	0.0805 U	0.0805 U	**0.085**	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	**0.165**	**0.0157 J**
LSI-09	LSI-09_8-11	10/9/2012	P	0.66	0.92	**6.4**	**1.92**	**5.38**	**0.536**	NT	**3.76**	**0.613**	**0.507**	**0.587**	**2.62**	**0.424**	**0.747**	**0.793**	**1.22**	**0.178**	**0.571**	**0.466**	**4.45**	**0.271**
LSI-11	LSI-11_8-11	10/10/2012	P	0.66	0.92	**3.24**	**1.41**	**4.63**	**1.66**	NT	**6.5**	**0.556**	**0.969**	**4.29**	**3.79**	**0.413**	**1.07**	**3.86**	**1.78**	**0.141**	**1.86**	**0.85**	**2.97**	**0.13**
LSI-20	LSI-20_8-11	10/10/2012	P	0.66	0.92	**0.828**	**0.327**	**0.6**	**0.0681**	NT	**0.421**	**0.139**	**0.0774**	**0.0837**	**0.291**	**0.129**	**0.127**	**0.101**	**0.203**	0.119 U	**0.0914**	0.119 U	**0.593**	**0.0445**
LSI-24	LSI-24_8-11	10/12/2012	P	0.66	0.92	**0.35**	**0.12**	**0.198**	0.0620 U	NT	**0.122**	**0.0664**	0.0620 U	0.0620 U	**0.139**	0.0620 U	0.0620 U	0.0620 U	**0.131**	0.124 U	0.0620 U	0.124 U	**0.211**	**0.024**
MC-03	MCO3-0-0.3	7/12/2011	P	0	0.3	NT	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.273 UJ	0.137 UJ	0.273 UJ	0.0273 U	0.0273 U
MC-03	MCO3-7.1	7/12/2011	P	6.8	7.1	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0105 U	0.0105 U
MC-03	MC03-12.8	7/12/2011	P	12.5	12.8	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0127 U	0.0127 U
MC-04	MC04-3.3	7/12/2011	P	0	3.3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0158 U	0.0158 U
MC-04	MC04-0-0.3	7/12/2011	P	0	0.3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0135 U	0.0135 U
MC-04	MC04-9.5	7/12/2011	P	9.2	9.5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0105 U	0.0105 U
PWS-01	PWS-01_8-9_SE	7/10/2012	P	0.66	0.75	NT	0.0674 U	**0.144**	**0.104**	NT	**0.172**	0.0674 U	0.0674 U	**0.355**	**0.0862**	0.0674 U	0.0674 U	**0.133**	0.0674 U	0.135 U	0.0674 U	0.135 U	**0.127**	**0.00772 J**
PWS-01	PWS-1_8-10	10/10/2012	P	0.66	0.83	**0.103**	0.0625 U	**0.113**	0.0625 U	NT	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.125 U	0.0625 U	**1.1**	**0.164**	**0.00626 J**
PWS-02	PWS-02_1-4_SE	7/10/2012	P	0.08	0.33	NT	**0.375 J**	**0.869 J**	**0.258 J**	NT	**0.891 J**	**0.168 J**	**0.139 J**	**0.785 J**	**0.49 J**	**0.168 J**	0.113 UJ	**0.374 J**	**0.223 J**	0.225 UJ	**0.184 J**	**0.228 J**	**0.888 J**	**0.0641 J**
PWS-02	PWS-02_8-10_SE	7/10/2012	P	0.66	0.83	NT	5.43 U	**24**	**13.9**	NT	**55.3**	5.43 U	**8.07**	**49.2**	**19.2**	5.43 U	5.43 U	**27.6**	**7.77**	10.9 U	**10.7**	10.9 U	**14.7**	0.543 U
PWS-02	PWS-02_8-11	10/11/2012	P	0.66	0.92	**1.9**	**1.28**	**4.97**	**2.7**	NT	**10.1**	**0.343**	**1.45**	**9.26**	**4.07**	**0.199**	**0.841**	**5.14**	**1.52**	0.211 U	**1.93**	**0.541**	**3.4**	**0.0725**
PWS-03	PWS-03_8-11_SE	7/12/2012	P	0.66	0.92	NT	**3.7**	**9**	**0.763**	NT	**4.23**	**1.08**	**0.751**	**1.94**	**3.03**	**0.872**	**0.407**	**1.25**	**1.68**	0.751 U	**0.609**	0.751 U	**9.76**	**0.443**
PWS-03	PWS-3_8-11	10/10/2012	P	0.66	0.92	**5.6**	**1.61**	**3.64**	**0.256**	NT	**1.96**	**0.605**	**0.227**	**0.522**	**1.3**	**0.543**	**0.618**	**0.422**	**0.684**	**0.26**	**0.268**	**0.346**	**6.36**	**0.289**
PWS-04	PWS-04_1-4_SE	7/10/2012	P	0.08	0.33	NT	**0.279**	**0.614**	**0.103**	NT	**0.414**	**0.115**	**0.0837**	**0.203**	**0.288**	**0.129**	0.0708 U	**0.152**	**0.146**	0.142 U	**0.0857**	0.142 U	**0.626**	**0.052**
PWS-04	PWS-04_8-11_SE	7/10/2012	P	0.66	0.92	NT	**0.39**	**1.02**	**0.176**	NT	**0.932**	**0.172**	**0.192**	**0.655**	**0.574**	**0.163**	**0.187**	**0.364**	**0.322**	0.145 U	**0.204**	0.145 U	**1.01**	**0.0684**
PWS-04	PWS-4_8-11	10/10/2012	P	0.66	0.92	**2.46**	**0.555**	**0.987**	0.0643 U	NT	**0.531**	**0.279**	0.0643 U	**0.0937**	**0.296**	**0.239**	**0.13**	**0.0810**	**0.159**	0.129 U	0.0643 U	0.129 U	**2.03**	**0.191**
PWS-05	PWS-05_8-11_SE	7/12/2012	P	0.66	0.92	NT	**0.812**	**2**	**0.276**	NT	**1.38**	**0.334**	**0.224**	**0.995**	**0.915**	**0.227**	**0.132**	**0.582**	**0.474**	0.158 U	**0.271**	**1.26**	**2.06**	**0.123 J**
PWS-05	PWS-5_8-11	10/10/2012	P	0.66	0.92	**1.12**	**0.315**	**0.584**	**0.0970**	NT	**0.456**	**0.149**	**0.0849**	**0.257**	**0.318**	**0.133**	**0.147**	**0.217**	**0.144**	0.15 U	**0.126**	**0.211**	**1.24**	**0.0604**
PWS-06	PWS-06_8-11_SE	7/12/2012	P	0.66	0.92	NT	**1.29**	**5.37**	**1.04**	NT	**6.08**	**0.502**	**0.96**	**4.53**	**3.36**	**0.333**	**0.429**	**2.32**	**1.28**	0.656 U	**1.01**	**4.21**	**3.72**	**0.107 J**
PWS-06	PWS-6_8-11	10/10/2012	P	0.66	0.92	**0.958**	**0.352**	**0.846**	**0.292**	NT	**1.29**	**0.19**	**0.179**	**1.04**	**0.638**	**0.184**	**0.193**	**0.765**	**0.294**	0.165 U	**0.326**	**1.29**	**0.693**	**0.0534**
PWS-07	PWS-07_8-11_SE	7/10/2012	P	0.66	0.92	NT	**1.31**	**2.27**	**0.357**	NT	**1.87**	**0.455**	0.0807 U	**1.42**	**1.12**	**0.334**	**0.397**	**0.789**	**0.553**	0.161 U	**0.403**	**0.245**	**2.38**	**0.177**
PWS-07	PWS-7_8-10	10/11/2012	P	0.66	0.83	**3.4**	**1.01**	**2.06**	**0.381**	NT	**2.01**	**0.521**	**0.29**	**0.915**	**1.18**	**0.488**	**0.551**	**0.963**	**0.665**	**0.167**	**0.536**	**0.378**	**2.07**	**0.186**
PWS-07	PWS-7_8-10 DUP	10/11/2012	FD	0.66	0.83	**3.36**	**0.933**	**1.76**	**0.338**	NT	**1.55**	**0.452**	**0.234**	**0.877**	**0.962**	**0.42**	**0.424**	**0.67**	**0.483**	**0.15**	**0.334**	**0.282**	**2.56**	**0.197**
PWS-08	PWS-08_8-11_SE	7/12/2012	P	0.66	0.92	NT	**0.408**	**1.18**	**0.298**	NT	**1.55**	**0.191**	**0.301**	**1.26**	**0.824**	**0.173**	**0.152**	**0.745**	**0.405**	0.178 U	**0.369**	**0.361**	**0.802**	**0.0492**
PWS-08	PWS-8_8-11	10/9/2012	P	0.66	0.92	**0.978**	**0.299**	**0.541**	**0.107**	NT	**0.513**	**0.14**	**0.0856**	**0.299**	**0.355**	**0.151**	**0.149**	**0.21**	**0.182**	0.165 U	**0.138**	**0.616**	**0.615**	**0.0554**
PWS-09	PWS-09_8-11_SE	7/12/2012	P	0.66	0.92	NT	**0.196**	**0.566**	**0.196**	NT	**0.647**	**0.0922**	**0.108**	**0.363**	**0.302**	0.089 U	0.089 U	**0.268**	**0.146**	0.178 U	**0.117**	**0.231**	**0.409**	**0.0297**
PWS-09	PWS-9_8-11	10/9/2012	P	0.66	0.92	**0.127**	0.0942 U	**0.14**	0.0942 U	NT	**0.124**	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.188 U	0.0942 U	0.188 U	**0.227**	0.00942 U
PWS-10	PWS-10_8-11_SE	7/11/2012	P	0.66	0.92	NT	**0.511**	**1.53**	**0.394**	NT	**2.03**	**0.172**	**0.355**	**1.53**	**1.02**	**0.174**	**0.231**	**0.926**	**0.409**	0.17 U	**0.429**	**0.53**	**0.911**	0.0851 U
PWS-10	PWS-10_8-11	10/10/2012	P	0.66	0.92	**0.256**	**0.134**	**0.376**	**0.109**	NT	**0.489**	0.0659 U	**0.0718**	**0.287**	**0.282**	0.0659 U	**0.0864**	**0.212**	**0.132**	0.132 U	**0.116**	**0.35**	**0.302**	**0.0156**
PWS-11	PWS-11_8-11_SE	7/9/2012	P	0.66	0.92	NT	**0.618**	**1.93**	**0.694**	NT	**3.39**	**0.218**	**0.587**	**3.79**	**1.55**	**0.206**	**0.241**	**1.92**	**0.55**	0.177 U	**0.698**	**0.543**	**1.31**	0.0883 U
PWS-11	PWS-11B_8-11_SE	7/13/2012	P	0.66	0.92	NT	**0.514**	**1.82**	**0.551**	NT	**2.67**	**0.226**	**0.45**	**2.32**	**1.18**	**0.223**	**0.205**	**1.35**	**0.478**	0.186 U	**0.525**	**5.42**	**1.17**	0.0929 U
PWS-11	PWS-11_8-11	10/10/2012	P	0.66	0.92	**0.393**	**0.142**	**0.283**	**0.0801**	NT	**0.397**	**0.0838**	0.0728 U	**0.242 J**	**0.228**	**0.0947**	**0.108**	**0.174**	**0.116**	0.146 U	**0.0941**	0.146 U	**0.253**	**0.0296**
PWS-12	PWS-12_8-11_SE	7/12/2012	P	0.66	0.92	NT	**0.152**	**0.273**	0.0979 U	NT	**0.164**	**0.11**	0.0979 U	0.0979 U	**0.13**	0.0979 U	0.0979 U	0.0979 U	0.0979 U	0.196 U	0.0979 U	0.196 U	**0.33**	**0.035**
PWS-12	PWS-12_8-11 DUP_SE	7/12/2012	FD	0.66	0.92	NT	**0.105**	**0.197**	0.0933 U	NT	**0.134**	0.0933 U	0.0933 U	0.0933 U	**0.0963**	0.0933 U	0.0933 U	0.0933 U	0.0933 U	0.187 U	0.0933 U	0.187 U	**0.216**	**0.0191**
PWS-12	PWS-12_8-11	10/9/2012	P	0.66	0.92	**0.0404**	0.0804 U	0.0804 U	0.0804 U	NT	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.161 U	0.0804 U	0.161 U	**0.0273**	0.00804 U

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs						
						Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene
						Concentrations in mg/kg						
DAI-PWS 01	DAI-PWS-01-8-11	10/14/2013	P	0.66	0.92	**3.54 J**	**2.84 J**	**0.0491 J**	**5.18 J**	NT	**7.79 J**	**2.34 J**
DAI-PWS 02	DAI-PWS-02-8-11	10/14/2013	P	0.66	0.92	**0.142**	0.0129 U	**0.0724**	**0.0471**	NT	**0.073**	**0.135**
LSI-01	LSI-01_8-11	10/16/2012	P	0.66	0.92	**0.155**	**0.0386**	**0.0243**	**0.188**	**0.00931 J**	**0.152**	**0.103**
LSI-02	LSI-02_8-11	10/9/2012	P	0.66	0.92	**0.388**	**0.0711**	**0.069**	**0.116**	**0.0355**	**0.25**	**0.285**
LSI-09	LSI-09_8-11	10/9/2012	P	0.66	0.92	**21.5**	**0.741**	**0.947**	**1.2**	**0.62**	**2.54**	**13.3**
LSI-11	LSI-11_8-11	10/10/2012	P	0.66	0.92	**15.3**	**3.77**	**0.422**	**3.79**	**0.303**	**14**	**9.63**
LSI-20	LSI-20_8-11	10/10/2012	P	0.66	0.92	**1.47**	**0.0933**	**0.162**	**0.256**	**0.0873**	**0.618**	**1.12**
LSI-24	LSI-24_8-11	10/12/2012	P	0.66	0.92	**0.328**	**0.0287**	**0.146**	**0.0893**	**0.082**	**0.139**	**0.306**
MC-03	MCO3-0-0.3	7/12/2011	P	0	0.3	0.0273 U	0.0273 U	0.0273 U	0.0273 U	**0.0787**	0.0273 U	0.0273 U
MC-03	MCO3-7.1	7/12/2011	P	6.8	7.1	0.0105 U	0.0105 U	0.0105 U	0.0105 U	NT	0.0105 U	0.0105 U
MC-03	MC03-12.8	7/12/2011	P	12.5	12.8	0.0127 U	0.0127 U	0.0127 U	**0.0751**	NT	0.0127 U	0.0127 U
MC-04	MC04-3.3	7/12/2011	P	0	3.3	0.0158 U	0.0158 U	0.0158 U	**0.223**	NT	0.0158 U	0.0158 U
MC-04	MC04-0-0.3	7/12/2011	P	0	0.3	**0.0236**	**0.168**	0.0135 U	**0.0866**	NT	**0.235**	**0.0177**
MC-04	MC04-9.5	7/12/2011	P	9.2	9.5	0.0105 U	0.0105 U	0.0105 U	**0.105**	NT	0.0105 U	0.0105 U
PWS-01	PWS-01_8-9_SE	7/10/2012	P	0.66	0.75	**0.433**	**0.55**	**0.0357**	**0.0692**	**0.0255**	**0.489**	**0.321**
PWS-01	PWS-1_8-10	10/10/2012	P	0.66	0.83	**0.1**	**0.0360**	**0.0292**	**0.0152**	**0.0156**	**0.0490**	**0.0862**
PWS-02	PWS-02_1-4_SE	7/10/2012	P	0.08	0.33	**2.19 J**	**0.779 J**	**0.295 J**	**1.13 J**	**0.126 J**	**2.2 J**	**1.58 J**
PWS-02	PWS-02_8-10_SE	7/10/2012	P	0.66	0.83	**83.9**	**57.3**	**1.1 J**	**4.56**	**0.778 J**	**181**	**55**
PWS-02	PWS-02_8-11	10/11/2012	P	0.66	0.92	**15.2**	**7.45**	**0.267**	**0.504 J**	**0.178**	**30.8**	**7.38**
PWS-03	PWS-03_8-11_SE	7/12/2012	P	0.66	0.92	**18.6**	**1.95**	**1.92**	**5.7**	**0.83**	**6.48**	**14.5**
PWS-03	PWS-3_8-11	10/10/2012	P	0.66	0.92	**5.64**	**0.629**	**1.03**	**1.26**	**0.43**	**2.47**	**4.3**
PWS-04	PWS-04_1-4_SE	7/10/2012	P	0.08	0.33	**1.51**	**0.221**	**0.221**	**0.693**	**0.12**	**0.772**	**1.19**
PWS-04	PWS-04_8-11_SE	7/10/2012	P	0.66	0.92	**2.77**	**0.571**	**0.302**	**1.54**	**0.153**	**1.87**	**2.01**
PWS-04	PWS-4_8-11	10/10/2012	P	0.66	0.92	**1.34**	**0.156**	**0.793**	**0.339**	**0.47**	**0.711**	**1.15 J**
PWS-05	PWS-05_8-11_SE	7/12/2012	P	0.66	0.92	**4.44**	**0.921**	**0.506**	**2.2**	**0.345**	**3.14**	**3.29**
PWS-05	PWS-5_8-11	10/10/2012	P	0.66	0.92	**1.22**	**0.277**	**0.233**	**0.634**	**0.124**	**0.882**	**0.855**
PWS-06	PWS-06_8-11_SE	7/12/2012	P	0.66	0.92	**16.9**	**4.15**	**0.406**	**17.3**	**0.244**	**13.6**	**10.7**
PWS-06	PWS-6_8-11	10/10/2012	P	0.66	0.92	**2.38**	**0.969**	**0.184**	**2.05**	**0.0937**	**2.77**	**1.67**
PWS-07	PWS-07_8-11_SE	7/10/2012	P	0.66	0.92	**5.72**	**1.43**	**0.762**	**5.35**	**0.481**	**4.65**	**4.63**
PWS-07	PWS-7_8-10	10/11/2012	P	0.66	0.83	**4.43**	**1.05**	**0.619**	**1.99**	**0.411**	**3.16**	**3.5**
PWS-07	PWS-7_8-10 DUP	10/11/2012	FD	0.66	0.83	**3.29**	**0.962**	**0.758**	**2.53**	**0.463**	**2.42**	**2.6**
PWS-08	PWS-08_8-11_SE	7/12/2012	P	0.66	0.92	**3.46**	**1.17**	**0.186**	**2.44**	**0.123**	**4.01**	**2.52**
PWS-08	PWS-8_8-11	10/9/2012	P	0.66	0.92	**1.12**	**0.32**	**0.209**	**0.593**	**0.0916**	**0.962**	**0.775**
PWS-09	PWS-09_8-11_SE	7/12/2012	P	0.66	0.92	**1.43**	**0.327**	**0.124**	**1.16**	**0.125**	**1.27**	**1.1**
PWS-09	PWS-9_8-11	10/9/2012	P	0.66	0.92	**0.203**	**0.0675**	**0.0354**	**0.0943**	**0.0208**	**0.179**	**0.149**
PWS-10	PWS-10_8-11_SE	7/11/2012	P	0.66	0.92	**5.01**	**1.74**	**0.176**	**3.26**	**0.147**	**5.41**	**3.42**
PWS-10	PWS-10_8-11	10/10/2012	P	0.66	0.92	**0.916**	**0.331**	**0.0592**	**0.594**	**0.0362**	**0.915**	**0.556**
PWS-11	PWS-11_8-11_SE	7/9/2012	P	0.66	0.92	**7.03**	**3.76**	**0.274**	**8.95**	**0.172**	**9.72**	**4.46**
PWS-11	PWS-11B_8-11_SE	7/13/2012	P	0.66	0.92	**5.94**	**2.41**	**0.319**	**8.56**	**0.155**	**7.68**	**3.85**
PWS-11	PWS-11_8-11	10/10/2012	P	0.66	0.92	**0.821**	**0.23 J**	**0.124**	**0.682 J**	**0.0629**	**0.767**	**0.497**
PWS-12	PWS-12_8-11_SE	7/12/2012	P	0.66	0.92	**0.576**	**0.088**	**0.169 J**	**0.17**	**0.168**	**0.28**	**0.536**
PWS-12	PWS-12_8-11 DUP_SE	7/12/2012	FD	0.66	0.92	**0.386**	**0.0664**	**0.088 J**	**0.172**	**0.111**	**0.238**	**0.337**
PWS-12	PWS-12_8-11	10/9/2012	P	0.66	0.92	**0.0450**	0.00804 U	**0.0170**	**0.0109 J**	**0.0113 J**	**0.0203**	**0.0421**

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	TPH		TOC	Black Carbon	PAHs												
						Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Total Organic Carbon	Black Carbon	Total PAHs[1]	Total PAHs including Homologues	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
						Concentrations in mg/kg			%	Concentrations in mg/kg												
PWS-13	PWS-13_1-4_SE	7/11/2012	P	0.08	0.33	NT	NT	**27,000**	**0.16%**	**4.25**	**6.37**	**0.0589**	**0.144**	**0.0947**	**0.0341**	**0.272**	**0.192**	**0.278**	**0.336**	**0.192**	**0.166**	**0.107**
PWS-13	PWS-13_8-11_SE	7/11/2012	P	0.66	0.92	NT	NT	**20,000**	**0.15%**	**3.50**	**5.60**	**0.0378**	**0.103**	**0.0736**	**0.0238**	**0.108**	**0.238**	**0.25**	**0.464**	**0.218**	**0.126**	**0.152 J**
PWS-13	PWS-13_8-11	10/9/2012	P	0.66	0.92	NT	NT	**22,000**	**0.24%**	**6.54**	**47.2**	**0.0508**	**0.103**	**0.247**	**0.0297**	**0.215**	**0.496**	**0.28**	**0.271**	**0.241**	**0.0856**	**0.107**
PWS-13	PWS-13_8-11_1	10/9/2012	FD	0.66	0.92	NT	NT	NT	NT	**9.88**	**51.5**	**0.111 J**	**0.302 J**	**0.347 J**	**0.0537 J**	**0.317 J**	**0.599 J**	**0.323 J**	**0.429 J**	**0.312 J**	**0.16 J**	**0.138 J**
PWS-13	PWS-13_8-11_2	10/9/2012	FT	0.66	0.92	NT	NT	NT	NT	**5.00**	**33.6**	**0.0585 J**	**0.137 J**	**0.187 J**	**0.0341 J**	**0.159 J**	**0.29 J**	**0.258 J**	**0.302 J**	**0.252 J**	**0.135 J**	**0.0906 J**
PWS-14	PWS-14_4-8	10/11/2012	P	0.33	0.66	NT	NT	**22,000**	**0.18%**	**7.10**	**10.8**	**0.493**	**1.03**	**0.455**	0.0110 U	**0.17**	**0.15**	**0.0362**	**0.0770**	**0.0329**	**0.0119 J**	**0.0270**
PWS-15	PWS-15_8-11_SE	7/12/2012	P	0.66	0.92	NT	NT	**15,000**	**0.10%**	**0.515**	**1.41**	**0.00782 J**	**0.00952 J**	**0.00906 J**	0.00759 U	**0.0126 J**	**0.0179**	**0.0205 J**	**0.0265**	**0.0168 J**	0.00759 U	**0.0156 J**
PWS-15	PWS-15_8-11	10/11/2012	P	0.66	0.92	NT	NT	**8,100**	**0.12%**	**0.361**	**0.955**	0.00668 U	**0.0123 J**	**0.0236**	0.00668 U	**0.0101 J**	**0.0214**	**0.0112 J**	**0.0207 J**	**0.0107 J**	**0.00872 J**	**0.00782 J**
PWS-16	PWS-16_8-11_SE	7/9/2012	P	0.66	0.92	NT	NT	**20,000**	**0.15%**	**28.5**	**42.8**	**0.896**	**2.2**	**1.3**	**0.158**	**1.55**	**0.932**	**0.436**	**1**	**0.517**	**0.2**	**0.281**
PWS-16	PWS-16B_8-11_SE	7/13/2012	P	0.66	0.92	NT	NT	**22,000**	**0.17%**	**7.81**	**11.8**	**0.15**	**0.395**	**0.28**	**0.0597**	**0.336**	**0.439**	**0.254**	**0.54**	**0.283**	**0.148 J**	**0.169**
PWS-16	PWS-16_8-11	10/9/2012	P	0.66	0.92	NT	NT	**16,000**	**0.23%**	**2.42**	**3.95**	**0.0375**	**0.0844**	**0.0817**	**0.0176**	**0.106**	**0.146**	**0.0809**	**0.181 J**	**0.0988**	**0.0524**	**0.0553 J**
PWS-17	PWS-17_4-7	10/10/2012	P	0.33	0.58	NT	NT	**9,500**	**0.12%**	**0.90**	**1.56**	**0.0803**	**0.0458**	**0.149**	**0.00891 J**	**0.0238**	**0.0263**	**0.0203**	**0.0471 J**	**0.0283**	**0.0190**	**0.0137 J**
PWS-18	PWS-18_8-11_SE	7/11/2012	P	0.66	0.92	NT	NT	**35,000**	**0.19%**	**3.37**	**9.32**	**0.0391**	**0.0958**	**0.0556**	**0.023**	**0.134**	**0.291**	**0.137**	**0.177**	**0.121**	0.102 U	**0.0899**
PWS-18	PWS-18_8-10	10/11/2012	P	0.66	0.83	NT	NT	**28,000**	**0.24%**	**0.332**	**1.91**	0.00988 U	0.00988 U	0.00988 U	0.00988 U	0.00988 U	**0.0261**	**0.0289**	**0.0396 J**	**0.0308**	**0.0213**	**0.0134 J**
PWS-19	PWS-19_8-11_SE	7/11/2012	P	0.66	0.92	NT	NT	**16,000**	**0.15%**	**1.75**	**3.09**	**0.0245**	**0.0539**	**0.0543**	**0.0208**	**0.0443**	**0.0832**	**0.124**	**0.138**	**0.101**	**0.0861**	**0.0489**
PWS-19	PWS-19_8-11	10/11/2012	P	0.66	0.92	NT	NT	**13,000**	**0.19%**	**1.02**	**1.80**	**0.0150 J**	**0.0388**	**0.0172**	**0.0151 J**	**0.0233**	**0.0596**	**0.0830**	**0.104**	**0.0649**	**0.0666**	**0.0341**
PWS-20	PWS-20_8-11_SE	7/11/2012	P	0.66	0.92	NT	NT	**11,000**	**0.11%**	**0.96**	**1.71**	**0.0125 J**	**0.0305**	**0.0158**	**0.00791 J**	**0.0241**	**0.0439**	**0.0584**	**0.0791**	**0.0486**	**0.0274**	**0.0271**
PWS-20	PWS-20_8-11 DUP_SE	7/11/2012	FD	0.66	0.92	NT	NT	**10,000**	**0.12%**	**1.09**	**1.87**	**0.0126 J**	**0.0359**	**0.0143 J**	**0.00859 J**	**0.0253**	**0.0646**	**0.0852**	**0.12**	**0.0619**	**0.0336**	**0.0407**
PWS-20	PWS-20_8-11	10/9/2012	P	0.66	0.92	NT	NT	**11,000**	**0.16%**	**0.283**	**2.17**	0.00587 U	**0.00802 J**	0.00587 U	0.00587 U	0.00587 U	**0.0169**	**0.0193**	**0.0271 J**	**0.0172**	**0.0181**	**0.00892 J**
PWS-21	PWS-21_8-10_SE	7/11/2012	P	0.66	0.83	NT	NT	**11,000**	**0.11%**	**0.286**	**0.950**	0.00766 U	0.00766 U	0.00766 U	0.00766 U	0.00766 U	0.00766 U	0.0115 U	0.0115 U	0.0115 U	0.00766 U	0.0115 U
PWS-22	PWS-22_8-11 SEDIMENT	7/12/2012	P	0.66	0.92	NT	NT	NT	NT	**2.31**	**4.25**	**0.0137 J**	**0.0333**	**0.0986**	**0.0194**	**0.0762**	**0.221 J**	**0.124 J**	**0.229 J**	**0.109 J**	**0.0516 J**	**0.0652 J**
PWS-24	PWS-24_8-11 SEDIMENT	7/12/2012	P	0.66	0.92	NT	NT	NT	NT	**7.46**	**21.2**	**0.012 J**	**0.223**	**0.0227**	**0.0138 J**	**3.77**	**0.231**	**0.158**	**0.263**	**0.119**	**0.0619**	**0.0897**
PWS-25	PWS-25_8-11_SE	7/13/2012	P	0.66	0.92	NT	NT	**16,000**	**0.15%**	**16.6**	**24.3**	**0.237**	**0.625**	**0.536**	**0.109**	**0.509**	**0.795**	**0.797**	**1.53**	**0.783**	**0.421**	**0.522**
PWS-25	PWS-25_4-8	10/11/2012	P	0.33	0.66	NT	NT	**9,800**	**0.14%**	**12.4**	**17.4**	**0.0732**	**0.17**	**0.161**	**0.0476**	**0.367**	**1.33**	**1.14**	**1.74**	**0.836**	**0.439**	**0.613**
PWS-26	PWS-26_8-11_SE	7/13/2012	P	0.66	0.92	NT	NT	**12,000**	**0.16%**	**10.4**	**15.8**	**0.253**	**0.673**	**0.572**	**0.0506**	**0.477**	**0.353**	**0.29**	**0.515**	**0.264**	**0.183**	**0.172**
PWS-26	PWS-26_8-11	10/11/2012	P	0.66	0.92	NT	NT	**10,000**	**0.21%**	**8.23**	**15.1**	**0.154**	**0.336**	**0.322**	**0.0527**	**0.436**	**0.392 J**	**0.399 J**	**0.736 J**	**0.357 J**	**0.206**	**0.275 J**
PWS-26	PWS-26_8-11_DUP	10/11/2012	FD	0.66	0.92	NT	NT	**14,000**	**0.23%**	**12.3**	**19.5**	**0.163**	**0.382**	**0.326**	**0.0702**	**0.506**	**0.886 J**	**0.776 J**	**1.34 J**	**0.631 J**	**0.324**	**0.466 J**
PWS-27	PWS-27_8-11_SE	7/13/2012	P	0.66	0.92	NT	NT	**18,000**	**0.13%**	**1.08**	**2.05**	0.00805 U	**0.018**	**0.00987 J**	0.00805 U	**0.0179**	**0.0698**	**0.102**	**0.135**	**0.0711**	0.0805 U	**0.0458**
PWS-27	PWS-27_8-11	10/9/2012	P	0.66	0.92	NT	NT	**17,000**	**0.17%**	**1.06**	**2.14**	0.00689 U	**0.00972 J**	**0.0104 J**	**0.00934 J**	**0.0264**	**0.0645**	**0.0646**	**0.0950**	**0.0580**	**0.0491**	**0.0339**
PWS-28	PWS-28_8-11	10/10/2012	P	0.66	0.92	NT	NT	**11,000**	**0.17%**	**0.83**	**1.53**	**0.00614 J**	**0.0110 J**	0.00603 U	**0.0165**	**0.0106 J**	**0.0418**	**0.0853**	**0.0880**	**0.0683**	**0.0690**	**0.0310**
PWS-29	PWS-29_8-11	10/12/2012	P	0.66	0.92	NT	NT	**10,000**	**0.14%**	**5.68**	**8.78**	**0.728**	**0.00889 J**	**1.67**	0.0159 U	**0.233**	**0.0744**	**0.0255**	**0.0461 J**	**0.0189**	0.00797 U	**0.0158 J**
PWS-30	PWS-30_8-11	10/12/2012	P	0.66	0.92	NT	NT	**11,000**	**0.13%**	0.0726	0.812	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U
SB--01	SB01-0-0.3	7/14/2011	P	0	0.3	48.6 U	97.2 U	**24,000**	NT	**0.994**	NA	NT	NT	0.0458 U	0.0458 U	**0.0474**	**0.0659**	**0.0630**	NT	NT	**0.0630**	NT
SB--01	SB01-5	7/14/2011	P	4.7	5	**42.4 N**	53.7 U	NT	NT	**18.8**	NA	NT	NT	**1.84**	0.209 U	**1**	**0.572**	0.209 U	NT	NT	0.209 U	NT
SB--02	SB02-0.0.3	7/14/2011	P	0	0.3	41.4 U	82.9 U	**24,000**	NT	**0.955**	**2.64**	NT	NT	0.0366 U	0.0366 U	**0.0492**	**0.0557**	**0.0436**	NT	**0.0390**	**0.0367**	NT
SB--02	SB02-12.5	7/14/2011	P	12.2	12.5	30.1 U	60.2 U	NT	NT	0.237	NA	NT	NT	0.0296 U	0.0296 U	0.0296 U	0.0296 U	0.0296 U	0.0296 U	NT	0.0296 U	0.0296 U
SB-03	SB03_0-0.3	7/14/2011	P	0	0.3	54.9 U	110 U	**23,000**	NT	**0.650**	NA	NT	NT	0.0214 U	0.0214 U	**0.0386**	**0.0403**	**0.0326**	NT	NT	**0.0339**	NT
SB-03	SB03-7	7/14/2011	P	6.7	7	**788 N**	**803 N**	NT	NT	**147**	NA	NT	NT	**11.5**	0.888 U	**10.5**	**4.16**	**1.17**	NT	NT	0.888 U	NT
SB-03	SB03-11	7/14/2011	P	10.7	11	28.5 U	57.0 U	NT	NT	0.198	NA	NT	NT	0.0248 U	0.0248 U	0.0248 U	0.0248 U	0.0248 U	0.0248 U	NT	0.0248 U	0.0248 U
SB-03	SB03-11 DUPLICATE	7/14/2011	FD	10.7	11	28.6 U	57.1 U	NT	NT	0.154	NA	NT	NT	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	NT	0.0193 U	0.0193 U
SB-04	SB04-0-0.3	7/14/2011	P	0	0.3	43.9 U	87.9 U	**21,000**	NT	**2.23**	NA	NT	NT	**0.0577 J**	0.0370 U	**0.134 J**	**0.116**	**0.0996**	NT	NT	**0.0956**	NT
SB-04	SB04-3	7/14/2011	P	2.7	3	**1030 N**	**726 N**	NT	NT	**421**	**666**	NT	NT	**39.6**	**0.943**	**24**	**11.7**	**4.04**	NT	**2.9**	**1.28**	NT
SB-05	SB05-0-0.3	7/14/2011	P	0	0.3	**35.5 N**	**80.7**	**5,700**	NT	**1.83**	**3.24**	NT	NT	**0.161**	**0.0242**	**0.101**	**0.0609**	**0.0489**	NT	**0.0580**	**0.0360**	NT
SB-05	SB05-4	7/14/2011	P	3.7	4	**2070 N**	**1010 N**	NT	NT	**637**	**1,325**	NT	NT	**70.8**	**1.23**	**40.9**	**15.9**	**4.13**	NT	**5.07**	**1.05**	NT
SB-05	SB05-8	7/14/2011	P	7.7	8	**36.8 N**	50.0 U	NT	NT	**15.1**	NA	NT	NT	**1.9**	0.114 U	**0.645**	**0.356**	0.114 U	NT	NT	0.114 U	NT

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs																	
						Benzofluoranthenes	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(a,h)anthracene
						Concentrations in mg/kg																	
PWS-13	PWS-13_1-4_SE	7/11/2012	P	0.08	0.33	NT	**0.13**	**0.238**	0.101 U	NT	**0.257**	0.101 U	0.101 U	**0.201**	**0.162**	0.101 U	0.101 U	**0.184**	0.101 U	0.201 U	0.101 U	0.201 U	**0.277**	**0.0275**
PWS-13	PWS-13_8-11_SE	7/11/2012	P	0.66	0.92	NT	**0.223**	**0.281**	0.0918 U	NT	**0.187**	**0.094**	0.0918 U	**0.121**	**0.126**	**0.11**	0.0918 U	**0.1**	**0.133**	0.184 U	0.0918 U	0.184 U	**0.314**	**0.0301**
PWS-13	PWS-13_8-11	10/9/2012	P	0.66	0.92	**0.381**	**1.5**	**1.96**	**0.674**	NT	**3.79**	**1.84**	**1.41**	**1.66**	**5.68**	**1.41**	**1.74**	**5.33**	**4.6**	**0.557**	**3.79**	**4.37**	**0.885**	**0.0440**
PWS-13	PWS-13_8-11_1	10/9/2012	FD	0.66	0.92	**0.572 J**	**1.77 J**	**2.34 J**	**0.638 J**	NT	**4.27 J**	**2.06 J**	**1.07 J**	**2.19 J**	**5.5 J**	**1.66 J**	**1.42 J**	**5.59 J**	**5.26 J**	**0.547 J**	**3.68 J**	**2.93 J**	**1.12 J**	**0.0432 J**
PWS-13	PWS-13_8-11_2	10/9/2012	FT	0.66	0.92	**0.401 J**	**1.22 J**	**1.33 J**	**0.396 J**	NT	**2.66 J**	**1.51 J**	**0.726 J**	**1.5 J**	**3.59 J**	**1.06 J**	**0.951 J**	**4.14 J**	**3.7 J**	**0.537 J**	**2.64 J**	**2.18 J**	**0.449 J**	**0.0392 J**
PWS-14	PWS-14_4-8	10/11/2012	P	0.33	0.66	**0.102**	0.11 U	**0.252**	0.11 U	NT	**0.389**	0.11 U	0.11 U	**0.445**	**0.197**	0.11 U	0.11 U	**0.19**	0.11 U	0.219 U	0.11 U	0.219 U	**0.173**	0.0110 U
PWS-15	PWS-15_8-11_SE	7/12/2012	P	0.66	0.92	NT	0.0759 U	0.0759 U	0.0759 U	NT	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	**0.0896**	0.0759 U	0.152 U	0.0759 U	**0.238**	**0.0248**	0.00759 U
PWS-15	PWS-15_8-11	10/11/2012	P	0.66	0.92	**0.0276**	0.0668 U	0.0668 U	0.0668 U	NT	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.134 U	0.0668 U	0.134 U	**0.0215**	0.00668 U
PWS-16	PWS-16_8-11_SE	7/9/2012	P	0.66	0.92	NT	**0.63**	**1.58**	**0.442**	NT	**2.07**	**0.223**	**0.363**	**1.83**	**1.01**	**0.25**	**0.17**	**0.964**	**0.377**	0.169 U	**0.388**	**0.232**	**1.11**	0.0844 U
PWS-16	PWS-16B_8-11_SE	7/13/2012	P	0.66	0.92	NT	**0.258**	**0.609**	**0.107**	NT	**0.462**	**0.101**	**0.102**	**0.327**	**0.309**	**0.113**	0.0855 U	**0.208**	**0.221**	0.171 U	**0.118**	0.171 U	**0.554**	0.0855 U
PWS-16	PWS-16_8-11	10/9/2012	P	0.66	0.92	**0.231**	**0.101**	**0.209**	0.0711 U	NT	**0.192**	0.0711 U	0.0711 U	**0.0916**	**0.143**	**0.0934**	0.0711 U	**0.0814**	**0.0806**	0.142 U	0.0711 U	0.142 U	**0.197**	**0.0148**
PWS-17	PWS-17_4-7	10/10/2012	P	0.33	0.58	**0.0587**	0.0553 U	0.0553 U	0.0553 U	NT	0.0553 U	0.0553 U	0.0553 U	**0.0597**	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.111 U	0.0553 U	0.111 U	**0.0403**	0.00553 U
PWS-18	PWS-18_8-11_SE	7/11/2012	P	0.66	0.92	NT	**0.224**	**0.641**	0.102 U	NT	**0.411**	**0.198**	**0.135**	**0.163**	**0.289**	**0.2**	**0.147**	**0.268**	**0.201**	0.204 U	**0.292**	**2.37**	**0.836**	0.102 U
PWS-18	PWS-18_8-10	10/11/2012	P	0.66	0.83	**0.0507**	0.0988 U	0.0988 U	0.0988 U	NT	0.0988 U	0.0988 U	0.0988 U	0.0988 U	0.0988 U	0.0988 U	0.0988 U	0.0988 U	0.0988 U	0.198 U	0.0988 U	**0.797**	**0.0314**	0.00988 U
PWS-19	PWS-19_8-11_SE	7/11/2012	P	0.66	0.92	NT	**0.138**	**0.128**	0.0881 U	NT	**0.102**	**0.135**	0.0881 U	0.0881 U	0.0881 U	**0.134**	0.0881 U	0.0881 U	0.0881 U	0.176 U	0.0881 U	0.176 U	**0.109**	**0.015 J**
PWS-19	PWS-19_8-11	10/11/2012	P	0.66	0.92	**0.135**	0.0787 U	0.0787 U	0.0787 U	NT	0.0787 U	0.0787 U	0.0787 U	0.0787 U	0.0787 U	0.0787 U	0.0787 U	0.0787 U	0.0787 U	0.157 U	0.0787 U	0.157 U	**0.0927**	**0.0101 J**
PWS-20	PWS-20_8-11_SE	7/11/2012	P	0.66	0.92	NT	0.0781 U	0.0781 U	0.0781 U	NT	0.0781 U	0.0781 U	0.0781 U	0.0781 U	0.0781 U	0.0781 U	0.0781 U	0.0781 U	0.0781 U	0.156 U	0.0781 U	0.156 U	**0.0546**	0.00781 U
PWS-20	PWS-20_8-11 DUP_SE	7/11/2012	FD	0.66	0.92	NT	0.0785 U	0.0785 U	0.0785 U	NT	0.0785 U	0.0785 U	0.0785 U	0.0785 U	0.0785 U	0.0785 U	0.0785 U	0.0785 U	0.0785 U	0.157 U	0.0785 U	0.157 U	**0.0738**	**0.0094 J**
PWS-20	PWS-20_8-11	10/9/2012	P	0.66	0.92	**0.0341**	0.0587 U	0.0587 U	0.0587 U	NT	0.0587 U	0.0587 U	0.0587 U	0.0587 U	0.0587 U	0.0587 U	0.0587 U	0.0587 U	0.0587 U	0.117 U	0.0587 U	**1.42**	**0.0232**	0.00587 U
PWS-21	PWS-21_8-10_SE	7/11/2012	P	0.66	0.83	NT	0.0766 U	0.0766 U	0.0766 U	NT	0.0766 U	0.0766 U	0.0766 U	0.0766 U	0.0766 U	0.0766 U	0.0766 U	0.0766 U	0.0766 U	0.153 U	0.0766 U	0.153 U	0.00766 U	0.00766 U
PWS-22	PWS-22_8-11 SEDIMENT	7/12/2012	P	0.66	0.92	**0.301**	**0.194**	**0.343**	0.0725 U	NT	**0.164**	**0.13**	0.0725 U	0.0725 U	**0.219**	**0.0749**	0.0725 U	0.0725 U	**0.255**	0.145 U	**0.0783**	0.145 U	**0.277**	**0.0182**
PWS-24	PWS-24_8-11 SEDIMENT	7/12/2012	P	0.66	0.92	**0.353**	**0.152**	**0.695**	0.0759 U	NT	**0.385**	0.0759 U	0.0759 U	**0.131**	**0.143**	0.0759 U	0.0759 U	0.0759 U	**0.105**	0.152 U	0.0759 U	**11.4**	**0.269**	**0.0183**
PWS-25	PWS-25_8-11_SE	7/13/2012	P	0.66	0.92	NT	**0.578**	**1.25**	**0.173**	NT	**0.953**	**0.267**	**0.197**	**0.523**	**0.593**	**0.231**	**0.108**	**0.371**	**0.291**	0.164 U	**0.207**	**0.275**	**1.25**	**0.117 J**
PWS-25	PWS-25_4-8	10/11/2012	P	0.33	0.66	**2.27**	**0.578**	**1.21**	**0.0922**	NT	**0.399**	**0.197**	0.0734 U	**0.17**	**0.3**	**0.146**	**0.118**	**0.113**	**0.153**	0.147 U	0.0734 U	**0.299**	**1.64**	**0.14**
PWS-26	PWS-26_8-11_SE	7/13/2012	P	0.66	0.92	NT	**0.22**	**0.581**	**0.163**	NT	**0.752**	**0.137**	**0.133**	**0.556**	**0.341**	**0.114**	0.0819 U	**0.353**	**0.168**	0.164 U	**0.158**	**0.406**	**0.502**	0.0819 U
PWS-26	PWS-26_8-11	10/11/2012	P	0.66	0.92	**0.966**	**0.271 J**	**0.591 J**	**0.146**	NT	**0.612**	**0.132 J**	**0.0903**	**0.346**	**0.356 J**	**0.113**	**0.129 J**	**0.251**	**0.18**	0.149 U	**0.13**	**2.59 J**	**0.711 J**	**0.0554 J**
PWS-26	PWS-26_8-11_DUP	10/11/2012	FD	0.66	0.92	**1.74**	**0.548 J**	**1.09 J**	**0.161**	NT	**0.833**	**0.243 J**	**0.123**	**0.361**	**0.599 J**	**0.183**	**0.217 J**	**0.253**	**0.297**	0.151 U	**0.153**	**0.876 J**	**1.32 J**	**0.0995 J**
PWS-27	PWS-27_8-11_SE	7/13/2012	P	0.66	0.92	NT	**0.0807**	**0.0849**	0.0805 U	NT	0.0805 U	**0.145**	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	**0.084**	0.0805 U
PWS-27	PWS-27_8-11	10/9/2012	P	0.66	0.92	**0.123**	**0.0697**	**0.0954**	0.0689 U	NT	**0.119**	**0.0705**	0.0689 U	0.0689 U	**0.118**	**0.0994**	0.0689 U	0.0689 U	**0.0965**	0.138 U	0.0689 U	0.138 U	**0.0923**	**0.0103 J**
PWS-28	PWS-28_8-11	10/10/2012	P	0.66	0.92	**0.114**	**0.0695**	0.0603 U	0.0603 U	NT	0.0603 U	**0.0682**	0.0603 U	0.0603 U	0.0603 U	**0.0616**	0.0603 U	0.0603 U	0.0603 U	0.121 U	0.0603 U	0.121 U	**0.0658**	**0.0103 J**
PWS-29	PWS-29_8-11	10/12/2012	P	0.66	0.92	**0.0595**	0.0797 U	**0.101**	**0.132**	NT	**0.266**	0.0797 U	0.0797 U	**0.948**	**0.0895**	0.0797 U	0.0797 U	**0.323**	0.0797 U	0.159 U	**0.0912**	0.159 U	**0.0728**	0.00797 U
PWS-30	PWS-30_8-11	10/12/2012	P	0.66	0.92	0.0171 U	0.0853 U	0.0853 U	0.0853 U	NT	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.171 U	0.0853 U	0.171 U	0.00853 U	0.00853 U
SB--01	SB01-0-0.3	7/14/2011	P	0	0.3	**0.132**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.0986**	0.0458 U
SB--01	SB01-5	7/14/2011	P	4.7	5	**0.429**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.589**	0.209 U
SB--02	SB02-0.0.3	7/14/2011	P	0	0.3	**0.0939**	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.366 UJ	0.183 UJ	0.366 UJ	**0.0669**	0.0366 U
SB--02	SB02-12.5	7/14/2011	P	12.2	12.5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0296 U	0.0296 U
SB-03	SB03_0-0.3	7/14/2011	P	0	0.3	**0.0720**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.0563**	0.0214 U
SB-03	SB03-7	7/14/2011	P	6.7	7	**2.87**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**4.46**	0.888 U
SB-03	SB03-11	7/14/2011	P	10.7	11	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0248 U	0.0248 U
SB-03	SB03-11 DUPLICATE	7/14/2011	FD	10.7	11	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0193 U	0.0193 U
SB-04	SB04-0-0.3	7/14/2011	P	0	0.3	**0.204**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.16**	0.0370 U
SB-04	SB04-3	7/14/2011	P	2.7	3	**9.5**	**5.7 J**	**21.2 J**	**9.4 J**	**28.4 J**	**41.8 J**	**1.58 J**	**5.4 J**	**50.3 J**	**18.4 J**	1.45 UJ	**3.03 J**	**33.3 J**	**6.7 J**	2.91 UJ	**12.7 J**	2.91 UJ	**11.9**	**0.441**
SB-05	SB05-0-0.3	7/14/2011	P	0	0.3	**0.122**	0.105 UJ	**0.135 J**	0.105 UJ	0.105 UJ	**0.156 J**	0.105 UJ	0.105 UJ	**0.114 J**	**0.114 J**	0.105 UJ	0.105 UJ	**0.148 J**	0.105 UJ	0.211 UJ	0.105 UJ	0.211 UJ	**0.0961**	0.0211 U
SB-05	SB05-4	7/14/2011	P	3.7	4	**10.1**	**12.6 J**	**57 J**	**29.2 J**	**119 J**	**128 J**	**3.01 J**	**12.7 J**	**145 J**	**48.6 J**	1.6 UJ	**7.85 J**	**76.5 J**	**14.9 J**	3.2 UJ	**24.6 J**	3.2 UJ	**16.9**	0.717 U
SB-05	SB05-8	7/14/2011	P	7.7	8	0.227 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.31**	0.114 U

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs						
						Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene
						Concentrations in mg/kg						
PWS-13	PWS-13_1-4_SE	7/11/2012	P	0.08	0.33	**0.596**	**0.142**	**0.162**	**0.359**	**0.0946**	**0.496**	**0.612**
PWS-13	PWS-13_8-11_SE	7/11/2012	P	0.66	0.92	**0.433**	**0.0971**	**0.126**	**0.255**	**0.101**	**0.341**	**0.37**
PWS-13	PWS-13_8-11	10/9/2012	P	0.66	0.92	**0.977**	**0.208**	**0.0701**	**0.276**	**0.0965**	**1.24**	**1.01**
PWS-13	PWS-13_8-11_1	10/9/2012	FD	0.66	0.92	**1.63 J**	**0.334 J**	**0.127 J**	**0.766 J**	**0.123 J**	**1.77 J**	**1.6 J**
PWS-13	PWS-13_8-11_2	10/9/2012	FT	0.66	0.92	**0.662 J**	**0.169 J**	**0.109 J**	**0.305 J**	**0.088 J**	**0.965 J**	**0.748 J**
PWS-14	PWS-14_4-8	10/11/2012	P	0.33	0.66	**0.505**	**0.417**	**0.0150 J**	**3.95**	**0.0177 J**	**0.79**	**0.293**
PWS-15	PWS-15_8-11_SE	7/12/2012	P	0.66	0.92	**0.0976**	**0.00974 J**	**0.00778 J**	**0.0233**	**0.086**	**0.0736**	**0.0789**
PWS-15	PWS-15_8-11	10/11/2012	P	0.66	0.92	**0.0584**	**0.0150**	**0.00881 J**	**0.0329**	**0.0264**	**0.0405**	**0.0480**
PWS-16	PWS-16_8-11_SE	7/9/2012	P	0.66	0.92	**4.9**	**1.56**	**0.229**	**5.44**	**0.173**	**5.75**	**3.48**
PWS-16	PWS-16B_8-11_SE	7/13/2012	P	0.66	0.92	**1.39**	**0.311**	**0.176**	**0.999**	**0.13**	**0.895**	**1.09**
PWS-16	PWS-16_8-11	10/9/2012	P	0.66	0.92	**0.465**	**0.0989**	**0.0551**	**0.187**	**0.0305**	**0.316**	**0.339**
PWS-17	PWS-17_4-7	10/10/2012	P	0.33	0.58	**0.0825**	**0.0625**	**0.0172**	**0.195**	**0.0162**	**0.124**	**0.0568**
PWS-18	PWS-18_8-11_SE	7/11/2012	P	0.66	0.92	**0.31**	**0.0949**	0.102 U	**0.276**	**0.11**	**0.311**	**0.373**
PWS-18	PWS-18_8-10	10/11/2012	P	0.66	0.83	**0.0322**	0.00988 U	**0.0183 J**	**0.0227**	**0.0158 J**	**0.0238**	**0.0360**
PWS-19	PWS-19_8-11_SE	7/11/2012	P	0.66	0.92	**0.189**	**0.0587**	**0.066**	**0.239**	**0.0871**	**0.174**	**0.209**
PWS-19	PWS-19_8-11	10/11/2012	P	0.66	0.92	**0.0949**	**0.0213**	**0.0557**	**0.116**	**0.0472**	**0.0747**	**0.103**
PWS-20	PWS-20_8-11_SE	7/11/2012	P	0.66	0.92	**0.116**	**0.0221**	**0.0316**	**0.148**	**0.0985**	**0.0866**	**0.11**
PWS-20	PWS-20_8-11 DUP_SE	7/11/2012	FD	0.66	0.92	**0.123**	**0.0216**	**0.0378**	**0.12**	**0.0978**	**0.101**	**0.114**
PWS-20	PWS-20_8-11	10/9/2012	P	0.66	0.92	**0.0352**	0.00587 U	**0.0144**	**0.0287**	**0.0240**	**0.0195**	**0.0353**
PWS-21	PWS-21_8-10_SE	7/11/2012	P	0.66	0.83	0.00766 U	0.00766 U	0.00766 U	0.00766 U	**0.219**	0.00766 U	0.00766 U
PWS-22	PWS-22_8-11 SEDIMENT	7/12/2012	P	0.66	0.92	**0.292**	**0.0607**	**0.0643 J**	**0.122**	**0.0428 J**	**0.277**	**0.267**
PWS-24	PWS-24_8-11 SEDIMENT	7/12/2012	P	0.66	0.92	**0.343**	**0.571**	**0.0724**	**0.228**	**0.0424**	**0.94**	**0.368**
PWS-25	PWS-25_8-11_SE	7/13/2012	P	0.66	0.92	**2.8**	**0.643**	**0.514**	**1.45**	**0.217**	**2.01**	**2.36**
PWS-25	PWS-25_4-8	10/11/2012	P	0.33	0.66	**1.56**	**0.268**	**0.516**	**0.473**	**0.274**	**0.667**	**1.11**
PWS-26	PWS-26_8-11_SE	7/13/2012	P	0.66	0.92	**1.6**	**0.756**	**0.191**	**1.35**	**0.121**	**1.98**	**1.24**
PWS-26	PWS-26_8-11	10/11/2012	P	0.66	0.92	**1.22**	**0.435**	**0.221 J**	**0.776**	**0.0950 J**	**1.09**	**0.854**
PWS-26	PWS-26_8-11_DUP	10/11/2012	FD	0.66	0.92	**1.77**	**0.428**	**0.373 J**	**1**	**0.175 J**	**1.2**	**1.28**
PWS-27	PWS-27_8-11_SE	7/13/2012	P	0.66	0.92	**0.129**	**0.0129 J**	0.0805 U	**0.0665**	**0.0862**	**0.0652**	**0.135**
PWS-27	PWS-27_8-11	10/9/2012	P	0.66	0.92	**0.186**	**0.0141**	**0.0436**	**0.0228**	**0.0516**	**0.103**	**0.186**
PWS-28	PWS-28_8-11	10/10/2012	P	0.66	0.92	**0.132**	**0.00635 J**	**0.0560**	**0.0211**	**0.0287**	**0.0605**	**0.106**
PWS-29	PWS-29_8-11	10/12/2012	P	0.66	0.92	**0.415**	**1.2**	**0.0103 J**	**0.0226**	**0.0161**	**1.61**	**0.25**
PWS-30	PWS-30_8-11	10/12/2012	P	0.66	0.92	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U
SB--01	SB01-0-0.3	7/14/2011	P	0	0.3	**0.141**	0.0458 U	**0.0581**	0.0458 U	NT	**0.0778**	**0.133**
SB--01	SB01-5	7/14/2011	P	4.7	5	**3.4**	**1.02**	0.209 U	**0.308**	NT	**7.14**	**1.99**
SB--02	SB02-0.0.3	7/14/2011	P	0	0.3	**0.155**	0.0366 U	**0.0376**	**0.0784**	**0.0404**	**0.0961**	**0.128**
SB--02	SB02-12.5	7/14/2011	P	12.2	12.5	0.0296 U	0.0296 U	0.0296 U	0.0296 U	NT	0.0296 U	0.0296 U
SB-03	SB03_0-0.3	7/14/2011	P	0	0.3	**0.119**	0.0214 U	**0.0329**	**0.0337**	NT	**0.0514**	**0.0968**
SB-03	SB03-7	7/14/2011	P	6.7	7	**28.5**	**13.3**	0.888 U	**4.32**	NT	**47.3**	**17.5**
SB-03	SB03-11	7/14/2011	P	10.7	11	0.0248 U	0.0248 U	0.0248 U	0.0248 U	NT	0.0248 U	0.0248 U
SB-03	SB03-11 DUPLICATE	7/14/2011	FD	10.7	11	0.0193 U	0.0193 U	0.0193 U	0.0193 U	NT	0.0193 U	0.0193 U
SB-04	SB04-0-0.3	7/14/2011	P	0	0.3	**0.432 J**	**0.0750**	**0.0875**	**0.0837**	NT	**0.337 J**	**0.312 J**
SB-04	SB04-3	7/14/2011	P	2.7	3	**73.8**	**40.9**	**1.59**	**10.3**	**1.19**	**143**	**47.3**
SB-05	SB05-0-0.3	7/14/2011	P	0	0.3	**0.395**	**0.0791**	**0.0415**	**0.0676**	**0.0214**	**0.29**	**0.275**
SB-05	SB05-4	7/14/2011	P	3.7	4	**111**	**73.5**	**1.36**	**2.22**	**1.83**	**222**	**63.8**
SB-05	SB05-8	7/14/2011	P	7.7	8	**2.37**	**1.95**	0.114 U	**0.326**	NT	**5.55**	**1.34**

Please refer to notes at end of table.

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Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	TPH		TOC	Black Carbon	PAHs												
						Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Total Organic Carbon	Black Carbon	Total PAHs[1]	Total PAHs including Homologues	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
						Concentrations in mg/kg			%	Concentrations in mg/kg												
SB-06	SB06-0-0.3	7/14/2011	P	0	0.3	43.8 U	87.6 U	**22,000**	NT	**2.13**	NA	NT	NT	0.0398 U	0.0398 U	**0.119**	**0.157**	**0.131**	NT	NT	**0.106**	NT
SB-06	SB06-5	7/14/2011	P	4	5	**551 N**	**354**	NT	NT	**165**	**256**	NT	NT	**16.1**	**0.282**	**11.1**	**4.23**	**1.14**	NT	**0.748**	**0.349**	NT
SB-06	SB06-13.5	7/14/2011	P	13.2	13.5	48.5 U	97.0 U	NT	NT	0.306	NA	NT	NT	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NT	0.0381 U	0.0381 U
SB-06	SB06-13.5 DUPLICATE	7/14/2011	FD	13.2	13.5	46.7 U	93.4 U	NT	NT	0.309	NA	NT	NT	0.0385 U	0.0385 U	0.0385 U	0.0385 U	0.0385 U	NT	NT	0.0385 U	NT
SB-07	SB07-12.8	7/13/2011	P	12.5	12.8	38.1 U	76.2 U	NT	NT	**0.184**	NA	NT	NT	0.0152 U	0.0152 U	0.0152 U	0.0152 U	0.0152 U	0.0152 U	NT	0.0152 U	0.0152 U
SB-07	SB07-0-0.3	7/13/2011	P	0	0.3	30.6 U	61.1 U	**15,000**	NT	**0.138**	NA	NT	NT	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	NT	0.0129 U	0.0129 U
SB-08	SB08-0-0.3	7/13/2011	P	0	0.3	50.7 U	101 U	**29,000**	NT	**1.71**	**3.70**	NT	NT	**0.0444**	0.0422 U	**0.0833**	**0.107**	**0.0962**	NT	**0.0819**	**0.0728**	NT
SB-08	SB08-4.5	7/13/2011	P	4.2	4.5	**223 N**	**215**	NT	NT	**122**	**186**	NT	NT	**18.9**	**0.241**	**6.89**	**1.93**	**0.591**	NT	**0.496**	**0.198**	NT
SB-08	SB08-8	7/13/2011	P	7.7	8	**53.3 N**	50.0 U	NT	NT	**16.0**	NA	NT	NT	**1.59**	**0.0177**	**0.535**	**0.149**	**0.0290**	NT	NT	0.00834 U	NT
SB-08A	SB08A-0-0.3	7/13/2011	P	0	0.3	48.3 U	96.6 U	**23,000**	NT	**1.12**	NA	NT	NT	**0.0235 J**	0.0199 U	**0.0862**	**0.0747**	**0.0475 J**	NT	NT	**0.0396 J**	NT
SB-08B	SB08B-0-0.3	7/13/2011	P	0	0.3	51.1 U	**131 N**	**25,000**	NT	**0.687**	NA	NT	NT	0.0183 U	0.0183 U	**0.0388**	**0.0505**	**0.0413**	NT	NT	**0.0378**	NT
SB-08C	SB08C-0-0.3	7/13/2011	P	0	0.3	48.1 U	96.2 U	**25,000**	NT	**2.75**	NA	NT	NT	**0.0680**	**0.0204**	**0.195**	**0.117**	**0.0595**	NT	NT	**0.0458**	NT
SB-09	SB09-0-0.3	7/14/2011	P	0	0.3	86.0 U	**208**	**28,000**	NT	**55.9**	**83.0**	NT	NT	**5.4**	0.196 U	**1.74**	**0.832**	**0.339**	NT	**0.265**	**0.215**	NT
SB-09	SB09-5	7/14/2011	P	4.7	5	**1130 N**	**949 N**	NT	NT	**501**	NA	NT	NT	**47.1**	1.86 U	**31.4**	**15**	**4.46**	NT	NT	1.86 U	NT
SB-10	SB10-0-0.3	7/13/2011	P	0	0.3	49.4 U	98.7 U	**24,000**	NT	**13.5**	**20.8**	NT	NT	**1.09**	0.206 U	**0.607**	**0.346**	0.206 U	NT	**0.135**	0.206 U	NT
SB-10	SB10-8	7/13/2011	P	7.7	8	**518 N**	**90.4 N**	NT	NT	**210**	NA	NT	NT	**17.9**	**0.366**	**5.52**	**2.89**	**0.793**	NT	NT	**0.18**	NT
SB-10	SB10-3	7/13/2011	P	2.7	3	**1400**	**572**	NT	NT	**523**	NA	NT	NT	**61.7**	**0.963**	**28.2**	**11.2**	**3.12**	NT	NT	**0.815**	NT
SB-10	SB10-2	7/13/2011	P	1.7	2	**780 N**	**494 N**	NT	NT	**580**	**953**	NT	NT	**73.7**	**0.921**	**29.2**	**9.28**	**2.5**	NT	**1.93**	**0.757**	NT
SB-11	SB11-0-0.3	7/13/2011	P	0	0.3	58.0 U	116 UJ	**28,000**	NT	**2.25**	**4.33**	NT	NT	0.0442 U	0.0442 U	**0.131**	**0.118**	**0.0853**	NT	**0.0835**	**0.0659**	NT
SB-11	SB11-15.5	7/13/2011	P	15.2	15.5	**2750 N**	**383 N**	NT	NT	**917**	NA	NT	NT	**87.1**	**1.97**	**31**	**10.9**	**2.3**	NT	NT	0.568 U	NT
SB-11	SB11-4	7/13/2011	P	3.7	4	**14000 N**	**5120 N**	NT	NT	**2,453**	NA	NT	NT	**191**	**3.76**	**119**	**36.6**	**11.1**	NT	NT	**2.82**	NT
SB-11	SB11-24	7/13/2011	P	23.5	24	**349 N**	**61.5 N**	NT	NT	**86.2**	NA	NT	NT	**7.79**	**0.195**	**4.02**	**1.39**	**0.344**	NT	NT	0.0972 U	NT
SB-12	SB12-0-0.3	7/14/2011	P	0	0.3	111 U	221 U	**26,000**	NT	**8.89**	NA	NT	NT	0.414 U	0.414 U	**0.429**	**0.588**	0.414 U	NT	NT	0.414 U	NT
SB-12	SB12-3.9	7/14/2011	P	3.6	3.9	**425 N**	**551**	NT	NT	**140**	NA	NT	NT	**11.3**	0.624 U	**7.35**	**4.15**	**1.32**	NT	NT	0.624 U	NT
SB-12	SB12-9	7/14/2011	P	11.7	12	71.2 U	142 U	NT	NT	**5.22**	NA	NT	NT	**0.352**	0.159 U	**0.256**	**0.222**	0.159 U	NT	NT	0.159 U	NT
SB-13	SB13-0-0.3	7/14/2011	P	0	0.3	49.3 U	98.5 U	**33,000**	NT	**5.97**	NA	NT	NT	**0.391**	0.191 U	**0.275**	**0.338**	0.191 U	NT	NT	0.191 U	NT
SB-13	SB13-2.5	7/14/2011	P	2.2	2.5	**1680 N**	**909**	NT	NT	**1,036**	NA	NT	NT	**118**	1.89 U	**60.4**	**26.8**	**7.28**	NT	NT	**2.06**	NT
SB-13	SB13-4.4	7/14/2011	P	4.1	4.4	39.4 U	78.8 U	NT	NT	**6.78**	NA	NT	NT	**0.638**	0.353 U	0.353 U	0.353 U	0.353 U	0.353 U	NT	0.353 U	0.353 U
SB-14	SB14-0-0.3	7/15/2011	P	0	0.3	**1380 N**	**898 N**	NT	NT	**580**	**893**	NT	NT	**62.7**	**0.988**	**37.6**	**14.5**	**3.85**	NT	**2.39**	**0.96**	NT
SB-14	SB14-6-7	7/15/2011	P	6	7	**3820 N**	**2010 NJ**	NT	NT	**890**	**1,336**	NT	NT	**90.8**	**2.3**	**58**	**24.6**	**7.72 J**	**15.6 J**	**5.79**	**2.65**	**5.28**
SB-15	SB15-0-0.3	7/15/2011	P	0	0.3	**28.3 N**	**81.5**	**14,000**	NT	**13.9**	**19.0**	NT	NT	0.629 U	0.629 U	**0.643**	**0.896**	**0.995**	NT	**0.894**	0.629 U	NT
SB-15	SB15-8.5	7/15/2011	P	8.2	8.5	**2570 N**	**889 N**	NT	NT	**1,030**	**1,589**	NT	NT	**104**	**1.32**	**47.9**	**17.9**	**5.47**	NT	**3.51**	**1.46**	NT
SB-15	SB15-4	7/15/2011	P	3.7	4	**174 N**	**181**	NT	NT	**32.6**	NA	NT	NT	**6.54**	0.133 U	**1.2**	**0.547**	**0.242**	NT	NT	**0.155**	NT
SB-16	SB16-0-0.3	7/15/2011	P	0	0.3	41.1 U	82.2 U	**28,000**	NT	**3.33**	**5.78**	NT	NT	0.193 U	0.193 U	0.193 U	**0.303**	**0.252**	NT	**0.362**	0.193 U	NT
SB-16	SB16-10	7/15/2011	P	9.7	10	**99.9 N**	**90.4 N**	NT	NT	**61.0**	NA	NT	NT	**6.27**	**0.157**	**2.78**	**1.47**	**0.327**	NT	NT	**0.117**	NT
SB-16	SB16-5-6	7/15/2011	P	5	6	**1260 N**	**1220 N**	NT	NT	**570**	NA	NT	NT	**30.5**	2.21 U	**83.2**	**23.4**	**10.8**	NT	NT	**4.18**	NT
SB-17	SB17-5-6	7/15/2011	P	5	6	**417 N**	**550**	NT	NT	**95.3**	NA	NT	NT	**7.56**	0.695 U	**4.04**	**2.73**	**0.795**	NT	NT	0.695 U	NT
SB-17	SB17-0-0.3	7/15/2011	P	0	0.3	**39.7 N**	**135**	**27,000**	NT	**12.0**	NA	NT	NT	0.586 U	0.586 U	0.586 U	**0.799**	0.586 U	NT	NT	0.586 U	NT
SB-18	SB18-0-0.3	7/15/2011	P	0	0.3	**168 N**	**413 N**	**36,000**	NT	**61.6**	NA	NT	NT	1.9 U	1.9 U	**3.9**	**4.53**	**3.99**	NT	NT	**2.2**	NT
SB-18	SB18-18	7/15/2011	P	17.7	18	**63.6 N**	83.0 U	NT	NT	**55.9**	NA	NT	NT	**2.64**	0.129 U	**9.63**	**2.97**	**1.38**	NT	NT	**0.487**	NT
SB-18	SB18-4	7/15/2011	P	3.7	4	**1810 N**	**694 N**	NT	NT	**1,258**	NA	NT	NT	**138**	**1.81**	**37.3**	**20**	**4.45**	NT	NT	**1.31**	NT
SB-19	SB19-0-0.3	7/15/2011	P	0	0.3	49.0 U	97.9 U	**14,000**	NT	**3.31**	NA	NT	NT	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	NT	0.383 U	0.383 U
SB-19	SB19-1.0	7/15/2011	P	0.7	1	36.2 U	72.5 U	NT	NT	**5.10**	NA	NT	NT	**0.623**	0.152 U	**0.232**	**0.174**	0.152 U	NT	NT	0.152 U	NT
SB-19	SB19-10	7/15/2011	P	9.7	10	35.4 U	70.7 U	NT	NT	0.224	NA	NT	NT	0.0280 U	0.0280 U	0.0280 U	0.0280 U	0.0280 U	0.0280 U	NT	0.0280 U	0.0280 U

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs																	
						Benzofluoranthenes	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(a,h)anthracene
						Concentrations in mg/kg																	
SB-06	SB06-0-0.3	7/14/2011	P	0	0.3	**0.286**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.312**	0.0398 U
SB-06	SB06-5	7/14/2011	P	4	5	**2.71**	**1.76 J**	**7.93 J**	**3.77 J**	**8.43 J**	**17.1 J**	0.723 UJ	**1.73 J**	**19.7 J**	**6.86 J**	0.723 UJ	**1.11 J**	**12.5 J**	**2.44 J**	1.45 UJ	**4.62 J**	1.45 UJ	**4.21**	0.145 U
SB-06	SB06-13.5	7/14/2011	P	13.2	13.5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0381 U	0.0381 U
SB-06	SB06-13.5 DUPLICATE	7/14/2011	FD	13.2	13.5	0.0770 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0385 U	0.0385 U
SB-07	SB07-12.8	7/13/2011	P	12.5	12.8	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0152 U	0.0152 U
SB-07	SB07-0-0.3	7/13/2011	P	0	0.3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0129 U	0.0129 U
SB-08	SB08-0-0.3	7/13/2011	P	0	0.3	**0.226**	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.422 UJ	0.211 UJ	0.422 UJ	**0.17**	0.0422 U
SB-08	SB08-4.5	7/13/2011	P	4.2	4.5	**1.53**	**0.845 J**	**4.12 J**	**2.32 J**	**14 J**	**9.59 J**	0.721 UJ	**0.885 J**	**13.7 J**	**3.28 J**	0.721 UJ	0.721 UJ	**7.83 J**	**0.935 J**	1.44 UJ	**2.52 J**	1.44 UJ	**2.06**	0.144 U
SB-08	SB08-8	7/13/2011	P	7.7	8	**0.0714**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.14**	0.00834 U
SB-08A	SB08A-0-0.3	7/13/2011	P	0	0.3	**0.108 J**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.103**	0.0199 U
SB-08B	SB08B-0-0.3	7/13/2011	P	0	0.3	**0.0937**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.0685**	0.0183 U
SB-08C	SB08C-0-0.3	7/13/2011	P	0	0.3	**0.142**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.14**	0.0200 U
SB-09	SB09-0-0.3	7/14/2011	P	0	0.3	**0.81**	0.98 UJ	**1.88 J**	**1.38 J**	**4.37 J**	**4.24 J**	0.98 UJ	0.98 UJ	**3.76 J**	**2.02 J**	0.98 UJ	0.98 UJ	**2.94 J**	0.98 UJ	1.96 UJ	**1.34 J**	1.96 UJ	**0.962**	0.196 U
SB-09	SB09-5	7/14/2011	P	4.7	5	**9.73**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**14.1**	1.86 U
SB-10	SB10-0-0.3	7/13/2011	P	0	0.3	**0.415**	0.206 UJ	**0.551 J**	**0.234 J**	**1.91 J**	**0.973 J**	0.206 UJ	0.206 UJ	**1.05 J**	**0.452 J**	0.206 UJ	0.206 UJ	**0.684 J**	0.206 UJ	0.413 UJ	**0.233 J**	0.413 UJ	**0.365**	0.206 U
SB-10	SB10-8	7/13/2011	P	7.7	8	**1.74**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**2.4**	**0.0744**
SB-10	SB10-3	7/13/2011	P	2.7	3	**6.94**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**9.99**	**0.308**
SB-10	SB10-2	7/13/2011	P	1.7	2	**6.18**	**3.92 J**	**19.5 J**	**12.9 J**	**135 J**	**50.4 J**	**0.961 J**	**4.17 J**	**74.5 J**	**16.3 J**	0.887 UJ	**2.23 J**	**34.2 J**	**4.9 J**	1.77 UJ	**10.1 J**	1.77 UJ	**8.84**	0.71 U
SB-11	SB11-0-0.3	7/13/2011	P	0	0.3	**0.201**	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.221 UJ	0.442 UJ	0.221 UJ	0.442 UJ	**0.166**	0.0442 U
SB-11	SB11-15.5	7/13/2011	P	15.2	15.5	**5.33**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**9.99**	0.568 U
SB-11	SB11-4	7/13/2011	P	3.7	4	**24.4**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**36.8**	1.71 U
SB-11	SB11-24	7/13/2011	P	23.5	24	**0.783**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**1.35**	0.0972 U
SB-12	SB12-0-0.3	7/14/2011	P	0	0.3	0.828 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.823**	0.414 U
SB-12	SB12-3.9	7/14/2011	P	3.6	3.9	**3.17**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**4.27**	0.624 U
SB-12	SB12-9	7/14/2011	P	11.7	12	0.318 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.202**	0.159 U
SB-13	SB13-0-0.3	7/14/2011	P	0	0.3	0.383 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.328**	0.191 U
SB-13	SB13-2.5	7/14/2011	P	2.2	2.5	**17.3**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**27.4**	1.89 U
SB-13	SB13-4.4	7/14/2011	P	4.1	4.4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.353 U	0.353 U
SB-14	SB14-0-0.3	7/15/2011	P	0	0.3	**8.54**	**5.63 J**	**28.9 J**	**17 J**	**46.5 J**	**63.1 J**	**1.33 J**	**6.1 J**	**60.2 J**	**21.9 J**	**0.443 J**	**3.24 J**	**35.3 J**	**7.42 J**	0.343 UJ	**12 J**	**1.5 J**	**13.5**	**0.323**
SB-14	SB14-6-7	7/15/2011	P	6	7	NT	**10.9 J**	**48.4 J**	**22.2 J**	**68.5 J**	**82 J**	**2.49 J**	**6.88 J**	**78.1 J**	**34.3 J**	**0.835 J**	**4.08 J**	**49.5 J**	**12.1 J**	**0.534 J**	**17 J**	**2.53 J**	**27.8**	**0.869**
SB-15	SB15-0-0.3	7/15/2011	P	0	0.3	**2.18**	**0.74 J**	**0.791 J**	0.145 UJ	**0.347 J**	**0.412 J**	**0.248 J**	0.145 UJ	**0.313 J**	**0.258 J**	0.145 UJ	0.145 UJ	**0.222 J**	**0.237 J**	0.289 UJ	0.145 UJ	0.289 UJ	**1.08**	0.629 U
SB-15	SB15-8.5	7/15/2011	P	8.2	8.5	**12.2**	**7.01 J**	**32 J**	**15.6 J**	**210 J**	**67.1 J**	5.33 UJ	**6.92 J**	**102 J**	**25 J**	5.33 UJ	5.33 UJ	**47.3 J**	**9.76 J**	10.7 UJ	**14.2 J**	10.7 UJ	**16.6**	**0.504**
SB-15	SB15-4	7/15/2011	P	3.7	4	**0.62**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.618**	0.133 U
SB-16	SB16-0-0.3	7/15/2011	P	0	0.3	**0.621**	**0.236 J**	**0.366 J**	0.173 UJ	0.173 UJ	**0.192 J**	0.173 UJ	0.173 UJ	0.173 UJ	0.173 UJ	0.173 UJ	0.173 UJ	0.173 UJ	0.173 UJ	0.346 UJ	0.173 UJ	0.346 UJ	**0.387**	0.193 U
SB-16	SB16-10	7/15/2011	P	9.7	10	**0.987**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**1.76**	0.116 U
SB-16	SB16-5-6	7/15/2011	P	5	6	**25.3**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**27.4**	2.21 U
SB-17	SB17-5-6	7/15/2011	P	5	6	**2.05**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**2.92**	0.695 U
SB-17	SB17-0-0.3	7/15/2011	P	0	0.3	**1.28**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**1.14**	0.586 U
SB-18	SB18-0-0.3	7/15/2011	P	0	0.3	**9.46**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**7.77**	1.9 U
SB-18	SB18-18	7/15/2011	P	17.7	18	**2.88**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**3.7**	**0.157**
SB-18	SB18-4	7/15/2011	P	3.7	4	**10.9**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**17.6**	1.09 U
SB-19	SB19-0-0.3	7/15/2011	P	0	0.3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.383 U	0.383 U
SB-19	SB19-1.0	7/15/2011	P	0.7	1	0.303 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.152 U	0.152 U
SB-19	SB19-10	7/15/2011	P	9.7	10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0280 U	0.0280 U

Please refer to notes at end of table.

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Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
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St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs						
						Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene
						Concentrations in mg/kg						
SB-06	SB06-0-0.3	7/14/2011	P	0	0.3	**0.329**	**0.0440**	**0.104**	**0.0624**	NT	**0.147**	**0.269**
SB-06	SB06-5	7/14/2011	P	4	5	**30.4**	**17.7**	**0.419**	**1.36**	**0.483**	**55.7**	**18.8**
SB-06	SB06-13.5	7/14/2011	P	13.2	13.5	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NT	0.0381 U	0.0381 U
SB-06	SB06-13.5 DUPLICATE	7/14/2011	FD	13.2	13.5	0.0385 U	0.0385 U	0.0385 U	0.0385 U	NT	0.0385 U	0.0385 U
SB-07	SB07-12.8	7/13/2011	P	12.5	12.8	0.0152 U	0.0152 U	0.0152 U	**0.0704**	NT	0.0152 U	0.0152 U
SB-07	SB07-0-0.3	7/13/2011	P	0	0.3	0.0129 U	0.0129 U	0.0129 U	**0.0412**	NT	0.0129 U	0.0129 U
SB-08	SB08-0-0.3	7/13/2011	P	0	0.3	**0.276**	0.0422 U	**0.0734**	**0.142**	0.0422 U	**0.119**	**0.213**
SB-08	SB08-4.5	7/13/2011	P	4.2	4.5	**16.1**	**11.8**	**0.249**	**19.2**	**0.196**	**32.4**	**10.1**
SB-08	SB08-8	7/13/2011	P	7.7	8	**1.24**	**1.61**	**0.00917**	**6.28**	NT	**3.67**	**0.656**
SB-08A	SB08A-0-0.3	7/13/2011	P	0	0.3	**0.194**	**0.0315 J**	**0.0403 J**	**0.0497**	NT	**0.161 J**	**0.146**
SB-08B	SB08B-0-0.3	7/13/2011	P	0	0.3	**0.112**	0.0183 U	**0.0386**	**0.0281**	NT	**0.0435**	**0.0971**
SB-08C	SB08C-0-0.3	7/13/2011	P	0	0.3	**0.872**	**0.0854**	**0.0489**	**0.0712**	NT	**0.353**	**0.522**
SB-09	SB09-0-0.3	7/14/2011	P	0	0.3	**7.3**	**5.92**	**0.216**	**16.1**	0.196 U	**11.5**	**4.23**
SB-09	SB09-5	7/14/2011	P	4.7	5	**94.5**	**48.6**	1.86 U	**3.39**	NT	**171**	**58.2**
SB-10	SB10-0-0.3	7/13/2011	P	0	0.3	**1.83**	**0.942**	0.206 U	**3.81**	**0.0424**	**2.49**	**1.06**
SB-10	SB10-8	7/13/2011	P	7.7	8	**18.3**	**16.4**	**0.24**	**88.7**	NT	**44**	**10.6**
SB-10	SB10-3	7/13/2011	P	2.7	3	**69.7**	**57.6**	**1.03**	**73.9**	NT	**156**	**41.9**
SB-10	SB10-2	7/13/2011	P	1.7	2	**78.2**	**73**	**1.02**	**55.8**	0.71 U	**193**	**46.4**
SB-11	SB11-0-0.3	7/13/2011	P	0	0.3	**0.49**	**0.0691**	**0.0691**	**0.193**	0.0442 U	**0.223**	**0.347**
SB-11	SB11-15.5	7/13/2011	P	15.2	15.5	**83**	**90**	**0.659**	**330**	NT	**221**	**43.4**
SB-11	SB11-4	7/13/2011	P	3.7	4	**243**	**174**	**3.66**	**950**	NT	**511**	**145**
SB-11	SB11-24	7/13/2011	P	23.5	24	**10.2**	**8.12**	**0.108**	**22.3**	NT	**23.9**	**5.62**
SB-12	SB12-0-0.3	7/14/2011	P	0	0.3	**2.17**	0.414 U	0.414 U	0.414 U	NT	**1.23**	**1.58**
SB-12	SB12-3.9	7/14/2011	P	3.6	3.9	**25.7**	**13.4**	0.624 U	**5.6**	NT	**46**	**16.2**
SB-12	SB12-9	7/14/2011	P	11.7	12	**1.04**	**0.354**	0.159 U	0.159 U	NT	**1.52**	**0.642**
SB-13	SB13-0-0.3	7/14/2011	P	0	0.3	**1.24**	**0.39**	0.191 U	0.191 U	NT	**1.39**	**0.849**
SB-13	SB13-2.5	7/14/2011	P	2.2	2.5	**185**	**116**	**2.36**	**5.55**	NT	**356**	**110**
SB-13	SB13-4.4	7/14/2011	P	4.1	4.4	**1.01**	**0.596**	0.353 U	0.353 U	NT	**1.99**	**0.598**
SB-14	SB14-0-0.3	7/15/2011	P	0	0.3	**104**	**61.4**	**1.25**	**4.01**	**0.749**	**204**	**62**
SB-14	SB14-6-7	7/15/2011	P	6	7	**150**	**71.8**	**3.05 J**	**84.3**	**1.83**	**245**	**98.1**
SB-15	SB15-0-0.3	7/15/2011	P	0	0.3	**2.26**	0.629 U	0.629 U	**0.644**	0.578 U	**1.06**	**1.97**
SB-15	SB15-8.5	7/15/2011	P	8.2	8.5	**115**	**91.4**	**1.85**	**257**	2.13 U	**285**	**71.3**
SB-15	SB15-4	7/15/2011	P	3.7	4	**3.16**	**4.46**	**0.19**	**5.09**	NT	**7.65**	**1.95**
SB-16	SB16-0-0.3	7/15/2011	P	0	0.3	**0.459**	0.193 U	0.193 U	0.193 U	0.173 U	0.193 U	**0.353**
SB-16	SB16-10	7/15/2011	P	9.7	10	**11.7**	**4.87**	**0.14**	**4.55**	NT	**18.9**	**6.9**
SB-16	SB16-5-6	7/15/2011	P	5	6	**128**	**33.7**	**5.15**	**4.62**	NT	**103**	**88.2**
SB-17	SB17-5-6	7/15/2011	P	5	6	**19.2**	**9.02**	0.695 U	**2.46**	NT	**31.4**	**11.7**
SB-17	SB17-0-0.3	7/15/2011	P	0	0.3	**2.85**	0.586 U	0.586 U	0.586 U	NT	**1.23**	**2.11**
SB-18	SB18-0-0.3	7/15/2011	P	0	0.3	**10.6**	1.9 U	**2.63**	1.9 U	NT	**3.92**	**7.82**
SB-18	SB18-18	7/15/2011	P	17.7	18	**9.8**	**3.01**	**0.607**	**0.703**	NT	**11.3**	**6.62**
SB-18	SB18-4	7/15/2011	P	3.7	4	**168**	**135**	**1.65**	**254**	NT	**368**	**99.4**
SB-19	SB19-0-0.3	7/15/2011	P	0	0.3	**0.433**	0.383 U	0.383 U	0.383 U	NT	0.383 U	0.383 U
SB-19	SB19-1.0	7/15/2011	P	0.7	1	**0.868**	**0.452**	0.152 U	0.152 U	NT	**1.49**	**0.577**
SB-19	SB19-10	7/15/2011	P	9.7	10	0.0280 U	0.0280 U	0.0280 U	0.0280 U	NT	0.0280 U	0.0280 U

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Table 5-6
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Updated Supplemental RI Report
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St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	TPH		TOC	Black Carbon	PAHs												
						Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Total Organic Carbon	Black Carbon	Total PAHs[1]	Total PAHs including Homologues	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
						Concentrations in mg/kg			%	Concentrations in mg/kg												
SB-20	SB20-0-0.3	7/15/2011	P	0	0.3	47.9 U	**144**	**21,000**	NT	**5.69**	NA	NT	NT	**0.291**	0.165 U	**0.214**	**0.325**	**0.223**	NT	NT	**0.177**	NT
SB-20	SB20-6-7	7/15/2011	P	6	7	**45.0 N**	65.3 U	NT	NT	**17.2**	NA	NT	NT	**2.86**	0.113 U	**0.631**	**0.281**	0.113 U	NT	NT	0.113 U	NT
SB-21	SB21-0-0.3	7/15/2011	P	0	0.3	39.9 U	79.8 U	**29,000**	NT	**5.49**	NA	NT	NT	0.27 U	0.27 U	0.27 U	**0.462**	**0.428**	NT	NT	0.27 U	NT
SB-21	SB021-6-7	7/15/2011	P	6	7	**238**	**330**	NT	NT	**117**	NA	NT	NT	**14.2**	0.923 U	**8.38**	**2.75**	**0.967**	NT	NT	0.923 U	NT
SB-22	SB22-7.5-8	7/15/2011	P	7.5	8	**1790 N**	**1620 N**	NT	NT	**586**	NA	NT	NT	**48.2**	**0.953**	**150**	**9.19**	**2.68**	NT	NT	**0.797**	NT
SB-23	SB23-0-0.3	7/15/2011	P	0	0.3	26.1 U	52.1 U	**520**	NT	**0.857**	NA	NT	NT	**0.193**	0.0108 U	**0.0354**	**0.0259**	**0.0146**	NT	NT	0.0108 U	NT
SB-24	SB24-0-0.3	7/16/2011	P	0	0.3	**164 NJ**	**226**	**44,000**	NT	**52.0**	NA	NT	NT	**2.79**	1.73 U	1.73 U	**2.18**	1.73 U	NT	NT	1.73 U	NT
SB-25	SB25-1.5	7/16/2011	P	1.2	1.5	**95.2 N**	**203**	NT	NT	**88.2**	**135**	NT	NT	**6.14**	**0.263**	**4.12**	**2.51**	**0.988**	NT	**0.73**	**0.491**	NT
SB-26	SB26-0-0.3	7/16/2011	P	0	0.3	46.6 U	93.1 U	**29,000**	NT	**21.2**	NA	NT	NT	**1.19**	0.826 U	**0.961**	**0.873**	0.826 U	NT	NT	0.826 U	NT
SB-26	SB26-4-4.5	7/16/2011	P	4	4.5	**105 N**	**155 N**	NT	NT	**143**	**230**	NT	NT	**15.2**	0.432 U	**7.47**	**2.9**	**0.864**	NT	**0.685**	0.432 U	NT
SB-27	SB27-0-0.3	7/16/2011	P	0	0.3	**93.6 N**	**216**	**27,000**	NT	**87.3**	NA	NT	NT	**16.2**	0.758 U	**3.64**	**1.62**	0.758 U	NT	NT	0.758 U	NT
SB-28	SB28-0-0.3	7/16/2011	P	0	0.3	**253 N**	**289 N**	**27,000**	NT	**117**	**168**	NT	NT	**7.81**	**0.397**	**4.95**	**2.92**	**1.53**	**2.95**	**1.36**	**0.818**	**0.899**
SB-28	SB28-2	7/16/2011	P	1.7	2	**518 N**	**443 N**	NT	NT	**232**	**328**	NT	NT	**10.8 J**	**1.04**	**9.58**	**7.41**	**2.41**	NT	**1.84**	**0.876**	NT
SSED-2	SSED-2	10/6/2011	P	0	0.3	**2830 N**	**889 N**	**24,000 J**	NT	**1,082**	NA	NT	NT	**99.2**	**1.78**	**44**	**16.9**	**4.55**	NT	NT	**1.14**	NT
SSED-5	SSED-5	10/6/2011	P	0	0.3	**982 N**	**3400**	**19,000**	NT	**1,120**	NA	NT	NT	**165**	**2.22**	**49.4**	**26.9**	**6.38**	NT	NT	**1.46**	NT
SSED-6	SSED-6	10/6/2011	P	0	0.3	**10400 N**	**4900 N**	**150,000**	NT	**4,831**	NA	NT	NT	**367**	**8.47**	**263**	**122**	**19.7**	NT	NT	**3.54**	NT
SSED-7	SSED-7	10/7/2011	P	0	0.3	**4240 N**	**2840 N**	**92,000**	NT	**1,017**	NA	NT	NT	**104**	12 U	**73.4**	**36.1**	**12.3**	NT	NT	12 U	NT
SSED-9	SSED-9	10/7/2011	P	0	0.3	36.4 UJ	72.8 U	**19,000**	NT	**31.1**	NA	NT	NT	**3.43**	**0.0987**	**1.46**	**0.573**	**0.107**	NT	NT	**0.0367**	NT
SSED-MC-1	SSED-MC-1	10/6/2011	P	0	0.3	**9300 N**	**1400 N**	**61,000**	NT	**3,028**	NA	NT	NT	**406**	**3.91**	**173**	**57.5**	**10.6**	NT	NT	**1.98**	NT
SSED-MC-3	SSED-MC-3	10/7/2011	P	0	0.3	34.7 U	69.3 U	**16,000**	NT	**0.849**	NA	NT	NT	**0.454**	0.0267 U	0.0267 U	0.0267 U	0.0267 U	0.0267 U	NT	0.0267 U	0.0267 U
SSED-MC-4	SSED-MC-4	10/7/2011	P	0	0.3	**354 N**	**107 N**	**10,000**	NT	**131**	NA	NT	NT	**18.2**	**0.219**	**7.97**	**2.93**	**0.812**	NT	NT	**0.196**	NT

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs																	
						Benzofluoranthenes	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(a,h)anthracene
						Concentrations in mg/kg																	
SB-20	SB20-0-0.3	7/15/2011	P	0	0.3	**0.665**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.497**	0.165 U
SB-20	SB20-6-7	7/15/2011	P	6	7	0.226 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.318**	0.113 U
SB-21	SB21-0-0.3	7/15/2011	P	0	0.3	**0.856**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.566**	0.27 U
SB-21	SB021-6-7	7/15/2011	P	6	7	**2.44**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**3.34**	0.923 U
SB-22	SB22-7.5-8	7/15/2011	P	7.5	8	**6.03**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**11.6**	**0.276**
SB-23	SB23-0-0.3	7/15/2011	P	0	0.3	**0.0341**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.0247**	0.0108 U
SB-24	SB24-0-0.3	7/16/2011	P	0	0.3	3.47 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**1.87**	1.73 U
SB-25	SB25-1.5	7/16/2011	P	1.2	1.5	**2.32**	**1.37 J**	**5.32 J**	**1.77 J**	**5.87 J**	**8.64 J**	**0.392 J**	**0.946 J**	**5.99 J**	**4.33 J**	0.178 UJ	**0.626 J**	**4.8 J**	**3.39 J**	0.355 UJ	**2.13 J**	**0.58 J**	**2.8**	0.178 U
SB-26	SB26-0-0.3	7/16/2011	P	0	0.3	1.65 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.826 U	0.826 U
SB-26	SB26-4-4.5	7/16/2011	P	4	4.5	**2.08**	**1.59 J**	**7.65 J**	**3.8 J**	**8.36 J**	**15.3 J**	**0.56 J**	**1.99 J**	**17.7 J**	**6.2 J**	**0.35 J**	**1 J**	**10.7 J**	**5.5 J**	0.432 UJ	**4.03 J**	**1.34 J**	**3.02**	0.432 U
SB-27	SB27-0-0.3	7/16/2011	P	0	0.3	1.52 U	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**1.69**	0.758 U
SB-28	SB28-0-0.3	7/16/2011	P	0	0.3	NT	**1.6 J**	**5.41 J**	**1.96 J**	**14 J**	**7.76 J**	**0.406 J**	**0.724 J**	**7.18 J**	**3.37 J**	0.182 UJ	**0.498 J**	**3.43 J**	**1.26 J**	0.364 UJ	**1.31 J**	**0.433 J**	**4.8**	**0.222**
SB-28	SB28-2	7/16/2011	P	1.7	2	**5.89**	**3.13 J**	**11.4 J**	**5.25 J**	**8.75 J**	**21.6 J**	0.864 UJ	**2.11 J**	**9.51 J**	**9.27 J**	0.864 UJ	**1.31 J**	**10.8 J**	**3.89 J**	1.73 UJ	**4.86 J**	1.73 UJ	**7.21 J**	0.346 U
SSED-2	SSED-2	10/6/2011	P	0	0.3	**10.8**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**15.7**	0.886 U
SSED-5	SSED-5	10/6/2011	P	0	0.3	**15.7**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**24.4**	**0.633**
SSED-6	SSED-6	10/6/2011	P	0	0.3	**61.6**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**128**	2 U
SSED-7	SSED-7	10/7/2011	P	0	0.3	**30.4**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**35.9**	12 U
SSED-9	SSED-9	10/7/2011	P	0	0.3	**0.325**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**0.634**	0.0203 U
SSED-MC-1	SSED-MC-1	10/6/2011	P	0	0.3	**27.8**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**53.7**	**0.982**
SSED-MC-3	SSED-MC-3	10/7/2011	P	0	0.3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0267 U	0.0267 U
SSED-MC-4	SSED-MC-4	10/7/2011	P	0	0.3	**1.95**	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	**2.67**	**0.0736**

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Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs						
						Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene
						Concentrations in mg/kg						
SB-20	SB20-0-0.3	7/15/2011	P	0	0.3	**0.977**	**0.245**	**0.218**	**0.212**	NT	**0.758**	**0.722**
SB-20	SB20-6-7	7/15/2011	P	6	7	**2.23**	**2.04**	0.113 U	**2.35**	NT	**4.73**	**1.34**
SB-21	SB21-0-0.3	7/15/2011	P	0	0.3	**0.78**	0.27 U	**0.285 J**	0.27 U	NT	**0.372**	**0.757**
SB-21	SB021-6-7	7/15/2011	P	6	7	**16.2**	**12.5**	0.923 U	**8.73**	NT	**35.5**	**10.6**
SB-22	SB22-7.5-8	7/15/2011	P	7.5	8	**72.3**	**60.8**	**0.999**	**10.3**	NT	**168**	**43.4**
SB-23	SB23-0-0.3	7/15/2011	P	0	0.3	**0.12**	**0.145**	0.0108 U	**0.0262**	NT	**0.142**	**0.0740**
SB-24	SB24-0-0.3	7/16/2011	P	0	0.3	**10.8**	**2.98**	1.73 U	**2.89**	NT	**14**	**7.54**
SB-25	SB25-1.5	7/16/2011	P	1.2	1.5	**16**	**6.13**	**0.525**	**12.6**	**0.329**	**22.5**	**10.4**
SB-26	SB26-0-0.3	7/16/2011	P	0	0.3	**3.39**	**1.56**	0.826 U	**2.92**	NT	**4.68**	**2.29**
SB-26	SB26-4-4.5	7/16/2011	P	4	4.5	**24.3**	**16.2**	**0.44**	**6.43**	**0.249**	**48.4**	**14.6**
SB-27	SB27-0-0.3	7/16/2011	P	0	0.3	**13.4**	**12.2**	0.758 U	**4.36**	NT	**23.7**	**7.86**
SB-28	SB28-0-0.3	7/16/2011	P	0	0.3	**17**	**7.74**	**0.968**	**29.6**	**0.395**	**23.3**	**10.5**
SB-28	SB28-2	7/16/2011	P	1.7	2	**49.2**	**14.5**	**1.03**	**20.4**	**0.723**	**70.1**	**30.7**
SSED-2	SSED-2	10/6/2011	P	0	0.3	**111**	**90.3**	**1.55**	**346**	NT	**270**	**68.4**
SSED-5	SSED-5	10/6/2011	P	0	0.3	**191**	**178**	**2.09**	**42.9**	NT	**307**	**107**
SSED-6	SSED-6	10/6/2011	P	0	0.3	**864**	**565**	**5.19**	**318**	NT	**1510**	**594**
SSED-7	SSED-7	10/7/2011	P	0	0.3	**169**	**90.1**	12 U	**12.7**	NT	**312**	**117**
SSED-9	SSED-9	10/7/2011	P	0	0.3	**4.59**	**3.21**	**0.0418**	**7.6**	NT	**6.18**	**2.85**
SSED-MC-1	SSED-MC-1	10/6/2011	P	0	0.3	**387**	**427**	**2.96**	**49.9**	NT	**1170**	**256**
SSED-MC-3	SSED-MC-3	10/7/2011	P	0	0.3	0.0267 U	**0.0905**	0.0267 U	**0.0945**	NT	**0.0490**	0.0267 U
SSED-MC-4	SSED-MC-4	10/7/2011	P	0	0.3	**19.9**	**16.2**	**0.269**	**0.814**	NT	**46.5**	**12.1**

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Cascadia Associates, LLC

Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	TPH		TOC	Black Carbon	PAHs												
						Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Total Organic Carbon	Black Carbon	Total PAHs[1]	Total PAHs including Homologues	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
						Concentrations in mg/kg			%	Concentrations in mg/kg												
Phase 3 Location #1	PWS-090617-1	09/06/2017	P	0	1	NT	NT	29,000	0.363 J	10.0	NA	**0.155**	**0.41**	**0.384**	**0.054**	**0.393**	**0.567**	**0.252**	**0.533 J, M-02**	**0.23**	**0.105**	**0.159 J, M-02**
Phase 3 Location #2	PWS-090617-2	09/06/2017	P	0	1	NT	NT	29,000	0.154 J	3.64	NA	**0.0526**	**0.0949**	**0.123**	**0.0313 J**	**0.127**	**0.172**	**0.155**	**0.21 J, M-02**	**0.131**	**0.0797**	**0.0687 J, M-02**
Phase 3 Location #3	PWS-090517-3	09/05/2017	P	0	1	NT	NT	29,000	0.181 J	4.57	NA	**0.0609**	**0.166**	**0.145**	**0.03 J, Q-42**	**0.119**	**0.187 J, M-02**	**0.178**	**0.243 J, M-02**	**0.139**	**0.122**	**0.0798 J, M-02**
Phase 3 Location #4	PWS-090517-4	09/05/2017	P	0	1	NT	NT	21,000	0.127 J	8.11	NA	**0.1**	**0.246**	**0.416**	**0.049**	**0.294**	**0.363**	**0.326**	**0.495 J, M-02**	**0.213**	**0.141**	**0.186 J, M-02**
Phase 3 Location #5	PWS-090517-5	09/05/2017	P	0	1	NT	NT	14,000	0.068 J	3.39	NA	**0.0137**	**0.0331**	**0.0246**	**0.0161**	**0.0755**	**0.129**	**0.0427**	**0.129 J, M-02**	**0.0534**	**0.0177**	**0.037 J, M-02**
Phase 3 Location #6	PWS-090517-6	09/05/2017	P	0	1	NT	NT	21,000	0.245 J	1.58	NA	**0.0129**	**0.0314**	**0.0628**	**0.0148**	**0.054**	**0.0802**	**0.0789**	**0.135 J, M-02**	**0.0704**	**0.0509**	**0.041 J, M-02**
Phase 3 Location #7	PWS-090517-7	09/05/2017	P	0	1	NT	NT	21,000	0.128 J	3.50	NA	**0.0262**	**0.0654**	**0.202**	**0.0198**	**0.0941**	**0.162**	**0.0847**	**0.15 J, M-02**	**0.0736**	**0.0467**	**0.0443 J, M-02**
Phase 3 Location #8	PWS-090517-8	09/05/2017	P	0	1	NT	NT	23,000	0.244 J	4.56	NA	**0.0548**	**0.133**	**0.155**	**0.0461**	**0.185**	**0.245**	**0.188**	**0.342 J, M-02**	**0.171**	**0.119**	**0.0985 J, M-02**
Phase 3 Location #9	PWS-090517-9	09/05/2017	P	0	1	NT	NT	25,000	0.205 J	53.5	NA	**0.391**	**0.624**	**4.25**	**0.124**	**2.67**	**2.03**	**0.701**	**1.27 J, M-02**	**0.495**	**0.225**	**0.403 J, M-02**
Phase 3 Location #10	PWS-090517-10	09/05/2017	P	0	1	NT	NT	23,000	0.162 J	11.3	NA	**0.0949**	**0.11 J**	**0.687**	**0.0524**	**0.476**	**0.478**	**0.273**	**0.519 J, M-02**	**0.222**	**0.126**	**0.162 J, M-02**
Phase 3 Location #10	PWS-090517-DUP	09/05/2017	FD	0	1	NT	NT	26,000	0.225 J	9.68	NA	**0.152**	**0.295 J**	**0.559**	**0.0469**	**0.389**	**0.45**	**0.331**	**0.569 J, M-02**	**0.257**	**0.16**	**0.181 J, M-02**
Phase 3 Location #11	PWS-090517-11	09/05/2017	P	0	1	NT	NT	23,000	0.255 J	8.83	NA	**0.13**	**0.363**	**0.282**	**0.0873**	**0.408**	**0.43**	**0.366**	**0.741 J, M-02**	**0.358**	**0.209**	**0.21 J, M-02**
Phase 3 Location #12	PWS-090617-12	09/06/2017	P	0	1	NT	NT	10,000	U J	22.7	NA	**0.0661**	**0.171**	**0.326**	**0.141**	**0.984**	**1.79**	**1.91**	**2.95 J, M-02**	**1.5**	**0.641**	**1.18 J, M-02**
Phase 3 Location #13	PWS-090617-13	09/06/2017	P	0	1	NT	NT	23,000	0.067 J	42.0	NA	**0.171**	**0.529**	**0.553**	**0.366**	**1.51**	**3.78**	**2.42**	**4.66 J, M-02**	**2.07**	**0.896**	**1.45 J, M-02**
Phase 3 Location #14	PWS-090517-14	09/05/2017	P	0	1	NT	NT	19,000	0.217 J	14.6	NA	**0.249**	**0.516 J, Q-42**	**0.599**	**0.0576**	**0.747**	**0.62**	**0.283**	**0.608 J, M-02**	**0.254**	**0.111**	**0.183 J, M-02**
Phase 3 Location #15	PWS-090617-15	09/06/2017	P	0	1	NT	NT	19,000	0.158 J	3.15	NA	**0.0692**	**0.0717**	**0.233**	**0.0294**	**0.116**	**0.128**	**0.143**	**0.263 J, M-02**	**0.128**	**0.0811**	**0.0748 J, M-02**

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St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs																	
						Benzofluoranthenes	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(a,h)anthracene
						Concentrations in mg/kg																	
Phase 3 Location #1	PWS-090617-1	09/06/2017	P	0	1	NT	**0.331**	**0.823**	**0.223**	NT	**0.965**	0.17 U	**0.17**	**0.486**	**0.652**	0.17 U	**0.175**	**0.325**	**0.329**	0.341 U	**0.183**	0.341 U	**0.589**	**0.028 J**
Phase 3 Location #2	PWS-090617-2	09/06/2017	P	0	1	NT	**0.332**	**0.431**	0.195 U	NT	**0.971**	**0.377**	**0.305**	**0.837**	**1.2**	**0.347**	**0.347**	**1.25**	**0.934**	0.39 U	**0.836**	**0.764**	**0.238**	0.0195 U
Phase 3 Location #3	PWS-090517-3	09/05/2017	P	0	1	NT	0.168 U	**0.325**	0.168 U	NT	**0.544**	0.168 U	0.168 U	**0.375**	**0.426**	0.168 U	0.168 U	**0.446**	**0.256**	0.336 U	**0.266**	**0.412**	**0.242 J, M-02**	**0.0178 J**
Phase 3 Location #4	PWS-090517-4	09/05/2017	P	0	1	NT	**0.264**	**0.499**	**0.145**	NT	**0.794**	**0.19**	**0.154**	**0.397**	**0.491**	**0.146**	**0.135**	**0.415**	**0.298**	**0.0886**	**0.249**	**0.283**	**0.452**	**0.0369**
Phase 3 Location #5	PWS-090517-5	09/05/2017	P	0	1	NT	**0.081**	**0.268**	0.0309 U	NT	**0.515**	**0.0372**	**0.0736**	**0.0429**	**0.298**	**0.0318**	**0.0582**	**0.0508**	**0.127**	0.0618 U	**0.0401**	0.0618 U	**0.221**	**0.00487 J**
Phase 3 Location #6	PWS-090517-6	09/05/2017	P	0	1	NT	**0.0564**	**0.11**	0.0379 U	NT	**0.112**	**0.0394**	0.0379 U	**0.062**	**0.0829**	0.0379 U	0.0379 U	**0.0594**	**0.0465**	0.0757 U	0.0379 U	0.0757 U	**0.117**	**0.0103**
Phase 3 Location #7	PWS-090517-7	09/05/2017	P	0	1	NT	**0.105**	**0.273**	**0.0852**	NT	**0.404**	**0.0717**	**0.077**	**0.169**	**0.272**	**0.0675**	**0.056**	**0.236**	**0.135**	0.0715 U	**0.13**	**0.0916**	**0.17**	**0.0104**
Phase 3 Location #8	PWS-090517-8	09/05/2017	P	0	1	NT	**0.176**	**0.349**	0.162 U	NT	**0.362**	0.162 U	0.162 U	**0.164**	**0.275**	0.162 U	0.162 U	0.162 U	0.162 U	0.324 U	0.162 U	0.324 U	**0.287**	**0.0262 J**
Phase 3 Location #9	PWS-090517-9	09/05/2017	P	0	1	NT	**0.879**	**3.48**	**1.56**	NT	**7.18**	0.385 U	**0.862**	**5.6**	**3.56**	0.385 U	**0.679**	**4.42**	**1.38**	0.769 U	**2.0**	**3.71**	**1.79**	**0.0625 J**
Phase 3 Location #10	PWS-090517-10	09/05/2017	P	0	1	NT	**0.279**	**0.761**	**0.281**	NT	**1.23**	**0.183**	**0.202**	**0.822**	**0.749**	0.165 U	**0.21**	**0.659**	**0.373**	0.329 U	**0.349**	0.329 U	**0.513**	**0.0338**
Phase 3 Location #10	PWS-090517-DUP	09/05/2017	FD	0	1	NT	**0.233**	**0.561**	**0.216**	NT	**0.825**	0.156 U	0.156 U	**0.726**	**0.432**	0.156 U	0.156 U	**0.446**	**0.214**	0.311 U	**0.208**	0.311 U	**0.564**	**0.0378**
Phase 3 Location #11	PWS-090517-11	09/05/2017	P	0	1	NT	**0.295**	**0.62**	**0.172**	NT	**0.589**	0.16 U	0.16 U	**0.376**	**0.438**	0.16 U	0.16 U	**0.222**	**0.222**	0.321 U	0.16 U	0.321 U	**0.638**	**0.0516**
Phase 3 Location #12	PWS-090617-12	09/06/2017	P	0	1	NT	**1.53**	**2.67**	**0.156**	NT	**1.66**	**0.643**	**0.176**	**0.284**	**0.983**	**0.405**	**0.17**	**0.238**	**0.42**	0.262 U	**0.163**	**0.32**	**4.15**	**0.203**
Phase 3 Location #13	PWS-090617-13	09/06/2017	P	0	1	NT	**2.59**	**4.96**	**0.403**	NT	**2.9**	**1.09**	**0.512**	**0.683**	**2.79**	**0.604**	**0.836**	**0.529**	**1.58**	**0.47**	**0.396**	**0.705**	**5.54**	**0.319**
Phase 3 Location #14	PWS-090517-14	09/05/2017	P	0	1	NT	**0.303**	**1.01**	**0.235**	NT	**1.64**	**0.13**	**0.257**	**0.752**	**0.921**	0.12 U	**0.217**	**0.53**	**0.337**	0.239 U	**0.253**	**0.415**	**0.752**	**0.0315**
Phase 3 Location #15	PWS-090617-15	09/06/2017	P	0	1	NT	**0.11**	**0.179**	**0.0643**	NT	**0.25**	**0.0538**	**0.0442**	**0.195**	**0.151**	**0.0487**	0.042 U	**0.135**	**0.0711**	0.0839 U	**0.059**	**0.0906**	**0.2**	**0.0179**

Please refer to notes at end of table.

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Table 5-6
Bulk Sediment Analytical Results Summary - TPH, TOC, Black Carbon, PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PAHs						
						Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene
						Concentrations in mg/kg						
Phase 3 Location #1	PWS-090617-1	09/06/2017	P	0	1	**1.72**	**0.507**	**0.123**	**1.5**	**0.109**	**1.74**	**1.05**
Phase 3 Location #2	PWS-090617-2	09/06/2017	P	0	1	**0.629**	**0.138**	**0.0811**	**0.166**	**0.138**	**0.592**	**0.546**
Phase 3 Location #3	PWS-090517-3	09/05/2017	P	0	1	**0.766**	**0.138**	**0.111**	**0.455 J, Q-42**	**0.164**	**0.773**	**0.665**
Phase 3 Location #4	PWS-090517-4	09/05/2017	P	0	1	**1.27**	**0.295**	**0.169**	**0.611**	**0.208**	**1.76**	**0.827**
Phase 3 Location #5	PWS-090517-5	09/05/2017	P	0	1	**1.15**	**0.0289**	**0.0186**	**0.0819**	**0.0309**	**0.693**	**0.64**
Phase 3 Location #6	PWS-090517-6	09/05/2017	P	0	1	**0.244**	**0.0485**	**0.0523**	**0.0717**	**0.08**	**0.185**	**0.184**
Phase 3 Location #7	PWS-090517-7	09/05/2017	P	0	1	**0.763**	**0.145**	**0.0478**	**0.102**	**0.0666**	**0.799**	**0.522**
Phase 3 Location #8	PWS-090517-8	09/05/2017	P	0	1	**0.875**	**0.119**	**0.12**	**0.302**	**0.146**	**0.508**	**0.627**
Phase 3 Location #9	PWS-090517-9	09/05/2017	P	0	1	**11.1**	**4.72**	**0.276**	**0.749**	**0.228**	**15.5**	**6.95**
Phase 3 Location #10	PWS-090517-10	09/05/2017	P	0	1	**2.33**	**0.775**	**0.144**	**0.285**	**0.0753**	**2.59**	**1.52**
Phase 3 Location #10	PWS-090517-DUP	09/05/2017	FD	0	1	**1.46**	**0.655**	**0.181**	**0.844**	**0.0999**	**1.95**	**0.944**
Phase 3 Location #11	PWS-090517-11	09/05/2017	P	0	1	**1.49**	**0.301**	**0.245**	**0.939**	**0.167**	**0.919**	**0.984**
Phase 3 Location #12	PWS-090617-12	09/06/2017	P	0	1	**1.97**	**0.386**	**0.786**	**0.419**	**0.461**	**1.51**	**1.37**
Phase 3 Location #13	PWS-090617-13	09/06/2017	P	0	1	**7.16**	**0.763**	**1.19**	**1.16**	**0.587**	**2.7**	**4.91**
Phase 3 Location #14	PWS-090517-14	09/05/2017	P	0	1	**3.4**	**0.655**	**0.138**	**1.18 J, Q-42**	**0.0827**	**2.97**	**1.96 J, Q-42**
Phase 3 Location #15	PWS-090617-15	09/06/2017	P	0	1	**0.461**	**0.22**	**0.0876**	**0.127**	**0.0492**	**0.475**	**0.32**

Notes:
BOLD indicates analyte was detected at or above the detection limit listed
Results have been validated
2011 and 2013 data reported to the reporting limit; 2012 data reported to the method detection limit
Total PAHs were calculated by summing the detected concentrations.
If an analyte was not detected, 1/2 the reporting or detection limit (as applicable) was included in the sum.
PAHs were analyzed using EPA Methods 8270D and 8270D-SIM
TPH were analyzed using method NWTPH-Dx
TOC was analyzed by Apex Laboratories using Standard Method 5310B-Modified
C-*n* PAHs indicate groups of alkyl-substituted PAH constituents with *n* carbon atoms in attached alkyl groups.
[1] "Total PAH" sums without homologues include analytical results for: Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene. Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene

Porewater samples (PWS) were taken between 0 and 1 foot below the mudline.
For Porewater samples, the highest of two values for Black carbon was used.
Analysis of Soot (aka Black Carbon) was performed by Alpha Analytical using ES&T publications by Accardi-Dey and Gschwend, 2003; and Gustafsson (et. al.), 1997.

Acronyms/Abbreviations
% = percent
EPA = United States Environmental Protection Agency
FD = field duplicate
FT = field triplicate
ft bgs = feet below ground surface
J = estimated result
mg/kg = milligrams per kilogram
N = presumptively identified result
NJ = presumptively identified and estimated result
NT = not tested
NA = not available or not applicable
P = primary sample
PAHs = polycyclic aromatic hydrocarbons
TOC = total organic carbon
TPH = total petroleum hydrocarbons
U = not detected at or above the stated level
UJ = not detected at or above the stated level, which is an approximate value
Q-42 = Matrix Spike and/or Duplicate analysis was performed on this sample. % Recovery or Relative P
M-02 = Due to matrix interference, this analyte cannot be accurately quantified. The reported result is

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Table 5-7
Sediment Porewater Analytical Results – DOC and PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	DOC		PAHs																	
				Dissolved Organic Carbon	Fl/Py Ratio	Total PAHs	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)Anthracene	Benzo(a)Pyrene	Benzo(b)Fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)Perylene	Benzo(k)Fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C1-Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes
				mg/L		Concentrations in µg/L																	
LSI-01	LSI-01_8-11 POREWATER	10/16/2012	P	NT	NA	**2.56**	0.320 U	0.270 U	**0.18**	0.120 U	0.0161 U	0.0107 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
LSI-02	LSI-02_8-11 POREWATER	10/9/2012	P	NT	1.45	**3.63**	0.320 U	0.270 U	**0.76**	0.120 U	0.0161 U	0.0107 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
LSI-09	LSI-09_8-11 POREWATER	10/9/2012	P	NT	1.81	**22.2**	0.320 UJ	0.270 UJ	**2.79 J**	**0.170 J**	**0.168**	**0.0788 J**	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.00645 UJ	**0.442 J**	**1.26 J**	NT	**1.02 J**	0.0125 UJ	**0.812 J**
LSI-11	LSI-11_8-11 POREWATER	10/10/2012	P	NT	1.86	**72.8**	**0.44**	**0.42**	**18.5**	**1.08**	**0.341**	**0.0487 J**	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.00645 UJ	**0.303 J**	**3.02 J**	NT	**1.92 J**	0.0125 UJ	**1.16 J**
LSI-20	LSI-20_8-11 POREWATER	10/10/2012	P	NT	1.18	**4.31**	0.320 U	0.270 U	**1.49**	0.120 U	0.0161 U	0.0107 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.00645 UJ	0.114 UJ	**0.380 J**	NT	0.263 UJ	0.0125 UJ	0.339 UJ
LSI-24	LSI-24-8-11 POREWATER	10/12/2012	P	NT	1.24	**4.42**	0.320 U	0.270 U	**1.66**	**0.18**	0.022 U	0.0107 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.0530 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-01	PWS-01_8-9_PW	7/10/2012	P	2.00 U	NA	**17.7**	**1.36**	0.27 U	**9.31**	**0.902**	**0.0447**	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	**0.466**	NT	0.263 U	0.0125 UJ	0.339 U
PWS-01	PWS-1_8-10 POREWATER	10/10/2012	P	2.00 U	1.78	**10.1**	0.320 UJ	0.270 UJ	**4.89 J**	**0.350 J**	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	**0.360 J**	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-02	PWS-02_1-4_PW	7/10/2012	P	**2.47**	NA	2.41	0.32 U	0.27 U	0.15 U	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-02	PWS-02_8-10_PW	7/10/2012	P	**6.65**	1.92	**1,720**	**19.4**	**8.62**	**289**	**25.2**	**21.1**	**0.42 J**	0.053 U	NT	0.053 U	0.053 U	NT	**0.0812 J**	**5.25**	**72.5**	NT	**64.2**	0.0125 UJ	**19.5**
PWS-02	PWS-02_8-11 POREWATER	10/11/2012	P	NT	1.84	**1,380**	**81.1**	**52.2**	**275**	**14**	**18.7**	**0.505 J**	0.0400 UJ	**0.0436 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	**3.65 J**	**50.9 J**	NT	**37.5 J**	0.0125 UJ	**10.8 J**
PWS-03	PWS-03_8-11_PW	7/12/2012	P	2.00 U	1.86	**5.46**	0.32 U	0.27 U	**0.916**	**0.14**	**0.097 J**	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	**0.387**	0.0125 UJ	0.339 U
PWS-03	PWS-3_8-11 POREWATER	10/10/2012	P	**3.69**	1.66	**4.19**	0.320 UJ	0.270 UJ	**0.640 J**	0.120 UJ	**0.0428**	**0.0122 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	**0.292 J**	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-04	PWS-04_1-4_PW	7/10/2012	P	2.00 U	NA	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-04	PWS-04_8-11_PW	7/10/2012	P	2.00 U	1.52	**2.80**	0.32 U	0.27 U	**0.281**	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-04	PWS-4_8-11 POREWATER	10/10/2012	P	2.00 U	1.68	**3.13**	0.320 UJ	0.270 UJ	**0.540 J**	0.120 UJ	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-05	PWS-05_8-11_PW	7/12/2012	P	2.00 U	1.70	**3.91**	0.32 U	0.27 U	**0.853**	0.12 U	**0.021 J**	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	**0.493**	NT	0.263 U	0.0125 UJ	0.339 U
PWS-05	PWS-5_8-11 POREWATER	10/10/2012	P	**12.4**	1.84	**3.40**	0.320 UJ	0.270 UJ	**0.680 J**	0.120 UJ	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-06	PWS-06_8-11_PW	7/12/2012	P	**2.06**	1.86	**3.36**	0.32 U	0.27 U	**0.902**	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-06	PWS-6_8-11 POREWATER	10/10/2012	P	**30.4**	1.74	**6.30**	0.320 UJ	0.270 UJ	**1.68 J**	**0.130 J**	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	**0.279 J**	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-07	PWS-07_8-11_PW	7/10/2012	P	2.00 U	1.65	**4.89**	0.32 U	0.27 U	**0.993**	**0.121**	**0.0589**	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	**0.304**	NT	**0.367**	0.0125 UJ	0.339 U
PWS-07	PWS-7_8-10 DUP POREWATER	10/11/2012	FD	**8.22**	1.82	**23.2**	0.320 U	0.270 U	**4.57 J**	**0.480 J**	**0.862 J**	0.0735 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	**0.226 J**	**1.20 J**	NT	**0.946 J**	0.0125 UJ	0.339 UJ
PWS-07	PWS-7_8-10 POREWATER	10/11/2012	P	**7.68**	1.70	**6.68**	0.320 U	0.270 U	**1.21 J**	**0.130 J**	0.0853 UJ	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	**0.600 J**	NT	**0.358 J**	0.0125 UJ	0.339 UJ
PWS-08	PWS-08_8-11_PW	7/12/2012	P	2.00 U	1.64	**4.42**	0.32 U	0.27 U	**0.718**	0.12 U	**0.0168**	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	**0.309**	NT	**0.35**	0.0125 UJ	0.339 U
PWS-08	PWS-8_8-11 POREWATER	10/9/2012	P	**4.10**	1.65	**4.26**	0.320 UJ	0.270 UJ	**0.700 J**	0.120 UJ	**0.0454**	**0.0170 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	**0.300 J**	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-09	PWS-09_8-11_PW	7/12/2012	P	**2.10**	NA	**2.52**	0.32 U	0.27 U	**0.185**	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-09	PWS-9_8-11 POREWATER	10/9/2012	P	**9.46**	NA	**3.13**	0.320 UJ	0.270 UJ	**0.450 J**	0.120 UJ	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	**0.284 J**	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-10	PWS-10_8-11_PW	7/11/2012	P	**14.6**	1.87	**12.7**	0.32 U	0.27 U	**2.57**	**0.285**	**0.0921**	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	**0.926**	NT	**0.712**	0.0125 UJ	0.339 U
PWS-10	PWS-10_8-11 POREWATER	10/10/2012	P	**112**	1.87	**12.0**	0.320 U	0.270 U	**2.86**	**0.2**	0.0748 U	0.0200 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	**0.779 J**	NT	**0.565 J**	0.0125 UJ	0.339 UJ
PWS-11	PWS-11_8-11_PW	7/9/2012	P	**4.71**	1.38	**7.76**	**0.89**	0.27 U	**1.93**	**0.207**	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	**0.428**	NT	0.263 U	0.02 UJ	0.339 U
PWS-11	PWS-11B_8-11_PW	7/13/2012	P	2.00 U	1.73	**3.73**	0.32 U	0.27 U	**0.514**	0.12 U	**0.0348**	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	**0.397**	NT	0.263 U	0.0125 UJ	0.339 U
PWS-11	PWS-11_8-11 POREWATER	10/10/2012	P	**7.41**	NA	**2.68**	0.320 U	0.270 U	**0.33**	0.120 U	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-12	PWS-12_8-11_PW	7/12/2012	P	**2.57**	NA	**2.43**	0.32 U	0.27 U	**0.0973 J**	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-12	PWS-12_8-11 DUP_PW	7/12/2012	FD	2.00 U	NA	**2.51**	0.32 U	0.27 U	**0.175**	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-12	PWS-12_8-11 POREWATER	10/9/2012	P	**41.2**	NA	**2.41**	0.320 UJ	0.270 UJ	0.150 UJ	0.120 UJ	0.0161 U	**0.0176 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-13	PWS-13_1-4_PW	7/11/2012	P	**2.31**	NA	2.41	0.32 U	0.27 U	0.15 U	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-13	PWS-13_8-11_PW	7/11/2012	P	**2.08**	NA	2.41	0.32 U	0.27 U	0.15 U	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-13	PWS-13_8-11 POREWATER	10/9/2012	P	**91.2**	1.23	**57.9**	0.320 U	0.270 U	**1.39**	**0.24**	**0.0796**	**0.0190 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	**0.175 J**	**1.97 J**	NT	**3.01 J**	0.0125 UJ	**1.99 J**
PWS-14	PWS-14_4-8 POREWATER	10/11/2012	P	**10.1**	2.25	**1,010**	**41.7**	**69.5**	**26.8**	**1.12**	**0.723**	**0.0287 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	**0.177 J**	**3.56 J**	NT	**2.03 J**	0.0125 UJ	**0.715 J**

Please refer to notes at end of table.

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Table 5-7
Sediment Porewater Analytical Results – DOC and PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	DOC		PAHs																	
				Dissolved Organic Carbon	Fl/Py Ratio	Total PAHs	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)Anthracene	Benzo(a)Pyrene	Benzo(b)Fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)Perylene	Benzo(k)Fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C1-Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes
				mg/L		Concentrations in µg/L																	
PWS-15	PWS-15_8-11_PW	7/12/2012	P	**3.92**	NA	2.41	0.32 U	0.27 U	0.15 U	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-15	PWS-15_8-11 POREWATER	10/11/2012	P	**6.83**	NA	**2.91**	0.320 U	0.270 U	**0.46**	0.120 U	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-16	PWS-16_8-11_PW	7/9/2012	P	**19.1**	NA	**2.65**	0.32 U	0.27 U	**0.262**	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-16	PWS-16B_8-11_PW	7/13/2012	P	2.00 U	NA	**2.62**	0.32 U	0.27 U	**0.233**	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-16	PWS-16_8-11 POREWATER	10/9/2012	P	**109**	1.87	**5.87**	0.320 U	0.270 U	**1.23**	0.120 U	**0.0342**	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	**0.357 J**	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-17	PWS-17_4-7 POREWATER	10/10/2012	P	**7.12**	NA	**7.18**	**0.99**	0.270 U	**2.72**	**0.23**	0.0301 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	**0.327 J**	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-18	PWS-18_8-11_PW	7/11/2012	P	2.00 U	NA	2.41	0.32 U	0.27 U	0.15 U	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-18	PWS-18_8-10 POREWATER	10/11/2012	P	2.00 U	NA	2.39	0.320 U	0.270 U	0.150 U	0.120 U	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-19	PWS-19_8-11_PW	7/11/2012	P	**4.37**	NA	2.41	0.32 U	0.27 U	0.15 U	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-19	PWS-19_8-11 POREWATER	10/11/2012	P	**3.45**	NA	**2.41**	0.320 U	0.270 U	0.150 U	0.120 U	0.0161 U	**0.0207 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-20	PWS-20_8-11_PW	7/11/2012	P	**3.66**	NA	2.41	0.32 U	0.27 U	0.15 U	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-20	PWS-20_8-11 DUP_PW	7/11/2012	FD	2.00 U	NA	2.41	0.32 U	0.27 U	0.15 U	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-20	PWS-20_8-11 POREWATER	10/9/2012	P	**2.89**	NA	**2.40**	0.320 U	0.270 U	0.150 U	0.120 U	0.0161 U	**0.0137 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-22	PWS-22_8-11_PW	7/12/2012	P	**2.94**	NA	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-25	PWS-25_8-11_PW	7/13/2012	P	2.00 U	1.28	**3.89**	0.32 U	0.27 U	**0.647**	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	**0.299**	0.0125 UJ	0.339 U
PWS-25	PWS-25_4-8 POREWATER	10/11/2012	P	**4.55**	1.54	**3.13**	0.320 U	0.270 U	**0.19**	0.120 U	0.0161 U	**0.0240 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-26	PWS-26_8-11_PW	7/13/2012	P	**2.51**	1.50	**2.77**	0.32 U	0.27 U	**0.23**	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-26	PWS-26_8-11 POREWATER	10/11/2012	P	**8.95**	1.65	**3.17**	0.320 U	0.270 U	**0.55**	0.120 U	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-26	PWS-26_8-11_DUP POREWATER	10/11/2012	FD	2.00 U	1.65	**3.29**	0.320 U	0.270 U	**0.56**	0.120 U	**0.0163**	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-27	PWS-27_8-11_PW	7/13/2012	P	**93.8**	NA	2.41	0.32 U	0.27 U	0.15 U	0.12 U	0.0161 U	0.0107 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.00645 UJ	0.114 U	0.274 U	NT	0.263 U	0.0125 UJ	0.339 U
PWS-27	PWS-27_8-11 POREWATER	10/9/2012	P	**47.8**	NA	**2.47**	0.320 U	0.270 U	0.150 U	0.120 U	**0.0834**	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-28	PWS-28_8-11 POREWATER	10/10/2012	P	**4.01**	NA	2.39	0.320 U	0.270 U	0.150 U	0.120 U	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ
PWS-29	PWS-29_8-11 POREWATER	10/12/2012	P	**10.4**	2.28	**864**	**158**	0.270 U	**218**	**14**	**6.08**	**0.0562 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	**0.365 J**	**12.8 J**	NT	**4.77 J**	0.0125 UJ	**1.64 J**
PWS-30	PWS-30_8-11 POREWATER	10/12/2012	P	**4.36**	NA	2.39	0.320 U	0.270 U	0.150 U	0.120 U	0.0161 U	0.0107 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.00645 UJ	0.114 UJ	0.274 UJ	NT	0.263 UJ	0.0125 UJ	0.339 UJ

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-7
Sediment Porewater Analytical Results – DOC and PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	DOC		PAHs																	
				Dissolved Organic Carbon	Fl/Py Ratio	Total PAHs	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)Anthracene	Benzo(a)Pyrene	Benzo(b)Fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)Perylene	Benzo(k)Fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C1-Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes
				mg/L		Concentrations in µg/L																		
PWS-1	Shallow Porewater Site 1	09/06-09/26/17	P	NT	1.05	**1.34**	**0.000357 B**	**0.00031 B**	**0.013**	0.000113 U	**0.00048**	**0.0000231**	0.00000174 U	**0.0000104**	0.00000119 U	0.000000627 U	0.000000779 U	**0.0000246**	**0.00029**	**0.00484 B**	**0.00501 B**	**0.00132 B**	0.0000014 U	**0.00909 B**
PWS-1	Deep Porewater Site 1	09/06-09/26/17	P	NT	1.22	**34.2**	**0.382 B**	**0.0529 B**	**3.47**	**0.0221**	**0.00836**	**0.000188**	**0.0000289**	**0.0000385**	**0.000034**	0.000000588 U	**0.0000233**	**0.000113**	**0.00288**	**0.262 B**	**2.01 B**	**0.0541 B**	**0.00000863**	**0.193 B**
PWS-2	Shallow Porewater Site 2	09/06-09/26/17	P	NT	0.29	**116**	**0.406 B**	0.0000424 U	**0.0825**	0.000113 U	**0.00365**	**0.0000308**	0.00000143 U	**0.00000706**	**0.0000101**	0.000000511 U	0.00000064 U	**0.000158**	**0.00128**	**0.206 B**	**1.68 B**	**0.0692 B**	**0.0000162**	**0.575 B**
PWS-2	Deep Porewater Site 2	09/06-09/26/17	P	NT	0.65	**18.5**	**0.243 B**	0.0000413 U	**0.0265**	0.00011 U	**0.000408**	0.000000934 U	0.00000153 U	0.00000046 U	0.00000104 U	0.000000548 U	0.000000684 U	**0.0000227**	**0.000142**	**0.0305 B**	**1.13 B**	**0.00576 B**	0.00000124 U	**0.055 B**
PWS-3	Shallow Porewater Site 3	09/05-09/26/17	P	NT	0.81	**0.26**	0.0000165 U	0.0000424 U	**0.0018**	0.000113 U	0.0000121 U	0.000000932 U	0.00000152 U	0.000000459 U	0.00000103 U	0.000000545 U	0.000000681 U	**0.0000129**	**0.0000886**	**0.000341 B**	0.00245 U	**0.0011 B**	0.00000124 U	**0.000966 B**
PWS-3	Deep Porewater Site 3	09/05-09/26/17	P	NT	0.85	**0.34**	0.0000161 U	0.0000413 U	**0.00907**	0.00011 U	0.0000118 U	0.000000881 U	0.00000144 U	0.000000434 U	0.000000973 U	0.000000513 U	0.000000642 U	**0.0000077**	**0.0000501**	**0.000394 B**	0.00238 U	**0.000233 B**	0.00000117 U	**0.000364 B**
PWS-4	Shallow Porewater Site 4	09/05-09/26/17	P	NT	0.74	**0.44**	**0.000864 B**	**0.000819 B**	**0.0062**	0.000113 U	**0.000281**	**0.00000703**	0.000000872 U	**0.00000356**	0.000000579 U	0.000000304 U	0.00000039 U	**0.00000786**	**0.00011**	**0.000691 B**	**0.0102 B**	**0.00226 B**	0.000000748 U	**0.00316 B**
PWS-4	Deep Porewater Site 4	09/05-09/26/17	P	NT	1.26	**4.51**	**0.000606 B**	**0.000331 B**	**0.306**	0.00011 U	0.0000119 U	**0.0000275**	0.00000292 U	**0.0000114**	0.000002 U	0.00000106 U	0.0000013 U	**0.0000254**	**0.000385**	**0.0279 B**	**0.00456 B**	**0.00529 B**	0.00000229 U	**0.0246 B**
PWS-5	Shallow Porewater Site 5	09/05-09/26/17	P	NT	0.90	**1.31**	**0.00222 B**	**0.00234 B**	**0.00871**	0.000113 U	**0.000577**	**0.0000161**	0.00000168 U	**0.0000122**	**0.0000152**	0.000000604 U	0.000000752 U	0.00000287 U	**0.000208**	**0.00346 B**	**0.0247 B**	**0.00162 B**	0.00000136 U	**0.0109 B**
PWS-5	Deep Porewater Site 5	09/05-09/26/17	P	NT	0.45	**111**	0.0000161 U	0.0000413 U	0.0000533 U	**0.00476**	0.0000118 U	**0.000136**	**0.0000251**	**0.0000254**	**0.0000383**	0.000000568 U	0.000000707 U	**0.00048**	**0.00431**	**0.306 B**	0.00238 U	**0.131 B**	**0.0000504**	**1.12 B**
PWS-6	Shallow Porewater Site 6	09/05-09/26/17	P	NT	1.06	**0.36**	**0.00127 B**	**0.000413 B**	**0.00569**	0.000113 U	**0.000264**	**0.0000193**	0.00000222 U	**0.0000114**	**0.0000136**	0.000000801 U	0.000000989 U	**0.00002**	**0.000197**	**0.00099 B**	**0.00983 B**	**0.0006 B**	0.00000176 U	**0.00269 B**
PWS-6	Deep Porewater Site 6	09/05-09/26/17	P	NT	1.01	**0.52**	**0.000577 B**	**0.00013 JB**	**0.0425**	0.00011 U	**0.000189**	0.000000907 U	0.00000148 U	**0.00000468**	0.000001 U	0.00000053 U	**0.00000495**	**0.00000922**	**0.000101**	**0.00188 B**	**0.00274 B**	**0.00133 B**	0.0000012 U	**0.0026 B**
PWS-7	Shallow Porewater Site 7	09/05-09/26/17	P	NT	0.95	**0.38**	**0.00112 B**	**0.000795 B**	**0.0062**	0.000113 U	**0.000283**	**0.0000124**	0.00000121 U	**0.00000579**	**0.00000564**	0.000000428 U	**0.00000467**	**0.0000129**	**0.000164**	**0.00134 B**	**0.0086 B**	**0.00078 B**	0.000000999 U	**0.0039 B**
PWS-7	Deep Porewater Site 7	09/05-09/26/17	P	NT	0.89	**0.26**	0.0000161 U	0.0000413 U	**0.0103**	0.00011 U	**0.0001**	0.000000658 U	0.00000103 U	**0.00000315**	0.00000302 J	0.000000364 U	0.000000463 U	**0.00000624**	**0.0000803**	**0.000533 B**	0.00238 U	**0.00056 B**	0.000000867 U	**0.00192 B**
PWS-8	Shallow Porewater Site 8	09/05-09/26/17	P	NT	0.95	**0.64**	**0.00221 B**	**0.00156 B**	**0.0122**	**0.000448 J**	**0.000787**	**0.0000282**	**0.00000626**	**0.0000118**	**0.0000121**	0.000000394 U	**0.00000709**	**0.0000253**	**0.000395**	**0.00353 B**	**0.0161 B**	**0.00158 B**	0.000000932 U	**0.00953 B**
PWS-8	Deep Porewater Site 8	09/05-09/26/17	P	NT	1.09	**0.38**	**0.000302 B**	**0.000142 JB**	**0.0115**	**0.000354 J**	**0.000323**	**0.0000204**	0.00000198 U	**0.00000838**	**0.00000942**	0.000000714 U	**0.00000814**	**0.0000205**	**0.00022**	**0.00123 B**	0.00238 U	**0.000919 B**	0.00000158 U	**0.00334 B**
PWS-9	Shallow Porewater Site 9	09/05-09/26/17	P	NT	1.15	**0.41**	**0.000587 B**	**0.00034 B**	**0.0112**	0.000113 U	**0.000465**	**0.000028**	0.00000212 U	**0.0000126**	**0.0000137**	0.000000766 U	**0.00000977**	**0.000026**	**0.000284**	**0.0017 B**	**0.00422 B**	**0.000931 B**	0.00000169 U	**0.00324 B**
PWS-9	Deep Porewater Site 9	09/05-09/26/17	P	NT	1.10	**0.77**	**0.000451 B**	0.0000413 U	**0.0673**	**0.000532 J**	**0.000297**	**0.0000166**	0.0000017 U	**0.00000692**	**0.0000076**	0.00000061 U	**0.00000667**	**0.0000153**	**0.000205**	**0.00533 B**	0.00238 U	**0.00181 B**	0.00000137 U	**0.00663 B**
PWS-10	Shallow Porewater Site 10	09/05-09/26/17	P	NT	0.99	**0.81**	**0.000705 B**	**0.000394 B**	**0.0187**	0.000113 U	**0.000576**	**0.0000242**	**0.00000621 J**	**0.00000887**	**0.00000895**	0.000000511 U	**0.0000067**	**0.0000237**	**0.000341**	**0.00504 B**	**0.00524 B**	**0.00127 B**	0.00000117 U	**0.0108 B**
PWS-11	Shallow Porewater Site 11	09/05-09/26/17	P	NT	1.02	**0.57**	**0.000705 B**	**0.000594 B**	**0.0152**	**0.000383 J**	**0.00108**	**0.0000551**	**0.0000131**	**0.0000224**	**0.000022**	0.000000564 U	**0.000013**	**0.0000429**	**0.000545**	**0.00321 B**	**0.00644 B**	**0.00159 B**	0.00000128 U	**0.00758 B**
PWS-11	Deep Porewater Site 11	09/05-09/26/17	P	NT	1.05	**0.38**	**0.000371 B**	**0.000171 JB**	**0.0191**	0.000111 U	**0.000631**	**0.0000284**	**0.00000848**	**0.0000127**	**0.0000129**	0.000000573 U	**0.00000875**	**0.0000274**	**0.000304**	**0.00189 B**	**0.00357 B**	**0.000833 B**	0.00000129 U	**0.00436 B**
PWS-12	Shallow Porewater Site 12	09/06-09/26/17	P	NT	1.43	**3.29**	**0.0402 B**	**0.0456 B**	**0.063**	**0.00159**	**0.00357**	**0.000224**	**0.0000516**	**0.000107**	**0.000098**	**0.0000156**	**0.000058**	**0.00012**	**0.00269**	**0.037 B**	**0.366 B**	**0.0152 B**	**0.00000672**	**0.0326 B**
PWS-12	Deep Porewater Site 12	09/06-09/26/17	P	NT	1.29	**3.37**	**0.00205 B**	**0.00146 B**	**0.132**	0.000111 U	**0.00557**	**0.000234**	**0.000053**	**0.0000754**	**0.000072**	**0.0000158**	**0.0000406**	**0.000133**	**0.00186**	**0.0351 B**	**0.0146 B**	**0.0102 B**	**0.00000808**	**0.0396 B**
PWS-13	Shallow Porewater Site 13	09/06-09/26/17	P	NT	1.02	**0.80**	**0.000587 B**	**0.00034 B**	**0.0208**	**0.00061**	**0.00176**	**0.000104**	**0.0000239**	**0.0000372**	**0.0000373**	**0.00000882**	**0.0000183**	**0.0000541**	**0.00112**	**0.00958 B**	**0.00258 B**	**0.00228 B**	**0.00000426**	**0.0235 B**
PWS-13	Deep Porewater Site 13	09/06-09/26/17	P	NT	1.08	**5.41**	**0.00284 B**	**0.000773 B**	**0.391**	0.00011 U	**0.0000118 U**	**0.00021**	**0.0000418**	**0.0000584**	**0.0000544**	**0.0000118**	**0.0000298**	**0.000119**	**0.00202**	**0.0485 B**	**0.0118 B**	**0.0113 B**	**0.0000071**	**0.0625 B**
PWS-14	Shallow Porewater Site 14	09/05-09/26/17	P	NT	1.07	**0.54**	**0.00154 B**	**0.00118 B**	**0.0158**	0.000113 U	**0.000664**	**0.0000296**	**0.0000105**	**0.0000128**	**0.0000146**	0.000000651 U	**0.00000952**	**0.0000305**	**0.000302**	**0.00301 B**	**0.0109 B**	**0.00157 B**	0.00000145 U	**0.00617 B**
PWS-14	Deep Porewater Site 14	09/05-09/26/17	P	NT	1.58	**11.2**	**0.0467 B**	**0.0201 B**	**0.548**	0.00011 U	**0.00441**	**0.000221**	**0.00172**	**0.0000932**	**0.0000822**	**0.0000282**	**0.000051**	**0.000158**	**0.00211**	**0.0483 B**	**0.282 B**	**0.0152 B**	**0.0000124**	**0.0863 B**
PWS-15	Shallow Porewater Site 15	09/06-09/26/17	P	NT	1.18	**0.51**	**0.000752 B**	**0.000764 B**	**0.0104**	0.000113 U	**0.000453**	**0.0000498**	**0.0000173**	**0.0000237**	**0.000024**	**0.0000125**	**0.0000168**	**0.0000782**	**0.000394**	**0.00326 B**	**0.00662 B**	**0.00107 B**	0.00000249 U	**0.00845 B**
PWS-15	Deep Porewater Site 15	09/06-09/26/17	P	NT	0.99	**48.1**	**0.569 B**	**0.159 B**	**4.57**	0.00011 U	**0.0346**	**0.00112**	**0.000256**	**0.000336**	**0.00029**	0.000000588 U	**0.000177**	**0.000643**	**0.0088**	**0.315 B**	**2.93 B**	**0.0667 B**	**0.0000327**	**0.271 B**

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-7
Sediment Porewater Analytical Results – DOC and PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	PAHs																	
				C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(A,H)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)Pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene
				Concentrations in µg/L																	
LSI-01	LSI-01_8-11 POREWATER	10/16/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0530 UJ	0.0581 UJ	0.200 U	0.0530 UJ	1.12 U	0.0530 UJ	0.150 U	0.0493 UJ
LSI-02	LSI-02_8-11 POREWATER	10/9/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00893 J**	0.0530 UJ	**0.165 J**	**0.26**	0.0530 UJ	1.12 U	0.0530 UJ	**0.17**	**0.114 J**
LSI-09	LSI-09_8-11 POREWATER	10/9/2012	P	**1.50 J**	**0.907 J**	0.00183 UJ	0.0603 UJ	**4.34 J**	0.00511 UJ	0.0255 UJ	**2.02 J**	0.0173 UJ	**0.0468 J**	0.0530 UJ	**2.19 J**	**0.670 J**	0.0530 UJ	1.12 UJ	0.0530 UJ	**1.35 J**	**1.21 J**
LSI-11	LSI-11_8-11 POREWATER	10/10/2012	P	**10.7 J**	**0.903 J**	0.00183 UJ	0.0603 UJ	**14.6 J**	0.00511 UJ	0.0255 UJ	**2.95 J**	0.0173 UJ	**0.0435 J**	0.0530 UJ	**1.59 J**	**5.76**	0.0530 UJ	**1.58**	0.0530 UJ	**6.25**	**0.854 J**
LSI-20	LSI-20_8-11 POREWATER	10/10/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00840 J**	0.0530 UJ	**0.133 J**	0.200 U	0.0530 UJ	1.12 U	0.0530 UJ	0.150 U	**0.113 J**
LSI-24	LSI-24-8-11 POREWATER	10/12/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00855 UJ	0.0530 UJ	**0.117 J**	0.200 U	0.0530 UJ	1.12 U	0.0530 UJ	**0.16**	**0.0947 J**
PWS-01	PWS-01_8-9_PW	7/10/2012	P	**1.63**	0.00371 U	0.00183 UJ	0.0603 U	**0.479 J**	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	**2.05**	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-01	PWS-1_8-10 POREWATER	10/10/2012	P	**1.35 J**	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0400 UJ	**0.0909 J**	**1.16 J**	0.0400 UJ	1.12 UJ	0.0400 UJ	**0.320 J**	**0.0511 J**
PWS-02	PWS-02_1-4_PW	7/10/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-02	PWS-02_8-10_PW	7/10/2012	P	**313**	**21.9**	0.00183 UJ	0.0603 U	**261**	**3.02**	0.0255 UJ	**102**	**1.47**	**0.322 J**	0.053 U	**27.8**	**203**	0.053 U	1.12 U	0.053 U	**245**	**14.5**
PWS-02	PWS-02_8-11 POREWATER	10/11/2012	P	**281 J**	**9.54 J**	0.00183 UJ	0.0603 UJ	**154 J**	**0.629 J**	0.0255 UJ	**28.4 J**	**0.0902 J**	**0.288 J**	0.0400 UJ	**23.4 J**	**151**	0.0400 UJ	**1.42**	0.0400 UJ	**177**	**12.7 J**
PWS-03	PWS-03_8-11_PW	7/12/2012	P	0.778 U	**0.165 J**	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	**0.0215 J**	0.053 U	**0.468**	**0.71**	0.053 U	1.12 U	0.053 U	**0.401**	**0.252**
PWS-03	PWS-3_8-11 POREWATER	10/10/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.0206 J**	0.0400 UJ	**0.328 J**	**0.520 J**	0.0400 UJ	1.12 UJ	0.0400 UJ	**0.200 J**	**0.198 J**
PWS-04	PWS-04_1-4_PW	7/10/2012	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-04	PWS-04_8-11_PW	7/10/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	**0.145**	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	**0.0955**
PWS-04	PWS-4_8-11 POREWATER	10/10/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00764 J**	0.0400 UJ	**0.120 J**	**0.230 J**	0.0400 UJ	1.12 UJ	0.0400 UJ	0.150 UJ	**0.0714 J**
PWS-05	PWS-05_8-11_PW	7/12/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	**0.0938**	**0.254**	0.053 U	1.12 U	0.053 U	**0.183**	**0.0551**
PWS-05	PWS-5_8-11 POREWATER	10/10/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0400 UJ	**0.114 J**	**0.230 J**	0.0400 UJ	1.12 UJ	0.0400 UJ	**0.230 J**	**0.0619 J**
PWS-06	PWS-06_8-11_PW	7/12/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	**0.113**	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	**0.0608**
PWS-06	PWS-6_8-11 POREWATER	10/10/2012	P	**0.875 J**	0.00371 UJ	0.00183 UJ	0.0603 UJ	**1.11 J**	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0400 UJ	**0.126 J**	**0.330 J**	0.0400 UJ	1.12 UJ	0.0400 UJ	**0.200 J**	**0.0726 J**
PWS-07	PWS-07_8-11_PW	7/10/2012	P	0.778 U	**0.205 J**	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	**0.226**	**0.365**	0.053 U	1.12 U	0.053 U	**0.342**	**0.137**
PWS-07	PWS-7_8-10 DUP POREWATER	10/11/2012	FD	**2.82 J**	**0.377 J**	0.00183 UJ	0.0603 UJ	**2.40 J**	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.0543 UJ	0.0400 UJ	**1.16 J**	**2.80 J**	0.0400 UJ	1.12 U	0.0400 UJ	**3.27 J**	**0.638 J**
PWS-07	PWS-7_8-10 POREWATER	10/11/2012	P	0.778 UJ	**0.298 J**	0.00183 UJ	0.0603 UJ	**0.815 J**	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.0167 UJ	0.0400 UJ	**0.239 J**	**0.540 J**	0.0400 UJ	1.12 U	0.0400 UJ	**0.500 J**	**0.141 J**
PWS-08	PWS-08_8-11_PW	7/12/2012	P	0.778 U	**0.21 J**	0.00183 UJ	0.0603 U	**0.233 J**	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	**0.193**	**0.215**	0.053 U	1.12 U	0.053 U	**0.226**	**0.118**
PWS-08	PWS-8_8-11 POREWATER	10/9/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00931 J**	0.0400 UJ	**0.187 J**	**0.500 J**	0.0400 UJ	1.12 UJ	0.0400 UJ	**0.450 J**	**0.113 J**
PWS-09	PWS-09_8-11_PW	7/12/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-09	PWS-9_8-11 POREWATER	10/9/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.0104 J**	0.0400 UJ	**0.0722 J**	**0.270 J**	0.0400 UJ	1.12 UJ	0.0400 UJ	0.150 UJ	0.0493 UJ
PWS-10	PWS-10_8-11_PW	7/11/2012	P	**1.54**	**0.426 J**	0.00183 UJ	0.0603 U	**1.35**	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	**0.013 J**	0.053 U	**0.409**	**1.55**	0.053 U	1.12 U	0.053 U	**1.21**	**0.219**
PWS-10	PWS-10_8-11 POREWATER	10/10/2012	P	**1.37 J**	0.00371 UJ	0.00183 UJ	0.0603 UJ	**1.47 J**	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.0145 UJ	0.0400 UJ	**0.505 J**	**1.38**	0.0400 UJ	1.12 U	0.0400 UJ	**1.15**	**0.270 J**
PWS-11	PWS-11_8-11_PW	7/9/2012	P	**1.54**	0.00371 U	0.00183 UJ	0.0603 U	**1 J**	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	**0.101 J**	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	**0.0732 J**
PWS-11	PWS-11B_8-11_PW	7/13/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	**0.0111 J**	0.053 U	**0.225**	**0.285**	0.053 U	1.12 U	0.053 U	**0.176**	**0.13 J**
PWS-11	PWS-11_8-11 POREWATER	10/10/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0400 UJ	**0.0642 J**	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	0.150 U	0.0493 UJ
PWS-12	PWS-12_8-11_PW	7/12/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-12	PWS-12_8-11 DUP_PW	7/12/2012	FD	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-12	PWS-12_8-11 POREWATER	10/9/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.0144 J**	0.0400 UJ	0.0581 UJ	0.200 UJ	0.0400 UJ	1.12 UJ	0.0400 UJ	0.150 UJ	0.0493 UJ
PWS-13	PWS-13_1-4_PW	7/11/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-13	PWS-13_8-11_PW	7/11/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-13	PWS-13_8-11 POREWATER	10/9/2012	P	**13.7 J**	**2.12 J**	0.00183 UJ	0.0603 UJ	**25.1 J**	**0.410 J**	0.0255 UJ	**3.80 J**	0.0173 UJ	**0.0233 J**	0.0400 UJ	**0.266 J**	**0.59**	0.0400 UJ	1.12 U	0.0400 UJ	**1.7**	**0.216 J**
PWS-14	PWS-14_4-8 POREWATER	10/11/2012	P	**33.0 J**	**0.559 J**	0.00183 UJ	0.0603 UJ	**11.0 J**	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.0192 J**	0.0400 UJ	**1.03 J**	**13.9**	0.0400 UJ	**797**	0.0400 UJ	**6.89**	**0.458 J**

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-7
Sediment Porewater Analytical Results – DOC and PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	PAHs																	
				C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(A,H)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)Pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene
				Concentrations in µg/L																	
PWS-15	PWS-15_8-11_PW	7/12/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-15	PWS-15_8-11 POREWATER	10/11/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0400 UJ	**0.0655 J**	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	**0.17**	0.0493 UJ
PWS-16	PWS-16_8-11_PW	7/9/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-16	PWS-16B_8-11_PW	7/13/2012	P	0.778 U	**0.0579 J**	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 UJ
PWS-16	PWS-16_8-11 POREWATER	10/9/2012	P	**1.17 J**	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00481 J**	0.0400 UJ	**0.159 J**	**0.78**	0.0400 UJ	1.12 U	0.0400 UJ	**0.5**	**0.0852 J**
PWS-17	PWS-17_4-7 POREWATER	10/10/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	**0.370 J**	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0400 UJ	0.0581 UJ	**0.46**	0.0400 UJ	1.12 U	0.0400 UJ	**0.28**	0.0493 UJ
PWS-18	PWS-18_8-11_PW	7/11/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-18	PWS-18_8-10 POREWATER	10/11/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0400 UJ	0.0581 UJ	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	0.150 U	0.0493 UJ
PWS-19	PWS-19_8-11_PW	7/11/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-19	PWS-19_8-11 POREWATER	10/11/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00886 J**	0.0400 UJ	0.0581 UJ	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	0.150 U	0.0493 UJ
PWS-20	PWS-20_8-11_PW	7/11/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-20	PWS-20_8-11 DUP_PW	7/11/2012	FD	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 U
PWS-20	PWS-20_8-11 POREWATER	10/9/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00594 J**	0.0400 UJ	0.0581 UJ	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	0.150 U	0.0493 UJ
PWS-22	PWS-22_8-11_PW	7/12/2012	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-25	PWS-25_8-11_PW	7/13/2012	P	0.778 U	**0.315 J**	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	**0.0092 J**	0.053 U	**0.209**	0.2 U	0.053 U	1.12 U	0.053 U	**0.178**	**0.163 J**
PWS-25	PWS-25_4-8 POREWATER	10/11/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.0154 J**	0.0400 UJ	**0.334 J**	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	**0.17**	**0.217 J**
PWS-26	PWS-26_8-11_PW	7/13/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	**0.00636 J**	0.053 U	**0.151**	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	**0.101 J**
PWS-26	PWS-26_8-11 POREWATER	10/11/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00431 J**	0.0400 UJ	**0.137 J**	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	**0.21**	**0.0828 J**
PWS-26	PWS-26_8-11_DUP POREWATER	10/11/2012	FD	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00634 J**	0.0400 UJ	**0.138 J**	**0.22**	0.0400 UJ	1.12 U	0.0400 UJ	**0.19**	**0.0836 J**
PWS-27	PWS-27_8-11_PW	7/13/2012	P	0.778 U	0.00371 U	0.00183 UJ	0.0603 U	0.00329 U	0.00511 U	0.0255 UJ	0.00459 U	0.0173 U	0.004 UJ	0.053 U	0.0581 U	0.2 U	0.053 U	1.12 U	0.053 U	0.15 U	0.0493 UJ
PWS-27	PWS-27_8-11 POREWATER	10/9/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.00616 J**	0.0400 UJ	0.0581 UJ	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	0.150 U	0.0493 UJ
PWS-28	PWS-28_8-11 POREWATER	10/10/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0400 UJ	0.0581 UJ	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	0.150 U	0.0493 UJ
PWS-29	PWS-29_8-11 POREWATER	10/12/2012	P	**217 J**	**1.08 J**	0.00183 UJ	0.0603 UJ	**63.0 J**	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	**0.0344 J**	0.0400 UJ	**3.40 J**	**104**	0.0400 UJ	**1.29**	0.0400 UJ	**57**	**1.49 J**
PWS-30	PWS-30_8-11 POREWATER	10/12/2012	P	0.778 UJ	0.00371 UJ	0.00183 UJ	0.0603 UJ	0.00329 UJ	0.00511 UJ	0.0255 UJ	0.00459 UJ	0.0173 UJ	0.00400 UJ	0.0400 UJ	0.0581 UJ	0.200 U	0.0400 UJ	1.12 U	0.0400 UJ	0.150 U	0.0493 UJ

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Cascadia Associates, LLC

Table 5-7
Sediment Porewater Analytical Results – DOC and PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	PAHs																	
				C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(A,H)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)Pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene
				Concentrations in µg/L																	
PWS-1	Shallow Porewater Site 1	09/06-09/26/17	P	**0.0218 B**	**0.00327**	0.0000014 U	**0.00694**	**0.0943 B**	**0.00474**	0.0000014 U	**0.234 B**	**0.00144 B**	**0.0000247**	0.00000201 U	**0.000655**	**0.00652**	0.000000499 U	**0.00319 B**	**0.0000177**	**0.00118**	**0.000625**
PWS-1	Deep Porewater Site 1	09/06-09/26/17	P	**7.95 B**	**0.0434**	0.00000132 U	**0.0696**	**11.3 B**	**0.0354**	0.00000132 U	**7.58 B**	**0.00614 B**	**0.000163**	0.00000189 U	**0.00914**	**0.548**	0.000000468 U	**0.054 B**	**0.0000362**	**0.296**	**0.0075**
PWS-2	Shallow Porewater Site 2	09/06-09/26/17	P	**24.5 B**	**0.148**	0.00000117 U	**0.306**	**44.7 B**	**0.146**	0.00000117 U	**43.5 B**	**0.0637 B**	**0.0000453**	0.00000164 U	**0.000345**	**0.0614**	0.000000406 U	**0.0988 B**	0.00000126 U	**0.0273**	**0.00121**
PWS-2	Deep Porewater Site 2	09/06-09/26/17	P	**6.38 B**	**0.0108**	0.00000124 U	**0.0358**	**6.48 B**	**0.0137**	0.00000124 U	**4.16 B**	**0.00595 B**	0.000000621 U	0.00000176 U	**0.000128**	**0.0133**	0.000000436 U	0.000296 U	0.00000135 U	**0.00426**	**0.000196**
PWS-3	Shallow Porewater Site 3	09/05-09/26/17	P	0.00485 U	**0.00181**	0.00000124 U	0.0011 U	**0.0107 B**	0.000746 U	0.00000124 U	**0.0731 B**	0.0014 U	0.000000619 U	0.00000175 U	**0.000141**	**0.00126**	0.000000433 U	**0.000567 JB**	**0.0000187**	**0.000438**	**0.000174**
PWS-3	Deep Porewater Site 3	09/05-09/26/17	P	**0.0207 B**	**0.000752**	0.00000117 U	0.00107 U	**0.0659 B**	0.000726 U	0.00000117 U	**0.0825 B**	0.00137 U	0.000000585 U	0.00000165 U	**0.0000791**	**0.000838**	0.000000408 U	0.000296 U	0.00000126 U	**0.000664**	**0.0000934**
PWS-4	Shallow Porewater Site 4	09/05-09/26/17	P	**0.0207 B**	**0.0028**	0.000000748 U	**0.00573**	**0.0449 B**	**0.00335**	0.000000748 U	**0.15 B**	0.0014 U	**0.00000694**	0.000000974 U	**0.000221**	**0.00341**	0.000000241 U	**0.0048 B**	0.000000761 U	**0.00162**	**0.000299**
PWS-4	Deep Porewater Site 4	09/05-09/26/17	P	**0.653 B**	**0.00584**	0.00000229 U	**0.0119**	**1.69 B**	**0.00568**	0.00000229 U	**1.57 B**	**0.00157 B**	**0.00003**	0.00000341 U	**0.0013**	**0.0103**	0.000000844 U	0.000296 U	0.00000259 U	**0.0268**	**0.00103**
PWS-5	Shallow Porewater Site 5	09/05-09/26/17	P	**0.0996 B**	**0.00447**	0.00000136 U	**0.00943**	**0.374 B**	**0.00628**	0.00000136 U	**0.541 B**	**0.00256 B**	**0.0000269**	0.00000194 U	**0.000367**	**0.0042**	0.000000481 U	**0.0392 B**	**0.0000296**	**0.00172**	**0.000407**
PWS-5	Deep Porewater Site 5	09/05-09/26/17	P	**6.38 B**	**0.354**	0.00000128 U	**0.672**	**40.6 B**	**0.398**	0.00000128 U	**60.5 B**	**0.229**	**0.000187**	0.00000182 U	**0.0016**	**0.0478**	0.000000451 U	**0.00504 B**	**0.000052**	**0.0442**	**0.00359**
PWS-6	Shallow Porewater Site 6	09/05-09/26/17	P	**0.0186 B**	**0.00177**	0.00000176 U	**0.00392**	**0.042 B**	**0.00308**	0.00000176 U	**0.0933 B**	0.00141 U	**0.0000194**	0.00000257 U	**0.000332**	**0.00271**	0.000000637 U	**0.00459 B**	**0.0000239**	**0.000643**	**0.000313**
PWS-6	Deep Porewater Site 6	09/05-09/26/17	P	**0.0776 B**	**0.00177**	0.0000012 U	**0.00723**	**0.0994 B**	0.000726 U	0.0000012 U	**0.111 B**	0.00137 U	**0.00000611**	0.0000017 U	**0.000193**	**0.00283**	0.000000422 U	**0.000979 JB**	**0.00000895**	**0.00152**	**0.000191**
PWS-7	Shallow Porewater Site 7	09/05-09/26/17	P	**0.0169 B**	**0.00193**	0.000000999 U	**0.00716**	**0.0501 B**	0.000746 U	0.000000999 U	**0.104 B**	0.0014 U	**0.000011**	0.00000137 U	**0.000317**	**0.00254**	0.00000034 U	**0.00687 B**	**0.0000089**	**0.000762**	**0.000335**
PWS-7	Deep Porewater Site 7	09/05-09/26/17	P	**0.00486 B**	**0.00146**	0.000000867 U	**0.00598**	**0.0175 B**	**0.00237**	0.000000867 U	**0.0475 B**	0.00137 U	**0.0000039**	0.00000117 U	**0.000136**	**0.00117**	0.00000029 U	0.000296 U	**0.00000423 J**	**0.00047**	**0.000153**
PWS-8	Shallow Porewater Site 8	09/05-09/26/17	P	**0.0353 B**	**0.00479**	0.000000932 U	**0.0123**	**0.106 B**	**0.00652**	0.000000932 U	**0.239 B**	**0.00241 B**	**0.0000302**	0.00000126 U	**0.000752**	**0.00523**	0.000000313 U	**0.0104 B**	**0.0000126**	**0.0016**	**0.000795**
PWS-8	Deep Porewater Site 8	09/05-09/26/17	P	**0.0138 B**	**0.00224**	0.00000158 U	**0.00663**	**0.0494 B**	**0.00346**	0.00000158 U	**0.111 B**	0.00137 U	**0.0000197**	0.00000229 U	**0.000415**	**0.00194**	0.000000568 U	**0.00169 B**	**0.00000819 J**	**0.000878**	**0.000382**
PWS-9	Shallow Porewater Site 9	09/05-09/26/17	P	**0.0189 B**	**0.00266**	0.00000169 U	**0.00632**	**0.0507 B**	**0.00433**	0.00000169 U	**0.118 B**	0.00141 U	**0.0000314**	0.00000246 U	**0.000573**	**0.00387**	0.000000609 U	**0.00658 B**	**0.0000231**	**0.000943**	**0.000499**
PWS-9	Deep Porewater Site 9	09/05-09/26/17	P	**0.071 B**	**0.00291**	0.00000137 U	**0.00985**	**0.165 B**	**0.0038**	0.00000137 U	**0.264 B**	0.00137 U	**0.0000158**	0.00000196 U	**0.00054**	**0.00334**	0.000000485 U	**0.000922 JB**	**0.00000894**	**0.003**	**0.000491**
PWS-10	Shallow Porewater Site 10	09/05-09/26/17	P	**0.028 B**	**0.00393**	0.00000117 U	**0.00669**	**0.137 B**	**0.00457**	0.00000117 U	**0.409 B**	0.0014 U	**0.000025**	0.00000164 U	**0.000852**	**0.00733**	0.000000406 U	**0.00658 B**	**0.00000126 U**	**0.00103**	**0.00086**
PWS-11	Shallow Porewater Site 11	09/05-09/26/17	P	**0.0189 B**	**0.00444**	0.00000128 U	**0.00632**	**0.0858 B**	**0.0057**	0.00000128 U	**0.234 B**	0.0014 U	**0.0000558**	0.00000181 U	**0.00109**	**0.00622**	0.000000448 U	**0.00734 B**	**0.0000146**	**0.00144**	**0.00107**
PWS-11	Deep Porewater Site 11	09/05-09/26/17	P	**0.0163 B**	**0.00273**	0.00000129 U	**0.0063**	**0.0398 B**	**0.00373**	0.00000129 U	**0.115 B**	0.00138 U	**0.0000249**	0.00000184 U	**0.00065**	**0.00359**	0.000000456 U	**0.000327 JB**	**0.0000089**	**0.000976**	**0.000618**
PWS-12	Shallow Porewater Site 12	09/06-09/26/17	P	**0.449 B**	**0.0151**	0.00000184 U	**0.0172**	**0.596 B**	**0.0113**	0.00000184 U	**0.795 B**	**0.00435 B**	**0.000433**	0.00000269 U	**0.0118**	**0.094**	0.000000667 U	**0.509 B**	**0.0000289**	**0.0803**	**0.00824**
PWS-12	Deep Porewater Site 12	09/06-09/26/17	P	**0.53 B**	**0.0153**	0.00000208 U	**0.0208**	**1.06 B**	**0.0145**	0.00000208 U	**1.21 B**	**0.00633 B**	**0.000212**	0.00000308 U	**0.00433**	**0.0543**	0.000000761 U	**0.00746 B**	**0.0000262**	**0.0281**	**0.00336**
PWS-13	Shallow Porewater Site 13	09/06-09/26/17	P	**0.018 B**	**0.00764**	0.00000128 U	**0.0161**	**0.103 B**	**0.0096**	0.00000128 U	**0.388 B**	**0.00452 B**	**0.000106**	0.00000181 U	**0.00242**	**0.0109**	0.000000448 U	**0.00342 B**	**0.0000166**	**0.00137**	**0.00238**
PWS-13	Deep Porewater Site 13	09/06-09/26/17	P	**0.918 B**	**0.02**	0.00000141 U	**0.0408**	**1.67 B**	**0.0209**	0.00000141 U	**1.87 B**	**0.0103 B**	**0.000201**	0.00000203 U	**0.00475**	**0.102**	0.000000504 U	**0.00757 B**	**0.0000191**	**0.0499**	**0.0044**
PWS-14	Shallow Porewater Site 14	09/05-09/26/17	P	**0.0324 B**	**0.0039**	0.00000145 U	**0.00782**	**0.0791 B**	**0.00432**	0.00000145 U	**0.17 B**	0.0014 U	**0.0000288**	0.00000209 U	**0.000745**	**0.00605**	0.000000518 U	**0.0158 B**	**0.0000193**	**0.00198**	**0.000699**
PWS-14	Deep Porewater Site 14	09/05-09/26/17	P	**1.24 B**	**0.0284**	0.0000012 U	**0.0627**	**2.9 B**	**0.128**	0.0000012 U	**4.02 B**	0.00137 U	**0.000235**	0.0000017 U	**0.00426**	**0.0651**	**0.0000337**	**0.444 B**	**0.0000307**	**0.043**	**0.00269**
PWS-15	Shallow Porewater Site 15	09/06-09/26/17	P	**0.0207 B**	**0.00357**	0.00000249 U	**0.00622**	**0.0721 B**	**0.00532**	0.00000249 U	**0.18 B**	0.00142 U	**0.0000495**	0.00000372 U	**0.000879**	**0.00439**	0.000000922 U	**0.00474 B**	**0.0000579**	**0.00117**	**0.000747**
PWS-15	Deep Porewater Site 15	09/06-09/26/17	P	**14.6 B**	**0.0954**	0.00000132 U	**0.163**	**12.7 B**	**0.219**	0.00000132 U	**9.51 B**	0.00137 U	**0.00114**	0.00000189 U	**0.0151**	**0.564**	0.000000468 U	**0.155 B**	**0.000108**	**0.322**	**0.0152**

Acronyms/Abbreviations:

µg/L = micrograms per liter
DOC = dissolved organic carbon
FD = field duplicate
ID = identification
J = estimated concentration
mg/L = milligrams per liter
Fl = Fluoranthene
Py = Pyrene
NT = not tested
P = primary sample
PAHs = polycyclic aromatic hydrocarbons
U = analyte was not detected at or above reporting limit
UJ = analyte was not detected, reported quantitation limit is estimated
B = Sample was background corrected
NA = not available or not applicable

Cascadia Associates, LLC

Table 5-8
ΣIWTU Calculations from Direct Measurements of 34 PAHs in Porewater
Updated Supplemental RI Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

NAPL or non-NAPL Area	Sampling Period	Exposure Area [1]	Passive Sampler Location	Sample ID	Sample Type [2]	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/Anthracenes	C-2 Phenanthrenes/Anthracenes	C-3 Phenanthrenes/Anthracenes	C-4 Phenanthrenes/Anthracenes	Fluoranthene	Pyrene	C-1 Fluoranthrenes/Pyrenes	Benzo(a)anthracene
Final Chronic Value (µg/L)						193.6	81.69	30.24	11.10	4.048	306.9	55.85	39.3	13.99	5.305	1.916	19.13	20.73	7.436	3.199	1.256	0.5594	7.109	10.11	4.887	2.227
Non-NAPL Areas	July 2012	MC	PWS-27	PWS-27_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-01	PWS-01_8-9_PW	N	0.0058	0.0183	0.0539	0.0432	0.0011	0.0029	0.1667	0.0522	0.0333	0.0639	0.0315	0.0078	0.0022	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-03	PWS-03_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0005	0.0164	0.0181	0.0196	0.0639	0.0315	0.0210	0.0047	0.0520	0.0516	0.0041	0.0309	0.0658	0.0249	0.0233	0.0048
		SB	PWS-04	PWS-04_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0050	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0204	0.0094	0.0233	0.0048
		SB	PWS-05	PWS-05_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0153	0.0065	0.0352	0.0639	0.0315	0.0096	0.0010	0.0354	0.0012	0.0041	0.0309	0.0132	0.0055	0.0233	0.0048
		SB	PWS-06	PWS-06_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0162	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0159	0.0060	0.0233	0.0048
		SB	PWS-07	PWS-07_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0178	0.0093	0.0217	0.0639	0.0315	0.0179	0.0028	0.0494	0.0641	0.0041	0.0309	0.0318	0.0136	0.0233	0.0048
		SB	PWS-08	PWS-08_8-11_PW	N	0.0058	0.0072	0.0257	0.0210	0.0011	0.0004	0.0129	0.0055	0.0221	0.0639	0.0315	0.0118	0.0008	0.0471	0.0656	0.0041	0.0309	0.0271	0.0117	0.0233	0.0048
		SB	PWS-09	PWS-09_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0033	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-12	PWS-12_8-11 DUP_PW	FD	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0031	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-12	PWS-12_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0017	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-13	PWS-13_1-4_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-13	PWS-13_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-15	PWS-15_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-16	PWS-16_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0047	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-16	PWS-16B_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0042	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0181	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	PWS-25	PWS-25_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0116	0.0051	0.0196	0.0639	0.0315	0.0093	0.0008	0.0402	0.0985	0.0041	0.0309	0.0294	0.0161	0.0233	0.0048
		SB	PWS-26	PWS-26_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0041	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0212	0.0100	0.0233	0.0048
	October 2012	MC	PWS-17	PWS-17_4-7 POREWATER	N	0.0058	0.0138	0.0257	0.0333	0.0011	0.0007	0.0487	0.0117	0.0234	0.0639	0.0315	0.0146	0.0015	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		MC	PWS-27	PWS-27_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0040	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		MC	PWS-30	PWS-30_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	LSI-01	LSI-01_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0032	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048
		SB	LSI-02	LSI-02_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0136	0.0066	0.0196	0.0639	0.0315	0.0089	0.0008	0.0354	0.0012	0.0041	0.0309	0.0232	0.0113	0.0233	0.0048
		SB	LSI-20	LSI-20_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0267	0.0051	0.0272	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0187	0.0112	0.0233	0.0048
		SB	LSI-24	LSI-24-8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0006	0.0297	0.0051	0.0196	0.0639	0.0315	0.0084	0.0011	0.0354	0.0012	0.0041	0.0309	0.0165	0.0094	0.0233	0.0048
		SB	PWS-01	PWS-1_8-10 POREWATER	N	0.0058	0.0072	0.0446	0.0003	0.0011	0.0011	0.0876	0.0295	0.0257	0.0639	0.0315	0.0167	0.0008	0.0354	0.0012	0.0041	0.0309	0.0128	0.0051	0.0233	0.0048
		SB	PWS-03	PWS-3_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0115	0.0132	0.0209	0.0639	0.0315	0.0105	0.0021	0.0354	0.0012	0.0041	0.0309	0.0461	0.0196	0.0233	0.0055
		SB	PWS-04	PWS-4_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0097	0.0059	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0169	0.0071	0.0233	0.0048
		SB	PWS-05	PWS-5_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0122	0.0059	0.0196	0.0639	0.0315	0.0120	0.0008	0.0354	0.0012	0.0041	0.0309	0.0160	0.0061	0.0233	0.0048
		SB	PWS-06	PWS-6_8-11 POREWATER	N	0.0058	0.0072	0.0289	0.1000	0.0011	0.0004	0.0301	0.0084	0.0199	0.0639	0.0315	0.0105	0.0008	0.0354	0.0012	0.0041	0.0309	0.0177	0.0072	0.0233	0.0048
		SB	PWS-07	PWS-7_8-10 DUP POREWATER	FD	0.0058	0.0072	0.0933	0.2162	0.0011	0.0016	0.0818	0.0712	0.0858	0.0639	0.0315	0.1709	0.0416	0.1272	0.1178	0.0041	0.0309	0.1632	0.0631	0.0462	0.0330
		SB	PWS-07	PWS-7_8-10 POREWATER	N	0.0058	0.0072	0.0257	0.0734	0.0011	0.0004	0.0217	0.0137	0.0429	0.0639	0.0315	0.0261	0.0041	0.0481	0.0932	0.0041	0.0309	0.0336	0.0139	0.0233	0.0048
		SB	PWS-08	PWS-8_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0125	0.0127	0.0214	0.0639	0.0315	0.0235	0.0022	0.0354	0.0012	0.0041	0.0309	0.0263	0.0112	0.0233	0.0076
		SB	PWS-09	PWS-9_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0081	0.0069	0.0203	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0102	0.0049	0.0233	0.0048
		SB	PWS-12	PWS-12_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0079
		SB	PWS-13	PWS-13_8-11 POREWATER	N	0.0058	0.0072	0.4530	**2.2613**	0.9387	0.0008	0.0249	0.0150	0.1408	0.3751	0.0315	0.0889	0.0038	0.4048	0.6627	0.3264	0.0309	0.0374	0.0214	0.0358	0.0085
		SB	PWS-15	PWS-15_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0082	0.0051	0.0196	0.0639	0.0315	0.0089	0.0008	0.0354	0.0012	0.0041	0.0309	0.0092	0.0049	0.0233	0.0048
		SB	PWS-16	PWS-16_8-11 POREWATER	N	0.0058	0.0072	0.0387	0.0003	0.0011	0.0004	0.0220	0.0198	0.0255	0.0639	0.0315	0.0261	0.0016	0.0354	0.0012	0.0041	0.0309	0.0224	0.0084	0.0233	0.0048
		SB	PWS-25	PWS-25_4-8 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0034	0.0051	0.0196	0.0639	0.0315	0.0089	0.0008	0.0354	0.0012	0.0041	0.0309	0.0470	0.0215	0.0233	0.0108
		SB	PWS-26	PWS-26_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0098	0.0051	0.0196	0.0639	0.0315	0.0110	0.0008	0.0354	0.0012	0.0041	0.0309	0.0193	0.0082	0.0233	0.0048
		SB	PWS-26	PWS-26_8-11_DUP POREWATE	FD	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0100	0.0056	0.0196	0.0639	0.0315	0.0099	0.0008	0.0354	0.0012	0.0041	0.0309	0.0194	0.0083	0.0233	0.0048
		SB	PWS-28	PWS-28_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048

Please refer to notes at end of table.

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Table 5-8
ΣIWTU Calculations from Direct Measurements of 34 PAHs in Porewater
Updated Supplemental RI Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

NAPL or non-NAPL Area	Sampling Period	Exposure Area [1]	Passive Sampler Location	Sample ID	Sample Type [2]	Chrysene	C-1 Benz(a)anth/Chrysenes	C-2 Benz(a)anth/Chrysenes	C-3 Benz(a)anth/Chrysenes	C-4 Benz(a)anth/Chrysenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	ΣIWTU Full DLs
Final Chronic Value (µg/L)						2.042	0.8557	0.4827	0.1675	0.07062	0.6774	0.6415	0.9008	0.9573	0.9008	0.275	0.2825	0.4391	--
Non-NAPL Areas	July 2012	MC	PWS-27	PWS-27_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**
		SB	PWS-01	PWS-01_8-9_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.84**
		SB	PWS-03	PWS-03_8-11_PW	N	0.0105	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.72**
		SB	PWS-04	PWS-04_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**
		SB	PWS-05	PWS-05_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.56**
		SB	PWS-06	PWS-06_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**
		SB	PWS-07	PWS-07_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.67**
		SB	PWS-08	PWS-08_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.67**
		SB	PWS-09	PWS-09_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**
		SB	PWS-12	PWS-12_8-11 DUP_PW	FD	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**
		SB	PWS-12	PWS-12_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**
		SB	PWS-13	PWS-13_1-4_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**
		SB	PWS-13	PWS-13_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**
		SB	PWS-15	PWS-15_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**
		SB	PWS-16	PWS-16_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**
		SB	PWS-16	PWS-16B_8-11_PW	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**
		SB	PWS-25	PWS-25_8-11_PW	N	0.0045	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.67**
		SB	PWS-26	PWS-26_8-11_PW	N	0.0031	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**
	October 2012	MC	PWS-17	PWS-17_4-7 POREWATER	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.43**
		MC	PWS-27	PWS-27_8-11 POREWATER	N	0.0030	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.33**
		MC	PWS-30	PWS-30_8-11 POREWATER	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.32**
		SB	LSI-01	LSI-01_8-11 POREWATER	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**
		SB	LSI-02	LSI-02_8-11 POREWATER	N	0.0044	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.56**
		SB	LSI-20	LSI-20_8-11 POREWATER	N	0.0041	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.58**
		SB	LSI-24	LSI-24-8-11 POREWATER	N	0.0042	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.57**
		SB	PWS-01	PWS-1_8-10 POREWATER	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.47**
		SB	PWS-03	PWS-3_8-11 POREWATER	N	0.0101	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.41**
		SB	PWS-04	PWS-4_8-11 POREWATER	N	0.0037	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.34**
		SB	PWS-05	PWS-5_8-11 POREWATER	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.35**
		SB	PWS-06	PWS-6_8-11 POREWATER	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.47**
		SB	PWS-07	PWS-7_8-10 DUP POREWATER	FD	0.0266	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**2.52**
		SB	PWS-07	PWS-7_8-10 POREWATER	N	0.0082	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.61**
		SB	PWS-08	PWS-8_8-11 POREWATER	N	0.0046	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.39**
		SB	PWS-09	PWS-9_8-11 POREWATER	N	0.0051	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.34**
		SB	PWS-12	PWS-12_8-11 POREWATER	N	0.0071	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.33**
		SB	PWS-13	PWS-13_8-11 POREWATER	N	0.0114	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**6.92**
		SB	PWS-15	PWS-15_8-11 POREWATER	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.33**
		SB	PWS-16	PWS-16_8-11 POREWATER	N	0.0024	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.41**
		SB	PWS-25	PWS-25_4-8 POREWATER	N	0.0075	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.39**
		SB	PWS-26	PWS-26_8-11 POREWATER	N	0.0021	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.35**
		SB	PWS-26	PWS-26_8-11_DUP POREWATE	FD	0.0031	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.35**
		SB	PWS-28	PWS-28_8-11 POREWATER	N	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.32**

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 5-8
ΣIWTU Calculations from Direct Measurements of 34 PAHs in Porewater
Updated Supplemental RI Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

NAPL or non-NAPL Area	Sampling Period	Exposure Area [1]	Passive Sampler Location	Sample ID	Sample Type [2]	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/Anthracenes	C-2 Phenanthrenes/Anthracenes	C-3 Phenanthrenes/Anthracenes	C-4 Phenanthrenes/Anthracenes	Fluoranthene	Pyrene	C-1 Fluoranthrenes/Pyrenes	Benzo(a)anthracene
Final Chronic Value (µg/L)						193.6	81.69	30.24	11.10	4.048	306.9	55.85	39.3	13.99	5.305	1.916	19.13	20.73	7.436	3.199	1.256	0.5594	7.109	10.11	4.887	2.227
Non-NAPL Areas	Sept 2017	SB	PWS-1	Shallow Porewater Site 1	N	0.0000	0.0001	0.0007	0.0085	0.0578	0.0000	0.0002	0.0002	0.0003	0.0017	0.0036	0.0001	0.0000	0.0002	0.0010	0.0038	0.0026	0.0001	0.0001	0.0001	0.0000
		SB	PWS-1	Deep Porewater Site 1	N	0.0003	0.0246	0.2629	**1.0180**	**1.8725**	0.0001	0.0621	0.0139	0.0187	0.0364	0.0363	0.0155	0.0004	0.0073	0.0136	0.0282	0.0110	0.0013	0.0007	0.0006	0.0001
		MC	PWS-2	Shallow Porewater Site 2	N	0.0005	0.0206	0.8102	**4.0270**	**10.7460**	0.0000	0.0015	0.0016	0.0147	0.1084	0.1597	0.0014	0.0002	0.0093	0.0463	0.1162	0.1139	0.0000	0.0001	0.0003	0.0000
		MC	PWS-2	Deep Porewater Site 2	N	0.0000	0.0138	0.2110	0.5838	**1.0277**	0.0000	0.0005	0.0003	0.0022	0.0104	0.0187	0.0002	0.0000	0.0008	0.0034	0.0109	0.0106	0.0000	0.0000	0.0000	0.0000
		SB	PWS-3	Shallow Porewater Site 3	N	0.0000	0.0000	0.0002	0.0010	0.0181	0.0000	0.0000	0.0000	0.0000	0.0002	0.0006	0.0000	0.0000	0.0001	0.0006	0.0006	0.0025	0.0000	0.0000	0.0000	0.0000
				Deep Porewater Site 3		0.0000	0.0000	0.0007	0.0059	0.0204	0.0000	0.0002	0.0000	0.0000	0.0001	0.0006	0.0000	0.0000	0.0000	0.0002	0.0006	0.0024	0.0000	0.0000	0.0000	0.0000
		SB	PWS-4	Shallow Porewater Site 4	N	0.0000	0.0001	0.0007	0.0040	0.0371	0.0000	0.0001	0.0001	0.0000	0.0006	0.0030	0.0001	0.0000	0.0003	0.0009	0.0027	0.0025	0.0000	0.0000	0.0000	0.0000
				Deep Porewater Site 4		0.0000	0.0001	0.0216	0.1523	0.3878	0.0000	0.0055	0.0003	0.0020	0.0046	0.0062	0.0014	0.0000	0.0007	0.0018	0.0045	0.0028	0.0002	0.0001	0.0001	0.0000
		SB	PWS-5	Shallow Porewater Site 5	N	0.0002	0.0003	0.0033	0.0337	0.1336	0.0000	0.0002	0.0001	0.0002	0.0021	0.0049	0.0001	0.0000	0.0002	0.0014	0.0050	0.0046	0.0001	0.0000	0.0000	0.0000
				Deep Porewater Site 5		0.0000	0.0000	0.2110	**3.6577**	**14.9457**	0.0000	0.0000	0.0012	0.0219	0.2111	0.3507	0.0023	0.0000	0.0176	0.1107	0.3169	0.4094	0.0002	0.0004	0.0009	0.0001
		SB	PWS-6	Shallow Porewater Site 6	N	0.0000	0.0001	0.0006	0.0038	0.0230	0.0000	0.0001	0.0001	0.0001	0.0005	0.0020	0.0000	0.0000	0.0001	0.0006	0.0025	0.0025	0.0000	0.0000	0.0000	0.0000
				Deep Porewater Site 6		0.0000	0.0000	0.0026	0.0090	0.0274	0.0000	0.0008	0.0001	0.0001	0.0005	0.0038	0.0001	0.0000	0.0002	0.0006	0.0006	0.0024	0.0000	0.0000	0.0000	0.0000
		SB	PWS-7	Shallow Porewater Site 7	N	0.0000	0.0001	0.0006	0.0045	0.0257	0.0000	0.0001	0.0001	0.0001	0.0007	0.0037	0.0000	0.0000	0.0001	0.0006	0.0006	0.0025	0.0000	0.0000	0.0000	0.0000
				Deep Porewater Site 7		0.0000	0.0000	0.0002	0.0016	0.0117	0.0000	0.0002	0.0000	0.0000	0.0004	0.0031	0.0000	0.0000	0.0001	0.0005	0.0019	0.0024	0.0000	0.0000	0.0000	0.0000
		SB	PWS-8	Shallow Porewater Site 8	N	0.0001	0.0002	0.0012	0.0095	0.0590	0.0000	0.0002	0.0001	0.0003	0.0018	0.0064	0.0001	0.0000	0.0002	0.0015	0.0052	0.0043	0.0001	0.0001	0.0001	0.0000
				Deep Porewater Site 8		0.0000	0.0000	0.0005	0.0045	0.0274	0.0000	0.0002	0.0000	0.0001	0.0006	0.0035	0.0000	0.0000	0.0001	0.0007	0.0028	0.0024	0.0001	0.0000	0.0000	0.0000
		SB	PWS-9	Shallow Porewater Site 9	N	0.0000	0.0001	0.0006	0.0046	0.0292	0.0000	0.0002	0.0001	0.0001	0.0006	0.0033	0.0000	0.0000	0.0001	0.0008	0.0034	0.0025	0.0001	0.0000	0.0001	0.0000
				Deep Porewater Site 9		0.0000	0.0000	0.0023	0.0149	0.0652	0.0000	0.0012	0.0001	0.0004	0.0012	0.0051	0.0002	0.0000	0.0002	0.0009	0.0030	0.0024	0.0001	0.0000	0.0000	0.0000
		SB	PWS-10	Shallow Porewater Site 10	N	0.0000	0.0001	0.0009	0.0123	0.1010	0.0000	0.0003	0.0002	0.0004	0.0020	0.0035	0.0001	0.0000	0.0002	0.0012	0.0036	0.0025	0.0001	0.0001	0.0001	0.0000
				Deep Porewater Site 10		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		SB	PWS-11	Shallow Porewater Site 11	N	0.0000	0.0001	0.0006	0.0077	0.0578	0.0000	0.0003	0.0002	0.0002	0.0014	0.0033	0.0001	0.0001	0.0002	0.0014	0.0045	0.0025	0.0002	0.0001	0.0001	0.0000
				Deep Porewater Site 11		0.0000	0.0000	0.0005	0.0036	0.0284	0.0000	0.0003	0.0001	0.0001	0.0008	0.0033	0.0001	0.0000	0.0001	0.0009	0.0030	0.0025	0.0001	0.0001	0.0001	0.0000
		SB	PWS-12	Shallow Porewater Site 12	N	0.0026	0.0045	0.0148	0.0537	0.1964	0.0000	0.0011	0.0024	0.0026	0.0061	0.0090	0.0042	0.0002	0.0020	0.0047	0.0090	0.0078	0.0017	0.0008	0.0006	0.0001
				Deep Porewater Site 12		0.0000	0.0002	0.0175	0.0955	0.2989	0.0000	0.0024	0.0014	0.0025	0.0075	0.0109	0.0015	0.0003	0.0014	0.0048	0.0115	0.0113	0.0006	0.0003	0.0004	0.0001
		SB	PWS-13	Shallow Porewater Site 13	N	0.0000	0.0000	0.0006	0.0093	0.0958	0.0000	0.0004	0.0003	0.0007	0.0044	0.0084	0.0001	0.0001	0.0003	0.0024	0.0076	0.0081	0.0003	0.0002	0.0002	0.0000
				Deep Porewater Site 13		0.0000	0.0001	0.0304	0.1505	0.4620	0.0000	0.0070	0.0026	0.0035	0.0118	0.0213	0.0026	0.0000	0.0015	0.0063	0.0166	0.0184	0.0007	0.0004	0.0004	0.0001
		SB	PWS-14	Shallow Porewater Site 14	N	0.0001	0.0001	0.0011	0.0071	0.0420	0.0000	0.0003	0.0002	0.0002	0.0012	0.0041	0.0001	0.0000	0.0002	0.0012	0.0034	0.0025	0.0001	0.0001	0.0001	0.0000
				Deep Porewater Site 14		0.0023	0.0035	0.0410	0.2613	0.9931	0.0000	0.0098	0.0017	0.0035	0.0163	0.0327	0.0022	0.0002	0.0020	0.0089	0.1019	0.0024	0.0006	0.0003	0.0004	0.0001
		SB	PWS-15	Shallow Porewater Site 15	N	0.0000	0.0001	0.0007	0.0065	0.0445	0.0000	0.0002	0.0001	0.0002	0.0016	0.0032	0.0001	0.0000	0.0001	0.0011	0.0042	0.0025	0.0001	0.0001	0.0001	0.0000

Pleaser refer to notes at end of table.

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Table 5-8
ΣIWTU Calculations from Direct Measurements of 34 PAHs in Porewater
Updated Supplemental RI Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

NAPL or non-NAPL Area	Sampling Period	Exposure Area [1]	Passive Sampler Location	Sample ID	Sample Type [2]	Chrysene	C-1 Benz(a)anth/Chrysenes	C-2 Benz(a)anth/Chrysenes	C-3 Benz(a)anth/Chrysenes	C-4 Benz(a)anth/Chrysenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	ΣIWTU Full DLs
Final Chronic Value (µg/L)						2.042	0.8557	0.4827	0.1675	0.07062	0.6774	0.6415	0.9008	0.9573	0.9008	0.275	0.2825	0.4391	--
NAPL Areas	Sept 2017	SB	PWS-1	Shallow Porewater Site 1	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.08
		SB	PWS-1	Deep Porewater Site 1	N	0.0001	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**3.42**
		MC	PWS-2	Shallow Porewater Site 2	N	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**16.2**
		MC	PWS-2	Deep Porewater Site 2	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**1.89**
		SB	PWS-3	Shallow Porewater Site 3	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.02
				Deep Porewater Site 3		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.03
		SB	PWS-4	Shallow Porewater Site 4	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.05
				Deep Porewater Site 4		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.59
		SB	PWS-5	Shallow Porewater Site 5	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.19
				Deep Porewater Site 5		0.0001	0.0006	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	**20.26**
		SB	PWS-6	Shallow Porewater Site 6	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.04
				Deep Porewater Site 6		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.05
		SB	PWS-7	Shallow Porewater Site 7	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.04
				Deep Porewater Site 7		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.02
		SB	PWS-8	Shallow Porewater Site 8	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.09
				Deep Porewater Site 8		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.04
		SB	PWS-9	Shallow Porewater Site 9	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.05
				Deep Porewater Site 9		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.10
		SB	PWS-10	Shallow Porewater Site 10	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.13
				Deep Porewater Site 10		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00
		SB	PWS-11	Shallow Porewater Site 11	N	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.08
				Deep Porewater Site 11		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.04
		SB	PWS-12	Shallow Porewater Site 12	N	0.0002	0.0001	0.0000	0.0000	0.0000	0.0002	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.33
				Deep Porewater Site 12		0.0001	0.0002	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.47
		SB	PWS-13	Shallow Porewater Site 13	N	0.0001	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.14
				Deep Porewater Site 13		0.0001	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.74
		SB	PWS-14	Shallow Porewater Site 14	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.06
				Deep Porewater Site 14		0.0001	0.0002	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0018	0.0000	0.0001	0.0000	0.0001	**1.49**
		SB	PWS-15	Shallow Porewater Site 15	N	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.07

Notes:

All values are in toxic units (TU) based on narcotic effects in benthic organisms. Values in **BOLD** are greater than 1.

[1] Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[2] Sample Type: N = normal; FD = field duplicate

IWTU = interstitial water toxic units

µg/L = micrograms per liter

PAHs = polycyclic aromatic hydrocarbons

ΣIWTU = sum of interstitial water toxic units

TU = toxic units

Color Coding:

Blue shading indicates non-detection

Yellow to orange to red indicates detected values with increasing TU contribution.

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Table 5-9
Sediment Porewater Analytical Results Summary - VPH, BETX & Naphthalene
Updated Supplemental RI Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

		VPH							VOCs				
Sediment Porewater Sample ID	Sample Date	$C_{>5}$-C_6 Aliphatics	$C_{>6}$-C_8 Aliphatics	$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{13} Aromatics	Benzene	Toluene	Ethylbenzene	Xylenes, total	Naphthalene
		µg/L							µg/L				
PDB-92617-1	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-2	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-4	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-5	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-6	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-7	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-8	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-9	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-10	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-DUP	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-092617-11	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-92617-12	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-92617-13	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-92617-14	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U
PDB-92617-15	09/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U	0.2 U	1.0 U	0.5 U	1.5 U	2.0 U

Notes:

VPH = Volatile Petroleum Hydrocarbons using the Washington Ecology method where volatile aliphatic and aromatic hydrocarbons are collectively quantified within the ranges listed above by gas chromatography (GC) using a photo-ionization detector (PID) and flame ionization detector (FID).
µg/L = micrograms per liter
Selected volatile organic compounds (VOCs) - Benzene, toluene, ethylbenzene, and xylenes (BTEX), and naphthalene were analyzed by EPA Method 8260C
U = The analyte was not detected above the applicable reporting or detection limit.
PDB - Passive Diffusion Bag porewater sampling device.
The PDBs were prepared and provided by EON Products, Inc were equipped with Equilibrator ™ deionized water and deployed at co-located with other sediment, porewater, and/or surface water samples.
Passive samplers PDB-3, PDB-4, PDB-5, PDB-6, PDB-7, PDB-8, PDB-9, PDB-10, PDB-11, PDB-14 were deployed on September 5, 2017.
Passive samplers PDB-1, PDB-2, PWS-12, PDB-13, and PDB-15 were deployed on September 6, 2017.
All passive samplers were removed on September 26, 2017.
DUP = Field duplicate sample collected from Phase 3 sampling location PWS-10

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Table 5-10
Sediment Porewater Analytical Results Summary - OPAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

			Oxygenated Polycyclic Aromatic Hydrocarbons (22 OPAHs) by OSU FSES SOP 414.00 [2]																				
Sediment Porewater Sample ID	**Passive Sampling Location [1]**	**No. of Detected Analytes**	**Total OPAHs**	**1,2-Napthoquinone**	**1,4-Antraquinone**	**1,4-Benzoquinone**	**1,4Naphthoquinone**	**2,Ethylanthraquinone**	**4H,cyclopental[def]phenantrhen-5-one**	**5,12-Naphthacene-quinone**	**9,10-Anthraquinone**	**9,10-Phenanthrenequinone**	**9-Fluorenone**	**Aceanthracenequinone**	**Acenaphthenequinone**	**Benzaanthracene-7,12-dione**	**Benzanthrone**	**Benzo(c)phenanthrene(1,4)quinone**	**Benzo(cd)pyrenone**	**Benzofluorenone**	**Chromone**	**Perinaphthenone**	**Phenanthrene-1,4-dione**	**Pyrene-4,5-dione**	**Xanthone**
			µg/L																				
Shallow Porewater Site 1	PWS-1	5	0.458	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	**0.000253**	0.0000123 U	**0.00436**	0.654 U	**0.00107** B	0.0671 U	0.143 U	0.0000113 U	0.00000328 U	0.0000676 U	0.0000014 U	**0.000046**	**0.453**	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 1	PWS-1	0	0.0	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	0.00000564 U	0.000012 U	0.000331 U	0.636 U	0.0000259 U	0.0653 U	0.139 U	0.000011 U	0.00000323 U	0.0000658 U	0.00000162 U	0.00000231 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 2	PWS-2	2	0.0102	20.7 U	0.00596 U	0.867 U	0.0114 U	0.000005606 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	**0.01** B	0.0671 U	0.143 U	0.0000113 U	**0.000176**	0.0000676 U	0.00000144 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 2	PWS-2	2	0.0018	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	0.00000564 U	0.000012 U	0.000331 U	0.636 U	**0.00178** B	0.0653 U	0.139 U	0.000011 U	0.00000328 U	0.0000658 U	0.00000182 U	0.00000233 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 3	PWS-3	1	0.0004	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	**0.000387** B	0.0671 U	0.143 U	0.0000113 U	0.00000329 U	0.0000676 U	0.00000144 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 3	PWS-3	0	0.0	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	0.00000564 U	0.000012 U	0.000331 U	0.636 U	0.0000259 U	0.0653 U	0.139 U	0.000011 U	0.00000322 U	0.0000658 U	0.0000016 U	0.00000231 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 4	PWS-4	2	0.0010	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	**0.000173**	0.0000123 U	0.000341 U	0.654 U	**0.000832** B	0.0671 U	0.143 U	0.0000113 U	0.0000033 U	0.0000676 U	0.00000156 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 4	PWS-4	1	0.0002	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	**0.000155**	0.000012 U	0.000331 U	0.636 U	0.0000259 U	0.0653 U	0.139 U	0.000011 U	0.00000337 U	0.0000658 U	0.00000209 U	0.00000237 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 5	PWS-5	0	0.0	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	0.0000266 U	0.0671 U	0.143 U	0.0000113 U	0.00000328 U	0.0000676 U	0.00000125 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 5	PWS-5	1	0.0005	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	0.00000564 U	0.000012 U	0.000331 U	0.636 U	0.0000259 U	0.0653 U	0.139 U	0.000011 U	**0.000533**	0.0000658 U	0.00000158 U	0.00000231 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 6	PWS-6	1	0.0002	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	**0.000217** B	0.0671 U	0.143 U	0.0000113 U	0.00000328 U	0.0000676 U	0.00000137 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 6	PWS-6	1	0.0026	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	0.00000564 U	0.000012 U	0.000331 U	0.636 U	**0.00257** B	0.0653 U	0.139 U	0.000011 U	0.0000032 U	0.0000658 U	0.0000014 U	0.00000231 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 7	PWS-7	0	0.0	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	0.0000266 U	0.0671 U	0.143 U	0.0000113 U	0.00000328 U	0.0000676 U	0.00000131 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 7	PWS-7	0	0.0	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	0.00000564 U	0.0000121 U	0.000331 U	0.636 U	0.0000259 U	0.0653 U	0.139 U	0.000011 U	0.00000353 U	0.0000658 U	0.00000245 U	0.00000244 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 8	PWS-8	1	0.0007	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	**0.000668** B	0.0671 U	0.143 U	0.0000113 U	0.00000332 U	0.0000676 U	0.00000168 U	0.00000238 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 8	PWS-8	0	0.0	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	0.00000564 U	0.000012 U	0.000331 U	0.636 U	0.0000259 U	0.0653 U	0.139 U	0.000011 U	0.00000319 U	0.0000658 U	0.0000013 U	0.0000023 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 9	PWS-9	1	0.0011	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	**0.00111** B	0.0671 U	0.143 U	0.0000113 U	0.00000328 U	0.0000676 U	0.00000137 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 9	PWS-9	3	0.0032	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	**0.000489**	0.000012 U	0.000331 U	0.636 U	**0.00266** B	0.0653 U	0.139 U	0.000011 U	0.0000032 U	0.0000658 U	0.00000145 U	**0.000079**	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 10	PWS-10	0	0.0	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	0.0000266 U	0.0671 U	0.143 U	0.0000113 U	0.00000329 U	0.0000676 U	0.00000151 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 10	PWS-10	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Shallow Porewater Site 11	PWS-11	3	0.0006	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	**0.00048**	0.0000123 U	0.000341 U	0.654 U	0.0000266 U	0.0671 U	0.143 U	**0.0000982**	**0.0000232**	0.0000676 U	0.0000014 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 11	PWS-11	2	0.0005	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	**0.000494**	0.000012 U	0.000331 U	0.636 U	0.0000259 U	0.0653 U	0.139 U	0.000011 U	**0.0000187**	0.0000658 U	0.00000135 U	0.0000023 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 12	PWS-12	9	0.630	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	**0.0103**	**0.000536**	**0.0552**	0.654 U	**0.0212** B	0.0671 U	0.143 U	**0.000952**	**0.000113**	0.0000676 U	0.0000014 U	**0.000874**	**0.538**	0.000202 U	0.000916 U	0.0671 U	**0.00286**
Deep Porewater Site 12	PWS-12	6	0.570	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	**0.00108**	0.000012 U	**0.0121**	0.636 U	**0.00401** B	0.0653 U	0.139 U	0.000011 U	**0.000029**	0.0000658 U	0.00000142 U	**0.00018**	**0.553**	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 13	PWS-13	5	0.0117	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	**0.00107**	0.0000123 U	**0.00831**	0.654 U	**0.00208** B	0.0671 U	0.143 U	0.0000113 U	**0.0000296**	0.0000676 U	0.00000134 U	**0.00021**	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 13	PWS-13	6	0.0342	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	**0.0013**	**0.000129**	**0.0174**	0.636 U	**0.0151** B	0.0653 U	0.139 U	0.000011 U	**0.0000432**	0.0000658 U	0.00000148 U	**0.000249**	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 14	PWS-14	0	0.0	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	0.0000266 U	0.0671 U	0.143 U	0.0000113 U	0.00000328 U	0.0000676 U	0.00000138 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 14	PWS-14	6	0.0333	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	**0.000841**	**0.000221**	**0.0217**	0.636 U	**0.0101** B	0.0653 U	0.139 U	0.000011 U	**0.0000398**	0.0000658 U	0.00000182 U	**0.000351**	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U
Shallow Porewater Site 15	PWS-15	0	0.0	20.7 U	0.00596 U	0.867 U	0.0114 U	0.00000506 U	0.0000058 U	0.0000123 U	0.000341 U	0.654 U	0.0000266 U	0.0671 U	0.143 U	0.0000113 U	0.00000328 U	0.0000676 U	0.0000013 U	0.00000237 U	0.0572 U	0.000202 U	0.000916 U	0.0671 U	0.0000863 U
Deep Porewater Site 15	PWS-15	2	0.0001	20.1 U	0.0058 U	0.844 U	0.0111 U	0.00000493 U	0.00000564 U	0.000012 U	0.000331 U	0.636 U	0.0000259 U	0.0653 U	0.139 U	0.000011 U	**0.000073**	0.0000658 U	0.00000141 U	0.00000231 U	0.0557 U	0.000197 U	0.000891 U	0.0653 U	0.000084 U

Notes:

[1] The term "passive sampler" refers to the sampling hardware (sediment probes) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU SOPs to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These in situ passive samplers are designed to act as a carbon sink so that OPAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in sediment porewater.

[2] SOP 414.00 – Determination of Oxygenated PAHs (OPAHs) (a total of 22 analytes) using GC/MS.

µg/L - micrograms per liter.

Bold indicates analyte was detected at or above the method detection limit.

U = Value is below detection limit

B = The sample was background corrected

-- = the results of this sample have not been included because the LDPE strip was comprised in the hood and low molecular weight PAH surrogate standards below data quality objectives.

All values represent calculations of C_{free}, not traditional water concentrations

OPAHs - oxygenated polycyclic aromatic hydrocarbons
OSU FSES = Oregon State University Food Safety and Environmental Stewardship Program
SOP = Standard Operating Procedure
LDPE = low density polyethylene

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Table 5-11
Surface Water Analytical Results Summary - 34 PAHs
Updated Supplemental RI Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

					Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [2]																		
Sample ID	**Passive Sampler Location [1]**	**No. of Detected Analytes**	**Total PAHs**	**Fl/Py Ratio**	**Naphthalene**	**C-1 Naphthalenes**	**C-2 Naphthalenes**	**C-3 Naphthalenes**	**C-4 Naphthalenes**	**Acenaphthylene**	**Acenaphthene**	**Fluorene**	**C-1 Fluorenes**	**C-2 Fluorenes**	**C-3 Fluorenes**	**Phenanthrene**	**Anthracene**	**C-1 Phenanthrenes/ Anthracenes**	**C-2 Phenanthrenes/ Anthracenes**	**C-3 Phenanthrenes/ Anthracenes**	**C-4 Phenanthrenes/ Anthracenes**	**Fluoranthene**	**Pyrene**
			µg/L		µg/L																		
Surface Water Site 2	PWS-2	29	0.0518	0.80	**0.0107** B	**0.0396** B	**0.132** B	**0.46** B	**0.996** B	**0.000401**	**0.00952**	**0.00412**	**0.0109** B	**0.0359** B	**0.0321**	**0.0055**	**0.000581**	**0.00599** B	**0.0135**	**0.0191**	0.000276 U	**0.00363**	**0.00451**
Surface Water Site 3	PWS-3	30	0.0192	0.72	**0.00223** B	**0.00758** B	**0.043** B	**0.454** B	**1.94** B	**0.000298**	**0.00267**	**0.00196**	**0.00726** B	**0.047** B	**0.0474**	**0.00135**	**0.00052**	**0.00483** B	**0.0207**	**0.0309**	**0.00951** B	**0.0025**	**0.00347**
Surface Water Site 4	PWS-4	30	0.0260	0.68	**0.0034** B	**0.0102** B	**0.0618** B	**0.515** B	**2.62** B	**0.000292**	**0.00351**	**0.0022**	**0.00868** B	**0.0707** B	**0.08**	**0.00169**	**0.000558**	**0.00562** B	**0.0294**	**0.0424**	**0.00924** B	**0.00335**	**0.00494**
Surface Water Site 9	PWS-9	32	0.0634	0.80	**0.00426** B	**0.0194** B	**0.105** B	**0.832** B	**3.25** B	**0.000849**	**0.0159**	**0.00683**	**0.0198** B	**0.112** B	**0.102**	**0.00627**	**0.00202**	**0.0126** B	**0.0466**	**0.0625**	**0.0244** B	**0.00694**	**0.00871**
Surface Water Site 10-1	PWS-10	32	0.0797	0.75	**0.0108** B	**0.0318** B	**0.12** B	**0.815** B	**3.33** B	**0.000833**	**0.022**	**0.00805**	**0.0178** B	**0.0998** B	**0.0945**	**0.00671**	**0.00174**	**0.012** B	**0.0452**	**0.0576**	**0.0173** B	**0.00642**	**0.00856**
Surface Water Site 10-3	PWS-10	30	0.0657	0.73	**0.00861** B	**0.0264** B	**0.106** B	**0.712** B	**3.23** B	**0.000883**	**0.0173**	**0.00683**	**0.0158** B	**0.0916** B	**0.0906**	**0.00556**	**0.00144**	**0.0102** B	**0.0388**	**0.0501**	0.000276 U	**0.00553**	**0.00758**
Surface Water Site 12	PWS-12	31	0.0709	0.72	**0.00586** B	**0.0201** B	**0.0854** B	**0.586** B	**3.24** B	**0.000936**	**0.0128**	**0.00552**	**0.0114** B	**0.0887** B	**0.096**	**0.00563**	**0.00172**	**0.0111** B	**0.0455**	**0.0614**	**0.0236** B	**0.00665**	**0.00922**
Surface Water Site 13	PWS-13	31	0.0793	0.76	**0.00942** B	**0.0277** B	**0.0968** B	**0.672** B	**3.03** B	**0.00138**	**0.0157**	**0.00669**	**0.0155** B	**0.092** B	**0.0916**	**0.00576**	**0.00268**	**0.0126** B	**0.053**	**0.0826**	**0.0393** B	**0.0102**	**0.0134**
Surface Water Site 14	PWS-14	31	0.0327	0.72	**0.00475** B	**0.0093** B	**0.044** B	**0.38** B	**1.43** B	**0.000468**	**0.0093**	**0.00388**	**0.01** B	**0.0467** B	**0.0428**	**0.00241**	**0.00087**	**0.00456** B	**0.0175**	**0.0252**	**0.00987** B	**0.00259**	**0.00361**
Screening Level Value (SLV)[8]			--	--	620 [3]	--	--	--	--	4,840[4]	74[3]	3.9[5]	--	--	--	6.3[5]	0.09[3]	--	--	--	--	30[3]	0.3[4]

Notes:

[1] The term "passive sampler" refers to the sampling hardware (surface water cages) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU SOPs to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These *in situ* passive samplers are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in surface water.

[2] SOP 427.00 = Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.

[3] LCV Fish Surface Water Screening Benchmark.

[4] EPA Region 5 ESL Surface Water Screening Benchmark.

[5] OSWER Ambient Water Quality Criteria.

[6] EPA Region 6 FW Surface Water Screening Benchmark.

[7] Tier II SCV Surface Water Screening Benchmark.

[8] SLVs based on the Oak Ridge National Laboratory Risk Assessment Information System database (ORNL, 2014).

Passive samplers PWS-3, PWS-4, PWS-5, PWS-6, PWS-7, PWS-8, PWS-9, PWS-10, PWS-11, PWS-14 were deployed on September 5, 2017.
Passive samplers PWS-1, PWS-2, PWS-12, PWS-13, and PWS-15 were deployed on September 6, 2017.
All passive samplers were removed on September 26, 2017.
Total PAHs represent sum of all 63 freely dissolved concentrations (Cfree ∑63) measured on the passive sampler's media.
Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS)
PAHs = polycyclic aromatic hydrocarbons
µg/L = micrograms per liter
Bold indicates analyte was detected at or above the method detection limit.
J = estimated value.
U = The analyte was not detected above the applicable reporting or detection limit.
B = Sample was background corrected.
OSU FSES = Oregon State University Food Safety and Environmental Stewardship Program
SOP = Standard Operating Procedure
µg/L = micrograms per liter
Fl/Py = fluoranthene/pyrene
LDPE = low density polyethylene

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Table 5-11
Surface Water Analytical Results Summary - 34 PAHs
Phase 3 Data Gap Investigation Progress Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

				Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [2]														
Sample ID	**Passive Sampler Location [1]**	**No. of Detected Analytes**	**Total PAHs**	**C-1 Fluoranthrenes/ Pyrenes**	**Benzo(a)anthracene**	**Chrysene**	**C-1 Benz(a)anth/ Chrysenes**	**C-2 Benz(a)anth/ Chrysenes**	**C-3 Benz(a)anth/ Chrysenes**	**C-4 Benz(a)anth/ Chrysenes**	**Benzo(b)fluoranthene**	**Benzo(k)fluoranthene**	**Benzo(e)pyrene**	**Benzo(a)pyrene**	**Perylene**	**Indeno(1,2,3-cd)pyrene**	**Dibenzo(a,h)anthracene**	**Benzo(g,h,i)perylene**
			µg/L	µg/L														
Surface Water Site 2	PWS-2	29	0.0518	**0.00146**	**0.000162**	**0.000168**	**0.000152**	**0.00000542**	0.000000252 U	0.000000252 U	**0.0000447**	**0.00002**	**0.0000408**	**0.0000161**	**0.0000425**	0.000000089 U	0.000000358 U	**0.00000534**
Surface Water Site 3	PWS-3	30	0.0192	**0.00345**	**0.000118**	**0.000137**	**0.000429**	**0.0000239**	0.000000899 U	0.000000899 U	**0.0000493**	**0.0000191**	**0.0000608**	**0.0000226**	**0.000129**	0.000000081 U	0.000000326 U	**0.0000106**
Surface Water Site 4	PWS-4	30	0.0260	**0.00208**	**0.00018**	**0.000207**	**0.000144**	**0.00000802**	0.000000246 U	0.000000246 U	**0.0000651**	**0.0000276**	**0.0000802**	**0.0000298**	**0.00015**	0.000000086 U	0.000000348 U	**0.0000123**
Surface Water Site 9	PWS-9	32	0.0634	**0.00382**	**0.000307**	**0.000315**	**0.000219**	**0.00001**	0.000000185 U	0.000000185 U	**0.000111**	**0.0000363**	**0.000119**	**0.0000549**	**0.000139**	**0.000013**	**0.00000346**	**0.0000166**
Surface Water Site 10-1	PWS-10	32	0.0797	**0.00357**	**0.000293**	**0.000288**	**0.000192**	**0.00000827**	0.00000018 U	0.00000018 U	**0.0000928**	**0.0000394**	**0.0000965**	**0.0000478**	**0.000104**	**0.0000104**	**0.00000277**	**0.0000135**
Surface Water Site 10-3	PWS-10	30	0.0657	**0.00315**	**0.000225**	**0.000247**	**0.000158**	**0.00000831**	0.000000171 U	0.000000171 U	**0.0000729**	**0.0000298**	**0.0000765**	**0.0000408**	**0.000102**	**0.00000881**	0.000000229 U	**0.0000111**
Surface Water Site 12	PWS-12	31	0.0709	**0.00447**	**0.000353**	**0.000328**	**0.000222**	**0.0000104**	0.00000017 U	0.00000017 U	**0.000118**	**0.0000491**	**0.000116**	**0.0000664**	**0.0000969**	**0.0000116**	0.000000228 U	**0.0000156**
Surface Water Site 13	PWS-13	31	0.0793	**0.00689**	**0.000619**	**0.000566**	**0.000372**	**0.0000155**	0.00000019 U	0.00000019 U	**0.000208**	**0.0000908**	**0.000204**	**0.000123**	**0.000126**	**0.000017**	0.000000259 U	**0.0000232**
Surface Water Site 14	PWS-14	31	0.0327	**0.0012**	**0.0000801**	**0.0000956**	**0.0000734**	**0.00000412**	0.000000155 U	0.000000155 U	**0.0000337**	**0.0000129**	**0.000037**	**0.0000192**	**0.0000634**	**0.00000472**	0.000000205 U	**0.00000738**
Screening Level Value (SLV) [8]			--	--	0.027[7]	7[6]	--	--	--	--	9.07[4]	9.07[4]	--	0.014[7]	--	4.31[4]	5.0[6]	7.64[4]

Notes:

[1] The term "passive sampler" refers to the sampling hardware (surface water cages) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU SOPs to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These in situ passive samplers are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in surface water.

[2] SOP 427.00 = Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.

[3] LCV Fish Surface Water Screening Benchmark.

[4] EPA Region 5 ESL Surface Water Screening Benchmark.

[5] OSWER Ambient Water Quality Criteria.

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[8] SLVs based on the Oak Ridge National Laboratory Risk Assessment Information System database (ORNL, 2014).

Passive samplers PWS-3, PWS-4, PWS-5, PWS-6, PWS-7, PWS-8, PWS-9, PWS-10, PWS-11, PWS-14 were deployed on September 5, 2017.
Passive samplers PWS-1, PWS-2, PWS-12, PWS-13, and PWS-15 were deployed on September 6, 2017.
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Total PAHs represent sum of all 63 freely dissolved concentrations (Cfree ∑63) measured on the passive sampler's media.
Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS)
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OSU FSES = Oregon State University Food Safety and Environmental Stewardship Program
SOP = Standard Operating Procedure
µg/L = micrograms per liter
Fl/Py = fluoranthene/pyrene
LDPE = low density polyethylene

Cascadia Associates, LLC

Table 5-12
ΣSWTU Calculations from Direct Measurements of 34 PAHs in Surface Water
Updated Supplemental RI Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

						Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [1] (µg/L)																			
NAPL or non-NAPL Area	Sampling Period	Exposure Area [2]	Passive Sampler Location	Sample ID	Sample Type [3]	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/Anthracenes	C-2 Phenanthrenes/Anthracenes	C-3 Phenanthrenes/Anthracenes	C-4 Phenanthrenes/Anthracenes	Fluoranthene	Pyrene	C-1 Fluoranthrenes/Pyrenes	Benzo(a)anthracene
Final Chronic Value (µg/L)						193.6	81.69	30.24	11.10	4.048	306.9	55.85	39.3	13.99	5.305	1.916	19.13	20.73	7.436	3.199	1.256	0.5594	7.109	10.11	4.887	2.227
Non-NAPL Areas	September 2017	MC	PWS-2	Surface Water Site 2	N	5.53E-05	4.85E-04	0.0044	0.0414	0.246	1.31E-06	1.70E-04	1.05E-04	7.79E-04	0.0068	0.0168	2.88E-04	2.80E-05	8.06E-04	0.0042	0.0152	0.0005	5.11E-04	4.46E-04	2.99E-04	7.27E-05
		SB	PWS-3	Surface Water Site 3	N	1.15E-05	9.28E-05	0.0014	0.0409	0.479	9.71E-07	4.78E-05	4.99E-05	5.19E-04	0.0089	0.0247	7.06E-05	2.51E-05	6.50E-04	0.0065	0.0246	0.0170	3.52E-04	3.43E-04	7.06E-04	5.30E-05
		SB	PWS-4	Surface Water Site 4	N	1.76E-05	1.25E-04	0.0020	0.0464	0.647	9.51E-07	6.28E-05	5.60E-05	6.20E-04	0.0133	0.0418	8.83E-05	2.69E-05	7.56E-04	0.0092	0.0338	0.0165	4.71E-04	4.89E-04	4.26E-04	8.08E-05
		SB	PWS-9	Surface Water Site 9	N	2.20E-05	2.37E-04	0.0035	0.0750	0.803	2.77E-06	2.85E-04	1.74E-04	1.42E-03	0.0211	0.0532	3.28E-04	9.74E-05	1.69E-03	0.0146	0.0498	0.0436	9.76E-04	8.62E-04	7.82E-04	1.38E-04
		SB	PWS-10	Surface Water Site 10-1	N	5.58E-05	3.89E-04	0.0040	0.0734	0.823	2.71E-06	3.94E-04	2.05E-04	1.27E-03	0.0188	0.0493	3.51E-04	8.39E-05	1.61E-03	0.0141	0.0459	0.0309	9.03E-04	8.47E-04	7.31E-04	1.32E-04
		SB	PWS-10	Surface Water Site 10-3	FD	4.45E-05	3.23E-04	0.0035	0.0641	0.798	2.88E-06	3.10E-04	1.74E-04	1.13E-03	0.0173	0.0473	2.91E-04	6.95E-05	1.37E-03	0.0121	0.0399	0.0005	7.78E-04	7.50E-04	6.45E-04	1.01E-04
		SB	PWS-12	Surface Water Site 12	N	3.03E-05	2.46E-04	0.0028	0.0528	0.800	3.05E-06	2.29E-04	1.40E-04	8.15E-04	0.0167	0.0501	2.94E-04	8.30E-05	1.49E-03	0.0142	0.0489	0.0422	9.35E-04	9.12E-04	9.15E-04	1.59E-04
		SB	PWS-13	Surface Water Site 13	N	4.87E-05	3.39E-04	0.0032	0.0605	0.749	4.50E-06	2.81E-04	1.70E-04	1.11E-03	0.0173	0.0478	3.01E-04	1.29E-04	1.69E-03	0.0166	0.0658	0.0703	1.43E-03	1.33E-03	1.41E-03	2.78E-04
		SB	PWS-14	Surface Water Site 14	N	2.45E-05	1.14E-04	0.0015	0.0342	0.353	1.52E-06	1.67E-04	9.87E-05	7.15E-04	0.0088	0.0223	1.26E-04	4.20E-05	6.13E-04	0.0055	0.0201	0.0176	3.64E-04	3.57E-04	2.46E-04	3.60E-05

Notes:

All values are in toxic units (TU) based on narcotic effects in benthic organisms. Values in **BOLD** are greater than 1.

[1] SOP 427.00 = Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.

[2] Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3] Sample Type: N = normal; FD = field duplicate

SWTU = surface water toxic units

µg/L = micrograms per liter

PAHs = polycyclic aromatic hydrocarbons

ΣSWTU = sum of surface water toxic units

Color Coding:

Blue shading indicates non-detection

Yellow to orange to red indicates detected values with increasing TU contribution.

Cascadia Associates, LLC

Table 5-12
ΣSWTU Calculations from Direct Measurements of 34 PAHs in Surface Water
Phase 3 Data Gap Investigation Progress Report
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

						Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [1] (µg/L)														
NAPL or non-NAPL Area	Sampling Period	Exposure Area [2]	Passive Sampler Location	Sample ID	Sample Type [3]	Chrysene	C-1 Benz(a)anth/Chrysenes	C-2 Benz(a)anth/Chrysenes	C-3 Benz(a)anth/Chrysenes	C-4 Benz(a)anth/Chrysenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	ΣSWTU Full DLs	ΣSWTU 1/2 DLs
Final Chronic Value (µg/L)						2.042	0.8557	0.4827	0.1675	0.07062	0.6774	0.6415	0.9008	0.9573	0.9008	0.275	0.2825	0.4391	--	--
Non-NAPL Areas	September 2017	MC	PWS-2	Surface Water Site 2	N	8.23E-05	1.78E-04	1.12E-05	1.50E-06	3.57E-06	6.60E-05	3.12E-05	4.53E-05	1.68E-05	4.72E-05	3.24E-07	1.27E-06	1.22E-05	0.340	0.340
		SB	PWS-3	Surface Water Site 3	N	6.71E-05	5.01E-04	4.95E-05	5.37E-06	1.27E-05	7.28E-05	2.98E-05	6.75E-05	2.36E-05	1.43E-04	2.95E-07	1.15E-06	2.41E-05	0.607	0.607
		SB	PWS-4	Surface Water Site 4	N	1.01E-04	1.68E-04	1.66E-05	1.47E-06	3.48E-06	9.61E-05	4.30E-05	8.90E-05	3.11E-05	1.67E-04	3.13E-07	1.23E-06	2.80E-05	0.814	0.814
		SB	PWS-9	Surface Water Site 9	N	1.54E-04	2.56E-04	2.07E-05	1.10E-06	2.62E-06	1.64E-04	5.66E-05	1.32E-04	5.73E-05	1.54E-04	4.73E-05	1.22E-05	3.78E-05	**1.07**	**1.07**
		SB	PWS-10	Surface Water Site 10-1	N	1.41E-04	2.24E-04	1.71E-05	1.07E-06	2.55E-06	1.37E-04	6.14E-05	1.07E-04	4.99E-05	1.15E-04	3.78E-05	9.81E-06	3.07E-05	**1.07**	**1.07**
		SB	PWS-10	Surface Water Site 10-3	FD	1.21E-04	1.85E-04	1.72E-05	1.02E-06	2.42E-06	1.08E-04	4.65E-05	8.49E-05	4.26E-05	1.13E-04	3.20E-05	8.11E-07	2.53E-05	0.989	0.989
		SB	PWS-12	Surface Water Site 12	N	1.61E-04	2.59E-04	2.15E-05	1.01E-06	2.41E-06	1.74E-04	7.65E-05	1.29E-04	6.94E-05	1.08E-04	4.22E-05	8.07E-07	3.55E-05	**1.04**	**1.04**
		SB	PWS-13	Surface Water Site 13	N	2.77E-04	4.35E-04	3.21E-05	1.13E-06	2.69E-06	3.07E-04	1.42E-04	2.26E-04	1.28E-04	1.40E-04	6.18E-05	9.17E-07	5.28E-05	**1.04**	**1.04**
		SB	PWS-14	Surface Water Site 14	N	4.68E-05	8.58E-05	8.54E-06	9.25E-07	2.19E-06	4.97E-05	2.01E-05	4.11E-05	2.01E-05	7.04E-05	1.72E-05	7.26E-07	1.68E-05	0.467	0.467

Notes:

All values are in toxic units (TU) based on narcotic effects in benthic organisms. Values in **BOLD** are greater than 1.

[1] SOP 427.00 = Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.

[2] Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3] Sample Type: N = normal; FD = field duplicate

SWTU = surface water toxic units

µg/L = micrograms per liter

PAHs = polycyclic aromatic hydrocarbons

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Color Coding:

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Yellow to orange to red indicates detected values with increasing TU contribution.

Cascadia Associates, LLC

Table 5-13
Surface Water Analytical Results Summary - OPAHs
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Former Pope & Talbot Wood Treating Site
St Helens, Oregon

			Oxygenated Polycyclic Aromatic Hydrocarbons (22 OPAHs) by OSU FSES SOP 414.00 [2]																				
Sample ID	**No. of Detected Analytes**	**Total OPAHs**	**1,2-Napthoquinone**	**1,4-Antraquinone**	**1,4-Benzoquinone**	**1,4Naphthoquinone**	**2,Ethylanthraquinone**	**4H,cyclopental[def]phenantrhen-5-one**	**5,12-Naphthacene-quinone**	**9,10-Anthraquinone**	**9,10-Phenanthrenequinone**	**9-Fluorenone**	**Aceanthracenequinone**	**Acenaphthenequinone**	**Benzaanthracene-7,12-dione**	**Benzanthrone**	**Benzo(c)phenanthrene(1,4)quinone**	**Benzo(cd)pyrenone**	**Benzofluorenone**	**Chromone**	**Perinaphthenone**	**Phenanthrene-1,4-dione**	**Pyrene-4,5-dione**	**Xanthone**
			Units: µg/L																				
Surface Water Site 2	1	0.0001	4.06 U	0.00117 U	0.17 U	0.00225 U	0.000000995 U	0.00000114 U	0.00000242 U	0.0000669 U	0.128 U	0.00000523 U	0.0132 U	0.028 U	0.00000222 U	**0.0000173**	0.0000133 U	0.000000242 U	**0.000114**	0.0112 U	0.0000397 U	0.00018 U	0.0132 U	0.0000169 U
Surface Water Site 3	4	0.0008	4.06 U	0.00117 U	0.17 U	0.00225 U	0.000000995 U	**0.000508**	0.00000242 U	0.0000669 U	0.128 U	0.00000523 U	0.0132 U	0.028 U	**0.000129**	**0.0000243**	0.0000133 U	0.000000257 U	**0.000182**	0.0112 U	0.0000397 U	0.00018 U	0.0132 U	0.0000169 U
Surface Water Site 4	3	0.026	4.06 U	0.00117 U	0.17 U	0.00225 U	0.000000995 U	**0.000451**	0.000002424 U	0.0000669 U	0.128 U	0.00000523 U	0.0132 U	0.028 U	**0.000167**	0.000000644 U	0.0000133 U	0.000000252 U	**0.000185**	0.0112 U	0.0000397 U	0.00018 U	0.0132 U	0.0000169 U
Surface Water Site 9	4	0.0017	4.06 U	0.00117 U	0.17 U	0.00225 U	0.000000995 U	**0.000846**	**0.000077**	0.0000669 U	0.128 U	0.00000523 U	0.0132 U	0.028 U	**0.000308**	0.000000644 U	0.0000133 U	0.000000223 U	**0.00042**	0.0112 U	0.0000397 U	0.00018 U	0.0132 U	0.0000169 U
Surface Water Site 10-1	3	0.0018	4.06 U	0.00117 U	0.17 U	0.00225 U	0.000000995 U	**0.00118**	0.00000242 U	0.0000669 U	0.128 U	0.00000523 U	0.0132 U	0.028 U	**0.000228**	0.000000644 U	0.0000133 U	0.000000223 U	**0.000362**	0.0112 U	0.0000397 U	0.00018 U	0.0132 U	0.0000169 U
Surface Water Site 10-3	4	0.438	4.06 U	0.00117 U	0.17 U	0.00225 U	0.000000994 U	0.00000114 U	0.00000242 U	0.0000669 U	0.128 U	0.00000523 U	0.0132 U	0.028 U	**0.000347**	**0.0000332**	0.0000133 U	0.000000245 U	**0.0005**	**0.437**	0.0000397 U	0.00018 U	0.0132 U	0.0000169 U
Surface Water Site 12	5	0.414	4.06 U	0.00117 U	0.17 U	0.00225 U	0.000000995 U	**0.00152**	**0.000145**	0.0000669 U	0.128 U	0.00000523 U	0.0132 U	0.028 U	**0.000321**	0.000000644 U	0.0000133 U	0.000000253 U	**0.000534**	**0.412**	0.0000397 U	0.00018 U	0.0132 U	0.0000169 U
Surface Water Site 13	5	0.391	4.06 U	0.00117 U	0.17 U	0.00225 U	0.000000995 U	**0.00177**	**0.000109**	0.0000669 U	0.128 U	0.00000523 U	0.0132 U	0.028 U	**0.000259**	**0.0000446**	0.0000133 U	0.000000249 U	0.000000465 U	**0.389**	0.0000397 U	0.00018 U	0.0132 U	0.0000169 U
Surface Water Site 14	4	0.0008	4.06 U	0.00117 U	0.17 U	0.00225 U	0.000000995 U	**0.000524**	0.00000242 U	0.0000669 U	0.128 U	0.00000523 U	0.0132 U	0.028 U	**0.000127**	**0.000022**	0.0000133 U	0.000000253 U	**0.000143**	0.0112 U	0.0000397 U	0.00018 U	0.0132 U	0.0000169 U

Notes:

[1] The term "passive sampler" refers to the sampling hardware (sediment probes) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU SOPs to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These in situ passive samplers are designed to act as a carbon sink so that OPAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in sediment porewater.

[2] SOP 414.00 – Determination of Oxygenated PAHs (OPAHs) (a total of 22 analytes) using GC/MS.

µg/L - micrograms per liter.

U = Value is below detection limit

B = The sample was background corrected

Bold indicates analyte was detected at or above the method detection limit.

All values represent calculations of C_{free}, not traditional water concentrations

OPAHs - oxygenated polycyclic aromatic hydrocarbons

OSU FSES = Oregon State University Food Safety and Environmental Stewardship Program

SOP = Standard Operating Procedure

LDPE = low density polyethylene

Cascadia Associates, LLC

Table 8-1
Summary of RI Data Collection
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Count

Matrix	1996	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2010	2011	2012	2013	2017	Total
NAPL	1	1										1		1			4
Groundwater	57	136	36	29	26	26	22	13	11	13	1	12	20	61			463
Porewater													11	63		30	74
Sediment	24						26	30	20				120	92	2	15	329
Seep Water	1		3														4
Soil	165		102										12		23		302
Surface Water	4		10													9	14
Total	252	137	151	29	26	26	48	43	31	13	1	13	163	217	25		1,175

Analytical Test Count

Method Group	1996	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2010	2011	2012	2013	2017	Total
Dioxins	6																6
Fuels	75	89	66	18			22	11	11	12	1	25	121	61	25		537
Herbicides	105	90	65	18	17	18											313
Metals	105	89	67	18	17	18	11	6	3	5		12	23	61			435
SVOCs	140	99	80	21	18	20	48	41	31	13	0	12	126	193	25	45	867
VOCs	106	89	71	18	17	18						12	7			15	338
Other													136	209	25	15	385
Total	537	456	349	93	69	74	81	58	45	30	1	61	413	524	75	75	2,866

Analytical Results Count

Matrix	1996	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2010	2011	2012	2013	2017	Total
NAPL	69	6										3		35			113
Groundwater	2,156	4,468	1,337	951	762	843	477	238	223	262	4	355	462	1,551			14,089
Porewater														2,226		80	2,226
Sediment	432						468	540	360				2,571	2,548	36	80	7,035
Seep Water	21		93														114
Soil	2,962		1,983										221		421		5,587
Surface Water	176		450													80	626
Total	5,816	4,474	3,863	951	762	843	945	778	583	262	4	358	3,254	6,360	457	240	29,950

Please refer to notes at end of table.

Cascadia Associates, LLC

Table 8-1
Summary of RI Data Collection
Updated Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analytical Tests by Matrix Count

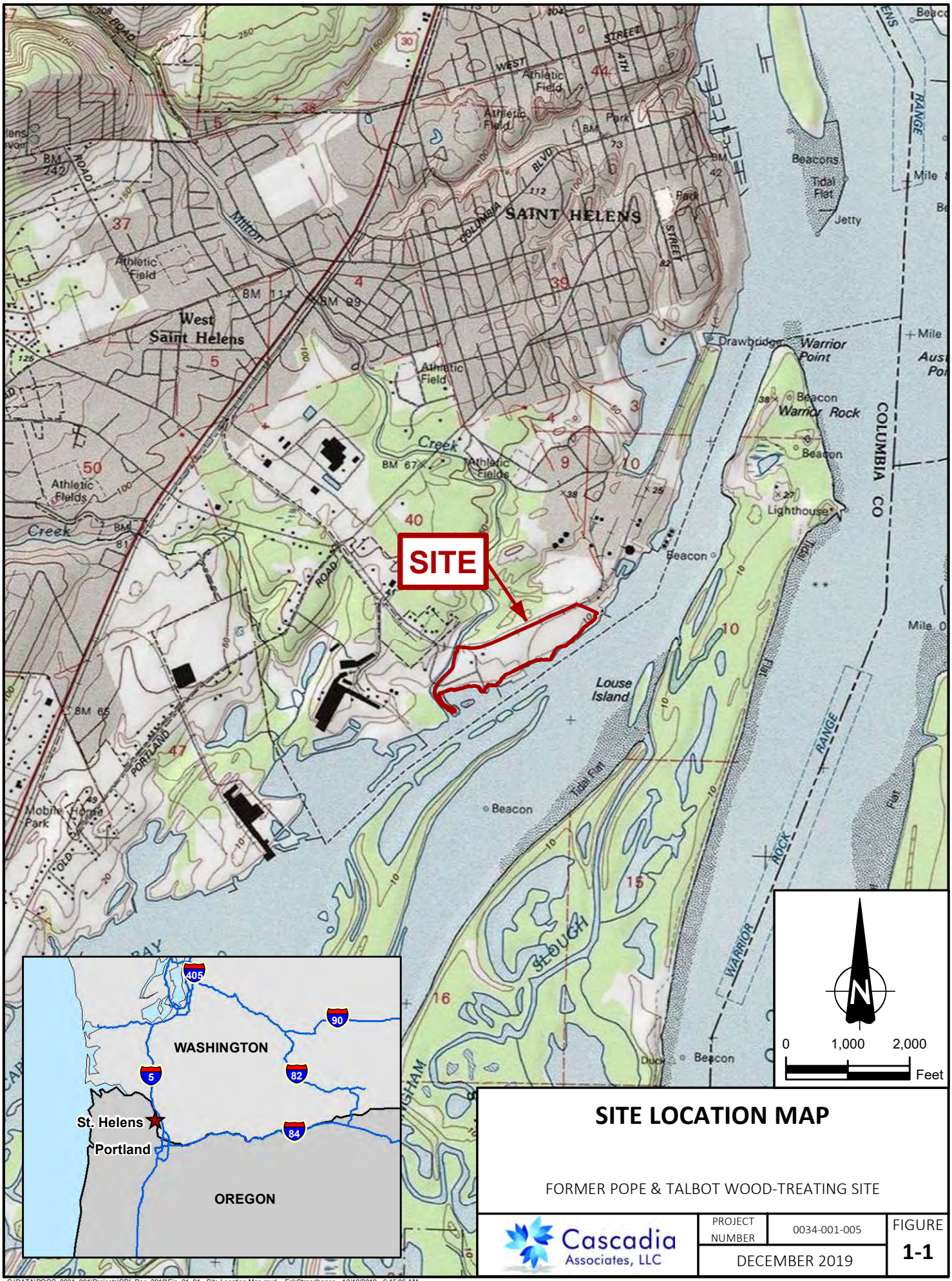
Analyte Class	1996	1997	1998	1999	2000	2001	2003	2004	2005	2006	2007	2010	2011	2012	2013	2017	Total
NAPL																	
Dioxins	1																1
Fuels	1	1										1					3
Herbicides	1																1
Metals	2																2
SVOCs	1													1			2
VOCs	1																1
Groundwater																	
Fuels	43	88	22	18			22	11	11	12	1	24	18	55			325
Herbicides	43	90	22	18	17	18											208
Metals	42	89	22	18	17	18	11	6	3	5		12	20	61			324
SVOCs	47	99	27	21	18	20	22	11	11	13	0	12	20	64	0		385
VOCs	44	89	22	18	17	18						12					220
Porewater																	
PAHs														61		90	151
Other														56		120	176
Sediment																	
Fuels													89	6	2	32	129
Metals													3				3
SVOCs	24						26	30	20				94	67	2	64	327
VOCs													7			64	71
Other													124	153	2		279
Seep Water																	
SVOCs	1		3														4
VOCs			3														3
Soil																	
Dioxins	5																5
Fuels	27		34										14		23		98
Herbicides	57		33														90
Metals	57		35														92
SVOCs	63		40										12		23		138
VOCs	57		36														93
Other													12		23		35
Surface Water																	
Fuels	4		10													18	14
Herbicides	4		10														14
Metals	4		10														14
SVOCs	4		10													36	14
VOCs	4		10													9	14
Total	537	456	349	93	69	74	81	58	45	30	1	61	413	524	75	433	3,299

Acronyms/Abbreviations
PAHs = polycyclic aromatic hydrocarbons
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds
NAPL = nonaqueous-phase liquid
RI = Remedial Investigation
Other = Total Organic Carbon, Dissolved Organic Carbon, grain size, and/or percent solids

Notes
Sample Count = number of samples collected from each medium
Analytical Test Count = number of tests run for each chemical class
Analytical Results Count = number of individual analyte results for each medium
Analytical Tests by Matrix Count = number of tests run for each chemical class and each medium
SVOCs include PAHs by various methods; refer to the 2000 RI Report (GeoEngineers 2000) for a full list of SVOC analytes reported in the RI.

Cascadia Associates, LLC

FIGURES



SITE LOCATION MAP

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		1-1

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LEGEND:

- Former 8-inch Creosote Pipeline (above ground)
- Former 8-inch Creosote Pipeline (below ground)
- Former Pipeline circa 1919
- Approximate Site Boundary

Boise Cascade St. Helens Pulp & Paper Mill

Former Log Dump

Former Oil Pipe Trestle

Former Dock

Former Oil AST

Former Creosote Storage Tank (circa 1919)

AREA 2

AREA 1

Railroad Tracks

Former Creosote Storage Tank (circa 1938-59)

Railroad Ave.

Shop / Warehouse

Former Railroad Loading Platform

Former Wood-Treatment Plant (retorts/pump house)

Former Creosote Storage Tanks

Milton Creek

Former Fuel Oil Storage Tanks

Former Shop

Former Boiler

Former Transfer Table Dock

Former Transfer Table

Historical Wastewater Discharge Pipe Location

Former Hog Fuel Loading Hopper

Scappoose Bay

Multnomah Channe

N

0 100 200

Feet

NOTE:
The locations of all features shown are approximate.
Site boundary is based on OHWM 14-foot contour (NAVD88) LiDAR data provided by USACE 2010.
Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000).
2018 Imagery provided by Oregon Geospatial Enterprise Office.

NAVD88 = North American Vertical Datum 1988
LiDAR = Light Detection and Ranging
OHW = Ordinary High Water
USACE = United States Army Corp of Engineers

SITE PLAN

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		1-2

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Railroad Tracks

Railroad Avenue

Milton Creek

Approximate Site Boundary

Former Pope & Talbot Wood-Treating Site

Former Creosote Storage Tanks

Former Fuel Oil Storage Tank

Former Shop

Peninsula

Man-made Cove

Former Boiler

Historical Wastewater Discharge Pipe Location

Circa 1938-1959

Former Creosote Storage Tanks

Former 8-inch Creosote Pipeline (below ground)

Former 8-inch Creosote Pipeline (above ground)

Former Pipeline circa 1919

Former Railroad Loading Platform

Circa 1919

Former Transfer Table

Former Wood-Treatment Plant (retorts/pump house)

Former Transfer Table Dock

AREA 1

AREA 2

Scappoose Bay

Former Hog Fuel Loading Hopper

NOTE:
The locations of all features shown are approximate.
Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000).
2018 Imagery provided by Oregon Geospatial Enterprise Office.
Topographic contours were derived from by USACE 2010 LiDAR using ArcGIS 10.7 Spatial Analyst.
Bathymetric contours were derived from bathymetric survey conducted by Solmar Hydro Inc. in April 2017.

N

0 75 150 Feet

Depth in Ft.
10
5
0
-5
-10

LEGEND:

- Site Topography Contours (1 ft. interval)
- Ordinary High Water 14-ft. (NAVD88)
- Bathymetric Contour (1 ft. interval)

AREA 1 SITE TOPOGRAPHY AND BATHYMETRY

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		2-1

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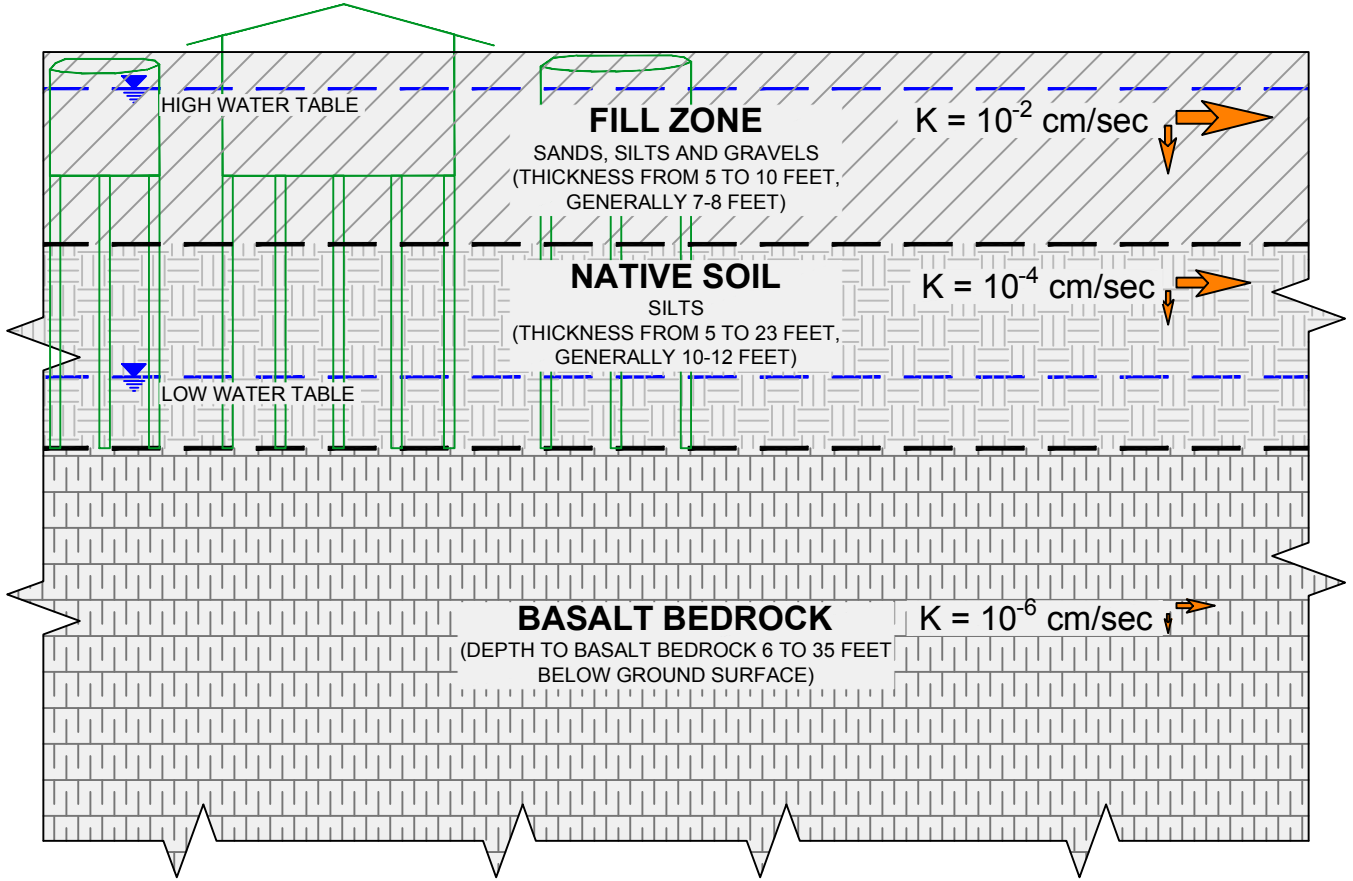

NOTES:

HISTORICAL SITE FEATURES

- K = HYDRAULIC CONDUCTIVITY
- GROUNDWATER ELEVATION DATA FROM SEPTEMBER 2010 TO AUGUST 2012.
- IN GENERAL, FILL PLACEMENT (DREDGE SAND) AT THE SITE OCCURRED IN THE EARLY 1970s. ADDITIONAL DREDGE FILL WAS PLACED ON THE EASTERN PORTION OF THE SITE IN 1975, AND APPROXIMATELY 5,000 CUBIC YARDS OF ROCK WAS PLACED IMMEDIATELY ADJACENT TO THE NORTH OF THE FORMER TRANSFER TABLE DOCK IN 1977 FOR BARGE LOADING (2000 RI REPORT).
- ZONE THICKNESSES ARE GENERAL THICKNESSES PRESENTED IN THE 2000 RI REPORT AND SUPPLEMENTAL RI REPORT.
- HYDRAULIC CONDUCTIVITY VALUES ARE APPROXIMATE AVERAGE VALUES OF RANGE PRESENTED IN 2000 RI REPORT.

GENERALIZED AREA 1 CROSS SECTION

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		2-2

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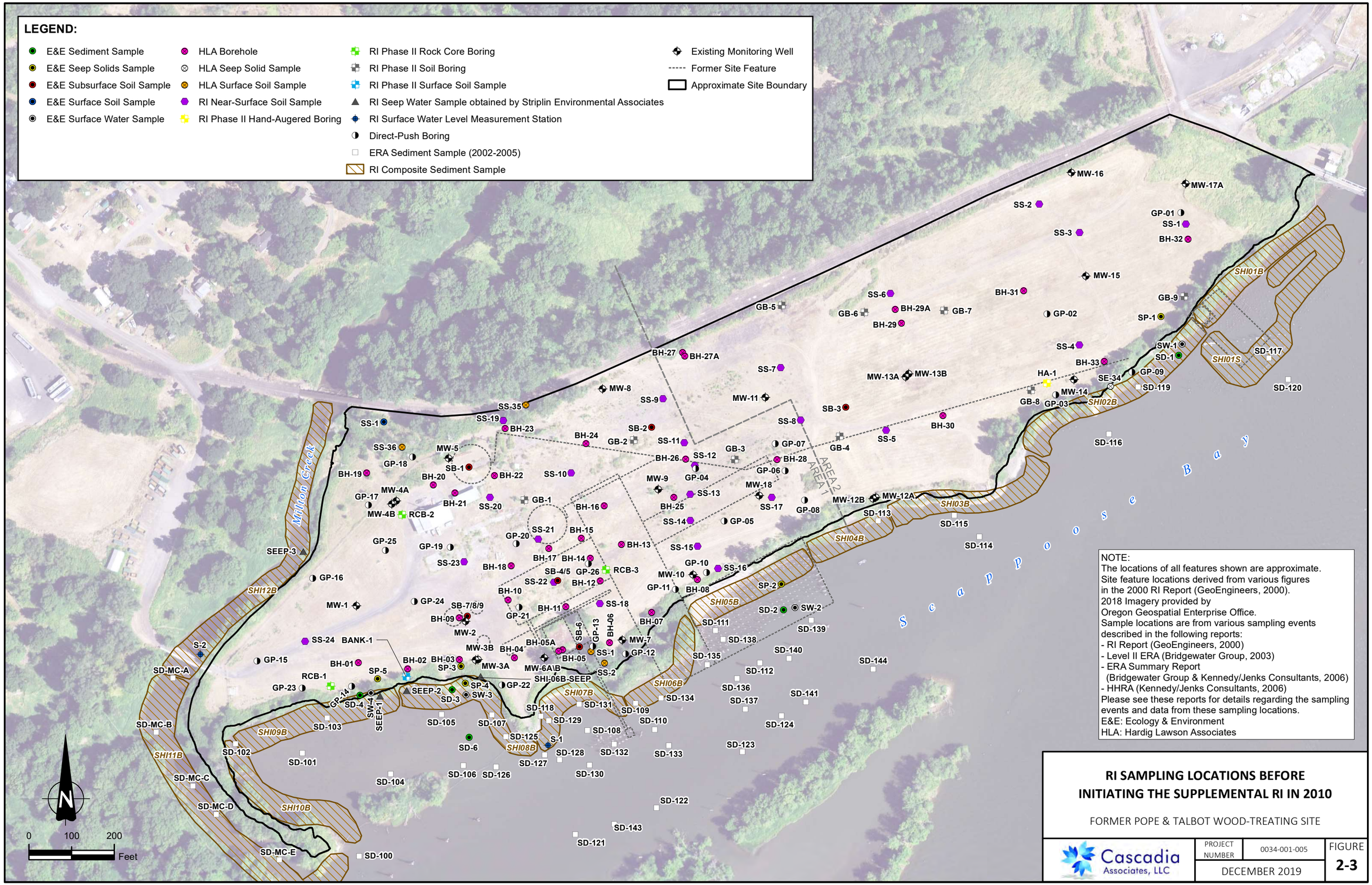
K:\11000\11200\11220\112203\dwg_SRI_Report_2019\4-2 - Cross Section C-C'.dwg - - - May. 28, 2019 7:00am - brian.johnson

LEGEND:

- E&E Sediment Sample
- E&E Seep Solids Sample
- E&E Subsurface Soil Sample
- E&E Surface Soil Sample
- E&E Surface Water Sample
- HLA Borehole
- HLA Seep Solid Sample
- HLA Surface Soil Sample
- RI Near-Surface Soil Sample
- RI Phase II Hand-Augered Boring
- RI Phase II Rock Core Boring
- RI Phase II Soil Boring
- RI Phase II Surface Soil Sample
- RI Seep Water Sample obtained by Striplin Environmental Associates
- RI Surface Water Level Measurement Station
- Direct-Push Boring
- ERA Sediment Sample (2002-2005)
- RI Composite Sediment Sample
- Existing Monitoring Well
- Former Site Feature
- Approximate Site Boundary



NOTE:
The locations of all features shown are approximate.
Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000).
2018 Imagery provided by Oregon Geospatial Enterprise Office.
Sample locations are from various sampling events described in the following reports:
- RI Report (GeoEngineers, 2000)
- Level II ERA (Bridgewater Group, 2003)
- ERA Summary Report (Bridgewater Group & Kennedy/Jenks Consultants, 2006)
- HHRA (Kennedy/Jenks Consultants, 2006)

Please see these reports for details regarding the sampling events and data from these sampling locations.
E&E: Ecology & Environment
HLA: Hardig Lawson Associates

RI SAMPLING LOCATIONS BEFORE INITIATING THE SUPPLEMENTAL RI IN 2010

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		2-3

C:\DATA\POCC_0034_001\Projects\SRI_Dec_2019\Fig_02_01_RI_Sampling_Locations.mxd - ErikStrandhagen - 12/9/2019 - 3:07:25 PM

LEGEND:

- Existing Monitoring Well
- Direct-Push Boring
- Seep
- RI Sample Location
- Surface Water Level Measurement Station
- October 2011 Shoreline Observation:
- March 2011 Phase 1 TarGOST Boring
- July 2011 Phase 2 Sediment Boring

July/October 2012 Sampling Event:

- Sediment Porewater Sample Location
- Limited Sediment Investigation (LSI) Sample Location

October 2013 Dock Area Investigation:

- Hand Auger
- Pothole
- DAI Boring

September 2017 Sampling Event:

- Phase 3 Data Gap Investigation Location
- Former Site Feature
- Approximate Upland Site Boundary

Milton Creek

AREA 2
AREA 1

Commencement Bay

NOTE:
2018 Imagery provided by Oregon Geospatial Enterprise Office.

N

0 75 150
Feet

SUPPLEMENTAL RI SAMPLING LOCATIONS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 3-1

C:\DATA\POCC_0034_001\Projects\SRI_Dec_2019\Fig_03_01_Supplemental RI Sampling Locations.mxd - ErikStrandhagen - 12/9/2019 - 3:10:05 PM

LEGEND:

- Groundwater Monitoring Well
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

MW-5
MW-4A
MW-4B
MW-21
MW-9
MW-18
MW-12A
MW-12B
AREA 1
AREA 2
MW-22
MW-23
MW-20
SHI 1
MW-10
MW-1
MW-24
MW-2A
MW-7
MW-6A with Pressure Transducer (Groundwater Monitoring Location)
MW-3A
MW-3B
MW-19
MW-25
Stiling Well with Pressure Transducer (Surface Water Monitoring Location)
Million Creek
Coos Bay Channel
Depth in Ft.
10
5
0
-5
-10
N
0 75 150
Feet

NOTE:
1. This drawing presents the results of a multibeam bathymetric survey conducted by Solmar Hydro, Inc.
2. Date of Survey: April 5th, 2017.
3. Survey monumentation and control established by Minister & Glaeser Surveying Inc.
4. This hydrographic survey was completed under the direction of a National Society of Professional Surveyors (NSPS) Certified Hydrographer.
5. Horizontal Datum: NAD83/11, Oregon State Plane Coordinate System, North Zone, Internaitonal Feet.
6. Vertical Datum: North American Vertical Datum of 1988 (NAVD88), International Feet.
7. Contour Interval: 1 foot.
8. Horizontal positions for navigation and data collection were determined by using an Applanix POS/MV 320 operating in Real Time Kinematic (RTK) mode.
9. Water surface elevations were derived using RTK GPS and the Geoid 2012A model.
10. Multibeam bathymetric data was collected using a R2 Sonic 2024 multibeam echosounder operating at 400 kHz.
11. Survey data is represented at a 0.5 foot grid resolution.
12. This bathymetric survey is representative of the condition of the bottom at the time of the survey. The condition of the bottom may change at any time after the date of this survey.
13. Bathymetric data was collected in accordance with the U.S. Army Corps of Engineers hydrographic manual EM-1110-02-1003 (November 2013).
14. 2018 Imagery provided by Oregon Geospatial Enterprise Office.

BATHYMETRY AND GROUNDWATER/SURFACE WATER MONITORING LOCATIONS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

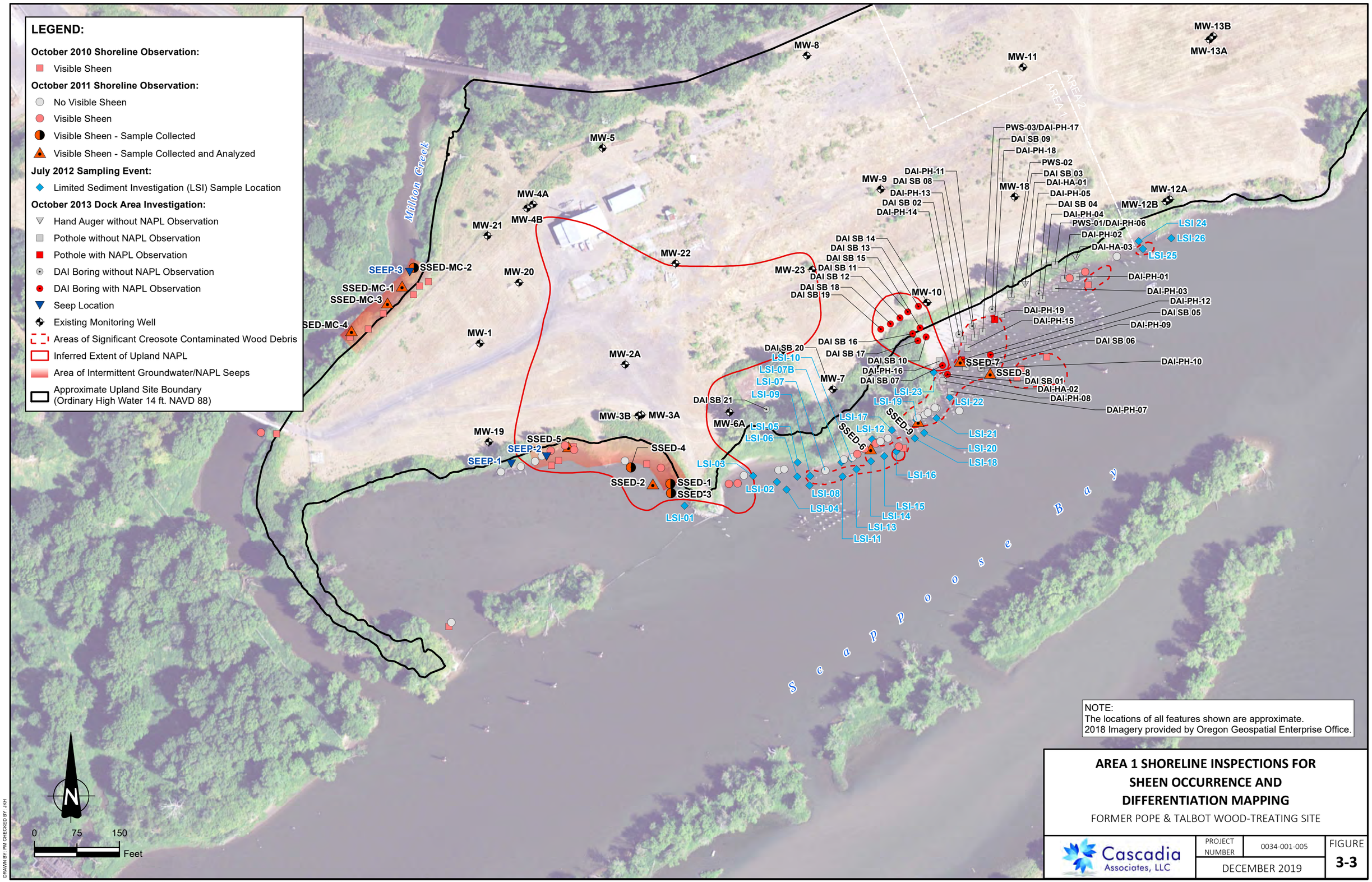
PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 3-2

DRAWN BY: PM CHECKED BY: JKH

\\POR-FS1\ClientData\11000\11200\11220\112203\dwg_SRI_Report_2019\3-2 - Bathymetry and Groundwater Monitoring Locations.mxd - brian.johnson - 12/11/2019 - 9:48:24 AM


LEGEND:
October 2010 Shoreline Observation:
Visible Sheen
October 2011 Shoreline Observation:
No Visible Sheen
Visible Sheen
Visible Sheen - Sample Collected
Visible Sheen - Sample Collected and Analyzed
July 2012 Sampling Event:
Limited Sediment Investigation (LSI) Sample Location
October 2013 Dock Area Investigation:
Hand Auger without NAPL Observation
Pothole without NAPL Observation
Pothole with NAPL Observation
DAI Boring without NAPL Observation
DAI Boring with NAPL Observation
Seep Location
Existing Monitoring Well
Areas of Significant Creosote Contaminated Wood Debris
Inferred Extent of Upland NAPL
Area of Intermittent Groundwater/NAPL Seeps
Approximate Upland Site Boundary
(Ordinary High Water 14 ft. NAVD 88)
Million Creek
AREA 2
AREA 1
MW-8
MW-11
MW-13B
MW-13A
MW-5
MW-4A
MW-4B
MW-21
MW-22
MW-20
MW-1
MW-2A
MW-19
MW-3B
MW-3A
MW-6A
MW-9
MW-18
MW-12A
MW-12B
MW-23
MW-10
MW-7
SEEP-3
SSED-MC-2
SSED-MC-1
SSED-MC-3
SSED-MC-4
SEEP-2
SEEP-1
SSED-5
SSED-4
SSED-2
SSED-1
SSED-3
SSED-7
SSED-8
SSED-9
SSED-6
PWS-03/DAI-PH-17
DAI SB 09
DAI-PH-18
PWS-02
DAI SB 03
DAI-HA-01
DAI-PH-05
DAI SB 04
DAI-PH-04
PWS-01/DAI-PH-06
DAI-PH-02
DAI-HA-03
DAI-PH-11
DAI SB 08
DAI-PH-13
DAI SB 02
DAI-PH-14
DAI SB 14
DAI SB 13
DAI SB 15
DAI SB 11
DAI SB 12
DAI SB 18
DAI SB 19
DAI SB 16
DAI SB 17
DAI SB 10
DAI SB 20
DAI SB 21
DAI SB 07
DAI SB 01
DAI SB 05
DAI SB 06
DAI-PH-01
DAI-PH-03
DAI-PH-12
DAI-PH-19
DAI-PH-15
DAI-PH-09
DAI-PH-10
DAI-PH-16
DAI-HA-02
DAI-PH-08
DAI-PH-07
LSI 24
LSI-26
LSI-25
LSI-10
LSI-07B
LSI-07
LSI-09
LSI-23
LSI-19
LSI-22
LSI-17
LSI-12
LSI-21
LSI-05
LSI-06
LSI-20
LSI-18
LSI-03
LSI-02
LSI-16
LSI-08
LSI-04
LSI-15
LSI-14
LSI-13
LSI-11
LSI-01
Salmon Bay
Scappoose
N
0
75
150
Feet
NOTE:
The locations of all features shown are approximate.
2018 Imagery provided by Oregon Geospatial Enterprise Office.
AREA 1 SHORELINE INSPECTIONS FOR SHEEN OCCURRENCE AND DIFFERENTIATION MAPPING
FORMER POPE & TALBOT WOOD-TREATING SITE
Cascadia Associates, LLC
PROJECT NUMBER
0034-001-005
DECEMBER 2019
FIGURE
3-3
DRAWN BY: PM CHECKED BY: JKH
\\POR-FS1\ClientData\11000\11200\11220\112203\dwg_SRI_Report_2019\3-3 - Area 1 Shoreline Inspections.mxd - brian.johnson - 12/13/2019 - 6:39:43 AM

LEGEND:

- Monitoring Well (feet NAVD88, 07/21/2017)
- Groundwater Elevation (feet NAVD88, 07/21/2017)
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Former Site Feature
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

NOTE:
Groundwater elevation in monitoring well MW-2A was not used in developing groundwater contours.
NM = Not Measured

MW-16 NM
MW-17A 12.32
MW-15 14.70
MW-13A 16.19
MW-13B 17.01
MW-14 11.89
MW-8 Dry
MW-11 18.54
AREA 1
AREA 2
MW-5 NM
MW-4B 17.39
MW-4A 17.41
MW-21 15.81
MW-9 18.44
MW-18 18.47
MW-12B 12.62
MW-12A 13.21
MW-20 17.23
MW-22 17.71
MW-23 18.91
MW-10 NM
MW-1 15.00
MW-24 15.45
MW-2A 19.58
MW-7 12.10
MW-3B 11.71
MW-3A 11.77
MW-6A 11.87
MW-19 10.02
MW-25 8.26
16
15
14
13
12
11
10
Milton Creek
Scappoose Bay
Multnomah Channel
N
0 100 200 Feet

DRAWN BY: PM CHECKED BY: JKH

\\POR-FS1\ClientData\11000\11200\11220\112203\dwg_SRI_Report_2019\3-4 - July 2017 Groundwater Elevation Contours.mxd - brian.johnson - 12/13/2019 - 6:43:22 AM

JULY 2017 GROUNDWATER ELEVATIONS AND INFERRED CONTOURS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		3-4

GWS-18
GWS-53
GWS-52
GWS-19
GWS-51
GWS-50
GWS-49
GWS-48
GWS-47
GWS-46
GWS-45
GWS-17
GWS-44
GWS-24
GWS-23
GWS-28
GWS-27
GWS-26
GWS-25
GWS-13
GWS-12
GWPS-1
GWPS-5
GWS-29
GWPS-6
GWPS-3
GWS-43
GWPS-7
GWS-15
GWS-14
GWS-16
GWPS-8
GWPS-4
GWS-41
GWS-42
GWS-39
GWPS-10
GWS-38
GWS-37
GWS-36
GWS-35
GWS-34
GWS-20
GWS-21
GWS-22
GWS-33
GWS-32
GWS-31
GWPS-9
GWS-40
GWS-30
GWPS-2
GWS-11
Milton Creek
Scappoose Bay
AREA A

N

0 75 150
Feet

LEGEND:

- Groundwater Discharge and Sheen Test Site
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Former Transfer Table Dock
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Depth in Ft.
10
5
0 (NAVD 88)
-5
-10

PHASE 1 AND 2 DATA GAP INVESTIGATION LOCATIONS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE 3-5
DECEMBER 2019		

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NOTE:
NM = Not Measured
SP-SM = Poorly Sorted Sand with Varying Amounts of Silt

GWS-18 7.6 SP-SM
GWS-53 1
GWS-52 0.8
GWS-19 7.6
GWS-51 1.4
GWS-50 0.9
GWS-49 0.3
GWS-48 0.8
GWS-47 6.1
GWS-46 8.7
GWS-24 7.8
GWS-23 7.7
GWS-26 9.2
GWS-45 5.2
GWS-17 8.4
GWS-44 4
GWS-25 10.8
GWS-13 8.6
GWS-12 8.3
GWS-11 9.9
GWPS-2 2
GWS-30 9.9
GWPS-1 NM
GWPS-5 4.5
GWS-28 10.8
GWS-27 12
GWS-29 8.8
GWPS-7 1.8
GWPS-6 3.4
GWPS-3 6.7
GWS-43 13.5
GWS-15 8.9
GWS-14 8
MW-6A with Pressure Transducer 13-15
Stiling Well with Pressure Transducer 13-15
GWS-42 10.8
GWS-16 8.6
GWPS-8 3.4
GWS-41 3.3
GWPS-4 6.7
GWS-39 11
GWPS-10 2.5
GWPS-9 3.8
GWS-40 3.1
GWS-36 9.7
GWS-37 8.9
GWS-38 6.4
GWS-35 9
GWS-34 3.8
GWS-20 5.8
GWS-21 5.8
GWS-22 2
GWS-33 3.6
GWS-32 5.9
GWS-31 10.3
SP-SM
Area A
Area B
Scappoose Bay
Milton Creek

N
0 75 150
Feet

LEGEND:

- Groundwater Monitoring Well
- Groundwater Discharge and Sheen Study (temperature contrast, Fahrenheit degrees)
- Inferred Extent of Sand in Surface Sediment
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Former Transfer Table Dock
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Depth in Ft. (NAVD 88): 10, 5, 0, -5, -10

GROUNDWATER DISCHARGE STUDY
TEMPERATURE CONTRAST BETWEEN SEDIMENT AND SURFACE WATER

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		3-6

DRAWN BY: PM CHECKED BY: JKH

\\POR-FS1\ClientData\11000\11200\11220\112203\dwg_SRI_Report_2019\3-6 - Groundwater Discharge Study.mxd - brian.johnson - 12/11/2019 - 1:42:29 PM

GWS-18
GWS-53
GWS-52
GWS-19
GWS-51
GWS-50
GWS-49
GWS-48
GWS-47
GWS-46
GWS-24
GWS-23
GWS-28
GWS-27
GWS-26
GWS-25
GWS-45
GWS-17
GWS-44
GWPS-1
GWPS-5
GWS-29
GWPS-6
GWPS-3
GWS-43
GWPS-7
GWS-16
GWS-15
GWS-14
GWPS-8
GWS-42
GWPS-10
GWS-39
GWPS-9
GWS-40
GWS-41
GWPS-4
GWS-30
GWPS-2
GWS-11
GWS-13
GWS-12
GWS-38
GWS-37
GWS-36
GWS-35
GWS-34
GWS-20
GWS-21
GWS-22
GWS-33
GWS-32
GWS-31
Milton Creek
Scappoose Bay
AREA 1

N
0 75 150
Feet

LEGEND:

Groundwater Discharge and Sheen Study:

- Biogenic Sheen
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy
- NAPL
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Former Transfer Table Dock
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Depth in Ft. (NAVD 88)
10
5
0
-5
-10

AREA 1 OFFSHORE SURFACE SEDIMENT INSPECTIONS 2017 SHEEN OCCURRENCE AND DIFFERENTIATION MAPPING

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 3-7

DRAWN BY: PM CHECKED BY: JKH

\\POR-FS1\ClientData\11000\11200\11220\112203\dwg_SRI_Report_2019\3-7 - Offshore Surface Sediment Sheen Inspections.mxd - brian.johnson - 12/11/2019 - 1:43:42 PM

SB08 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	1.7
4.5	123
8	16

SB15 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	12.6
4	32.4
8.5	1,030

SB10 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	13.1
2	581
3	523
8	210

PWS-07 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	35.9

PWS-07 (Oct. 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	28.3

DAI-PWS-01 (Oct. 2011)	
DEPTH	TOTAL PAHs
0.6-0.9	26.7

PWS-11 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	46.2

SSED-9 (Oct. 2011)	
DEPTH	TOTAL PAHs
0-0.3	31

SSED-7 (Oct. 2011)	
DEPTH	TOTAL PAHs
0-0.3	1,017

SB11 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	2.24
4	2,450
15.5	917
24	86.1

SSED-5 (Oct. 2011)	
DEPTH	TOTAL PAHs
0-0.3	1,120

SSED-2 (Oct. 2011)	
DEPTH	TOTAL PAHs
0-0.3	1,082

MC02A (July 2011)	
DEPTH	TOTAL PAHs
12	61.6 / 42.0

SB16 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	2.74
5-6	567
10	60.9

PWS-02 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	527

PWS-02 (Oct. 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	83

SB05 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	1.88
4	642
8	14.7

SB03 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	0.607
7	146
11	ND / ND

PWS-16 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	28.5

(2005)	
DEPTH	TOTAL PAHs
0-0.3	71.7

SSED-6 (Oct. 2011)	
DEPTH	TOTAL PAHs
0-0.3	4,831

PWS-25 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	16.6

SB18 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	56.8
4	1,260
18	55.9

PWS-10 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	25.0

LSI-09 (Oct. 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	61.8

PWS-03 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	85.8

PWS-03 (Oct. 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	35.5

SB06 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	2.07
5	166
13.5	ND / ND

(2005)	
DEPTH	TOTAL PAHs
0-0.3	79.9

PWS-05 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	24.5

SB17 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	9.41
5-6	93.9

SB04 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	2.19
3	424

LSI-11 (Oct. 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	64.8

SB09 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	55.8
5	497

PWS-06 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	81.6

SB14 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	583
6-7	895

PWS-02 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	0.955
12.5	0.237

MC04 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	0.89
3	0.35

SB13 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	5.2
2.5	1,030
4.4	4.83

PWS-13 (Oct. 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	9.9

PWS-24 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	7.46

PWS-22 (July 2012)	
DEPTH	TOTAL PAHs
0.6-0.9	2.31

SB12 (July 2011)	
DEPTH	TOTAL PAHs
0-0.3	6.82
3.9	138
12	4.59

Milton Creek

Scappoose Bay

AREA 2

LEGEND:

- Existing Monitoring Well

March 2011 Phase 1 TarGOST Boring:

- No Petroleum Sheen or NAPL Signal
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

July 2011 Phase 2 Sediment Boring:

- No Petroleum Sheen or NAPL Observation
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy (NAPL)
- Visible Creosote Sheen Observed in Surface Sediments (2010, 2011, 2012)

July/October 2012 Sampling Event:

Porewater Sample Location

- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

Limited Sediment Investigation (LSI) Sample Location

- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

October 2013 Dock Area

- Hand Auger without NAPL
- Pothole without NAPL Observation
- Pothole with NAPL Observation
- DAI Boring without NAPL Observation
- DAI Boring with NAPL Observation

September 2017 Phase 3 Investigation:

- Phase 3 Sampling Location with Surface Water Cage
- Phase 3 Bulk Sediment and Porewater Sample Location
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Former Transfer Table Dock
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Depth in Ft.

10
5
0 (NAVD 88)
-5
-10

N

0 75 150 Feet

NOTES:
All results in milligrams per kilogram (mg/kg)
Depths in feet below mud line (bml)
PAHs - Polycyclic Aromatic Hydrocarbons
Total values listed are the sum of the detected parent PAH analytes only

TOTAL PAHs IN SEDIMENT (SELECT HISTORICAL DATA)

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 3-8

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LEGEND:

- Shallow Shoreline Boring (#1-23) Completed on 10/22/2018
  Green Color Denotes Absence of Petroleum Sheen
  Red Color Denotes Presence of Petroleum Sheen
  (Moderate to Heavy)
- Offshore Location (#24-84) Completed on 11/29/2018
  Green Color Denotes Absence of Petroleum Sheen
  Red Color Denotes Presence of Petroleum Sheen
  (Moderate to Heavy)
- Existing Monitoring Well
- Former Site Feature
- Areas of Significante Creosote Contaminated Wood Debris

Previous Sample Location:

- Phase 2 Geoprobe Soil Boring
- SS-1 Surface Soil Sample
- Phase 1 HSA Soil Boring
- Phase 1 Surface Water Sample
- Phase 2 Surface Water Sample
- Transect for Composite Sediment Sample
- Approximate Upland Site Boundary
  (Ordinary High Water 14 ft. NAVD 88)

Rail Spur
MW-16
MW-17A
SS-2
GP-01
SS-1
SS-3
Former Log Dump
SHI01B
MW-15
Area 2 Shoreline Inspection
SS-6
GB-9
▲SW-09/30/98-SB-8
GB-6
GB-7
GP-02
Former Oil AST
Former Oil Pipe Trestle
SS-4
SHI01S
MW-13B
MW-13A
Former 8-inch
Creosote Pipeline
(Above Ground)
HA-1
MW-14
GP-09
GB-8
GP-03
SHI02B
Former Dock
GB-4
SS-5
▲SW-9/30/98-SB-7
MW-12A
MW-12B
SHI03B
AREA 1
AREA 2
SHI04B
Cascadia Bay

N

0 50 100
Feet

AREA 2 SHORELINE INSPECTION
2018 SHEEN OCCURRENCE AND DIFFERENTIATION MAPPING
FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		3-9

DRAWN BY: SD CHECKED BY: JKH

\\POR-FS1\ClientData\11000\11200\11220\112203\dwg_SRI_Report_2019\3-9 - Shallow Investigation Borings.mxd - brian.johnson - 12/11/2019 - 12:26:27 PM

LEGEND:

- Existing Monitoring Well
- Direct-Push Boring
- Seep

March 2011 Phase 1 TarGOST Boring:

- No Petroleum Sheen or NAPL Signal
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

July 2011 Phase 2 Sediment Boring:

- No Petroleum Sheen or NAPL Observation
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy (NAPL)
- Visible Creosote Sheen Observed in Surface Sediments (2010, 2011, 2012)

July/October 2012 Sampling Event:

Porewater Sample Location

- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

Limited Sediment Investigation (LSI) Sample Location

- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

October 2013 Dock Area Investigation:

- Hand Auger without NAPL Observation
- Pothole without NAPL Observation
- Pothole with NAPL Observation
- DAI Boring without NAPL Observation
- DAI Boring with NAPL Observation
- Phase 3 Sampling Location with Surface Water Cage
- Phase 3 Bulk Sediment and Porewater Sample Location
- Former Site Feature
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)
- Cross Section Location

Milton Creek

Willamette River

A A' B B' C C' D D' E E' F F' G G' H H'

N

0 75 150 Feet

NOTE:
2018 Imagery provided by Oregon Geospatial Enterprise Office.

CROSS SECTION LOCATIONS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-1

DRAWN BY: PM CHECKED BY: JKH

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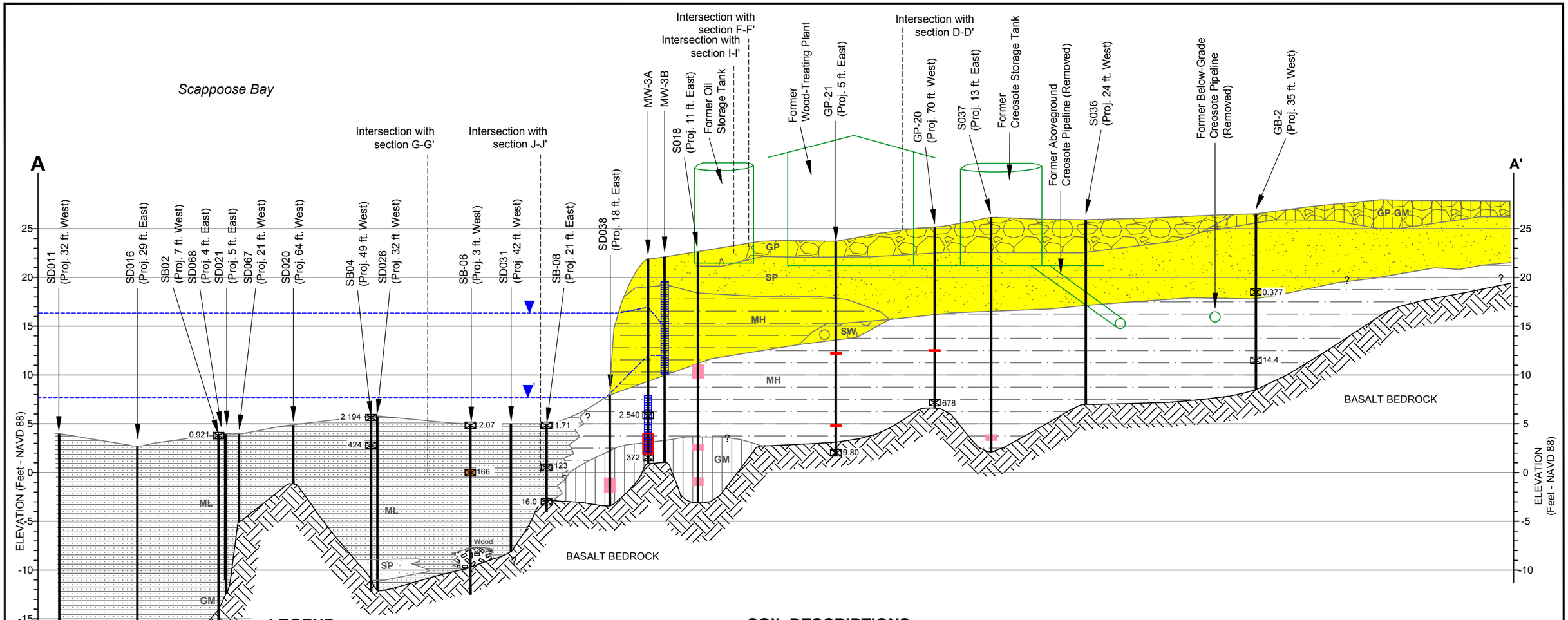


LEGEND

- FILL MATERIAL
- INFERRED HIGH WATER LEVEL (05/03/2012)
- INFERRED LOW WATER LEVEL (08/14/2012)
- MONITORING WELL SCREEN LOCATION
- TarGOST® SIGNAL INDICATIVE OF NAPL
- VISUAL OBSERVATION OF NAPL IN SOIL CORE
- PETROLEUM SHEEN - MODERATE
- NAPL — NON-AQUEOUS PHASE LIQUIDS (CREOSOTE)

SOIL DESCRIPTIONS

- GP - Coarse gravel with occasional cobbles and varying amounts of silt
- GM - Silty gravels, gravel-sand-silt mixtures
- GW - Well-graded gravel, gravel-sand mixtures
- GP-GM - Silty Gravel
- ML - Inorganic silt rock flour, or silt with slight plasticity
- MH - Inorganic silt, micaceous or diatomaceous silty soil
- SM - Silty-sand, sand-silt mixtures
- SP - Poorly graded sand, gravelly sand, little or no fines
- SW - Fine to coarse sand
- SW-SM - Fine to coarse sand and/or silty sand, sand silt mixtures
- SP-SM - Fine to medium and/or fine to coarse sand, sand with some silt
- Wood Chips
- Basalt Bedrock

NOTE: THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

HORIZONTAL SCALE: 0' 50' 100' 150' — 1" = 100'

VERTICAL SCALE: 0' 5' 10' 15' — 1" = 10'

10X VERTICAL SCALE EXAGGERATION

DRAWN BY: BRJ/SD CHECKED BY: -

K:\11000\11200\11220\112203\dwg_SRI_Report_2019\4-2 - Cross Section C-C'.dwg - - - May. 28, 2019 7:00am - brian.johnson

CROSS SECTION A-A'

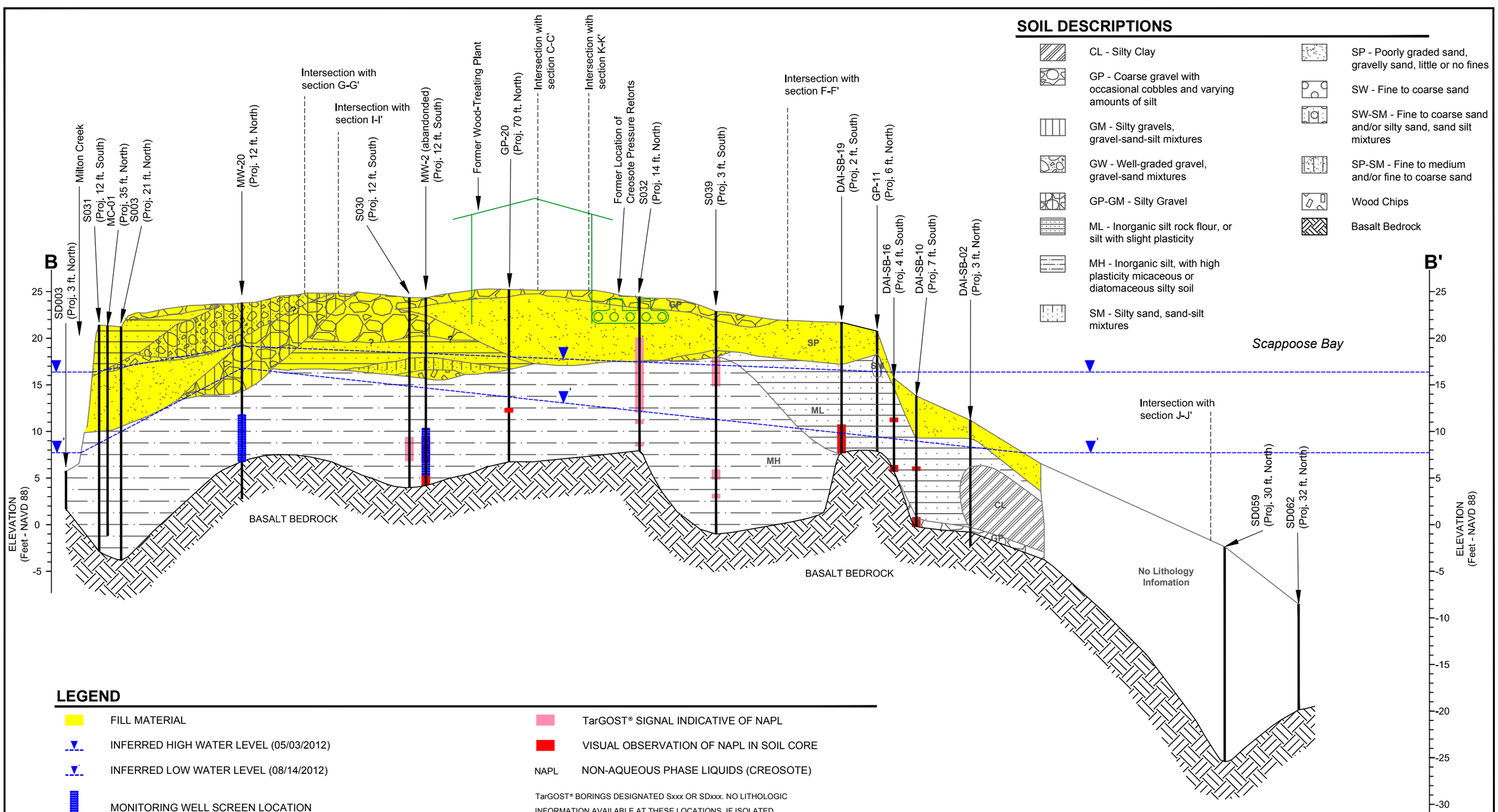
FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-2



SOIL DESCRIPTIONS

- CL - Silty Clay
- GP - Coarse gravel with occasional cobbles and varying amounts of silt
- GM - Silty gravels, gravel-sand-silt mixtures
- GW - Well-graded gravel, gravel-sand mixtures
- GP-GM - Silty Gravel
- ML - Inorganic silt rock flour, or silt with slight plasticity
- MH - Inorganic silt, with high plasticity micaceous or diatomaceous silty soil
- SM - Silty sand, sand-silt mixtures
- SP - Poorly graded sand, gravelly sand, little or no fines
- SW - Fine to coarse sand
- SW-SM - Fine to coarse sand and/or silty sand, sand silt mixtures
- SP-SM - Fine to medium and/or fine to coarse sand
- Wood Chips
- Basalt Bedrock

LEGEND

- FILL MATERIAL
- INFERRED HIGH WATER LEVEL (05/03/2012)
- INFERRED LOW WATER LEVEL (08/14/2012)
- MONITORING WELL SCREEN LOCATION
- TarGOST® SIGNAL INDICATIVE OF NAPL
- VISUAL OBSERVATION OF NAPL IN SOIL CORE
- NAPL — NON-AQUEOUS PHASE LIQUIDS (CREOSOTE)

TarGOST® BORINGS DESIGNATED Sxxx OR SDxxx. NO LITHOLOGIC INFORMATION AVAILABLE AT THESE LOCATIONS, IF ISOLATED.

NOTE: THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

HORIZONTAL SCALE: 0' 50' 100' 150' — 1" = 100'

VERTICAL SCALE: 0' 5' 10' 15' — 1" = 10'

10X VERTICAL SCALE EXAGGERATION

DRAWN BY: BRJ/SD CHECKED BY: -

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CROSS SECTION B-B'

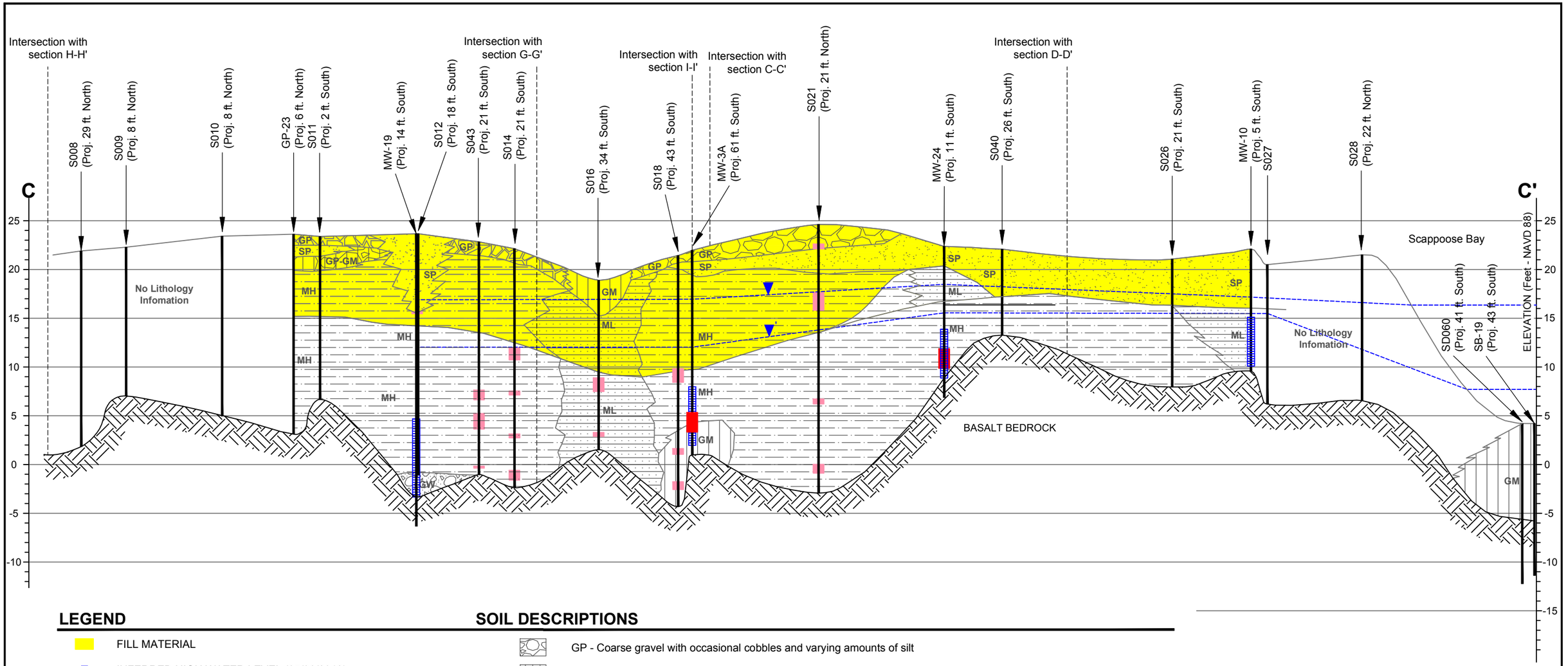
FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-3



LEGEND

- FILL MATERIAL
- INFERRED HIGH WATER LEVEL (05/03/2012)
- INFERRED LOW WATER LEVEL (08/14/2012)
- MONITORING WELL SCREEN LOCATION
- TarGOST® SIGNAL INDICATIVE OF NAPL
- VISUAL OBSERVATION OF NAPL IN SOIL CORE
- NAPL — NON-AQUEOUS PHASE LIQUIDS (CREOSOTE)

TarGOST® BORINGS DESIGNATED Sxxx OR SDxxx. NO LITHOLOGIC INFORMATION AVAILABLE AT THESE LOCATIONS, IF ISOLATED.

SOIL DESCRIPTIONS

- GP - Coarse gravel with occasional cobbles and varying amounts of silt
- GM - Silty gravels, gravel-sand-silt mixtures
- GW - Well-graded gravel, gravel-sand mixtures
- GP-GM - Silty Gravel
- ML - Inorganic silt rock flour, or silt with slight plasticity
- MH - Inorganic silt, micaceous or diatomaceous silty soil
- SP - Poorly graded sand, gravelly sand, little or no fines
- Basalt Bedrock

NOTE: THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

HORIZONTAL SCALE: 0' 50' 100' 150' — 1" = 100'

VERTICAL SCALE: 0' 5' 10' 15' — 1" = 10'

10X VERTICAL SCALE EXAGGERATION

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CROSS SECTION C-C'

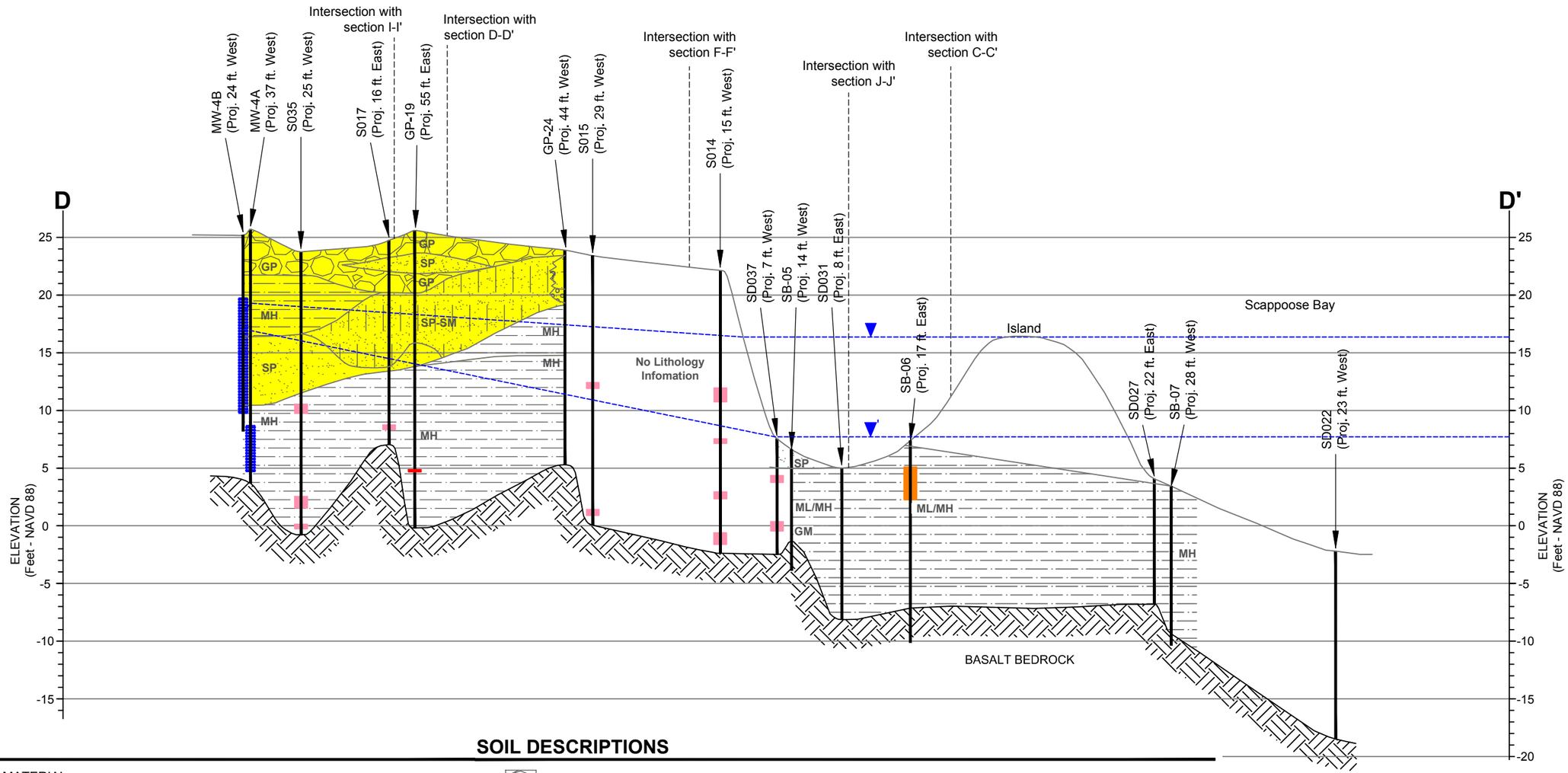
FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-4



LEGEND

- FILL MATERIAL
- INFERRED HIGH WATER LEVEL (05/03/2012)
- INFERRED LOW WATER LEVEL (08/14/2012)
- MONITORING WELL SCREEN LOCATION
- TarGOST® SIGNAL INDICATIVE OF NAPL
- VISUAL OBSERVATION OF NAPL IN SOIL CORE
- PETROLEUM SHEEN - MODERATE
- NAPL — NON-AQUEOUS PHASE LIQUIDS (CREOSOTE)

SOIL DESCRIPTIONS

- GP - Coarse gravel with occasional cobbles and varying amounts of silt
- MH - Inorganic silt, with high-plasticity micaceous or diatomaceous silty soil
- SP - Poorly graded sand, gravelly sand, little or no fines
- SP-SM - Fine to medium and/or fine to coarse sand
- SW-SM - Fine to coarse sand and/or silty sand, sand silt mixtures
- Basalt Bedrock
- GM - Silty gravels, gravel-sand-silt mixtures
- ML - Inorganic silt rock flour, or silt with slight plasticity

HORIZONTAL SCALE: 0' 50' 100' 150' — 1" = 100'

VERTICAL SCALE: 0' 5' 10' 15' — 1" = 10'

10X VERTICAL SCALE EXAGGERATION

NOTE: THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

TarGOST® BORINGS DESIGNATED Sxxx OR SDxxx. NO LITHOLOGIC INFORMATION AVAILABLE AT THESE LOCATIONS, IF ISOLATED.

CROSS SECTION D-D'

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-5

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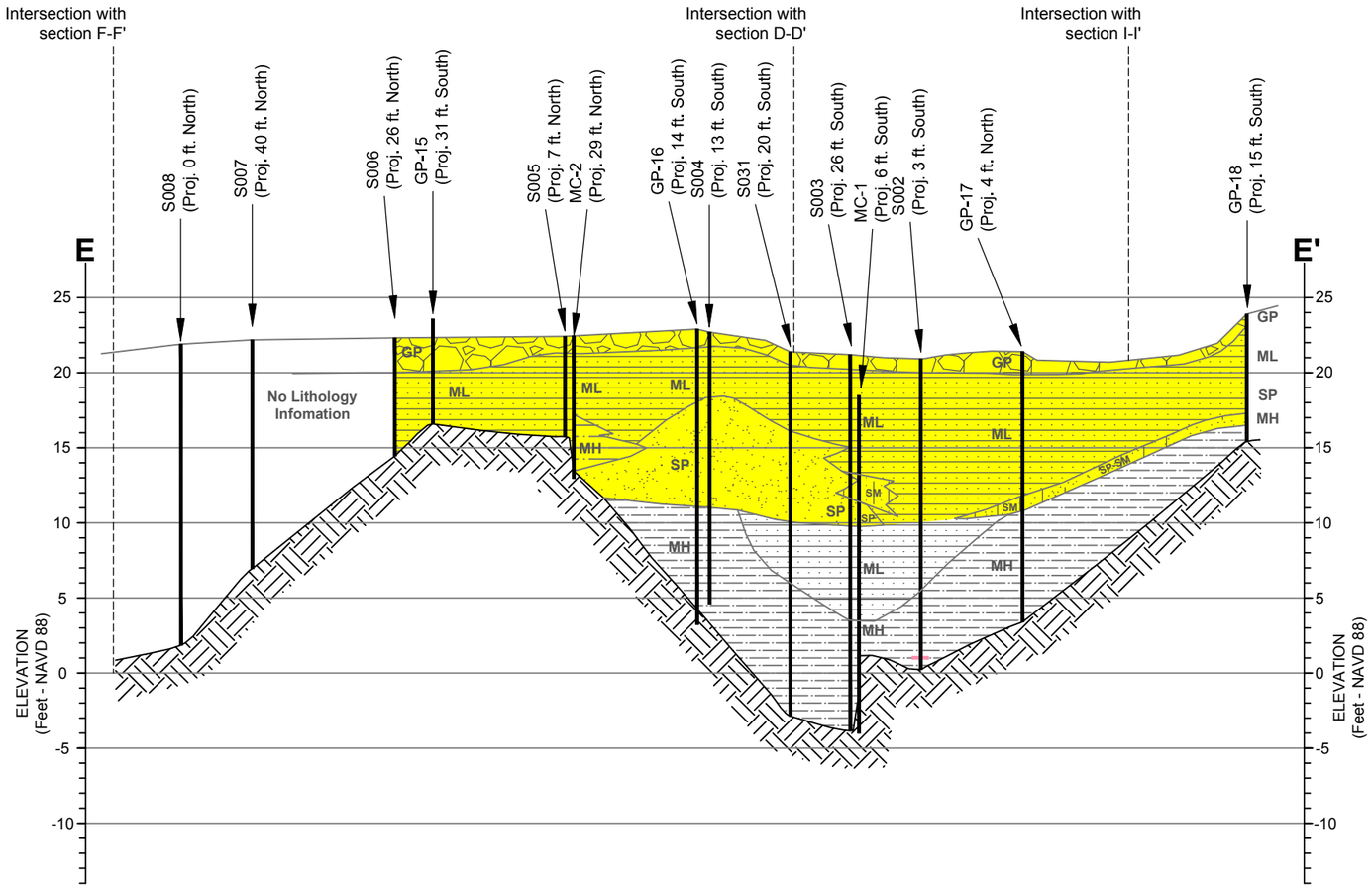


LEGEND

- FILL MATERIAL
- TarGOST® SIGNAL INDICATIVE OF NAPL
- VISUAL OBSERVATION OF NAPL IN SOIL CORE
- NAPL — NON-AQUEOUS PHASE LIQUIDS (CREOSOTE)

TarGOST® BORINGS DESIGNATED Sxxx OR SDxxx. NO LITHOLOGIC INFORMATION AVAILABLE AT THESE LOCATIONS, IF ISOLATED.

SOIL DESCRIPTIONS

- GP - Coarse gravel with occasional cobbles and varying amounts of silt
- ML - Inorganic silt rock flour, or silt with slight plasticity
- MH - Inorganic silt, micaceous or diatomaceous silty soil
- SP - Poorly graded sand, gravelly sand, little or no fines
- SP-SM - Fine to medium and/or fine to coarse sand
- SM - Silty-sand, sand-silt mixtures
- Basalt Bedrock

NOTE: THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

HORIZONTAL SCALE: 0' 50' 100' 150' — 1" = 100'

VERTICAL SCALE: 0' 5' 10' 15' — 1" = 10'

10X VERTICAL SCALE EXAGGERATION

DRAWN BY: BRJ/SD CHECKED BY: -

CROSS SECTION E-E'

FORMER POPE & TALBOT WOOD-TREATING SITE

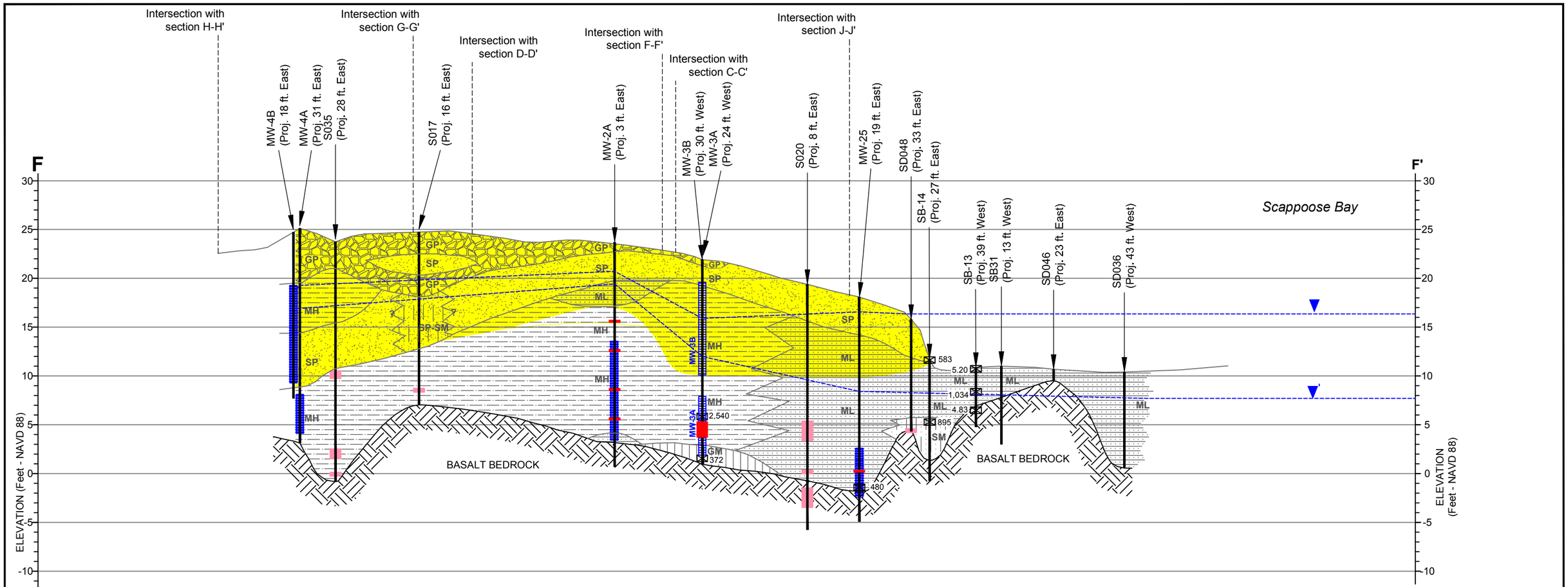
Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-6

K:\11000\11200\11220\112203\dwg_SRI_Report_2019\4-2 - Cross Section C-C'.dwg - - - May. 28, 2019 7:00am - brian.johnson



LEGEND

- FILL MATERIAL
- INFERRED HIGH WATER LEVEL (05/03/2012)
- INFERRED LOW WATER LEVEL (08/14/2012)
- MONITORING WELL SCREEN LOCATION
- TarGOST® SIGNAL INDICATIVE OF NAPL
- VISUAL OBSERVATION OF NAPL IN SOIL CORE
- NAPL — NON-AQUEOUS PHASE LIQUIDS (CREOSOTE)

SOIL DESCRIPTIONS

- GP - Coarse gravel with occasional cobbles and varying amounts of silt
- GM - Silty gravels, gravel-sand-silt mixtures
- GW - Well-graded gravel, gravel-sand mixtures
- GP-GM - Silty Gravel
- ML - Inorganic silt rock flour, or silt with slight plasticity
- MH - Inorganic silt, micaceous or diatomaceous silty soil
- SM - Silty-sand, sand-silt mixtures
- SP - Poorly graded sand, gravelly sand, little or no fines
- SW - Fine to coarse sand
- SW-SM - Fine to coarse sand and/or silty sand, sand silt mixtures
- SP-SM - Fine to medium and/or fine to coarse sand, sand with some silt
- Wood Chips
- Basalt Bedrock

NOTE: THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

HORIZONTAL SCALE: 0' 50' 100' 150' — 1" = 100'

VERTICAL SCALE: 0' 5' 10' 15' — 1" = 10'

10X VERTICAL SCALE EXAGGERATION

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CROSS SECTION F-F'

FORMER POPE & TALBOT WOOD-TREATING SITE

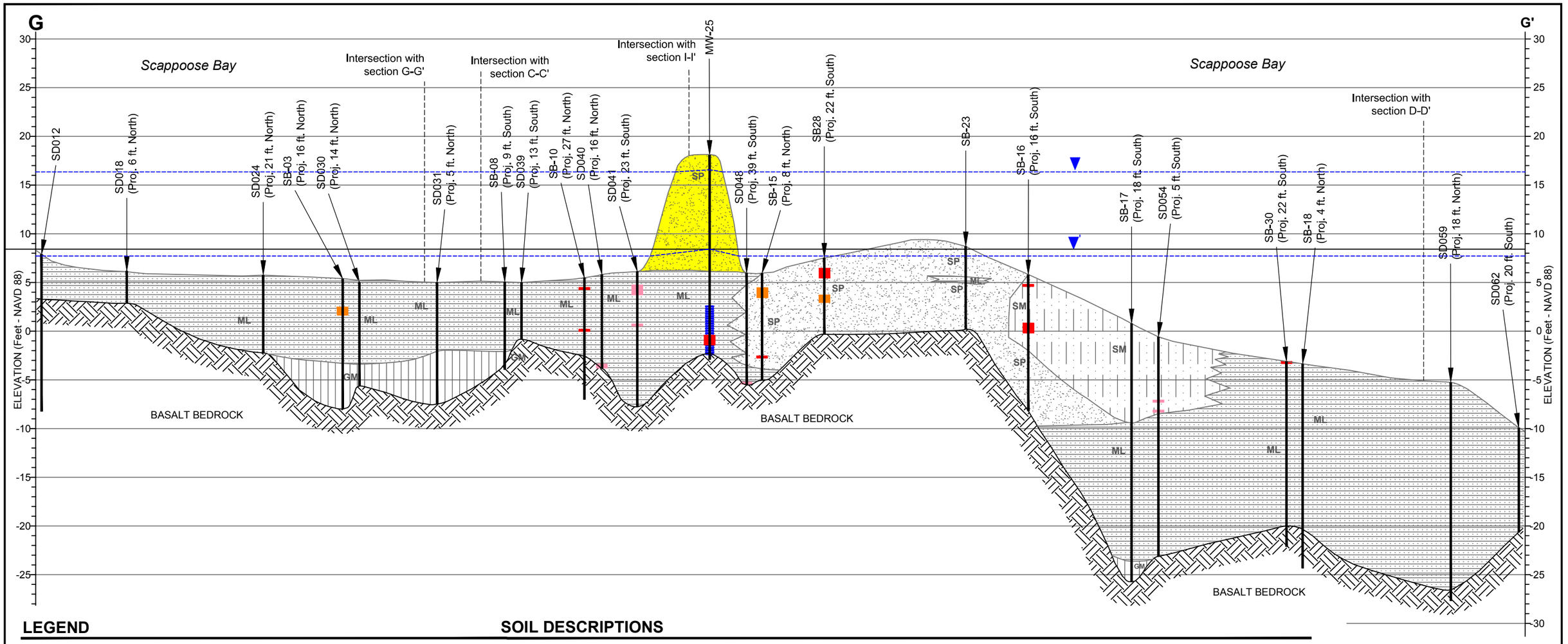
Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-7

K:\11000\11200\11220\112203\dwg_SRI_Report_2019\4-2 - Cross Section C-C'.dwg - - - May. 28, 2019 7:00am - brian.johnson



LEGEND

- FILL MATERIAL
- INFERRED HIGH WATER LEVEL (05/03/2012)
- INFERRED LOW WATER LEVEL (08/14/2012)
- MONITORING WELL SCREEN LOCATION
- TarGOST® SIGNAL INDICATIVE OF NAPL
- VISUAL OBSERVATION OF NAPL IN SOIL CORE
- PETROLEUM SHEEN - MODERATE
- NAPL — NON-AQUEOUS PHASE LIQUIDS (CREOSOTE)

SOIL DESCRIPTIONS

- GP - Coarse gravel with occasional cobbles and varying amounts of silt
- GM - Silty gravels, gravel-sand-silt mixtures
- GW - Well-graded gravel, gravel-sand mixtures
- GP-GM - Silty Gravel
- ML - Inorganic silt rock flour, or silt with slight plasticity
- MH - Inorganic silt, micaceous or diatomaceous silty soil
- SM - Silty-sand, sand-silt mixtures
- SP - Poorly graded sand, gravelly sand, little or no fines
- SW - Fine to coarse sand
- SW-SM - Fine to coarse sand and/or silty sand, sand silt mixtures
- SP-SM - Fine to medium and/or fine to coarse sand, sand with some silt
- Wood Chips
- Basalt Bedrock

HORIZONTAL SCALE: 0' 50' 100' 150' — 1" = 100'

VERTICAL SCALE: 0' 5' 10' 15' — 1" = 10'

10X VERTICAL SCALE EXAGGERATION

NOTE: THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

CROSS SECTION G-G'

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-8

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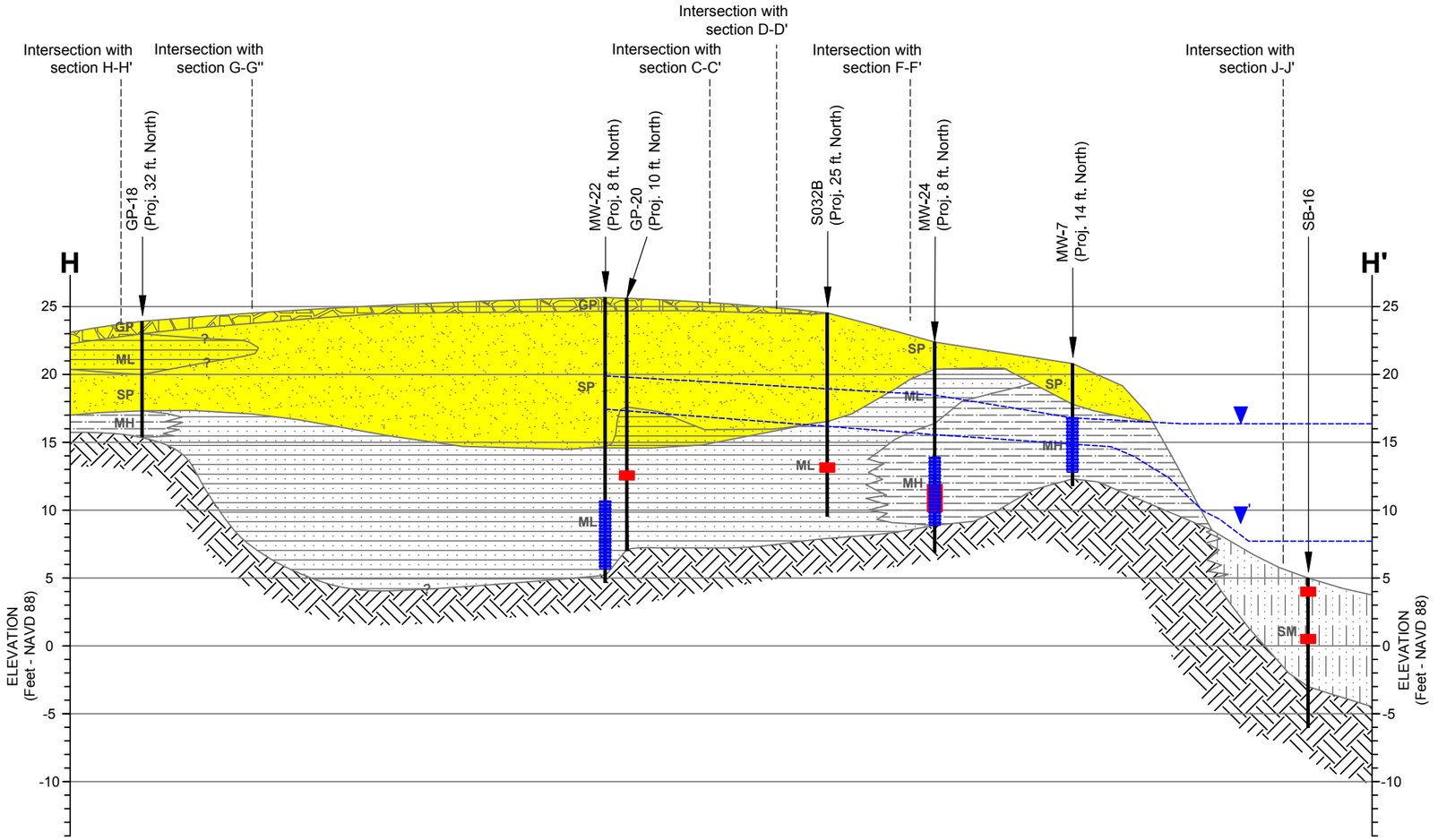

LEGEND

- FILL MATERIAL
- TarGOST® SIGNAL INDICATIVE OF NAPL
- VISUAL OBSERVATION OF NAPL IN SOIL CORE
- MONITORING WELL SCREEN LOCATION
- INFERRED HIGH WATER LEVEL (05/03/2012)
- INFERRED LOW WATER LEVEL (08/14/2012)

NOTE: THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

HORIZONTAL SCALE:
0' 50' 100' 150'
1" = 100'

VERTICAL SCALE:
0' 5' 10' 15'
1" = 10'
10X VERTICAL SCALE EXAGGERATION

SOIL DESCRIPTIONS

- GP - Coarse gravel with occasional cobbles and varying amounts of silt
- ML - Inorganic silt rock flour, or silt with slight plasticity
- MH - Inorganic silt, micaceous or diatomaceous silty soil
- SP - Poorly-graded sand, gravelly sand, little or no fines
- SP-SM - Fine to medium and/or fine to coarse sand
- SM - Silty-sand, sand-silt mixtures
- Basalt Bedrock

NAPL NON-AQUEOUS PHASE LIQUIDS (CREOSOTE)

CROSS SECTION H-H'

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-9

DRAWN BY: BRJ/SD CHECKED BY: -

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LEGEND:

- Existing Monitoring Well

March 2011 Phase 1 TarGOST Boring:

- No Petroleum Sheen or NAPL Signal
- Minor Signal (Petroleum Sheen - Slight)
- NAPL Signal

July 2011 Phase 2 Sediment Boring:

- No Petroleum Sheen or NAPL Observation
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy (NAPL)

July/October 2012 Sampling Event:

- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

October 2013 Dock Area Investigation:

- Hand Auger without NAPL
- Pothole without NAPL Observation
- Pothole with NAPL Observation
- DAI Boring without NAPL Observation
- DAI Boring with NAPL Observation
- Inferred Basalt Contour (4-foot interval) (darker shading indicates lower elevation)
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Scale: 0 75 150 Feet

NOTE:
2018 Imagery provided by
Oregon Geospatial Enterprise Office.
Vertical Datum = NAVD88

INFERRED BASALT ELEVATION CONTOURS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-10

DRAWN BY: PM CHECKED BY: JKH

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LEGEND:

- Monitoring Well
- Surface Water Level Measurement Station (with elevations)
- Former Site Feature
- Groundwater Elevation Contour - High Water Event (in feet, NAVD88) - 5/3/2012
- Groundwater Elevation Contour - Low Water Event (in feet, NAVD88) - 8/14/2012
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps

MW-16
MW-17A
MW-15
MW-8
MW-11
MW-13A
MW-13B
MW-14
AREA 2
AREA 1
MW-5
MW-4B
MW-4A
MW-21
MW-20
MW-22
MW-9
MW-18
MW-12B
MW-12A
MW-23
MW-10
MW-1
MW-2A
MW-24
MW-7
S-2
16.72
7.82
MW-3B
MW-3A
MW-6A
MW-19
MW-25
S-1C
16.36
7.71
Milton Creek
Commencement Bay

NOTE:
2018 Imagery provided by
Oregon Geospatial Enterprise Office.

The locations of all features shown are approximate. Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000).

Wells MW-9, MW-13B, and MW-22 not used in high water event contouring.

Well MW-22 not used in low water event contouring.

N

0 100 200 Feet

GROUNDWATER ELEVATION CONTOURS, 2012 HIGH AND LOW WATER EVENTS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE 4-11
DECEMBER 2019		

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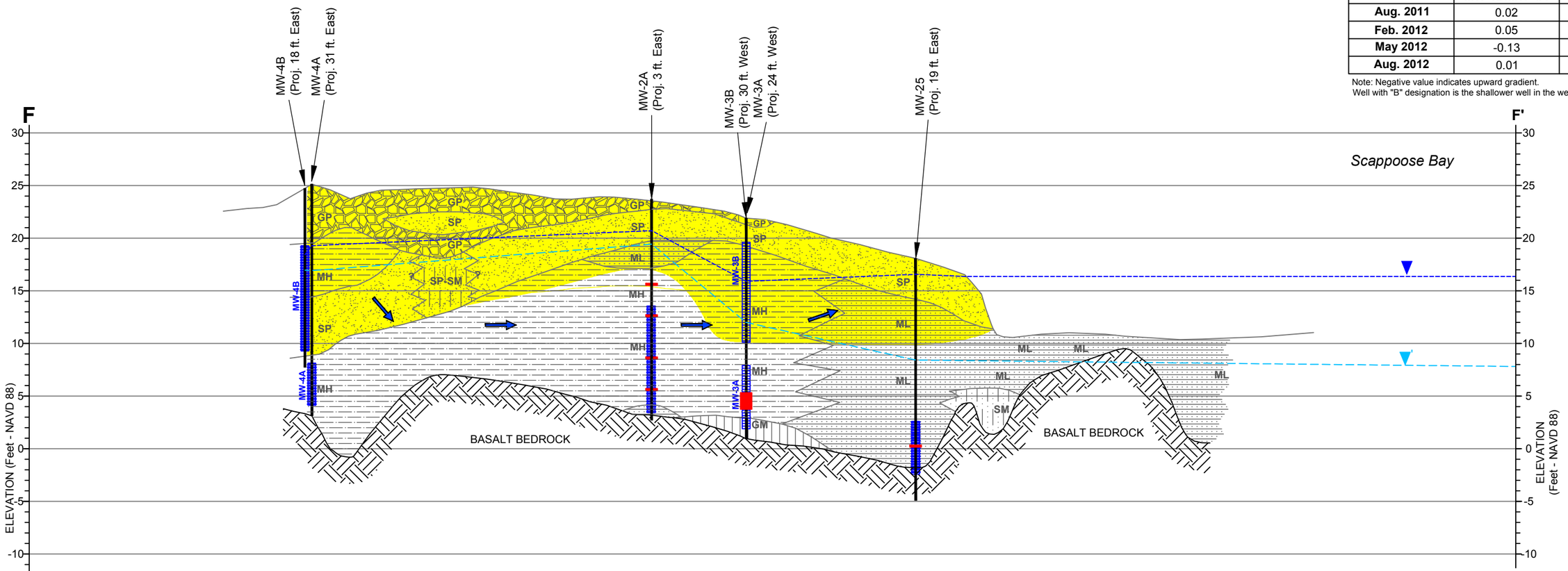
Vertical Gradient in Well Pairs		
	MW-4B:MW-4A	MW-3B:MW-3A
Aug. 2011	0.02	-0.01
Feb. 2012	0.05	0.00
May 2012	-0.13	-0.26
Aug. 2012	0.01	-0.01

Note: Negative value indicates upward gradient.
Well with "B" designation is the shallower well in the well pair.



LEGEND

- FILL MATERIAL
- INFERRED HIGH WATER LEVEL (05/03/2012)
- INFERRED LOW WATER LEVEL (08/14/2012)
- MONITORING WELL SCREEN LOCATION
- VISUAL OBSERVATION OF NAPL IN SOIL CORE
- GROUNDWATER FLOW (INFERRED)

SOIL DESCRIPTIONS

- GP - Coarse gravel with occasional cobbles and varying amounts of silt
- GM - Silty gravels, gravel-sand-silt mixtures
- GW - Well-graded gravel, gravel-sand mixtures
- GP-GM - Silty Gravel
- ML - Inorganic silt rock flour, or silt with slight plasticity
- MH - Inorganic silt, micaceous or diatomaceous silty soil
- SM - Silty-sand, sand-silt mixtures
- SP - Poorly-graded sand, gravelly sand, little or no fines
- SW - Fine to coarse sand
- SW-SM - Fine to coarse sand and/or silty sand, sand silt mixtures
- SP-SM - Fine to medium and/or fine to coarse sand, sand with some silt
- Wood Chips
- Basalt Bedrock

NOTE: THE LOCATIONS OF ALL FEATURES SHOWN ARE APPROXIMATE.

HORIZONTAL SCALE:
0' 50' 100' 150'
1" = 100'

VERTICAL SCALE:
0' 5' 10' 15'
1" = 10'
10X VERTICAL SCALE EXAGGERATION

DRAWN BY: BRJ/SD CHECKED BY: -

HYDROGEOLOGIC SUMMARY BASED ON F-F' WELL PAIRS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 4-12

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LEGEND:

- Existing Monitoring Well
- Former Site Feature
- Bathymetric Contour (1 ft. interval)
- Approximate Offshore Areas

Depth in Ft.
10
5
0
-5
-10

MW-16
MW-17A
MW-15
MW-14
MW-13A
MW-13B
MW-12A
MW-12B
MW-11
MW-10
MW-9
MW-8
MW-7
MW-6A\B
MW-5
MW-4A
MW-4B
MW-3A
MW-3B
MW-2
MW-1
MW-18

Upland Area 2
Area 2 Dock
Upland Area 1
Area 1 Dock
Cove Area
Upper Milton Creek
Lower Milton Creek
Milton Creek
AREA 2
AREA 1
Commencement Bay

N

0 100 200 Feet

NOTE:
The locations of all features shown are approximate.
Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000).
2018 Imagery provided by Oregon Geospatial Enterprise Office.
Bathymetric contours were derived from bathymetric survey conducted by Solmar Hydro Inc. in April 2017.

OFFSHORE AREAS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005
DECEMBER 2019	

FIGURE **4-15**

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LEGEND:

- Existing Monitoring Well

March 2011 Phase 1 TarGOST Boring:

- No Petroleum Sheen or NAPL Signal
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

July 2011 Phase 2 Sediment Boring:

- No Petroleum Sheen or NAPL Observation
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy (NAPL)
- Visible Creosote Sheen Observed in Surface Sediments (2010, 2011, 2012)

July/October 2012 Sampling Event:

Porewater_Sample_Location

- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

Limited Sediment Investigation (LSI) Sample Location

- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy

October 2013 Dock Area Investigation:

- Hand Auger without NAPL Observation
- Pothole without NAPL Observation
- Pothole with NAPL Observation
- DAI Boring without NAPL Observation
- DAI Boring with NAPL Observation

September 2017 Sampling Event:

- Phase 3 Data Gap Investigation Location (No Sheen)

- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Offshore Areas
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Million Creek

AREA 2
AREA 1

Area 2 Dock

Upper Milton Creek

Area 1 Dock

Cove Area

Lower Milton Creek

Scappoose Bay

N

0 100 200 Feet

NOTE:
2018 Imagery provided by Oregon Geospatial Enterprise Office.

ESTIMATED EXTENT OF NAPL

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 5-1

DRAWN BY: PM CHECKED BY: JKH

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Observations:

- Biogenic Sheen
- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy
- NAPL
- Area of Surface Petroleum Sheen - Slight
- Area of Surface Petroleum Sheen - Moderate to Heavy
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

INSET MAP

SEE INSET

Area 2 Dock

Area 1 Dock

Upper Milton Creek

Cove Area

Lower Milton Creek

Milton Creek

Scappoose Bay

0 50 100 Feet

N

0 100 200 Feet

NOTE:
Points labelled A & B are from visible sheen observed in surface sediment in October 2010.
2018 Imagery provided by Oregon Geospatial Enterprise Office.

SURFACE SEDIMENT EXHIBITING CREOSOTE SHEEN

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		5-2

DRAWN BY: PM CHECKED BY: JKH

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LEGEND:

Observations:

- Biogenic Sheen
- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy
- NAPL
- Area of Subsurface Petroleum Sheen - Slight
- Area of Subsurface Petroleum Sheen - Moderate to Heavy
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Milton Creek

Area 2 Dock

Area 1 Dock

Upper Milton Creek

Lower Milton Creek

Dupont Bay

SD001 SD002 SD003 SD004 SD005 SD006 SD007 SD008 SD009 SD010 SD011 SD012 SD013 SD014 SD015 SD016 SD017 SD018 SD020 SD021 SD022 SD023 SD025 SD026 SD027 SD028 SD029 SD031 SD032 SD033 SD034 SD035 SD036 SD037 SD038 SD039b SD040 SD041 SD042 SD043 SD044 SD045 SD046 SD047 SD048 SD049 SD050 SD051 SD052 SD053 SD054 SD055 SD056 SD058 SD059 SD060 SD061 SD062 SD063 SD064 SD065 SD066 SD067 SD068 SD-100 SD-102 SD-139

MC-01 MC-01A MC-02 MC-02A MC-03 MC-04

SD-MC-A SD-MC-B SD-MC-C SD-MC-D SD-MC-E

SB01 SB02 SB03 SB04 SB05 SB06 SB07 SB08 SB09 SB10 SB11 SB12 SB13 SB14 SB15 SB16 SB17 SB18 SB19 SB20 SB21 SB22 SB23 SB24 SB25 SB26 SB27 SB28 SB29 SB30 SB31

DAI-SB-01 DAI-SB-02 DAI-SB-03 DAI-SB-04 DAI-SB-05 DAI-SB-06 DAI-SB-07 DAI-SB-08 DAI-SB-09 DAI-SB-10 DAI-SB-11 DAI-SB-12 DAI-SB-13 DAI-SB-14 DAI-SB-15 DAI-SB-16 DAI-SB-17 DAI-SB-18 DAI-SB-19 DAI-SB-20 DAI-SB-21

N

0 100 200 Feet

NOTE:
Points labelled A & B are from visible sheen observed in surface sediment in October 2010.
2018 Imagery provided by Oregon Geospatial Enterprise Office.

SUBSURFACE SEDIMENT EXHIBITING CREOSOTE SHEEN

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 5-3

DRAWN BY: PM CHECKED BY: JKH

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LEGEND:

- Existing Monitoring Well
- Nearshore Monitoring Well
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Site Boundary
- Average Total PAH Concentration Isocontour (µg/L)* (darker shading indicates higher concentration)

Milton Creek

AREA 2
AREA 1

MW-5	
8/8/2011	0.493
2/21/2012	2.34
5/4/2012	3.96
8/15/2012	2.51

MW-4A	
8/8/2011	9.12
2/21/2012	24.3
5/4/2012	16.6
8/15/2012	15.1

MW-4B	
8/8/2011	1.73
2/21/2012	2.21
5/4/2012	0.62
8/15/2012	1.64

MW-21	
8/9/2011	289
2/21/2012	294
5/4/2012	356
8/15/2012	195

MW-20	
8/8/2011	84.2
2/21/2012	144
5/4/2012	266
8/15/2012	31.1

MW-1	
8/9/2011	438
2/20/2012	459
5/4/2012	635
8/14/2012	567

MW-22	
8/9/2011	9,924
2/20/2012	22,544
5/4/2012	13,682
8/15/2012	10,280

MW-9	
8/8/2011	245
2/20/2012	300
5/3/2012	233
8/14/2012	222

MW-18	
8/8/2011	0.541
2/20/2012	0.528
5/3/2012	0.460
8/14/2012	0.532

MW-23	
8/9/2011	267
2/20/2012	334
5/3/2012	255
8/14/2012	265

MW-10		
8/8/2011	129	**4.64**
2/20/2012	120	**6.79**
5/3/2012	277	**13.8**
8/14/2012	184	**11.6**

MW-24	
8/9/2011	5,745
2/21/2012	9,520
5/3/2012	4,628
8/14/2012	3,659

MW-7		
5/3/2012	3.14	0.319

MW-6A		
8/9/2011	456	**9.74**
2/21/2012	786	**41.2**
5/3/2012	671	**38.2**
8/14/2012	508	**37.5**

MW-19		
8/8/2011	5,064	**40.4**
2/21/2012	1,158	**28.4**
5/4/2012	2,718	**81.3**
8/14/2012	2,135	**75.5**

MW-2A	
8/9/2011	6,438
2/21/2012	11,401
5/3/2012	6,894
8/15/2012	6,672

MW-3B		
8/9/2011	9.21	0.495
2/21/2012	16.3	**1.59**
5/4/2012	11.3	**1.82**
8/15/2012	1.92	**1.39**

MW-3A		
8/9/2011	12,264	**291**
2/21/2012	15,895	**452**
5/4/2012	20,411	**594**
8/15/2012	16,763	**575**

MW-25		
8/9/2011	928	**14.4**
2/21/2012	1,749	**54.4**
5/3/2012	1,191	**81.5**
8/14/2012	1,607	**71.5**

MW-8, MW-11, MW-13A, MW-13B, MW-12B, MW-12A

1, 10, 100, 1,000, 10,000

N

0 75 150 Feet

*Isocontours estimated using average detected concentration at each well. Shallower interval "B" wells excluded from contouring.

Sample Date	Total PAH (µg/L)	ΣGWTU
8/9/2011	928	**14.4**
2/21/2012	1,749	**54.4**
5/3/2012	1,191	**81.5**
8/14/2012	1,607	**71.5**

NOTE:
Nearshore monitoring wells used to assess potential risk from discharge of groundwater to surface water.

Total PAHs were calculated by summing the detected concentrations. If an analyte was not detected, 1/2 the reporting limit was included in the sum.

GWTU = groundwater toxic units. Calculated using final chronic values based on narcotic effects in benthic organisms.

ΣGWTU = sum of groundwater water toxic units. Calculated using half the detection limit (DL) for non-detect values.

ΣGWTU calculated using either 14 or 16 parent PAHs and may be biased low as a result.

ΣGWTU values greater than 1 are in BOLD.

µg/L = micrograms per liter

2018 Imagery provided by Oregon Geospatial Enterprise Office.

TOTAL PAHS IN GROUNDWATER AND 2011-2012 OF GROUNDWATER TOXIC UNITS ΣGWTU RESULTS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 5-4

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LEGEND:

- Existing Monitoring Well
- Nearshore Monitoring Well
- Former Site Feature
- Average Diesel Range Hydrocarbon Concentration Isocontour (mg/L)* (darker shading indicates higher concentration)
- Approximate Site Boundary
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps

Milton Creek

AREA 1
AREA 2

1
10

MW-4A

8/8/2011	0.236 U	0.472 U
2/21/2012	**0.287 N**	**0.391 N**
5/4/2012	**0.238 N**	**0.53**
8/15/2012	**0.191 N**	0.374 U

MW-5

8/8/2011	0.238 U	0.476 U
2/21/2012	0.187 U	0.374 U
5/4/2012	0.19 U	**0.477**
8/15/2012	0.187 U	0.374 U

MW-4B

8/8/2011	0.236 U	0.472 U
2/21/2012	0.189 U	0.377 U
5/4/2012	0.187 U	0.374 U
8/15/2012	0.196 U	0.392 U

MW-21

8/9/2011	**3.65 N**	0.467 U
2/21/2012	**1.38 N**	0.377 U
5/4/2012	**1.69 N**	0.374 U
8/15/2012	**3.03 N**	0.377 U

MW-20

8/8/2011	**0.870 N**	0.495 U
2/21/2012	**0.657 N**	0.377 U
5/4/2012	**1.18 N**	0.762 U
8/15/2012	**0.385 N**	0.377 U

MW-1

8/9/2011	**4.48 N**	0.472 U
2/20/2012	**4.56 N**	**0.519 N**
5/4/2012	**5.37 N**	0.755 U
8/14/2012	**8.49 N**	**0.503 N**

MW-2A

8/9/2011	**26.1 N**	9.90 U
2/21/2012	**76.3 N**	2.99 U
5/3/2012	**81.1 N**	**3.81 N**
8/15/2012	**89.9 N**	1.51 U

MW-19

8/8/2011	**12.5 N**	10.1 U
2/21/2012	**3.66 N**	0.755 U
5/4/2012	**7.64 N**	0.784 U
8/14/2012	**7.49 N**	0.377 U

MW-3B

8/9/2011	0.236 U	0.472 U
2/21/2012	**0.349 N**	0.377 U
5/4/2012	0.187 U	**0.394**
8/15/2012	**0.732**	0.374 U

MW-3A

8/9/2011	**57.1 N**	10.1 U
2/21/2012	**49.1 N**	**3.26 N**
5/4/2012	**113 N**	15 U
8/15/2012	**116 N**	3.02 U

MW-22

8/9/2011	**23.8 N**	9.35 U
2/20/2012	**40.9 N**	1.51 U
5/4/2012	**44.6 N**	3.05 U
8/15/2012	**41.1 N**	1.51 U

MW-7

5/3/2012	0.19 U	0.381 U

MW-6A

8/9/2011	**4.28 N**	2.55 U
2/21/2012	**7.69 N**	0.755 U
5/3/2012	**8.3 N**	**0.723 NJ**
8/14/2012	**8.45 N**	**0.868 N**

MW-25

8/9/2011	**4.04 N**	0.510 U
2/21/2012	**10.1 N**	1.55 U
5/3/2012	**7.91 N**	**0.907 NJ**
8/14/2012	**9.51**	**0.554**

MW-8

MW-11

MW-9

8/8/2011	**1.52 N**	0.467 U
2/20/2012	**2.55 N**	0.755 U
5/3/2012	**2.18 N**	0.374 U
8/14/2012	**2.34 N**	0.374 U

MW-13A **MW-13B**

MW-18

8/8/2011	0.234 U	0.467 U
2/20/2012	0.187 U	0.374 U
5/3/2012	0.187 U	0.374 U
8/14/2012	0.187 U	0.374 U

MW-12B **MW-12A**

MW-23

8/9/2011	**0.949 N**	0.472 U
2/20/2012	**1.1 N**	0.748 U
5/3/2012	**1.19 N**	**0.459 NJ**
8/14/2012	**1.15**	0.374 U

MW-10

8/8/2011	**0.730 N**	0.467 U
2/20/2012	**0.771 N**	0.374 U
5/3/2012	**1.45 N**	0.381 U
8/14/2012	**1.03 N**	0.385 U

MW-24

8/9/2011	**11.5 N**	2.34 U
2/21/2012	**12.4 N**	1.5 U
5/3/2012	**10.8 N**	**0.673 NJ**
8/14/2012	**10.9**	**0.902**

Cascadia Point

Sample Date | Diesel-Range Hydrocarbons (mg/L) | Oil-Range Hydrocarbons (mg/L)

8/9/2011	**4.48 N**	0.472 U
2/20/2012	**4.56 N**	**0.519 N**
5/4/2012	**5.37 N**	0.755 U
8/14/2012	**8.49 N**	**0.503 N**

*Isocontours estimated using average detected concentration at each well. Shallower interval "B" wells excluded from contouring.

NOTE:
BOLD indicates analyte was detected at or above the reporting limit
Shading indicates an exceedance of the Freshwater Ecotox Habitat Goal Level (HGL) for diesel-range hydrocarbons (0.64 mg/L). HGL from San Francisco Bay Regional Water Quality Board (Rev. 2, 2019).
Nearshore monitoring wells used to assess potential risk from discharge of groundwater to surface water

mg/L = milligrams per liter
U = not detected at or above the stated level
N = Presumptively identified result
NJ = Presumptively identified and estimated result

2018 Imagery provided by Oregon Geospatial Enterprise Office.

N

0 75 150
Feet

TOTAL PETROLEUM HYDROCARBONS DETECTED IN GROUNDWATER 2011-2012

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 5-5

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LEGEND:

- October 2012 Sediment Porewater Sample Location
- July 2012 Sediment Porewater Sample Location
- Sediment Porewater Attempted Sample Location
- October 2012 Limited Sediment Investigation (LSI) Sample Location
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Upper Milton Creek

Lower Milton Creek

Milton Creek

Area 1 Dock

Cove Area

Scappoose Bay

PWS-17	Jul 12	Oct 12
	-	-
	-	0.34
	-	-

PWS-14	Jul 12	Oct 12
	-	-
	-	-
	-	9.7

PWS-29	Jul 12	Oct 12
	-	-
	-	-
	-	27

PWS-30	Jul 12	Oct 12
	-	-
	-	-
	-	0.28

PWS-11B	Jul 12	Oct 12
	-	-
	-	-
	0.60	-

PWS-11	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.24

PWS-07	Jul 12	Oct 12
	-	-
	-	-
	0.69	1.4

LSI-09	Oct 12
	-
	-
	1.8

PWS-16	Jul 12	Oct 12
	-	-
	-	-
	0.17	0.16

PWS-16B	Jul 12	Oct 12
	-	-
	-	-
	0.53	-

PWS-10	Jul 12	Oct 12
	-	-
	-	-
	0.60	0.40

PWS-12	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.11

LSI-01	Oct 12
	-
	-
	0.16

PWS-09	Jul 12	Oct 12
	-	-
	-	-
	0.42	0.23

PWS-08	Jul 12	Oct 12
	-	-
	-	-
	0.69	0.37

LSI-02	Oct 12
	-
	-
	0.21

PWS-06	Jul 12	Oct 12
	-	-
	-	-
	0.45	0.28

LSI-11	Oct 12
	-
	-
	3.9

PWS-22	Jul 12	Oct 12
	-	-
	-	-
	0.077	0.10

PWS-23	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.33

PWS-13	Jul 12	Oct 12
	0.40	-
	-	-
	0.42	2.8

PWS-20	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.33

PWS-18	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.44

PWS-19	Jul 12	Oct 12
	-	-
	-	-
	0.33	0.31

LSI 24	Oct 12
	-
	-
	0.21

PWS-28	Jul 12	Oct 12
	-	-
	-	-
	-	0.29

PWS-01	Jul 12	Oct 12
	-	-
	-	-
	0.85	0.62

PWS-02	Jul 12	Oct 12
	0.40	-
	-	-
	109	60

PWS-15	Jul 12	Oct 12
	-	-
	-	-
	0.076	0.25

PWS-26	Jul 12	Oct 12
	-	-
	-	-
	0.42	0.48

PWS-25	Jul 12	Oct 12
	-	-
	-	0.35
	0.68	-

PWS-03	Jul 12	Oct 12
	-	-
	-	-
	0.74	0.77

LSI-20	Oct 12
	-
	-
	0.22

PWS-04	Jul 12	Oct 12
	-	-
	-	-
	0.54	0.47

PWS-05	Jul 12	Oct 12
	-	-
	-	-
	0.57	0.22

PWS-21

LSI-03 LSI-04 LSI-05 LSI-06 LSI-07 LSI-07B LSI-08 LSI-10 LSI-12 LSI-13 LSI-14 LSI-15 LSI-16 LSI-17 LSI-18 LSI-19 LSI-21 LSI-22 LSI-23 LSI-25 LSI-26

SUM OF INTERSTITIAL WATER TOXIC UNITS (ΣIWTU) RESULTS

DEPTH INTERVAL (INCHES BELOW MUDLINE)	SAMPLING EVENT Jul 12	Oct 12
1" - 4"	0.76	-
4" - 8"	-	-
8" - 11"	0.76	6.1

BOLD = ΣIWTU > 1

NOTE:
The locations of all features shown are approximate. Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000). 2016 Imagery from live web service provided by ESRI online mapping system.

0 500 1,000 Feet

N

0 75 150 Feet

JULY & OCTOBER 2012 (ΣIWTU) RESULTS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 5-6

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Area 1 Dock

Upper Milton Creek

Cove Area

Milton Creek

Lower Milton Creek

Scappoose Bay

PWS-090517-7	
ΣIWTU	0.04

PWS-090517-8	
ΣIWTU	0.09

PWS-090517-9	
ΣIWTU	0.05
ΣSWTU	1.07

PWS-090517-10	
ΣIWTU	0.13
ΣSWTU	1.07

PWS-090517-11	
ΣIWTU	0.08

PWS-090617-12	
ΣIWTU	0.33
ΣSWTU	1.04

PWS-090617-13	
ΣIWTU	0.14
ΣSWTU	1.04

PWS-090617-14	
ΣIWTU	0.06
ΣSWTU	0.467

PWS-090617-15	
ΣIWTU	0.07

PWS-090517-6	
ΣIWTU	0.04

PWS-090617-2	
ΣIWTU	16.2
ΣSWTU	0.340

PWS-090517-5	
ΣIWTU	0.19

PWS-090517-1	
ΣIWTU	0.08

PWS-090517-4	
ΣIWTU	0.05
ΣSWTU	0.814

PWS-090517-3	
ΣIWTU	0.02
ΣSWTU	0.607

N

0 75 150

Feet

LEGEND:

- Phase 3 Data Gap Investigation Location
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Former Transfer Table Dock
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Depth in Ft.: 10, 5, 0, -5, -10

NOTES:
All values are in toxic units (TU) based on narcotic effects in benthic organisms.
ΣIWTU = Summation of Interstitial Water Toxic Units
ΣSWTU = Summation of Surface Water Toxic Units
Values in Yellow are greater than 1.
ΣIWTU calculations are for measured concentrations within the biologically active zone 3"-8" below mudline.
ΣSWTU are for water 12" above the mudline.
The ΣIWTU and ΣSWTU are based on direct measurements of 34 PAHs in sediment porewater and surface water samples.
Regarding non-detected analytes, the full detection limits were used in the ΣIWTU and ΣSWTU calculations.

SEPTEMBER 2017 ΣIWTU & ΣSWTU RESULTS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 5-7

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LEGEND:

Total PAHs including Homologues (mg/kg):

- < 1.6
- 1.7 - 10.0 (Below TEC)
- 10.1 - 50.0 (Above PEC)
- >50.1

Measured Porewater (Toxic Units):

- 0.050000 - 1.000000
- 1.000001 - 16.240000
- Surface Porewater Sample
- Area of Surface Petroleum Sheen - Slight
- Area of Surface Petroleum Sheen - Moderate to Heavy
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Milton Creek

Upper Milton Creek

Area 1 Dock

Cove Area

Lower Milton Creek

Scappoose Bay

PWS-090617-13
PWS-090617-12
PWS-090517-8
PWS-090517-7
PWS-090517-11
PWS-090517-6
PWS-090517-10
PWS-090517-14
PWS-090517-9
PWS-090617-15
PWS-090617-1
PWS-090617-2
PWS-090517-5
PWS-090517-4
PWS-090517-3

N

0 75 150 Feet

NOTE:
TEC = Threshold Effects Concentration
PEC = Probable Effects Concentration
mg/kg = milligrams per kilogram
PAHs = Polycyclic Aromatic Hydrocarbons
Total PAHs = Sum of 64 parent and alkylated homologues in mg/kg. Non-detects are included in the sum at the laboratory reported limit.
Porewater PAH IWTUs are in surface and subsurface.
Total PAHs in bulk sediment in surface include 34 parent and alkylated PAHs.
ΣIWTU = Summation of Interstitial Water Toxic Units
2018 Imagery provided by Oregon Geospatial Enterprise Office.

2017 DATA GAP INVESTIGATION RESULTS

COLLOCATION OF TOTAL PAHs IN SEDIMENT, ΣIWTU, AND PETROLEUM SHEEN IN SURFACE SEDIMENT

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
JANUARY 2020		5-8

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LEGEND:

- Existing Monitoring Well
- Surface Water Level Measurement Station (with High and Low Water Event Elevations)
- Former Site Feature
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)
- Groundwater Elevation Contour - High Water Event (in feet, NAVD88) - 5/3/2012
- Groundwater Elevation Contour - Low Water Event (in feet, NAVD88) - 8/14/2012
- Groundwater Flow Direction
- Surface Water Flow Direction
- Area of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps

MW-16
MW-17A
MW-15
MW-14
MW-13A
MW-13B
MW-12B
MW-12A
MW-18
MW-10
MW-9
MW-8
MW-11
MW-5
MW-4B
MW-4A
MW-21
MW-20
MW-22
MW-23
MW-1
MW-2A
MW-24
MW-7
MW-3B
MW-3A
MW-6A
MW-19
MW-25
S-1C
16.36
7.71
S-2
7.82
AREA 2
AREA 1
Multnomah Channel
Scappoose Bay
Milton Creek

NOTE:
The locations of all features shown are approximate.
2018 Imagery provided by
Oregon Geospatial Enterprise Office.

N

0 100 200 Feet

TRANSPORT SUMMARY PLAN VIEW

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE 6-1

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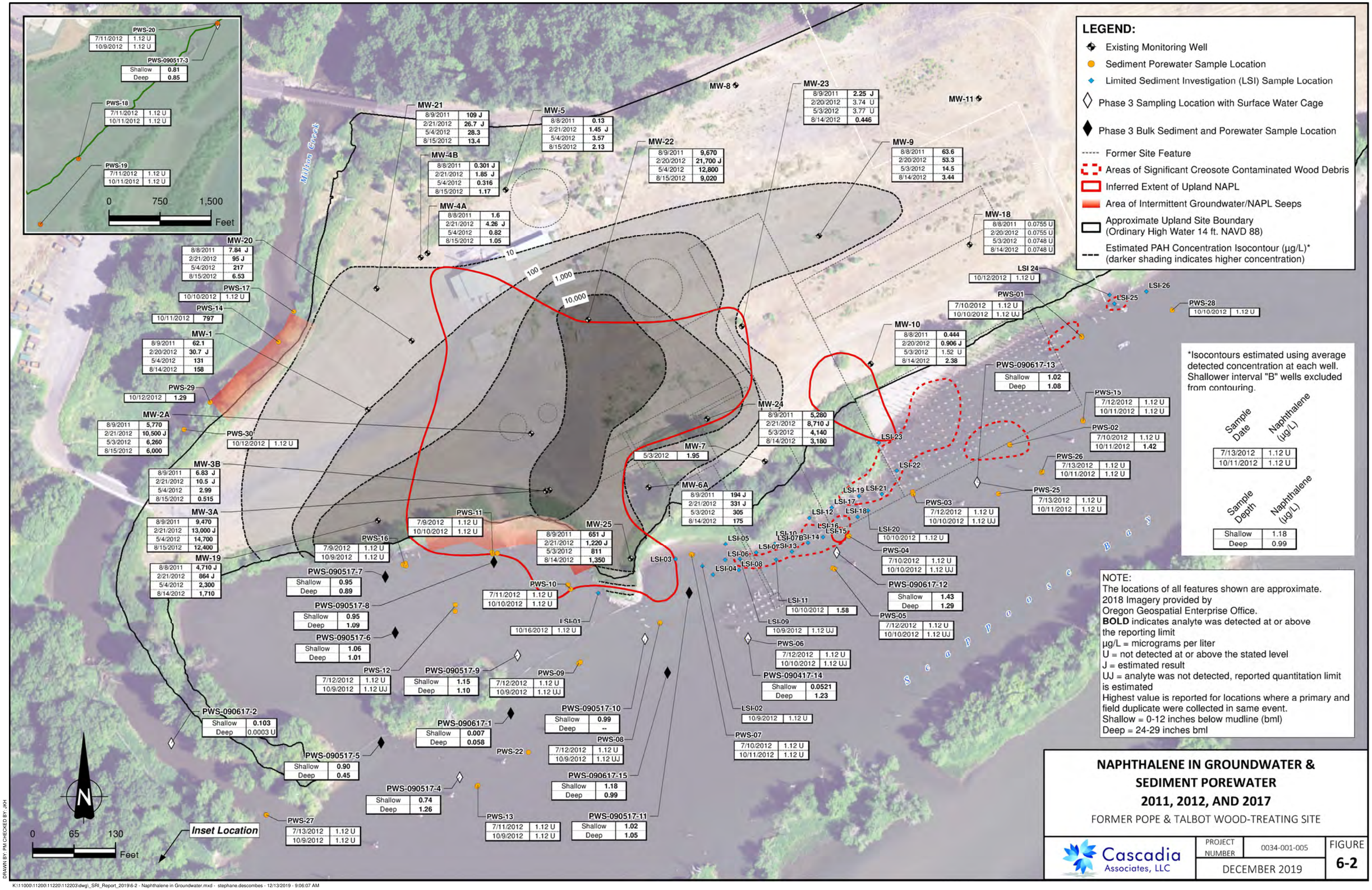

NAPHTHALENE IN GROUNDWATER & SEDIMENT POREWATER 2011, 2012, AND 2017

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		6-2

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LEGEND:

- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Former Transfer Table Dock
- Approximate Offshore Area
- Locality of Facility
- Offshore Priority Action Area
- Upland Priority Action Area
- Area of Surface Petroleum Sheen - Moderate to Heavy
- Area of Surface Petroleum Sheen - Slight

Area 2 Dock

Upland Area 2

AREA 2

AREA 1

Upland Area 1

Upper Milton Creek

Area 1 Dock

Cove Area

Milton Creek

Lower Milton Creek

Scappoose Bay

Multnomah Channel

N

0 100 200 Feet

DRAWN BY: PM CHECKED BY: JKH

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PRIORITY ACTION AREAS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		6-3

LEGEND:

- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Former Transfer Table Dock
- Locality of Facility
- Approximate Offshore Area
- Area of Surface Petroleum Sheen - Slight
- Area of Surface Petroleum Sheen - Moderate to Heavy
- Offshore Priority Action Area

Area 2 Dock

AREA 2
AREA 1

Area 1 Dock

Upper Milton Creek

Cove Area

Lower Milton Creek

Milton Creek

PWS-21

PWS-20

Willamette Cove

Multnomah Channel

N

0 100 200 Feet

REFERENCE SAMPLE LOCATIONS:

- Locality of Facility

Supplemental RI Sediment Sample Locations

- July 2012 Sediment Sample Location
- October 2012 Sediment Porewater Sample Location

Historical Risk Assessment Sediment Sample Locations

- Discrete Sediment Samples Collected Between 2003 - 2005

SD-BG-05

SD-BG-04

PWS-21

PWS-20

SD-BG-01

SD-BG-02

PWS-18

PWS-19

SD-BG-03

Multnomah Channel

Columbia River

LOCALITY OF FACILITY

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005
DECEMBER 2019	

FIGURE 7-1

C:\DATA\POCC_0034_001\Projects\SRI_Dec_2019\Fig_07_01_Locality_Facility_.mxd - ErikStrandhagen - 12/11/2019 - 5:17:06 PM

LEGEND

- FREE-PHASE CREOSOTE WITHIN THE INFERRED NAPL AREA
- NAPL TRAPPED IN MACRO-PORES OR SMALL SAND LENSES
- GROUNDWATER FLOW
- SURFACE WATER FLOW
- WATER TABLE FLUCTUATION

Human Receptor -
Construction or Excavation Worker / Industrial Worker

Surface
Water
Infiltration

Overland Flow

Former Operations
Area Creosote
Storage Tank

Fill
(sand, silt, gravel)

Seep

Human Receptor - Adult
Trespasser / Adult and
Adolescent Angler

Human Receptor -
Sport Fisher / Adult Boater

Treated Wood Debris
(source of creosote-
related sheens)

2 to 18 ft.
(generally 7-8 ft.)

2 to 21 ft.
(generally 10-12 ft.)

Timber Piles

Former Wood Treating
Operational Surface

Sediment Deposition
Post Wood Treating
Operations

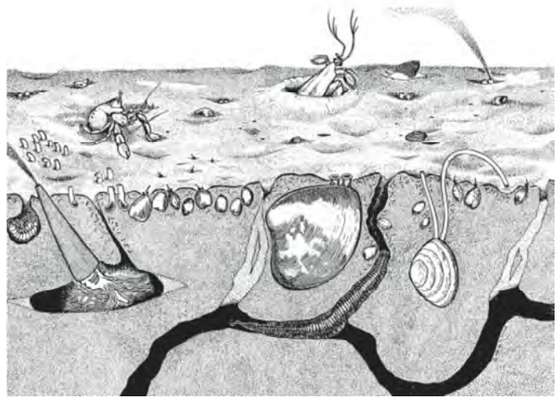
Native Soil
(primarily silt)

Scappoose Bay

Benthic Zone

Basalt Surface
6 to 28 ft. bgs

Basalt Bedrock



SCHEMATIC CONCEPTUAL SITE MODEL

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		9-1

DRAWN BY: BRJ/SD CHECKED BY: -

C:\Users\ErikStrandhagen\AppData\Local\Temp\AcPublish_12828\9-1 – Schematic Conceptual Site Model.dwg – – – Dec. 09, 2019 2:21pm – ErikStrandhagen

HUMAN HEALTH RISK ASSESSMENT (HHRA) CONCEPTUAL SITE MODEL (CSM)

PRIMARY SOURCE	PRIMARY RELEASE MECHANISM	SECONDARY SOURCE	SECONDARY RELEASE MECHANISM	PATHWAY	EXPOSURE ROUTE	ONSITE RECEPTORS – CURRENT/FUTURE: INDUSTRIAL WORKER	EXCAVATION WORKER	CONSTRUCTION WORKER	TRANSIENT / RECREATIONAL TRESPASSER [1] / ADULT BOATER [2]	SPORT FISHER
HISTORICAL INDUSTRIAL ACTIVITIES	RELEASES	SURFACE SOIL			INGESTION	●	●	●		
					DIRECT CONTACT	●	●	●		
					INHALATION (INDOOR & OUTDOOR AIR)	●	●	●		
			MIGRATION TO SURFACE WATER	FISH/SHELLFISH	INGESTION					●
		SUBSURFACE SOIL			INGESTION		●	●		
					DIRECT CONTACT		●	●		
					INHALATION (INDOOR & OUTDOOR AIR)	●	●	●		
		BEACH SOIL/SEDIMENT			INGESTION				●	●
					DIRECT CONTACT				●	●
					INHALATION (OUTDOOR AIR)				●	●
		SURFACE WATER DISCHARGE	MIGRATION TO SEDIMENT	FISH/SHELLFISH	INGESTION					●
		SHALLOW GROUNDWATER	VOC VOLATILIZATION	AIR	INHALATION (INDOOR & OUTDOOR)	●				
					DIRECT CONTACT		●	●		
			MIGRATION TO SURFACE WATER	FISH/SHELLFISH	INGESTION					●
					DIRECT CONTACT				●	
			MIGRATION TO SEDIMENT/SEDIMENT PORE WATER		DIRECT CONTACT				●	

LEGEND

● POTENTIALLY COMPLETE PATHWAY; QUANTITATIVE EVALUATION

→ COMPLETE PATHWAY

- - - - - - - - INCOMPLETE PATHWAY

1 THE RECREATIONAL TRESPASSER IS AN OLDER CHILD AS DESCRIBED IN THE 2006 HHRA.

2 THE ADULT BOATER WOULD BE EXPOSED TO SEDIMENT AND SEDIMENT PORE WATER IN THE SAME MANNER AS THE OLDER CHILD RECREATIONAL TRESPASSER

HUMAN HEALTH RISK ASSESSMENT CONCEPTUAL SITE MODEL

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

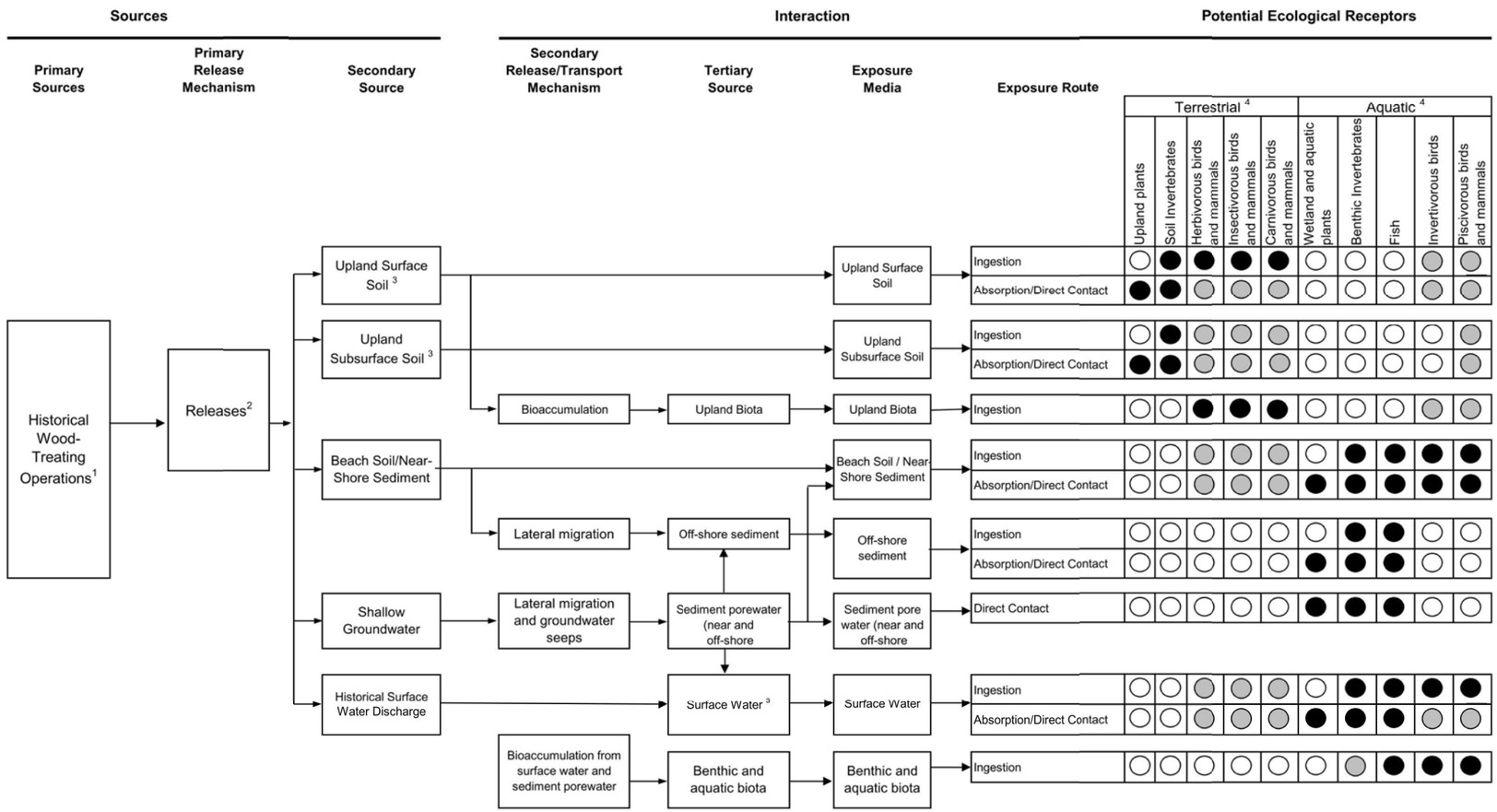
December 2019

FIGURE **10-1**

DRAWN BY: BRJ/SD CHECKED BY: -

K:\11000\11200\11220\112203\dwg_SRI_Report_2019\4-2 - Cross Section C-C'.dwg - - - May. 28, 2019 7:00am - brian.johnson

FIGURE 10-2
ECOLOGICAL RISK ASSESSMENT (ERA) CONCEPTUAL SITE MODEL (CSM)



Notes:

[1] The former wood-treating operations resulted in releases of contaminants of interest (mainly PAHs derived from creosote) and wastes to the historical (1919 through 1959) ground surface within Area 1.

[2] Specific releases are not documented; for the purpose of the RI, sources are defined based on knowledge of historical operations and investigation results that are indicative of creosote releases to the former ground surface (i.e., contamination near the Fill Zone/Native Soil contact). The main upland source area at the Site includes the former wood-treatment plant (i.e., retort pump house and retorts) and former creosote and fuel oil storage tanks located west of the wood treatment plant; collectively these are referred to as the "Former Operations Area" for the purposes of this report (Figure 1-2). This area generally is encompassed by the extent of DNAPL as defined through RI activities. Other ancillary operations immediately adjacent to Area 1 appear to have contributed to more localized shoreline and in-water areas of surface and/or near-surface sediment contamination, such as the historical wastewater discharge pipe, former hog fuel loading dock and hopper, and former transfer table dock.

[3] There have been no significant changes to the surface soil and subsurface soil data used in the 2006 ERA. Therefore, no revision to the ERA CSM for those exposure media has been completed.

[4] See the 2006 ERA for representative receptors.

- Complete Pathway
- Potentially Complete Pathway
- Incomplete Pathway

ECOLOGICAL RISK ASSESSMENT (ERA) CONCEPTUAL SITE MODEL (CSM)

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

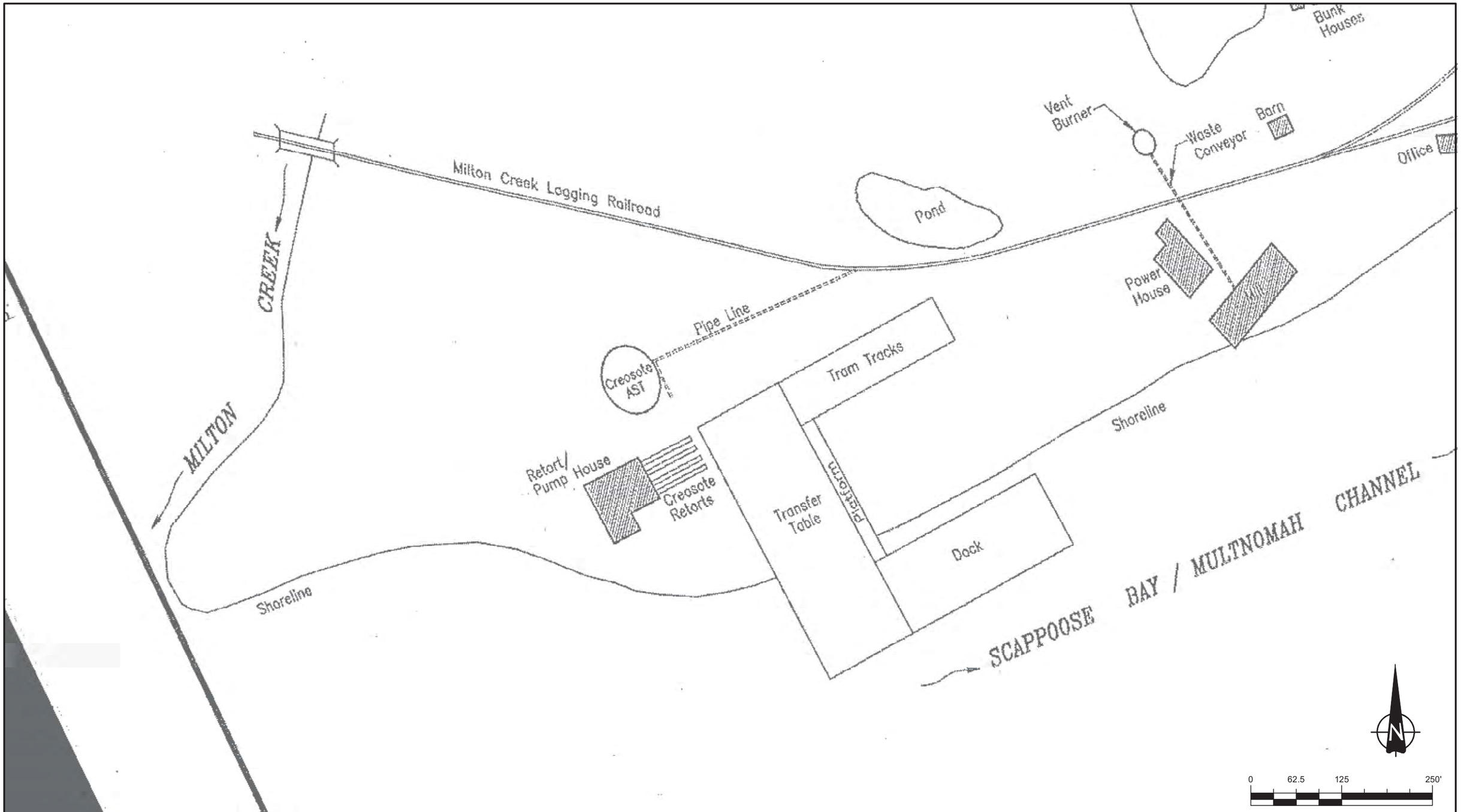
PROJECT NUMBER	0034-001-005
DECEMBER 2019	FIGURE 10-2

DRAWN BY: BRJ/SO CHECKED BY: -

K:\11000\11200\11220\112203\dwg_SRI_Report_2019\10-2 - Ecological Risk Assessment Concept. a Site Model.dwg - - - Jun 12, 2019 10:55am - brian.johnson

APPENDIX A

HISTORICAL SITE PLANS AND AERIAL PHOTOGRAPHS



NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

DWN BY: SD
CHK'D BY: MR
DATUM: NAD83
PROJECTION: OR SP N. Ft.
SCALE: 1 inch = 125 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

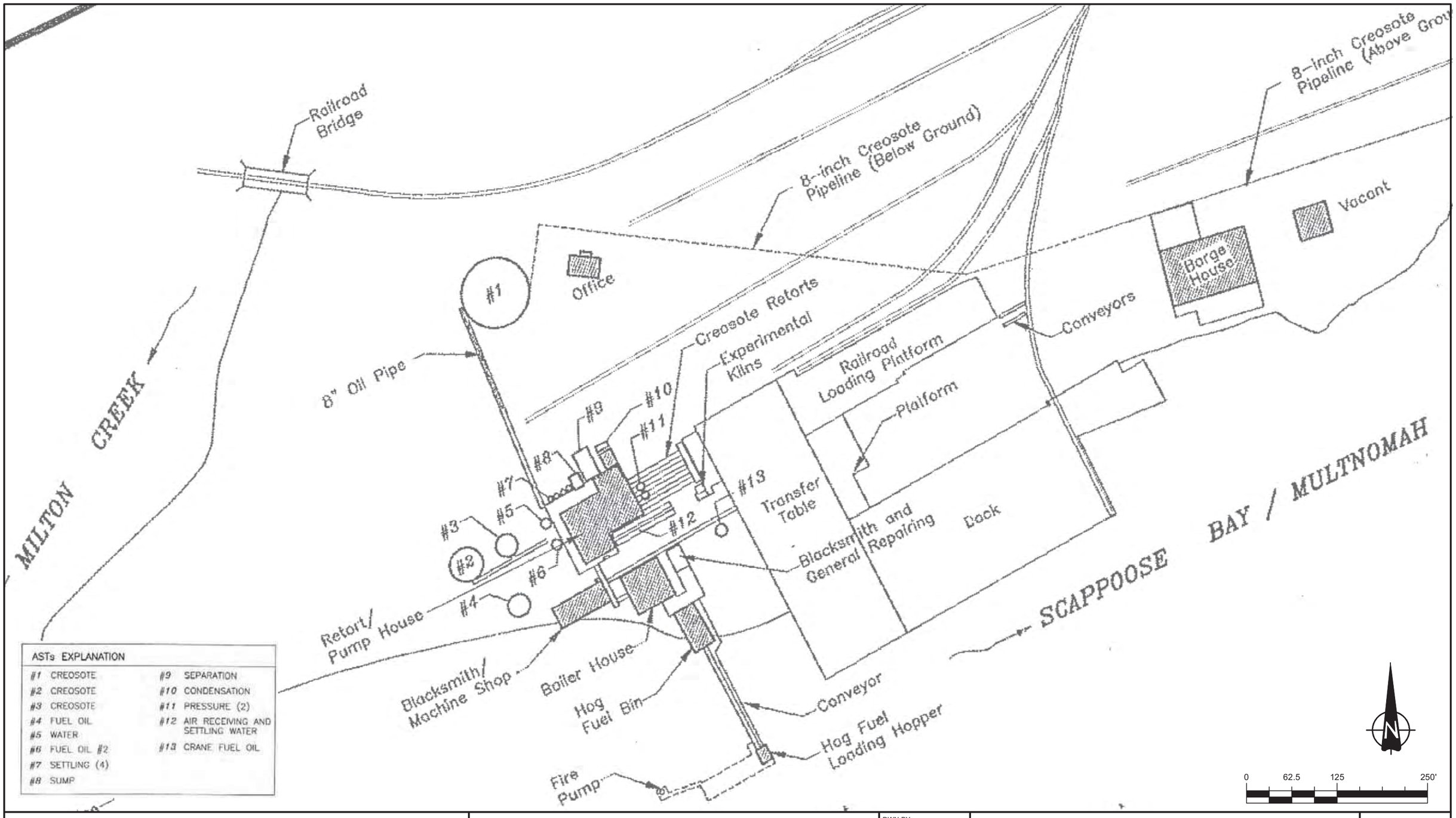
TITLE: 1919 SITE LAYOUT DIAGRAM

DATE: APRIL 2014
PROJECT NO.: 9-61M-112202.09
REV. NO.: -
FIGURE NO.: A-1

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-1 - 1919 Site Layout Diagram.mxd

CLIENT: PORT OF ST. HELENS		DWN BY: SD	PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE	DATE: APRIL 2014
		CHK'D BY: MR		PROJECT NO.: 9-61M-112202.09
AMEC 7376 S.W. Durham Road Portland, OR, U.S.A. 97224	amec	DATUM: -	TITLE: 1929	REV. NO.: -
		PROJECTION: -		FIGURE NO.: A-2
		SCALE: NOT TO SCALE		

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-2 - 1929 Aerial.mxd



ASTs	EXPLANATION		
#1	CREOSOTE	#9	SEPARATION
#2	CREOSOTE	#10	CONDENSATION
#3	CREOSOTE	#11	PRESSURE (2)
#4	FUEL OIL	#12	AIR RECEIVING AND SETTLING WATER
#5	WATER		
#6	FUEL OIL #2	#13	CRANE FUEL OIL
#7	SETTLING (4)		
#8	SUMP		

NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

DWN BY: SD
CHK'D BY: MR
DATUM: NAD83
PROJECTION: OR SP N. Ft.
SCALE: 1 inch = 125 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: 1938 SITE LAYOUT DIAGRAM

DATE: APRIL 2014
PROJECT NO.: 9-61M-112202.09
REV. NO.: -
FIGURE NO.: A-3

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-3 - 1938 Site Layout Diagram.mxd

NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

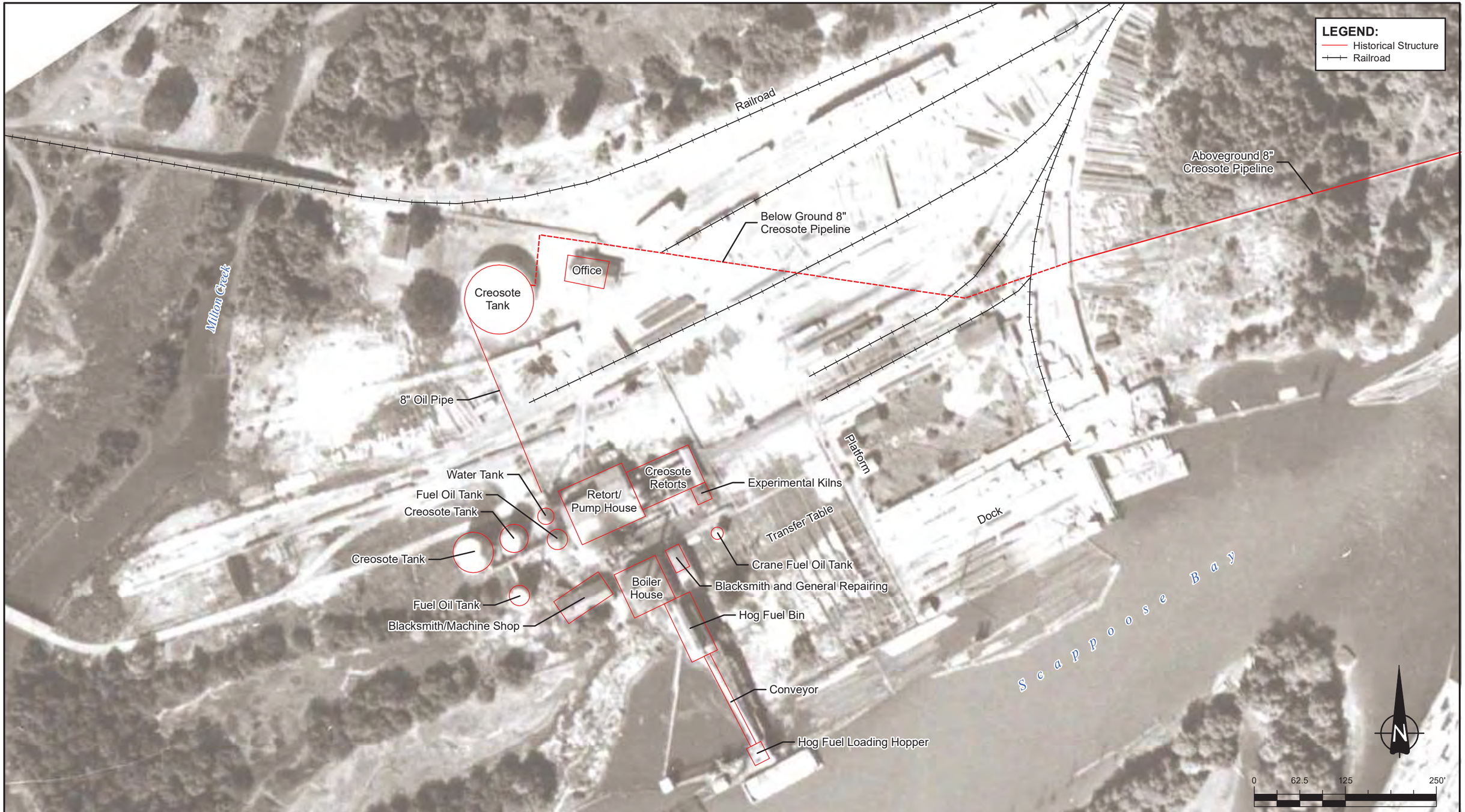
DWN BY:	SD
CHK'D BY:	MR
DATUM:	NAD83
PROJECTION:	OR SP N. Ft.
SCALE:	1 inch = 125 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: USACE 1939

DATE:	APRIL 2014
PROJECT NO.:	9-61M-112202.09
REV. NO.:	-
FIGURE NO.:	A-4

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-4 - 1939 Aerial.mxd



NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

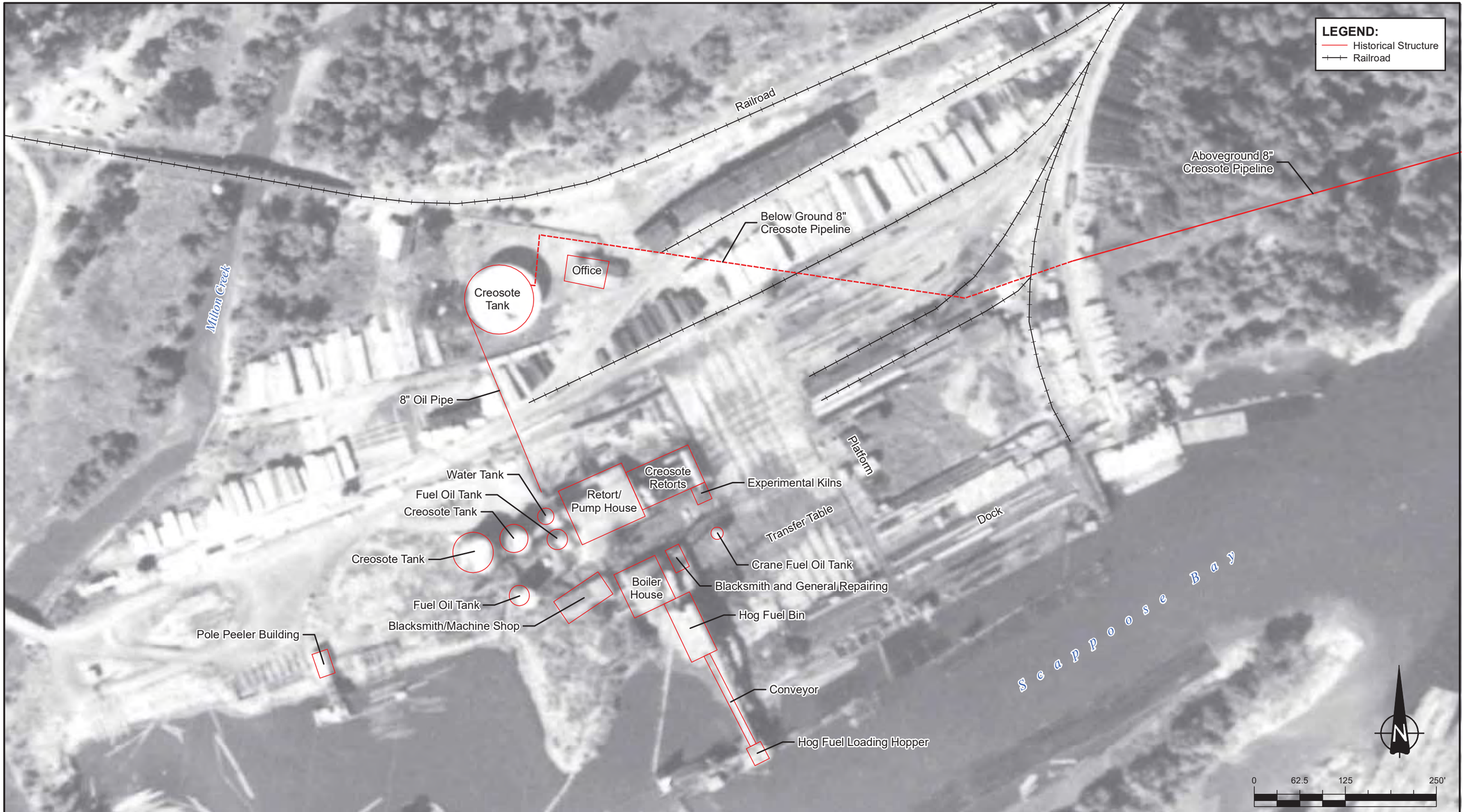
DWN BY: SD
CHK'D BY: MR
DATUM: NAD83
PROJECTION: OR SP N. Ft.
SCALE: 1 inch = 125 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: USACE 1948

DATE: APRIL 2014
PROJECT NO.: 9-61M-112202.09
REV. NO.: -
FIGURE NO.: A-5

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-5 - 1948 Aerial.mxd



NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

DWN BY:	SD
CHK'D BY:	MR
DATUM:	NAD83
PROJECTION:	OR SP N. Ft.
SCALE:	1 inch = 125 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: UO 1953

DATE:	APRIL 2014
PROJECT NO.:	9-61M-112202.09
REV. NO.:	-
FIGURE NO.:	A-6

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-6 - 1953 Aerial.mxd

ASTs/FACILITY EXPLANATION

#1 CREOSOTE	#10 WOLMAN WORKING (2)	#19 EXPERIMENTAL KILNS
#2 CREOSOTE	#11 PRESSURE (2)	#20 WOLMAN AND WOLMAN/PENTA RETORTS
#3 CREOSOTE	#12 AIR RECEIVING AND SETTLING WATER	#21 BLACKSMITH AND GENERAL REPAIRING
#4 FUEL OIL	#13 CRANE FUEL OIL	#22 CREOSOTE RETORTS (4)
#5 LIGHT FUEL OIL	#14 OIL STORAGE (PENTA)	
#6 LIGHT FUEL OIL	#15 UNLABELLED HORIZONTAL ASTs (3)	
#7 SETTLING (4)	#16 MEASURING (2)	
#8 SUMP	#17 WATER	
#9 SEPARATING (2)	#18 OIL (CIRCA 1941)	

Spokane

8-inch Creosote Pipeline (Below Ground)

8-inch Creosote Pipeline (Above Gro

Office

#1

8" Oil Line

#18

Conveyors

Chemical Building

#15

#10

#20

#9

#22

#14

#8

#7

#19

#3

#16

#5

#12

#13

#2

#6

#21

#17

#4

Railroad Loading Platform

Platform

Dock

Transfer Table

MILTON CREEK

Boiler House

Pole Peeler Building

Blacksmith and Machine Shop

Shoreline

Hog Fuel Bin

Hog Fuel Conveyor

Hog Fuel Loading Hopper

SCAPPOOSE BAY / MULTNOMAH CH

Fire Pump

N

0 62.5 125 250'

NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

DWN BY: SD
CHK'D BY: MR
DATUM: NAD83
PROJECTION: OR SP N. Ft.
SCALE: 1 inch = 125 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: 1959 SITE LAYOUT DIAGRAM

DATE: APRIL 2014
PROJECT NO.: 9-61M-112202.09
REV. NO.: -
FIGURE NO.: A-7

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-7 - 1959 Site Layout Diagram.mxd

NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

DWN BY:	SD
CHK'D BY:	MR
DATUM:	NAD83
PROJECTION:	OR SP N. Ft.
SCALE:	1 inch = 125 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: USACE 1966

DATE:	APRIL 2014
PROJECT NO.:	9-61M-112202.09
REV. NO.:	-
FIGURE NO.:	A-8

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-8 - 1966 Aerial.mxd

NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

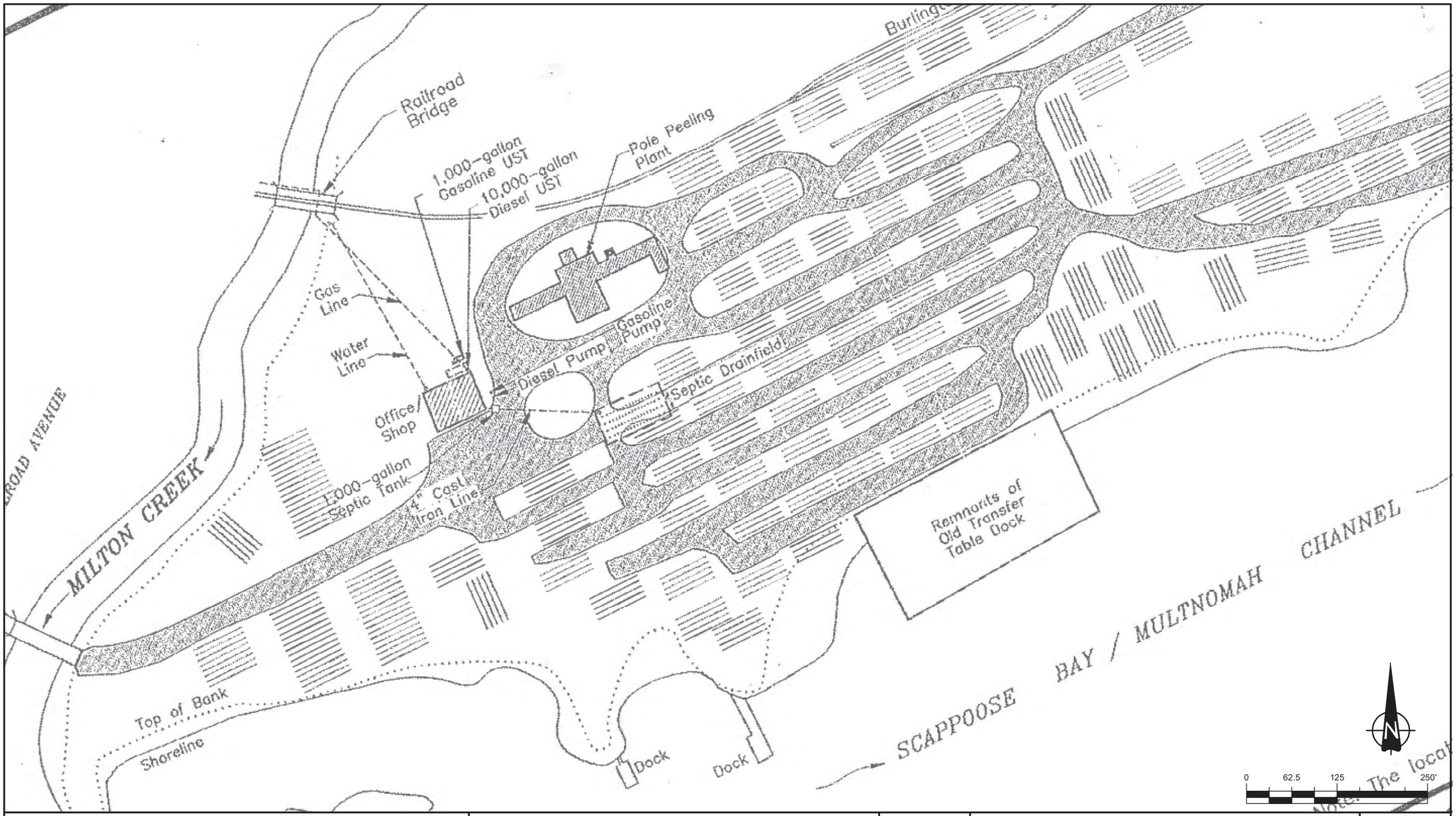
DWN BY: SD
CHK'D BY: MR
DATUM: NAD83
PROJECTION: OR SP N. Ft.
SCALE: 1 inch = 125 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: UO 1970

DATE: APRIL 2014
PROJECT NO.: 9-61M-112202.09
REV. NO.: -
FIGURE NO.: A-9

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-9 - 1970 Aerial.mxd



NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

DWN BY: SD
CHK'D BY: MR
DATUM: NAD83
PROJECTION: OR SP N. Ft.
SCALE: 1 inch = 125 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: 1974 SITE LAYOUT DIAGRAM

DATE: APRIL 2014
PROJECT NO.: 9-61M-112202.09
REV. NO.: -
FIGURE NO.: A-10

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-10 - 1974 Site Layout Diagram.mxd

NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

DWN BY: SD
CHK'D BY: MR
DATUM: NAD83
PROJECTION: OR SP N. Ft.
SCALE: 1 inch = 500 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: EDR 1977

DATE: APRIL 2014
PROJECT NO.: 9-61M-112202.09
REV. NO.: -
FIGURE NO.: A-11

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-11 - 1977 Aerial.mxd

NOTE: The locations of all features shown are approximate. Site features from GeoEngineers Figures circa 1998.

CLIENT: PORT OF ST. HELENS

AMEC
7376 S.W. Durham Road
Portland, OR, U.S.A. 97224

DWN BY:	SD
CHK'D BY:	MR
DATUM:	NAD83
PROJECTION:	OR SP N. Ft.
SCALE:	1 inch = 500 feet

PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE

TITLE: EDR 1990

DATE:	APRIL 2014
PROJECT NO.:	9-61M-112202.09
REV. NO.:	-
FIGURE NO.:	A-12

K:\11000\11200\11220\112202\DWG_2014_SRI_Report\Figure A-12 - 1990 Aerial.mxd

CLIENT: PORT OF ST. HELENS	DWN BY: SD	PROJECT: FORMER POPE & TALBOT WOOD-TREATING SITE	DATE: APRIL 2014
	CHK'D BY: MR		PROJECT NO.: 9-61M-112202.09
AMEC 7376 S.W. Durham Road Portland, OR, U.S.A. 97224	DATUM: -	TITLE: 2013	REV. NO.: -
	PROJECTION:		FIGURE NO.: A-13
	SCALE: NOT TO SCALE		

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APPENDIX B

FIELD METHODOLOGY

INTRODUCTION

This appendix provides additional detail regarding field activities completed as part of the Supplemental Remedial Investigation at the former Pope & Talbot wood-treating site located at 1550 Railroad Avenue in St Helens, Oregon (Site). Investigation tasks described herein were completed during or after 2010 and are described in previously submitted work plans and progress reports. Field activities described in this appendix include groundwater monitoring, shoreline inspections, Tar-specific Green Optical Screening Tool (TarGOST®) investigation, upland and offshore non-aqueous phase liquid (NAPL) delineation, sediment sampling (both whole sediment and porewater), and surface water sampling.

2010–2012 GROUNDWATER MONITORING

During each groundwater monitoring event, depth to water measurements were collected from each Area 1 and Area 2 monitoring well and from two surface water monitoring points located at Scappoose Bay and Milton Creek. Five groundwater monitoring events were conducted at the Site since 2010. In addition to water elevation measurements, creosote-related NAPL in wells was measured and documented if present. Groundwater samples were collected from the existing network of monitoring wells in Area 1 unless there was insufficient water in the well to purge and collect a sample.

Groundwater samples were collected using low-flow sampling techniques with a peristaltic pump connected to new polyethylene tubing lowered to the middle of the screened interval. Groundwater quality parameters were measured during well purging with a YSI model 556MPS hand held multiparameter water analyzer to ensure that the samples were representative of formation water. Turbidity was also measured during well purging using a Hach model 2100Q portable Turbidimeter. Samples were collected in new laboratory-provided containers. All samples were submitted to the analytical laboratory under standard chain-of-custody protocol and documentation. The field quality assurance/quality control sampling protocol included collecting field duplicate samples and use of laboratory-supplied trip blanks.

The following samples were collected during various groundwater monitoring events in addition to the standard sampling procedures described above.

- During groundwater monitoring in September 2010, the pump intake tubing was lowered to the bottom of the screened interval in each well and a sample was collected. As requested by the Oregon Department of Environmental Quality (DEQ), samples were collected from both regions of the screened interval (middle and bottom) to see if concentrations were significantly different.
- In August 2012, groundwater samples from wells MW-3A, MW-21, and MW-24 were collected and analyzed in accordance with ASTM International Standard Test Method D 7363-11 (Determination of Parent and Alkyl Polycyclic Aromatics using Solid-Phase

Microextraction and Gas Chromatography/Mass Spectrometry in Selected Ion Monitoring Mode) for freely dissolved PAHs. These groundwater samples were collected with the intention of comparing the concentration and distribution of freely dissolved PAHs near the upland source area to offshore sediment porewater samples.

- A sample of NAPL was collected from well MW-3A by lowering the tubing to the bottom of the screened interval after a water sample was collected from the middle of the screened interval. The NAPL sample was collected with the intention of comparing the concentration and distribution of PAHs in the upland source area to offshore sediment and porewater.

2010–2012 SHORELINE INSPECTIONS

Shoreline inspections were conducted during low water conditions at the Site in October 2010 and October 2012. The exposed shorelines and shallow water areas of Milton Creek and Scappoose Bay were visually inspected to document Site conditions and surface expressions of creosote NAPL (i.e., sheen, product, and/or tar body). The visual inspection was conducted during daily low tides to observe conditions during maximum shoreline exposure. In Scappoose Bay, saturated sediments as far as 42 feet from normal high-water marks were inspected. In Milton Creek, the full reach of the creek from the railroad bridge at the northeast corner of the Site to the discharge point at Scappoose Bay was inspected. Evidence of contamination was observed in multiple locations as indicated by visible sheen, staining, and/or creosote-like odors within the exposed surface sediments. Some of the sheen observed along Scappoose Bay and Milton Creek was biogenic in nature. The biogenic sheens lack the distinctive creosote odor (naphtha-like smell) and are brittle, in that the iridescent appearance on the surface of water cracks, breaks apart, or disaggregates upon disturbance (e.g., touching the sheen), and biogenic sheens at the Site generally appear to be more blue or bluish purple. In contrast, the creosote-related sheens produce a strong naphtha-like smell and are non-brittle, in that the iridescent appearance on the water surface rapidly coalesces upon disturbance. When disturbed, areas of creosote-impacted sediment imparted a visible sheen on the overlying surface water. Within areas of shallow water, the Port's environmental consultant staff walked across the submerged sediment to look for sheen "blossoms." A sheen blossom is the occurrence of a new sheen due to the migration of a droplet of NAPL (e.g., creosote) to the water surface overlying impacted sediment.

During each Area 1 shoreline inspection, field staff hand-dug shallow holes (potholes) to investigate the source of any sheen found on surface sediment within the intertidal zone mudflats and/or water seeps from the bank material. The potholes were generally advanced to a maximum depth of approximately 18 inches below grade using a variety of cleaned hand tools. During the 2012 shoreline inspection/sampling event, the Port's environmental consultant staff advanced select shoreline borings to depths of 3 to 5 feet below grade using a stainless steel decontaminated hand auger. All surface expressions of creosote impact, potholes, and hand borings were marked with wooden stakes and white flagging, and then located as a digital data point using a hand-held Trimble® model Geoxh 6000 global positioning system (GPS) unit. DEQ staff assigned to the project participated in each of these shoreline inspections.

Surface sediment samples were collected at selected locations, typically areas of obvious or suspected creosote impact from various locations along the exposed shoreline in Milton Creek and Scappoose Bay. Samples were generally collected within the upper 12 inches of sediment within the intertidal zone using a decontaminated stainless-steel trowel. Sediment from each sample location was mixed in a Ziploc® bag and placed in two sample jars. The jars were labeled and placed on ice in a cooler. All samples were submitted to the analytical laboratory under standard chain-of-custody protocol and documentation.

TARGOST® INVESTIGATION

Phase 1 Delineation of Upland and Offshore NAPL

TarGOST® data is collected using a specialized probe advanced by direct-push methods. The probe projects a laser through a sapphire window equipped into the side of a 4-foot-long, 1.5-inch outside diameter steel rod. Fluorescence measurements are collected by a sensor as the rod is advanced into the subsurface matrix. The laser-induced fluorescence (LIF) response produces real-time data in the field that is transferred to monitoring equipment at the surface, including depth (feet), total signal (%RE), various wave response channels (%RE Sctr and %RE Fluor), push rate (feet/second), and other data to calibrate the depth and response of the signal. As data is collected, fluorescent materials in the subsurface produce an LIF response or signal that is distinguished by the various wave response channels. Dakota Technologies of Fargo, North Dakota, operated the TarGOST® equipment and interpreted the LIF wave channel responses in the field to determine whether the fluorescent material appeared to be creosote NAPL or a different fluorescing medium (e.g., algae, natural organic matter, and minerals). Several macrocore direct-push borings were completed adjacent to TarGOST® borings to correlate the LIF response with observations of NAPL. Retrieved cores from the 3.25-inch diameter macrocore sampler were visually inspected and compared to TarGOST® logs.

Upland TarGOST® borings were completed using a track-mounted direct-push Geoprobe® unit. The borings were backfilled with bentonite chips upon completion. Offshore TarGOST® borings were completed using the direct-push Geoprobe® unit deployed from a barge. In order to minimize sediment disturbance, borings were advanced through a temporary steel casing that was lowered to the approximate sediment surface through a "moon pool" opening on the barge.
Each upland and offshore TarGOST® boring was completed to refusal at the bedrock surface. The TarGOST® probe tip is approximately 7.5 inches below the sapphire window, limiting the LIF response at the bottom of each boring. In upland borings, the zero line for depth designation was determined to be where the sapphire window was flush with the ground surface. In offshore borings, the zero line for depth designation was determined to be where the sapphire window was flush with the sediment mudline, the depth of which was measured at each location from the barge.

2011 OFFSHORE/UPLAND INVESTIGATION

Phase 2 Delineation of Offshore NAPL

The scope of the Phase 2 delineation of offshore NAPL included mobilizing drilling equipment on to a barge, which was then moved around the portions of Scappoose Bay and Milton Creek that are adjacent to Site Area 1. Boring locations were chosen based primarily on the results of the TarGOST® investigation. Diversified Marine, Inc. (DMI) was subcontracted to provide and operate a tugboat and barge used to collect sediment samples in Scappoose Bay and in Milton Creek downstream of the vehicle bridge leading to the Site. DMI used a skiff to move the barge short distances and to maneuver the barge into tight locations. The skiff was also used for trips to shore for materials and personnel.

A GPS unit was used to navigate the barge to targeted boring locations. Drilling services were provided by Boart Longyear, Inc. (Boart), and borings were completed using a mini track-mounted Sonic drill rig utilizing a combination of vibracore and sonic sampling methods, depending on the boring location. The barge/drill set-up used in Scappoose Bay and the lower reaches of Milton Creek could not be used upstream of the vehicle bridge due to width/height clearance restrictions.

Retrieved vibracore and sonic samples were processed on the deck of the barge. The vibracore sampler consisted of a thin-walled aluminum tube that was 12 feet long and 3 inches in diameter, with a sample catcher attached to the end of the tube to improve sample recovery. The sonic rig advanced the vibracore in a continuous run by both pushing and vibrating the sampler into the sediment. Shortly after retrieving the core, the dedicated core tube was cut open lengthwise with a power shear. The Port's environmental consultant's field personnel logged each sediment core using the Unified Soil Classification System (USCS) and documented the presence or absence of NAPL. Upon recovery of each sediment core, a portion of the sediment core was transferred to pre-labeled 8-ounce (oz) glass jars with Teflon®-lined lids for potential chemical analysis. The sample jars were packed full to minimize headspace in the containers. Immediately after the samples were collected, they were stored in a cooler with ice until they were delivered to the analytical laboratory under standard chain-of-custody protocol. The remaining portion of each sediment sample was used for logging and field screening. Cores of the soft sediment and underlying basalt bedrock were collected using a combination of vibracore and sonic drilling/sampling methods. In general, the vibracore method was used to collect sediment samples and the sonic method was used to drill through the sediment/basalt contact and into the basalt bedrock. At boring locations where depth to basalt was expected to be shallow (less than 5 to 10 feet below ground surface [bgs] or below mudline), the conventional sonic coring method was used to collect the sediment sample and drill into the basalt in a single continuous run. At boring locations where the depth of basalt was expected to be greater than 10 feet, the sediment core was collected using the vibracore method, and a conventional sonic core was collected through the sediment/basalt contact during a second core run. At selected locations, a clamshell (Van Veen sampler) was used to collect surface sediment samples.

Sediment cores deeper than 12 feet below mudline and cores drilled into the basalt were collected using a conventional 4-inch sonic core barrel which was 5, 10, or 15 feet in length. The sonic core was retrieved and extruded into 3-foot-long plastic core bags. The driller did not introduce any water while coring the basalt. All drilling and sampling equipment was cleaned prior to use with a hot water power washer or an Alconox soap solution, tap water rinse, and distilled water rinse.

Field screening for creosote impact (i.e., total PAHs, targeted PAHs, and extended diesel-range organics [EDRO]) was performed using a siteLAB® portable ultra-violet fluorescence (UVF) field meter. The UVF meter measures the fluorescence produced when light from a mercury vapor lamp is directed through an excitation filter, the sample extract, and an emission filter corresponding to the bandwidth at which aromatic hydrocarbons fluoresce. The UVF meter was calibrated using a PAH mixture purchased from siteLAB®. After calibration and before analyzing field samples, and after every 10 field samples, the calibration was checked by analyzing one of the calibration standards. If the measured concentration was within 15 percent of the standard concentration, the curve was considered valid. Aliquots of methanol used to extract the samples were analyzed at the beginning of each day, after each calibration check, and with each new bottle of methanol to test for possible contamination. Extraction efficiency and analytical accuracy also were tested by extracting a portion of a commercially prepared certified reference material spiked with individual PAHs. If the UVF meter's total PAH reading was within either the certified reference material manufacturer's certified confidence interval or prediction interval for the sum of the individual PAHs, extraction efficiency and analytical accuracy were confirmed.

Soil/sediment samples could not be placed directly into the UVF meter for analysis, because the device is limited to providing measurements on a liquid. Therefore, soil/sediment selected for UVF field screening underwent an extraction process by weighing out between 1 and 5 grams of sample into an extraction bottle or vial, adding 10 milliliters of methanol, and shaking the samples for 2 minutes. The samples were allowed to settle until the methanol layer separated from the sediment. The methanol was then extracted using a syringe filter and the resulting extract was stored in a clean vial until analyzed. If the concentration measured by the fluorometer was not within the instrument's calibration range, the sample was either diluted using clean methanol to bring the concentration within the instrument's range, or less diluted portions of the methanol extract were analyzed in cases where dilutions were performed prior to analysis. To calculate the total PAH concentration, the concentration reading from the UVF meter was multiplied by the dilution factor, including the dilution introduced by extracting the sample. The sample extracts also were used to measure EDRO by calibrating the fluorometer using a proprietary mixture of weathered hydrocarbons purchased from siteLAB®, and for targeted PAHs by calibrating the UVF meter using the same PAH mixture used for the total PAH analysis but a different emission filter.

In addition to the field screening methods described above, the sediment/soil samples collected from each boring were examined for the presence of NAPL and classified into one of three categories:

- No observed impacts – NAPL or sheens/staining indicative of creosote were not visually observed in the soil sample;
- Sheens/staining – creosote odors, staining and/or sheens were visually observed in the soil sample; or
- NAPL – free-phase creosote was visually observed in the soil sample.

Sediment samples from target intervals were placed in laboratory-prepared sample containers for chemical analysis. Target intervals were established in the field and samples were collected based on the results of the field screening methods and the TarGOST® investigation.

Phase 2 Delineation of Upland NAPL

The scope of the Phase 2 delineation of upland NAPL included installation of monitoring wells along the known inferred NAPL area and investigation of a potential NAPL migration pathway along the eastern Milton Creek shoreline. Monitoring wells were installed in July 2011. Boart was subcontracted to perform the drilling and install the monitoring wells. A mini track-mounted sonic drill rig was used, and the drilling was performed using sonic technology. The monitoring well borings were logged in the field, with particular attention paid to documenting the presence or absence of NAPL (i.e., visual, olfactory, headspace vapor, and water sheen testing). All drilling and sampling equipment was cleaned prior to use with a hot water power washer, or an Alconox soap solution, tap water rinse, and distilled water rinse.

The groundwater monitoring well borings were advanced through the Fill Material and Native Soil units and were extended approximately 1 foot into the upper surface of Basalt Bedrock. Continuous conventional sonic core samples of soil and basalt were collected and logged by a geologist. Upon recovery of the core, portions of the core sample were placed in laboratory-prepared sample containers for chemical analysis. The remaining portions of the core samples were logged and screened for evidence of NAPL. The field screening methods used included: (1) visual examination, (2) water sheen screening, and (3) headspace vapor screening using a photoionization detector. Specific details regarding monitoring well installation are discussed below.

Each monitoring well, with the exception of MW-2A, consisted of 2-inch diameter Schedule 40 polyvinyl chloride (PVC) casing and screen with locking caps. A steel, lockable aboveground monument equipped with a watertight cover was installed to protect the PVC well casing. Bollards were installed around the wells to provide protection. The monitoring wells were constructed in accordance with Oregon Water Resources Department (OWRD) monitoring well construction standards. Depending on vertical contaminant distribution in the soil, the new monitoring well screens varied between 5 and 13 feet in length and consisted of 0.010-inch slot screen width. A filter pack consisting of Colorado 20 to 40 silica sand was placed around the well screen interval. The annular space in each well was sealed between the top of the filter pack and approximately 2 feet bgs with hydrated bentonite chips to prevent infiltration of surface water and groundwater into the well bore from shallower zones. The base of each well was equipped with a 12-inch-long vertical solid sump to collect mobile dense nonaqueous phase liquids (DNAPL) that potentially may

be present. The DNAPL collection sump was completed within the upper 1 foot of the basalt bedrock, and the top of the sump/bottom of screen was set at the same depth as the native soil/basalt bedrock interface. A DNAPL funnel was installed at the bottom of the screen interval in the sand pack to direct DNAPL (if present) into the sump. The annular space below and surrounding the sump in each well was sealed from the base of the boring to the bottom of the filter pack with bentonite chips to mitigate downward migration of potential DNAPL.

The damaged well MW-2 was abandoned in accordance with Oregon Administrative Rule (OAR) 690-240-0510. MW-2 had been constructed with a PVC casing and well screen, and NAPL in the well may have deteriorated the PVC. Prior to abandoning the well, the aboveground monument and protective posts were removed. The monitoring well was abandoned by overdrilling and removing the well casing, annular bentonite seal, and sand filter pack. After drilling out MW-2, the boring was backfilled to grade with hydrated bentonite chips. The new MW-2A, replacing MW-2 within the inferred NAPL area, was installed at a new location approximately 80 feet to the south of the original well and within the approximate center of the inferred NAPL area. MW-2A was constructed with a more chemically resistant stainless-steel casing and wire wrap screen.

Each newly constructed monitoring well was developed to remove water introduced in the well during drilling (if any), minimize the amount of fine materials entering the well, and restore the hydraulic connection between the well screen and the surrounding soil. The wells were developed by surging, bailing, and pumping. Monitoring wells MW-2A and MW-24 were purged dry and allowed to recharge several times during development.

2012 POREWATER AND SEDIMENT SAMPLING

Two separate sediment sampling field events were conducted during high and low water conditions (July 2012 and October 2012, respectively) to evaluate seasonal fluctuations in NAPL migration. An attempt was made during the low water sampling event to closely replicate the high water event by returning to within approximately 5 feet of the initial sampling locations.

During the high water field event both proposed sample collection technologies, Power Grab and MudMole, were field-tested. A comparison was conducted to determine which method practically and consistently delivered an appropriate volume of sediment for porewater analysis while minimizing disturbance to the target sample depth interval. The Power Grab sampler consists of a stainless-steel, pneumatically operated grab sampler deployed from a boat. Two symmetrical jaws (12-inch radius and 12 inches wide) are closed by separate pneumatic drive cylinders. The Power Grab sampler collects surface sediment from 0 to 12 inches below the mud line over a 2-square-foot area. The sampler has an open top that is covered with a removable sheet of food-grade rubber to prevent sediment from washing out during retrieval. The Power Grab sampler is equipped with a downward-facing video camera that allowed for a visual inspection of the sediment surface during deployment. Using the camera, adjustments were made to avoid debris or other obstacles that might interfere with sample collection. In the event of poor recovery due to wood debris or other conditions the boat was moved approximately 5 feet from the original location and additional

attempts were made until sufficient sediment recovery was obtained. Measurements of oxidation reduction potential (ORP) were obtained prior to sampling by in-situ insertion of a combination platinum electrode to various depth intervals (Power Grab samples only).

The MudMole is a linear impact hammer sampling procedure that utilizes a 4-inch-square aluminum core tube connected to a stainless-steel cutter that is advanced using a pneumatically powered linear impact hammer. The sampling tube and impact hammer were lowered by a hydraulic winch and lightly hammered until penetration to the target interval. Prior to core collection, depth of water above the mudline was measured and marked on the drill core tube to gauge the penetration depth. Core penetration depth was calculated with a tape measure attached to the core head or extension rod. The sediment core was retrieved to the boat's deck for processing.

Based on the performance at the initial stations, it was determined that the Power Grab method was superior to the MudMole at this Site to achieve project objectives. As a result, the Power Grab was the selected sampling technology during the remaining high water sampling event and the low water sampling event.

Steel anchors with a 2-foot length of rope and a plastic float were installed at each porewater sampling location during the high water sampling event so that the same location could be found and sampled during the low water event. When returning to the sampling point during the low water event, the camera was used to locate the anchor.

Sediment samples collected in Milton Creek were not accessible by the sampling vessel due to shallow water conditions at the sample location and the vertical clearance of the downstream bridge. Samples were therefore collected with a hand-driven "cookie cutter" sediment coring device deployed by personnel accessing the location using hip waders from the adjacent bank. The "cookie cutter" is an 8-inch diameter stainless steel core sampler with a 12-inch penetration. The sampler has a vent on the top and sliding retention plate on the bottom. A decontaminated shovel was used to collect the sediment samples that were too stiff to collect with the "cookie cutter" sampler.

Once sampling volumes were successfully retrieved, observations, photographs, and other applicable Site conditions were recorded on field logs. Observations and measurements recorded on the field logs included:

- GPS location coordinates, depth of sampler penetration, and overlying water depth;
- Visual characterization of sediment grain size relative to the USCS;
- Description of any debris, discoloration, odors, and/or visible sheen present;
- Visual evidence of any biological activity, including associated depth interval; and
- ORP measurements.

In both events, the 8- to 11-inch depth interval below mud line at each sampling location was targeted for chemical analysis. Once the grab was photographed, overlying water was slowly

pumped off with a minimum of sample disturbance by siphoning. The upper 8 inches of surficial sediment (i.e., 0 to 8 inches below the mud line) was removed in layers using decontaminated stainless-steel hand tools. Sediment and associated porewater from the 1- to 4-inch and 4- to 7-inch intervals or strata below the mud line were removed from the sampler, homogenized in separate decontaminated stainless-steel mixing bowls, and archived for possible follow-up analysis. Sediment touching the sides of the grab sampler was not included in the compositing bowls.

After the upper layer of sediment was removed, the Port's environmental consultant field staff prepared a composite of the 8- to 11-inch depth interval of the sample for porewater extraction/analysis and bulk sediment chemical analyses. Subsamples of the composited sediment/porewater slurry were collected and submitted to the off-site analytical laboratory for porewater extraction and analysis and bulk sediment chemical analysis. Subsamples were placed in pre-cleaned and certified 16-oz or 32-oz glass jars with Teflon lined lids, placed on ice, and maintained at 4 to 6 degrees Celsius until transport to the analytical laboratory. All samples were handled under standard chain-of-custody procedures beginning at the time of collection. Sampling data were recorded on field log sheets.

For every sediment sample, an extra container was filled and archived (frozen upon receipt at the laboratory) to allow re-testing if quality control or other issues were identified. A complete set of archived samples from the overlying sediment strata was immediately frozen and held for 6 months for possible future chemistry and/or biological testing.

2012 LIMITED SEDIMENT INVESTIGATION

During the 2012 limited sediment investigation (LSI), borings generally were advanced using a stainless-steel decontaminated hand auger to 3.5 to 5 feet below mudline where possible, whether or not evidence of impact was observed within the uppermost foot. The rationale for having visual observations of soil and creosote conditions within the upper 3.5 to 5 feet of each LSI boring was to better evaluate the irregular distribution of NAPL in surface sediment along the shoreline from the western side of the peninsula to the east of the former transfer table dock. Soil/sediment samples were collected from most of the LSI boring locations; however, only a subset of collected samples were submitted for chemical analysis from the target interval (8 to 11 inches bgs) based on discussions with DEQ. In general, analyzed samples were selected based on their similarity to proximal LSI locations, presence of wood debris, and/or the presence of slight to moderate creosote impact.

2013 DOCK AREA INVESTIGATION

The scope of the October 2013 dock area investigation (DAI) included a combination of shallow hand tool investigations and deeper sonic and Geoprobe® direct-push borings. All drilling equipment, hand tools, and sampling equipment were cleaned prior to use with a hot water power washer, or an Alconox soap solution, tap water rinse, and distilled water rinse.

A track-mounted sonic drill rig was used to drill through the sediment or soil column to the basalt contact. Underlying basalt was also penetrated to determine the competency of the bedrock. A conventional 4-inch diameter sonic core barrel, 10 feet in length, was advanced. The sonic core was retrieved and extruded into 3-foot long plastic core bags. Direct-push borings were completed using a track-mounted Geoprobe® drill rig by advancing a 3.25-inch diameter macrocore sampler lined with an acetate liner to the basalt contact.

Shallow hand tool investigation borings completed during the DAI event were advanced using either a stainless-steel hand auger or a shovel depending on the sediment conditions. Hand tool borings and potholes were advanced at several locations regardless of surface observations (i.e., whether or not evidence of impact was observed at the sediment surface).

Field personnel described each soil/sediment core or shallow sediment profile using the USCS and documented the presence or absence of NAPL in the sediment. Upon recovery of sediment or soil, a portion of the volume was transferred to pre-labeled 8-oz glass jars with Teflon®-lined lids for potential chemical analysis. The sample jars were packed full to minimize headspace in the containers. Immediately after the samples were collected, they were stored in a cooler with ice until they were delivered to the analytical laboratory under standard chain-of-custody protocol. The remaining portion of each sediment sample was used for logging and field screening.

2017/2018 OFFSHORE DATA GAP INVESTIGATION

Bathymetric Survey, Pilot Test, Sheen Mapping and Groundwater Discharge Survey

The scope of the 2017 and 2018 Offshore Data Gap Investigation was completed between April 2017 and November 2018 to further assess the risk that bioavailable fractions of creosote related constituents, specifically PAHs and TPH to aquatic receptors outside of the inferred NAPL areas of Scappoose Bay and Milton Creek. Similar to prior supplement remedial investigations, the Data Gap Investigation was completed in a phased approach, with initial investigations (bathymetric survey and pilot testing of sheen mapping and groundwater discharge) occurring between April and July 2017.

A high-accuracy bathymetric survey of Scappoose Bay adjacent to Area 1 was completed by Solmar hydro, Inc of Portland, Oregon to better understand how the topography has changed since the last survey and to assist in understanding in-water conditions and interpreting investigation results. Additionally, a surface water stilling well (2-inch diameter PVC pipe casing) was attached to an existing timber pile in Scappoose Bayt adjacent to the peninsula. The top of casing (TOC) elevation of the stilling well was surveyed relative to the known TOC elevation of monitoring well MW-25 using an engineer's level and survey rod. A data logger transducer (LevelSCOUT®, water level pressure transducer and temperature sensor) was installed in the stilling well and MW-25 to compare water level and temperature in upland groundwater and Scappoose Bay. The data logger was moved to well MW-6A on June 23, 2017 because the groundwater responses to river stage could not be evaluated due to the hydraulic connection between shallow groundwater in well MW-25 and Scappoose Bay.

A groundwater discharge pilot study was completed on June 13 and 14, 2017 to evaluate the approaches and technology described in the April 26, 2017 Phase 1 and 2 Offshore Data Gap Investigation Work Plan. The Port's environmental consultant field staff attempted to collect sediment porewater from ten offshore locations. From a boat, field staff gauged the depth of the mudline below the water surface using ranging poles marked in tenths of a foot. The ranging pole was equipped with an 8-inch diameter disk at the base to help distinguish the mudline surface. A stainless steel PushPoint Sampler was advanced 8 to 12 inches below the sediment surface. At the base of the PushPoint Sampler was a 5-centimeter slotted screen. The slotted screen was connected to a peristaltic pump to draw porewater to the surface to attempt to (1) measure the porewater potentiometric surface and compare to river stage, and (2) compare water quality parameters (pH, temperature, specific conductivity, and dissolved oxygen [DO]) of the porewater and surface water using a YSI Multiparameter 556 meter (YSI 556) and flow through cell.. In general, field staff were not successful in measuring potentiometric differences between the porewater and surface water due to difficulty with fined grained silt clogging the screen interval of the PushPoint Sampler. Additionally, differences observed in the specific conductivity, temperature, and DO between the presumed porewater and surface water were determined to be unreliable due using the YSI 556 due to (1) suspended particulate matter present which affected specific conductivity measurements, (2) temperature equilibration as porewater was pumped through the surface water column, and the inability to maintain porewater flow through the PushPoint Sampler, which prevented a steady flow of water through the flow through cell. A small diameter thermocouple capable of being deployed within the PushPoint sampler allowed Cascadia personnel to measure the porewater temperature *in-situ.* Once the temperature reading from the thermocouple within the PushPoint Sampler stabilized the reading was recorded and the thermocouple was removed and lowered into the surface water column, approximately 12 inches above the mudline. The direct temperature measurements porewater and surface water were successful at measuring a 2 to 7 °F difference in in temperature. Based on the apparent effectiveness of the thermocouple compared to other methods, DEQ approved the use of the thermocouple device in subsequent sediment porewater and surface water measurements.

The pilot test also included testing of poling techniques to map the occurrence and type of sheen generated when surface sediments outside of the inferred NAPL area was disturbed. At each pilot test location, Cascadia person proceeded with disturbing the sediment by using a "poling" technique whereby a ranging pole marked in tenths of a foot and equipped with an 8-inch diameter disk at the base was utilized to measure the surface and bottom of the surface sediment to determine the mudline thickness and the ranging pole and disc were then vigorously moved through the surface sediment to attempt to generate a sheen. If a sheen was generated on the water surface, the sheen was evaluated using the Stick Test method, whereby an aluminum rod was used to break up the sheen and observe whether the sheen was broken into small platelets that failed to re-coalesce and/or dissipated, indicative of biogenic sheens, or whether the disturbed sheen swirled around and re-coalesced, which is indicative of a creosote-related sheen. A second test method utilized during the pilot study was the Jar Shake method. Field staff would collect surface water containing a sheen into a clear 8-ounce jar, once collected, the jar was capped and the

contents were shaken vigorously to mix and breakup any sheen, the contents allowed to sit for 60 second and were then observed to determine whether the sheen re-coalesced as a creosote sheen would be expected to or dissipated. Field staff, including the DEQ found that the Jar Shake method was difficult to collect sufficient sheen in a jar for the test to be conclusive. Following the pilot test, DEQ concurred that the Jar Shake method would be abandoned for the Phase 2 Sheen Mapping.

Full-Scale Sheen Study

Using a boat operated by the Port of Columbia County (Port), Cascadia personnel completed the full-scale groundwater discharge study and mapped the occurrence and type of sheen generated when the surface sediment was disturbed. The investigation was implemented between July 18 and 20, 2017. The Port's environmental consultant field staff compared the directly measured porewater temperature to surface water temperature at 32 locations within Scappoose Bay and 12 locations within Milton Creek located outside of the inferred NAPL areas. Field staff navigated to predetermined coordinates using global positioning system (GPS) receiver. Once the boat was at the desired location, the boat was secured and field staff recorded the thickness of the surface water column, the thickness of surface sediment, porewater and surface water temperatures, and noted whether a sheen was produced when poling rod and disc were then vigorously moved through the surface sediment to attempt to generate a sheen. Sheens were classified as either:

- No sheen
- Biogenic – attributed to the decomposition of organic material and/or iron/manganese reducing bacterial
- Slight Sheen
- Moderate Sheen – noticeable sheen observed which re-coalesced when disturbed during "stick-test".
- Heavy Sheen – widespread sheen, typically with odor associated which re-coalesced when disturbed during "stick-test". Creosote blebs sometimes observed.

Field observations were recorded on the field sheets with photos and were used in the selection of *in-situ* passive sample locations as part of Phase 3 of the Supplemental Remedial Investigation.

Phase 3 Offshore Data Gap Investigation

Phase 3 of the Offshore Data Gap Investigation was completed in September 2017 by the Port's environmental consultant (Cascadia) in conjunction with personnel with the Food Safety and Environmental Stewardship FSES) program at Oregon State University (OSU) of Corvallis, Oregon. Phase 3 of the Offshore Data Gap Investigation included collection of *in-situ* sediment porewater, surface water, and bulk sediment samples at 15 locations adjacent to the Area 1 shoreline. Nearshore locations were deployed by either FSES or the Port's environmental consultant personnel. The sampling devices were deployed at predetermined locations were selected based on the results of the Phase 2 activities discussed above. Offshore areas were deployed with assistance and assistance from Cascade Dive Company of Vancouver, Washington.

Surface bulk sediment samples were collected in the vicinity of the FSES passive samplers and passive diffusive bag (PDB) samplers using a 2-inch acrylic liner to remove a sediment core. The diver would advance the liner into the sediment by hand to the extent possible and remove the sediment core and hand it to Cascadia personnel on the boat where it each sediment core was examined for debris, visible sheen, biological activity and logged USCS. Upon recovery of each sediment core, the contents were transferred to a clean stainless-steel bowl and a portion of the sediment core was transferred to pre-labeled laboratory supplied containers for potential chemical analysis. The sample containers were packed full to minimize headspace in the containers. Immediately after the samples were collected, they were stored in a cooler with ice until they were delivered to the analytical laboratory under standard chain-of-custody protocol.

FSES personnel prepared specially designed passive samplers (either sediment probes or surface water cages) that included a low-density polyethylene (LDPE) sampling media, sheets approximately 100 cm long and 2.75 cm wide onto which performance reference compounds (PRCs) were applied. Immediately prior to deployment, FSES staff assembled the stainless-steel sampling probes and installed the sampling media. For sediment porewater, the probes consisted of two separate slotted intervals, each containing the LDPE sampling media separated by a blank spacer approximately 16-inches long. The probes were manually inserted into the surface sediment approximately 32 inches below the mudline, so that the slotted intervals targeted porewater between 3 and 8 inches and 24 and 29 inches below the mudline, respectively. Surface water passive samplers deployed by FSES personnel included the same type of LDPE sampling media used in the sediment porewater probes. The sampling media was placed inside a stainless-steel cage and attached to the sediment porewater probe. Surface water passive samplers (surface water cages) were deployed at eight of the fifteen Phase 3 sampling locations. The surface water cages were equipped with a float so that the cages were suspended approximately 12 inches above the mudline during deployment. The sediment porewater and surface water passive samplers are described in further detail the FSES SOPs. The FSES passive samplers were deployed for 20 to 21 days to allow sufficient time to equilibrate with sediment porewater or surface water. The sampling devices were retrieved the diver and handed to FSES personnel on a boat who removed the sampling material and processed placed the media in laboratory containers and transported to the FSES laboratory at OSU for post processing and analytical analysis.

Passive diffusion bag (PDB) sampler devices manufactured by EON Products were deployed polyvinyl chloride (PVC) probes and inserted within the upper 12-inches of the sediment in order to measure the concentration of dissolved phase TPH present in sediment porewater. The PDBs consisted of a low-density polyethylene material. When placed in water or sediment containing water, dissolved phase organic compounds diffuse through the wall of the bag in response to the concentration gradient between the porewater in the sediment and the distilled water in the bag. Immediately prior to deployment, Cascadia personnel filled the PDBs with distilled and deoxygenated water provided by Apex Lab. The screened interval of the probes was between 4 and 10 inches below the mudline. The assemblies were allowed to equilibrate with sediment porewater for 20 to 21 days before retrieval. The PVC probes containing the PDBs were retrieved by a diver

and passed to Cascadia personnel on a boat who noted the condition of the PDB and appearance of the water for color and clarity. Cascadia personnel used a small diameter transfer tube to pierce the LDPE material and transfer the water into pre-labeled laboratory supplied containers for potential chemical analysis. A small amount of water from the PDB was retained to collect water quality parameters, including temperature, pH, and conductivity. The sample containers used for analysis of volatiles were filled to minimize headspace. Immediately after the samples were collected, they were stored in a cooler with ice until they were delivered to the analytical laboratory under standard chain-of-custody protocol.

2018 Area 2 Shoreline Inspection

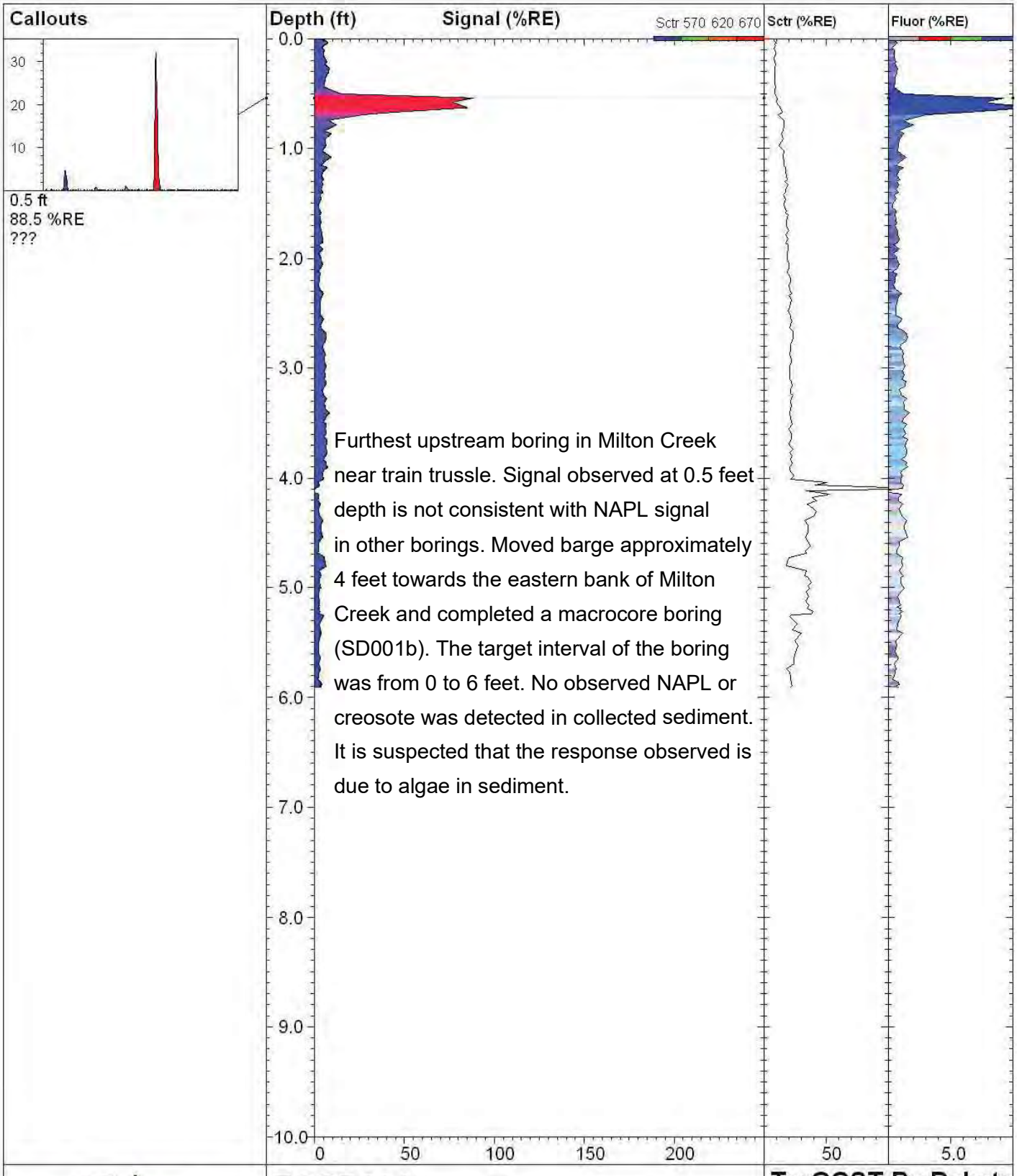
In response to the September 2018 DEQ email and subsequent telephone conversations, Cascadia prepared a work plan to visually map creosote sheen occurrence along the approximately 900-foot-long portion of the Scappoose Bay Area 2

Cascadia personnel, with DEQ oversight completed a low-tide inspection of the shoreline on October 22, 2018. Cascadia personnel used hand tools such as shovels or a hand-auger to pothole 18 to 24 inches below the surface to map the occurrence of creosote related sheen. A total of 23 potholes were completed along the shoreline of Area 2. Field observations including they type of soil present, debris, depth, type of sheen (if present) were recorded in the field notes and the location coordinates were recorded using a handheld GPS unit. The sheen, if present was classified in the same method described for Phase II above. Following the Area 2 shoreline inspection, Cascadia personnel completed an offshore inspection of Area 2 on November 29, 2018 to map the riverward extent of sheen and type. The poling method as described in the Phase I discussion above was conducted at 60 locations to disturb surface sediment and the sheen type, if present was evaluated using the Stick Test method. Personnel recorded the water depth, surface sediment thickness and sheen type, if present. The location coordinates for the 60 poling locations were recorded using a hand held GPS device.

APPENDIX C

SAMPLE, BORING, AND WELL CONSTRUCTION LOGS

TarGOST® Logs



DAKOTA TECHNOLOGIES
FARGO, ND 701.237.4908
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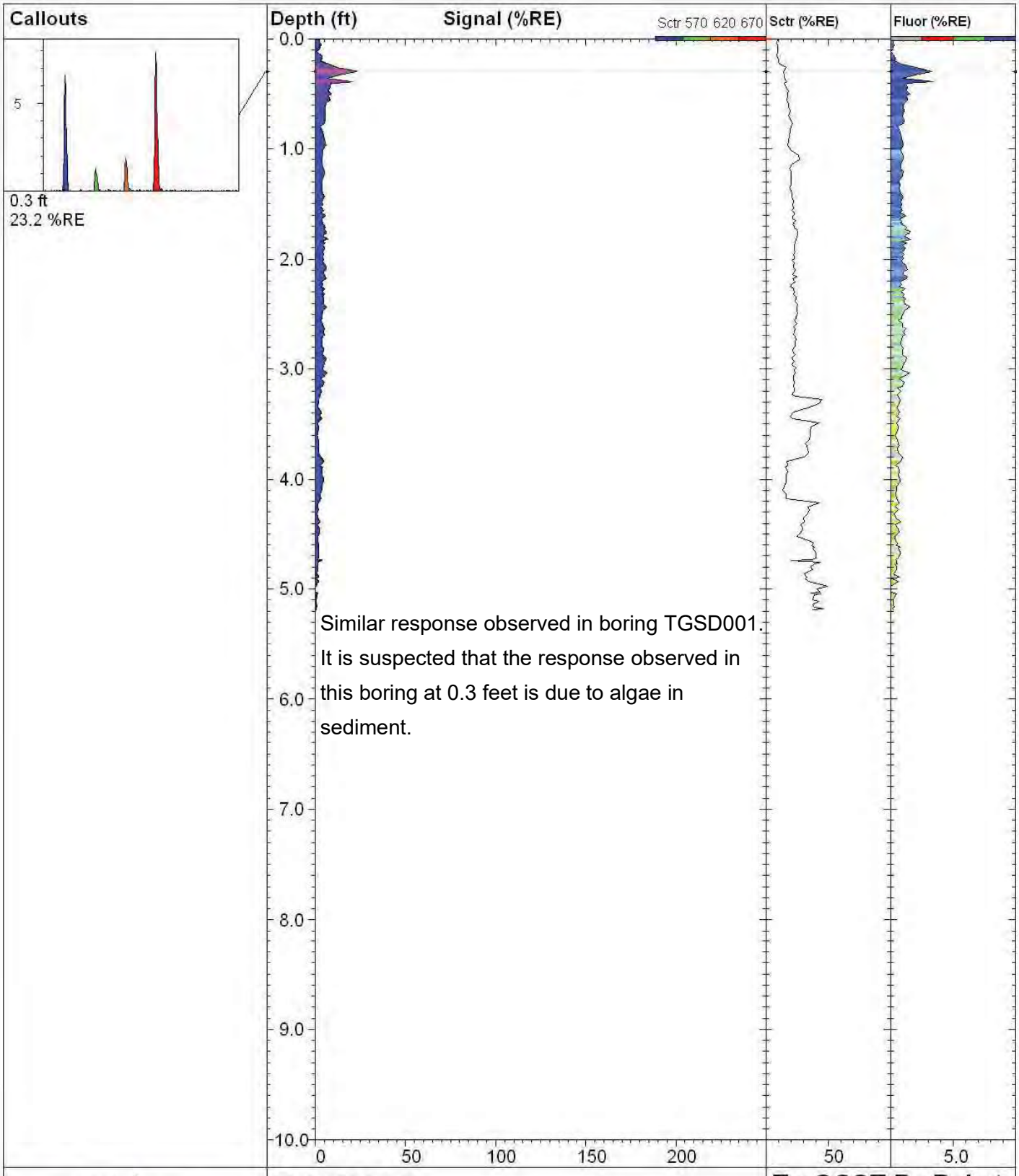
TGSD001

TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.91 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **88.5 %RE @ 0.54 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-23 09:36 PDT**



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TGSD002

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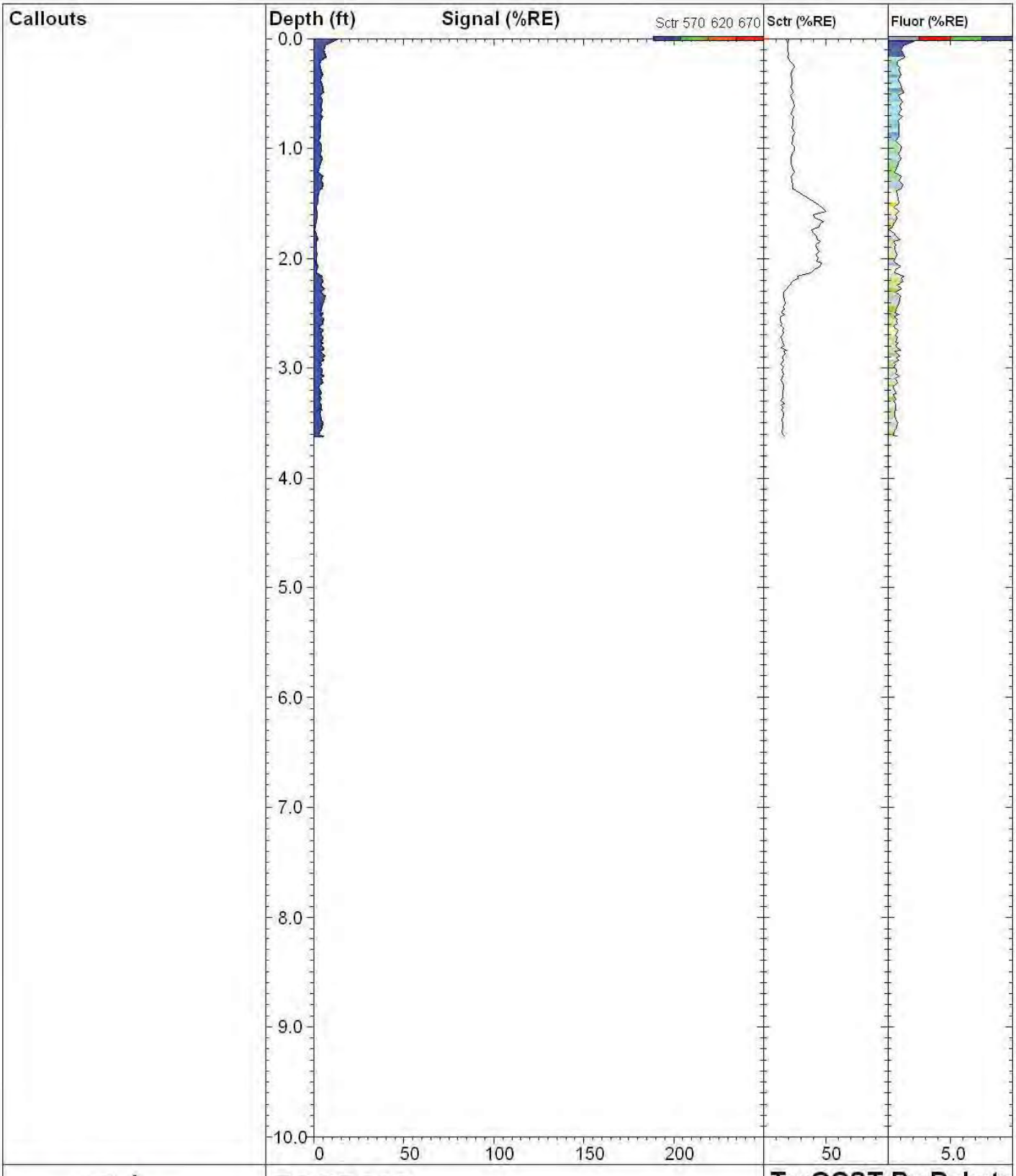
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.19 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **23.2 %RE @ 0.30 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-23 10:30 PDT**



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TGSD003

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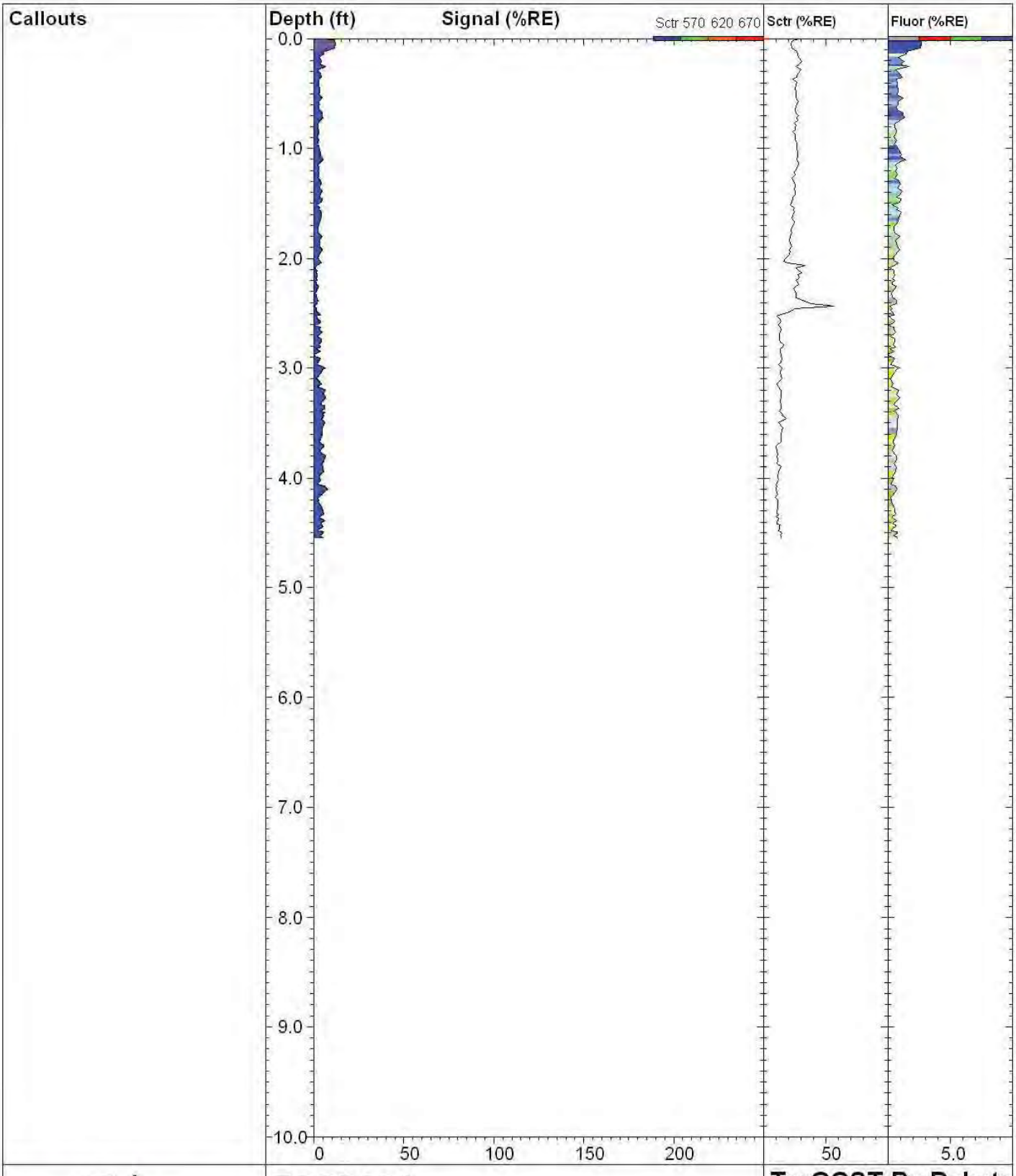
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **3.62 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **13.2 %RE @ 0.01 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-23 10:54 PDT**



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TGSD004

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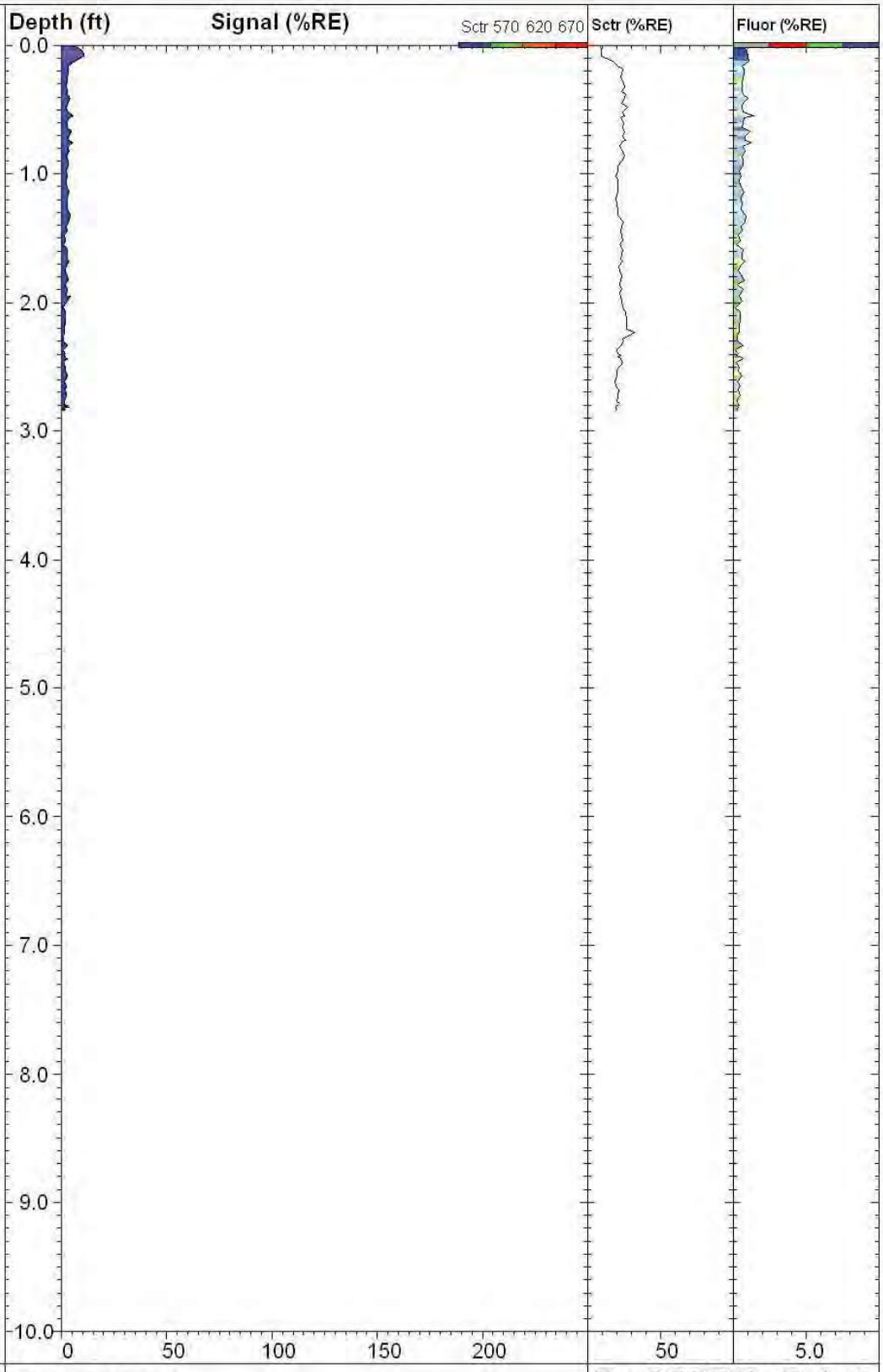
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **4.55 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **12.0 %RE @ 0.05 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-23 11:18 PDT**



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TGSD005

TarGOST By Dakota
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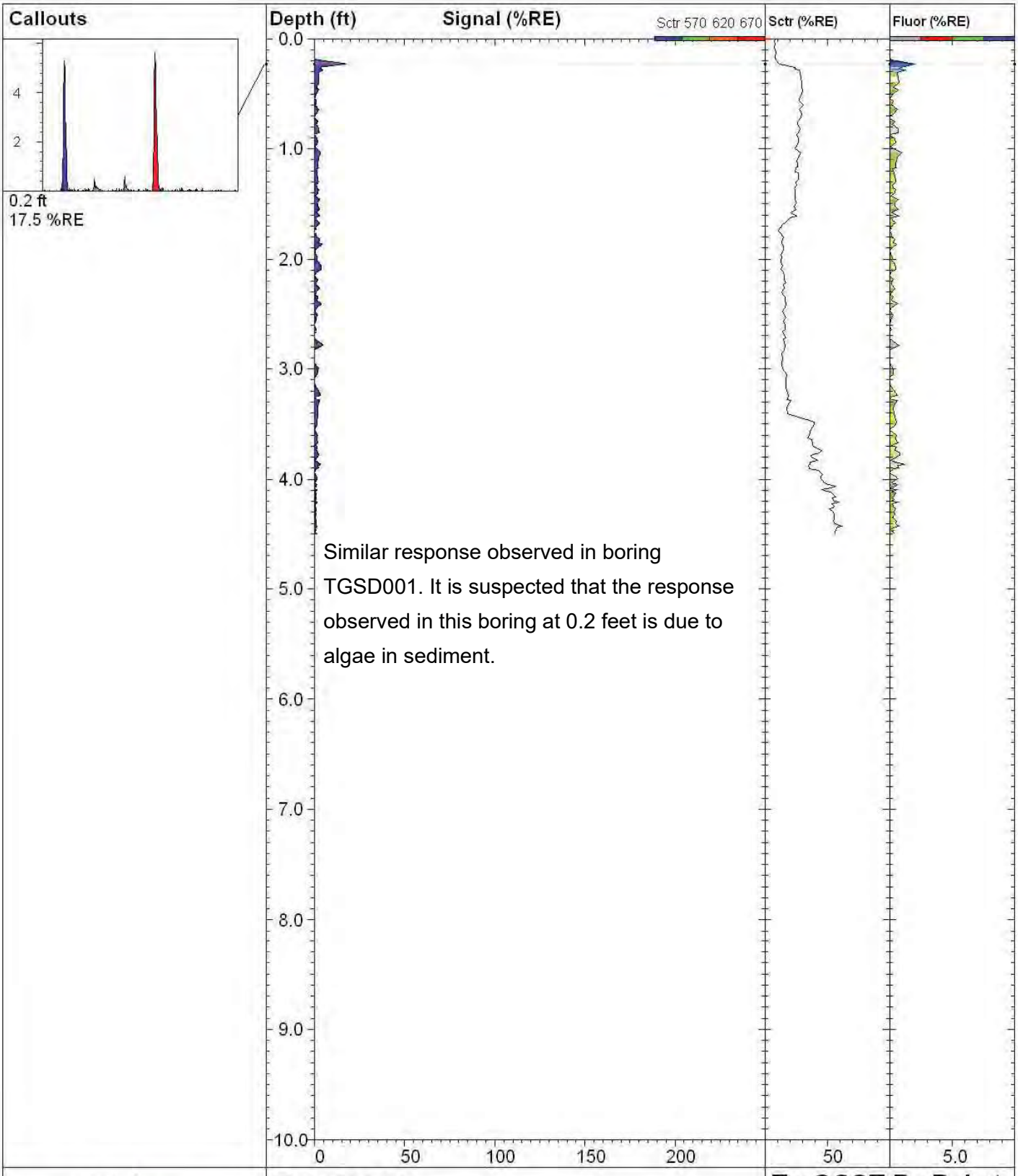
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **2.84 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **10.7 %RE @ 0.08 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-23 11:39 PDT**



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TGSD006

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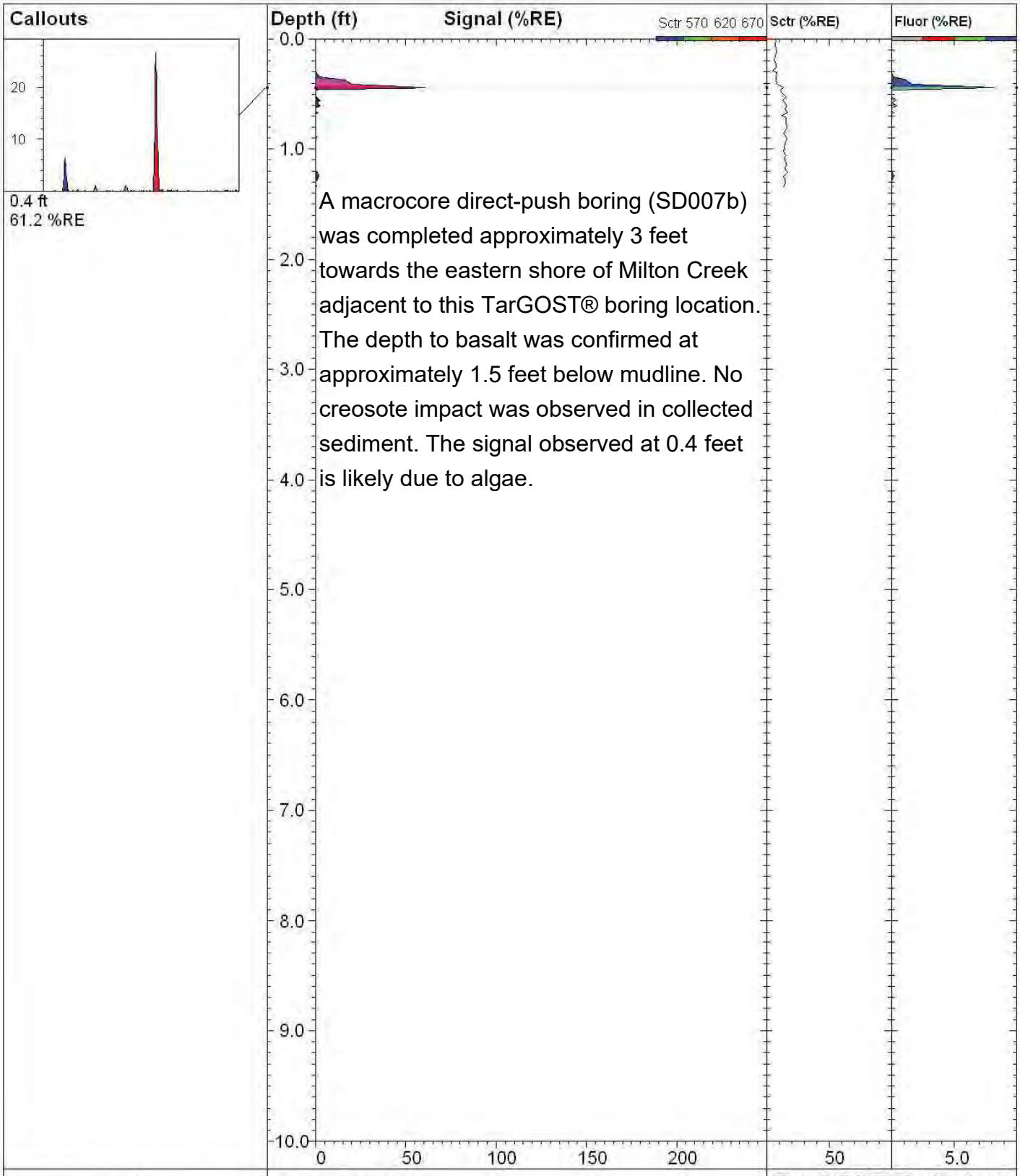
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **4.50 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **17.5 %RE @ 0.23 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-23 12:32 PDT**



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TGSD007

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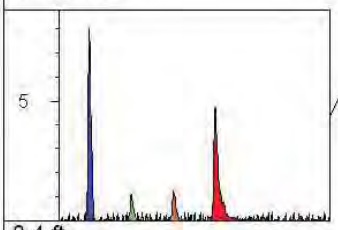
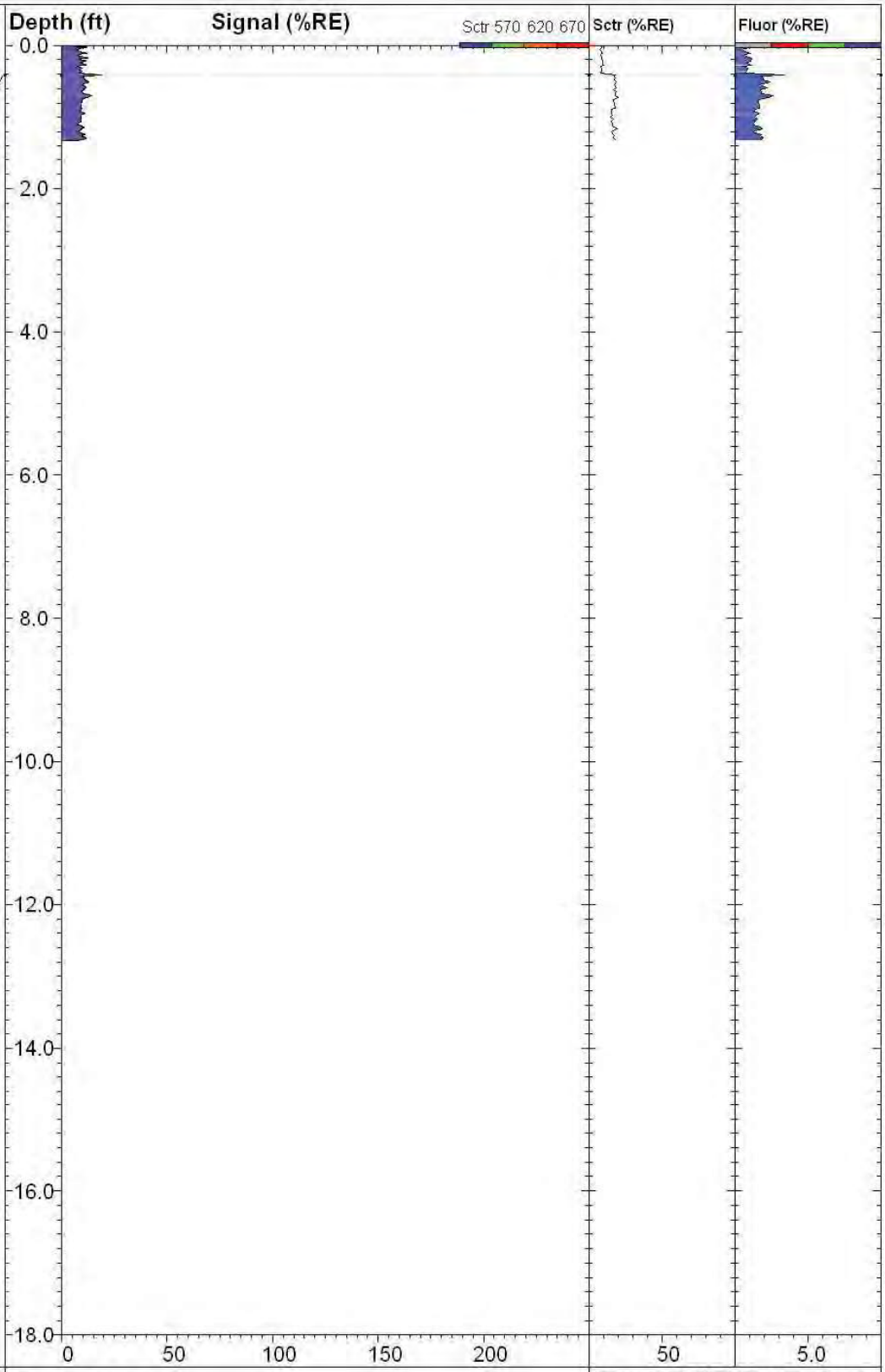
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **1.34 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **61.2 %RE @ 0.44 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-23 12:55 PDT**

Callouts



0.4 ft
18.8 %RE
from water



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TGSD008

TarGOST By Dakota
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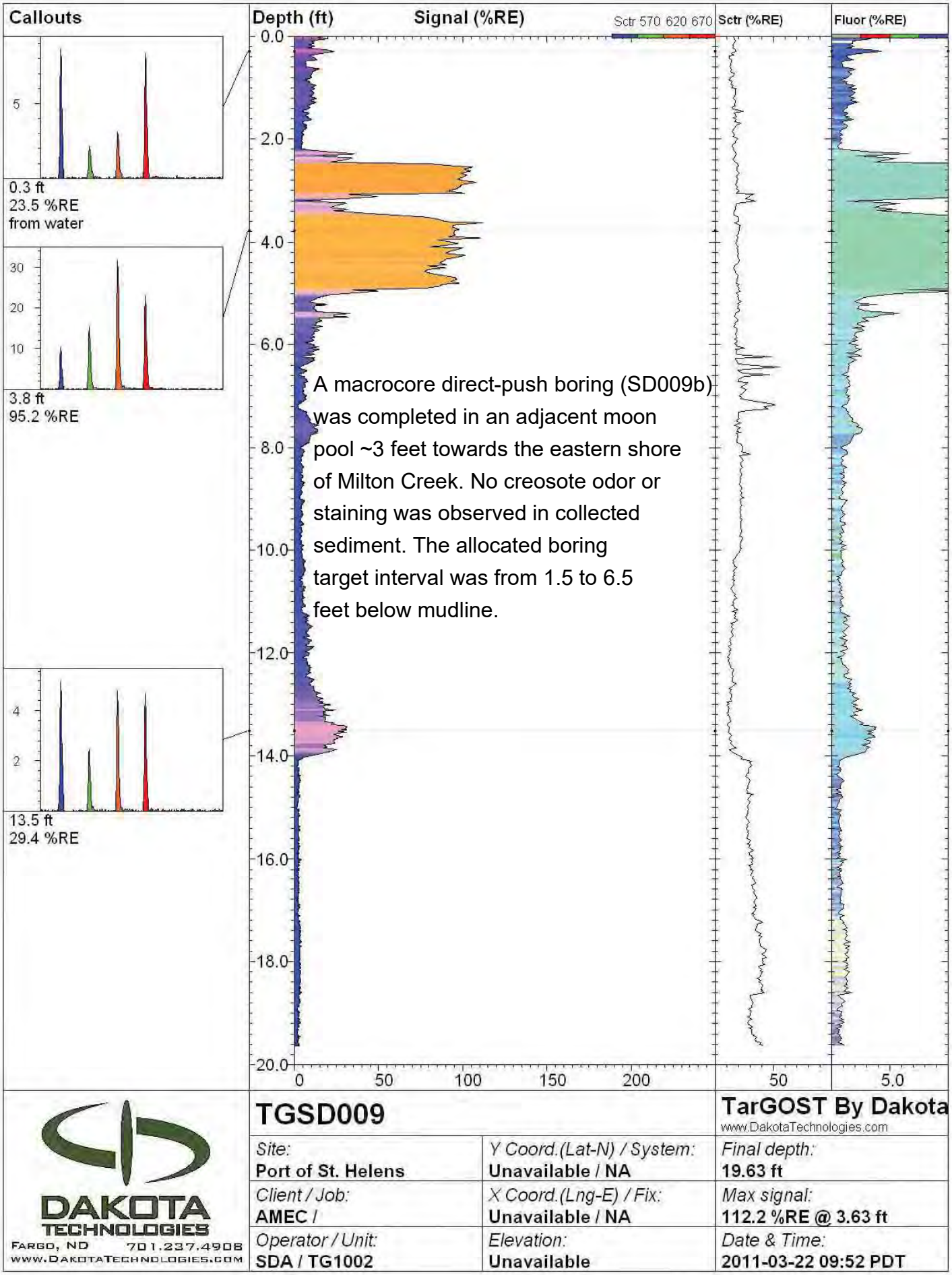
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **1.32 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **18.8 %RE @ 0.41 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 09:17 PDT**



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TGSD009

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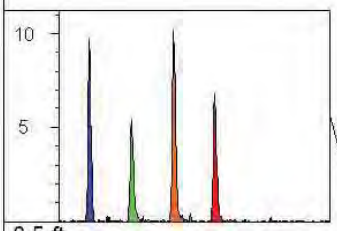
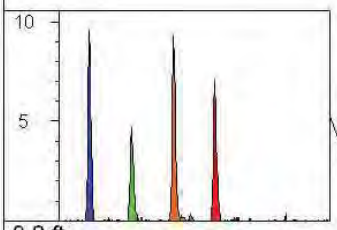
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **19.63 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **112.2 %RE @ 3.63 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 09:52 PDT**

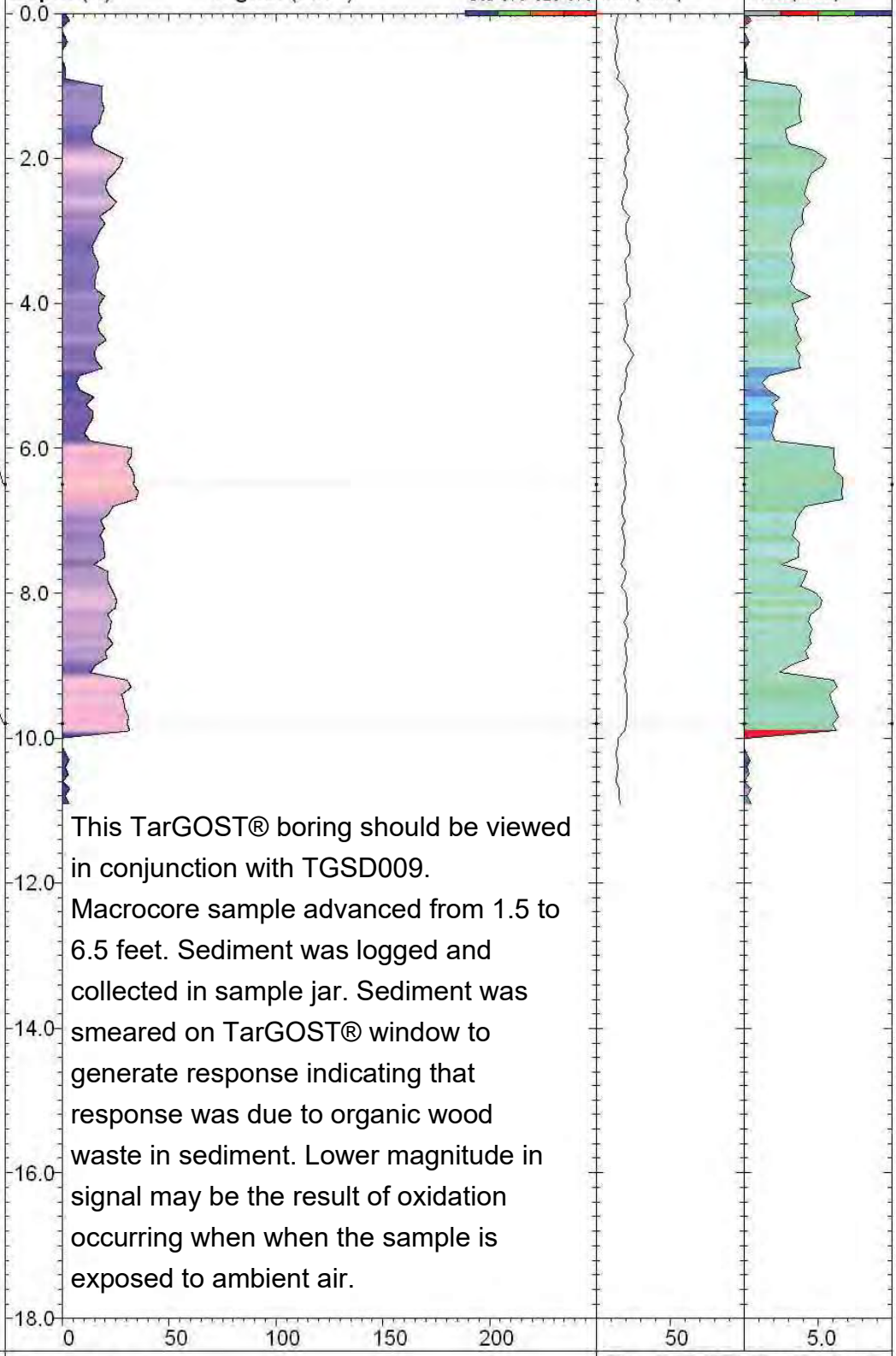
Callouts



6.5 ft
33.2 %RE
wood waste



9.8 ft
30.4 %RE
wood waste



This TarGOST® boring should be viewed in conjunction with TGSD009. Macrocore sample advanced from 1.5 to 6.5 feet. Sediment was logged and collected in sample jar. Sediment was smeared on TarGOST® window to generate response indicating that response was due to organic wood waste in sediment. Lower magnitude in signal may be the result of oxidation occurring when when the sample is exposed to ambient air.

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TGSD009b

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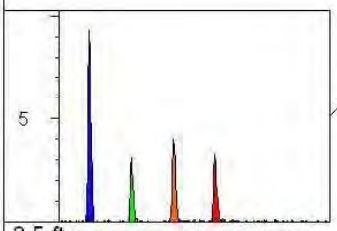
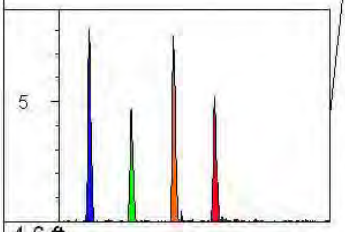
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **10.90 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **35.6 %RE @ 6.60 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 10:58 PDT**

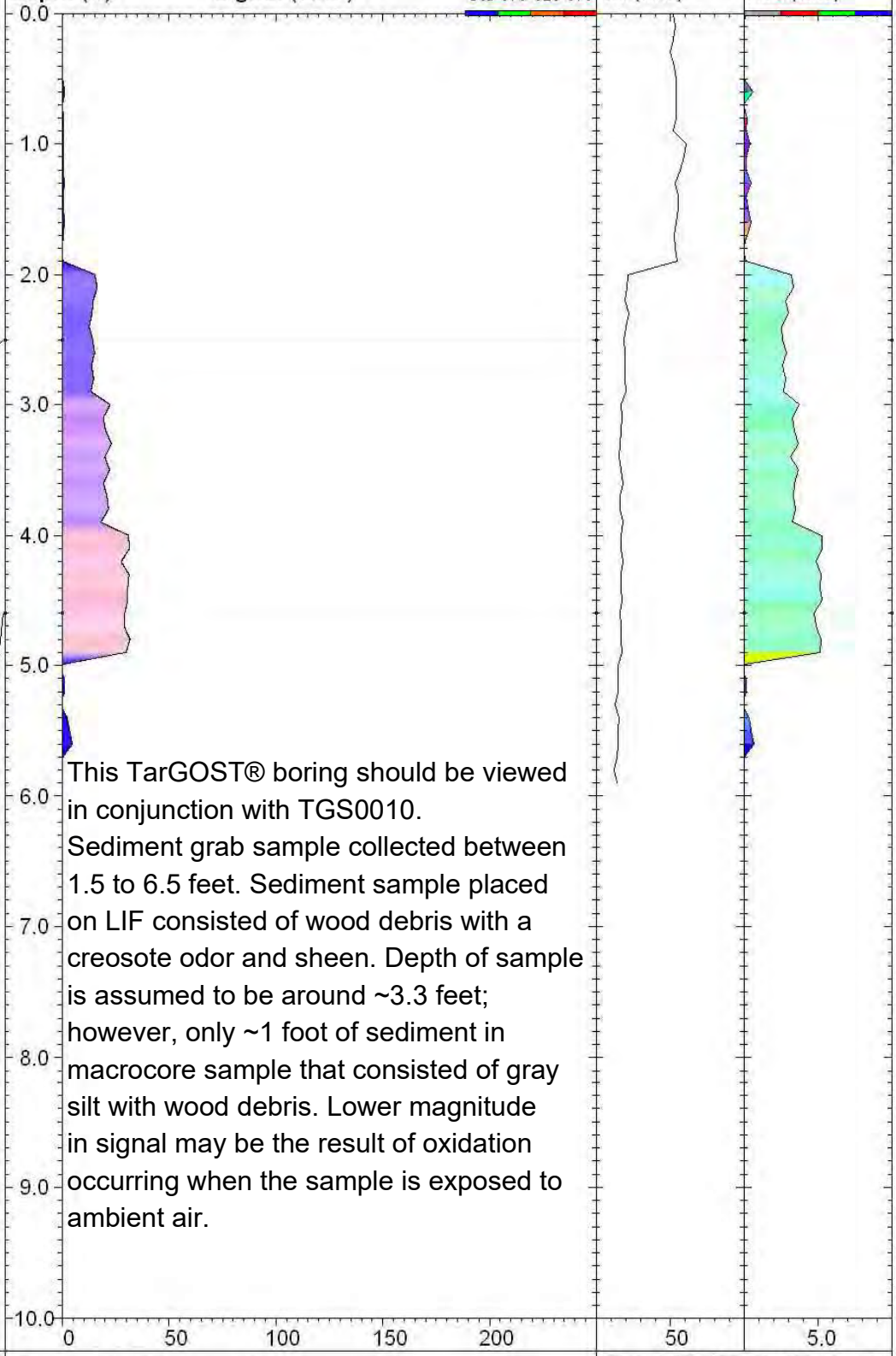
Callouts



2.5 ft
14.1 %RE



4.6 ft
29.2 %RE



This TarGOST® boring should be viewed in conjunction with TGS0010. Sediment grab sample collected between 1.5 to 6.5 feet. Sediment sample placed on LIF consisted of wood debris with a creosote odor and sheen. Depth of sample is assumed to be around ~3.3 feet; however, only ~1 foot of sediment in macrocore sample that consisted of gray silt with wood debris. Lower magnitude in signal may be the result of oxidation occurring when the sample is exposed to ambient air.

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TGSD010 sed

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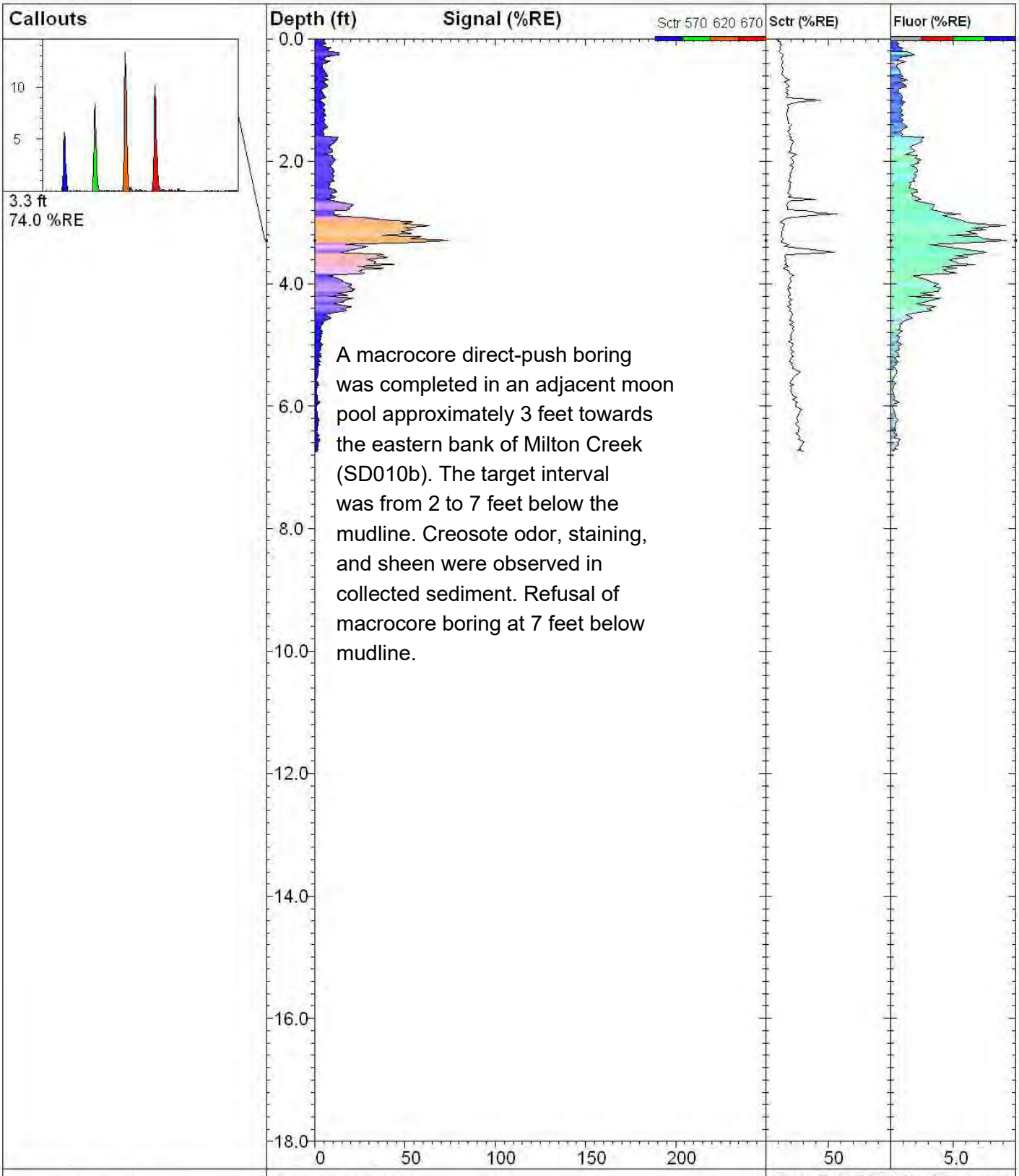
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.90 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **31.6 %RE @ 4.80 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 11:43 PDT**



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TGSD010

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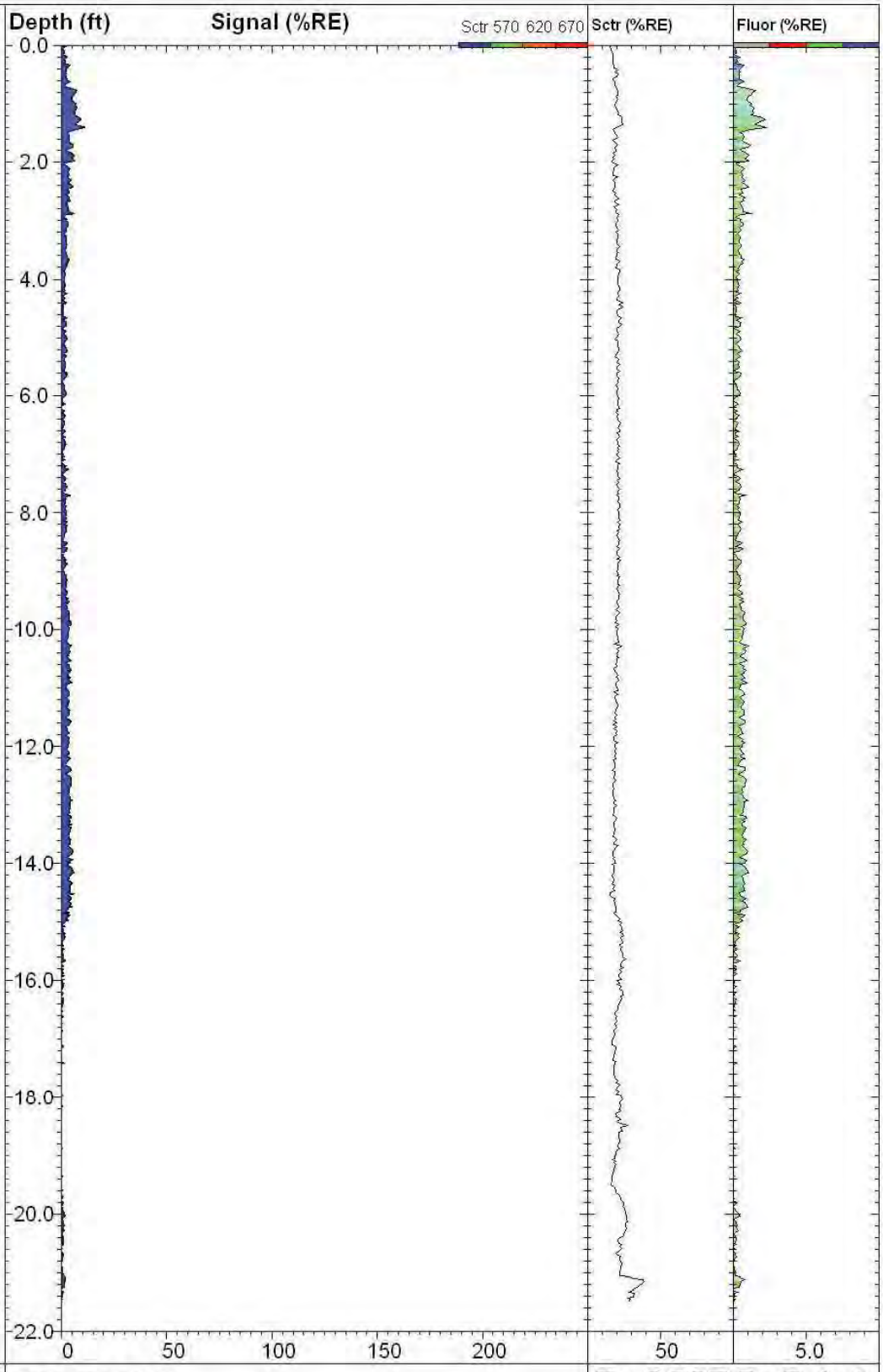
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **6.74 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **74.0 %RE @ 3.29 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 11:11 PDT**

Callouts



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TGSD011

TarGOST By Dakota
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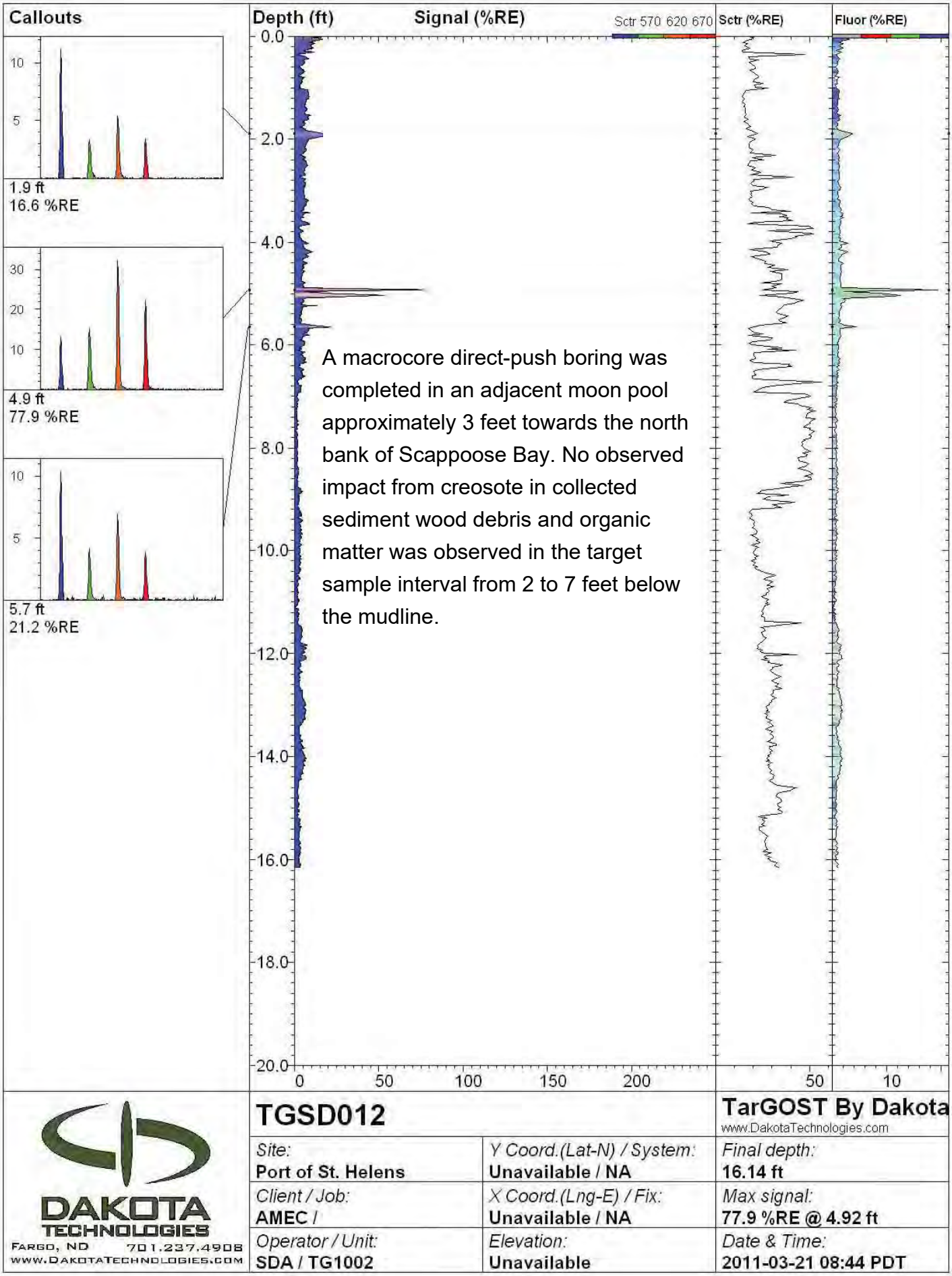
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **21.48 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **11.2 %RE @ 1.39 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 16:06 PDT**



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TGSD012

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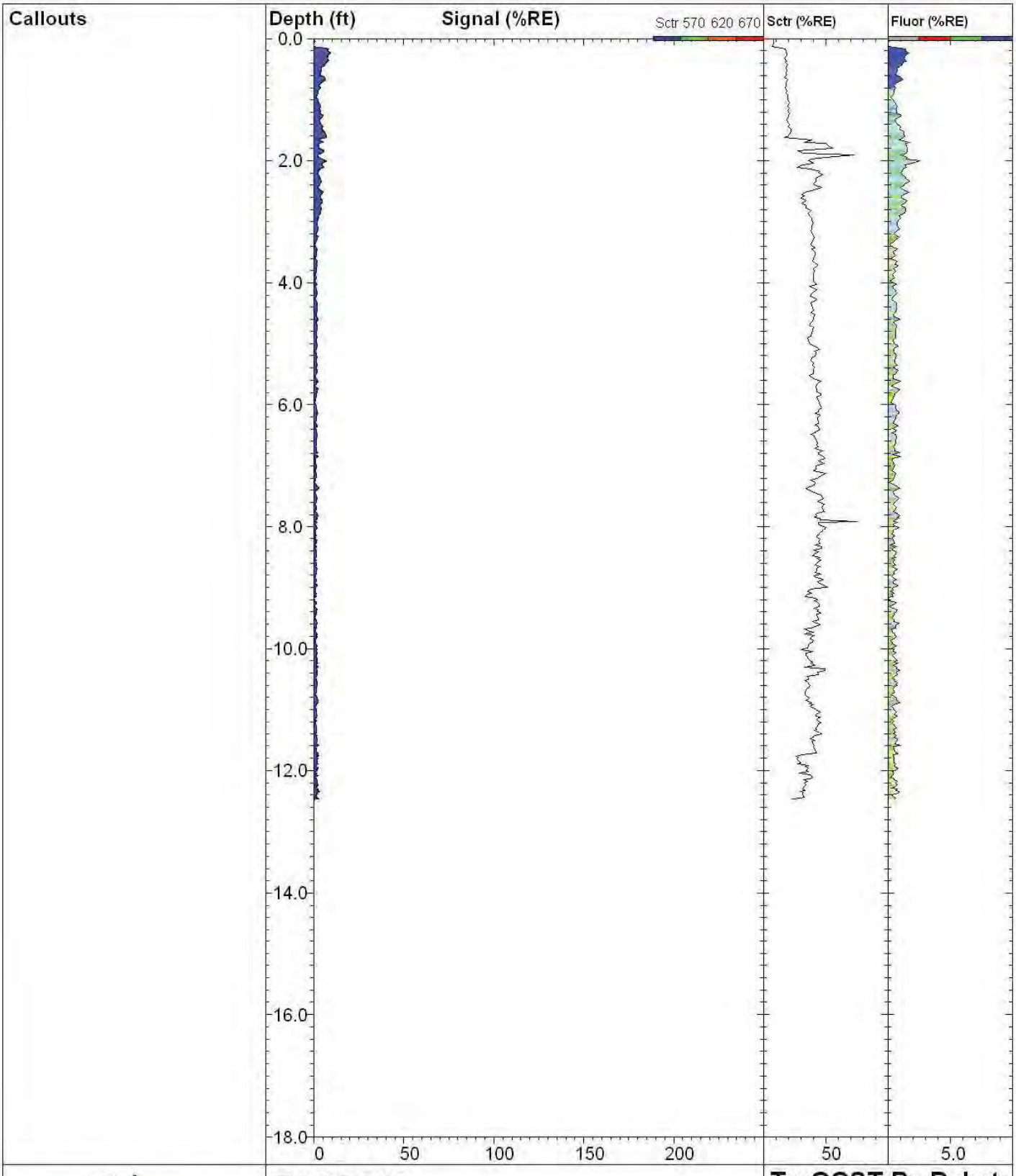
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **16.14 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **77.9 %RE @ 4.92 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 08:44 PDT**



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TGSD013

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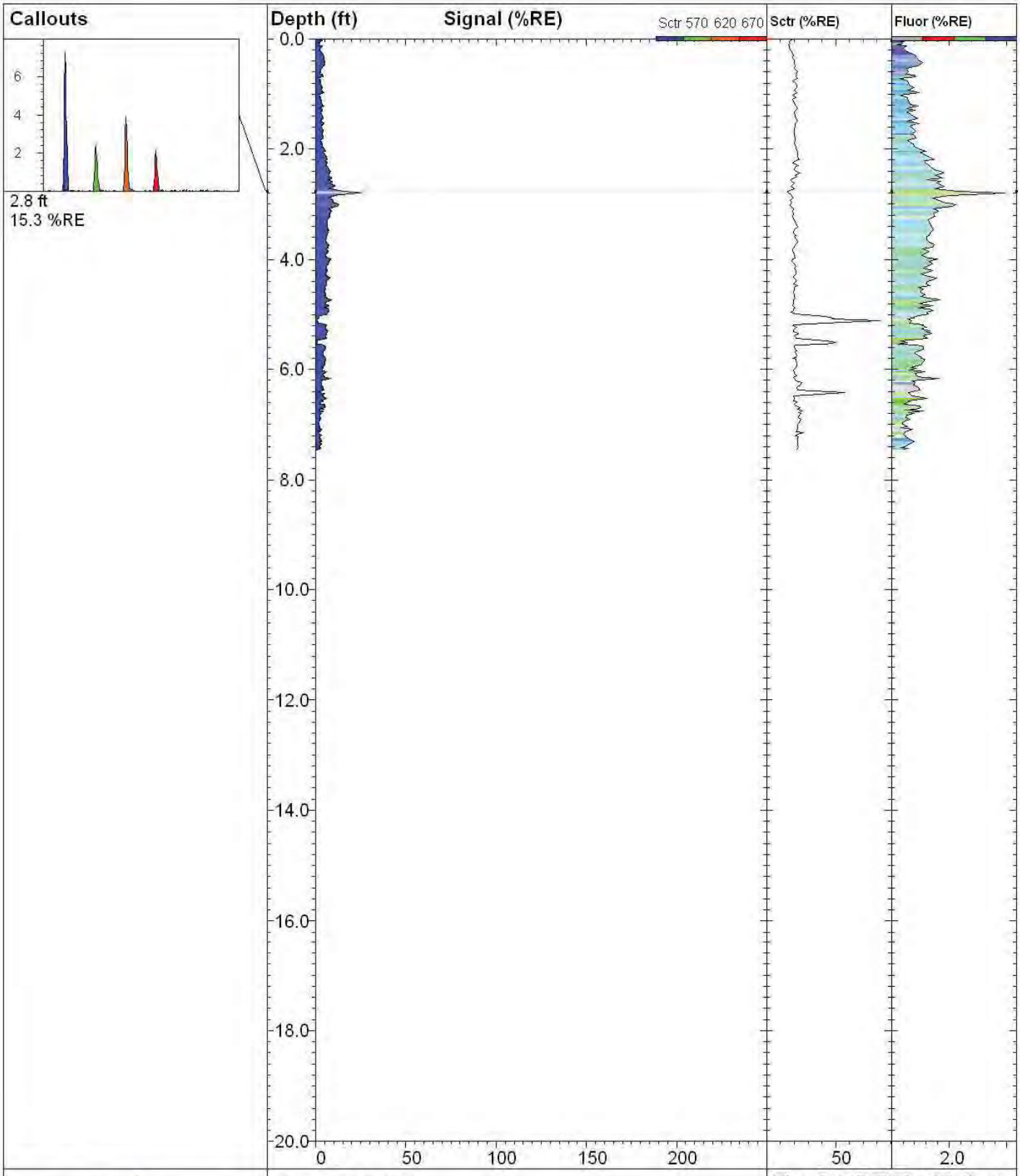
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **12.47 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **9.0 %RE @ 0.23 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 16:12 PDT**



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TGSD014

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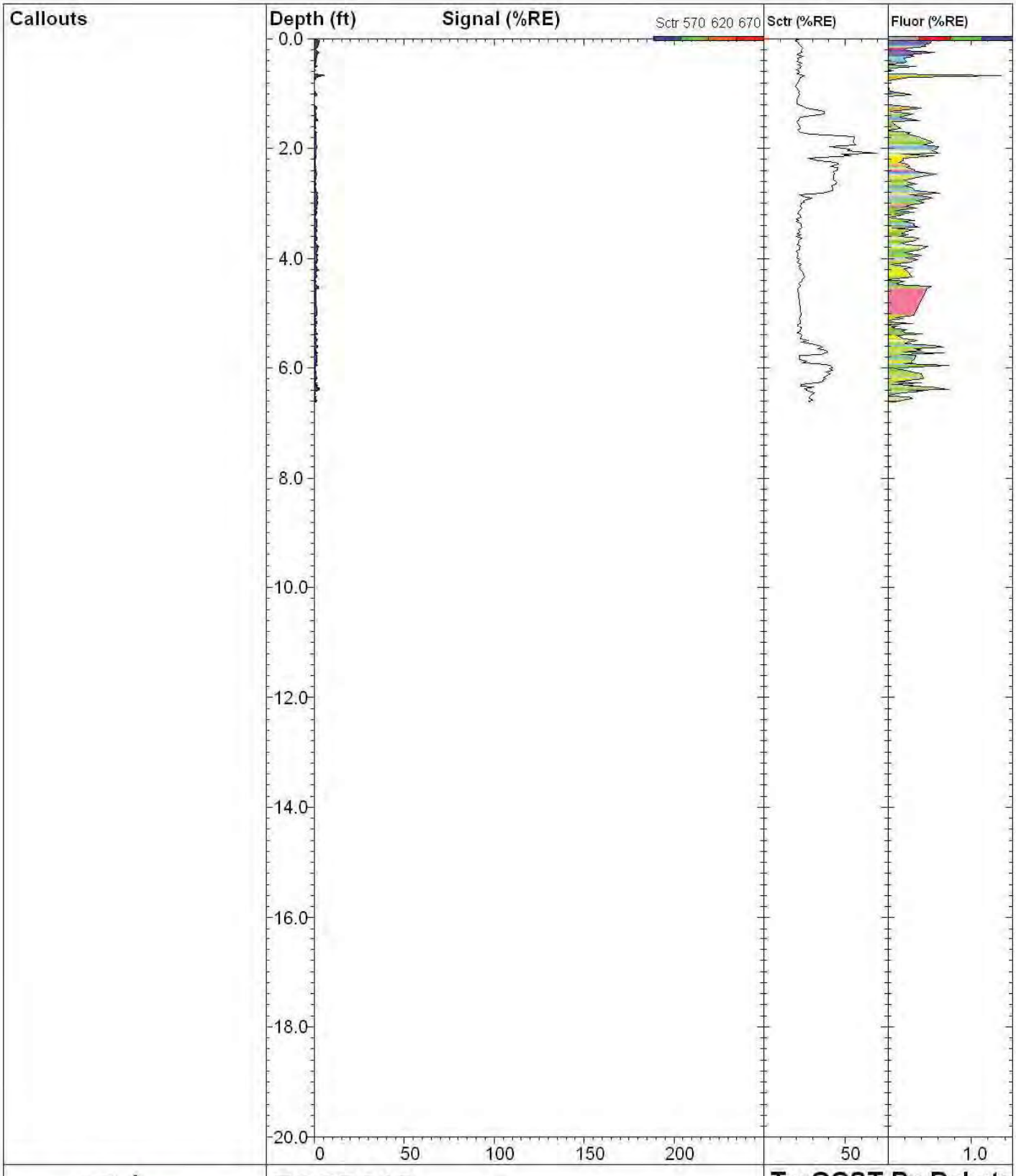
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **7.46 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **25.3 %RE @ 2.79 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 10:47 PDT**



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TGSD015

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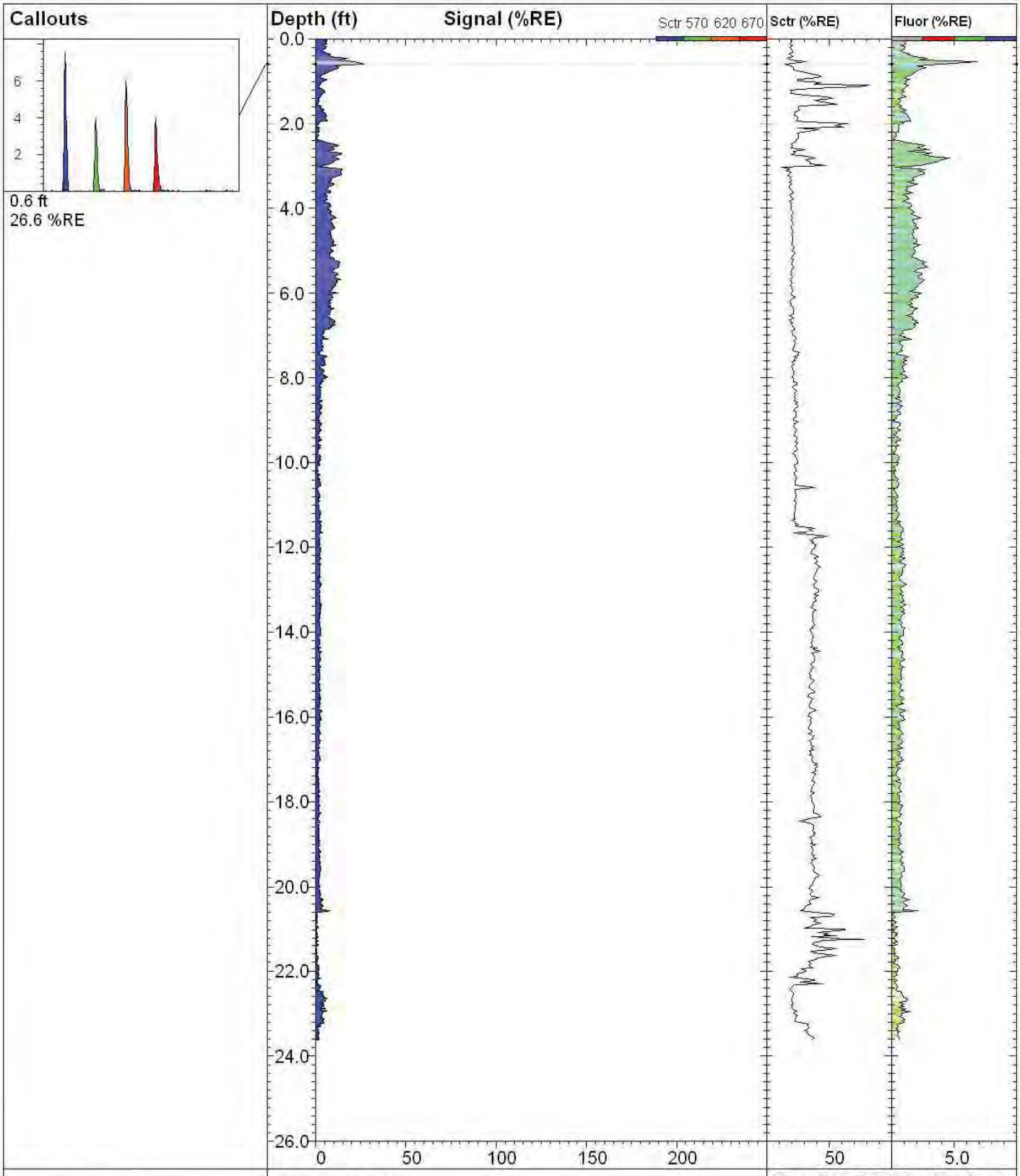
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **6.62 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.5 %RE @ 0.67 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 15:31 PDT**



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TGSD016

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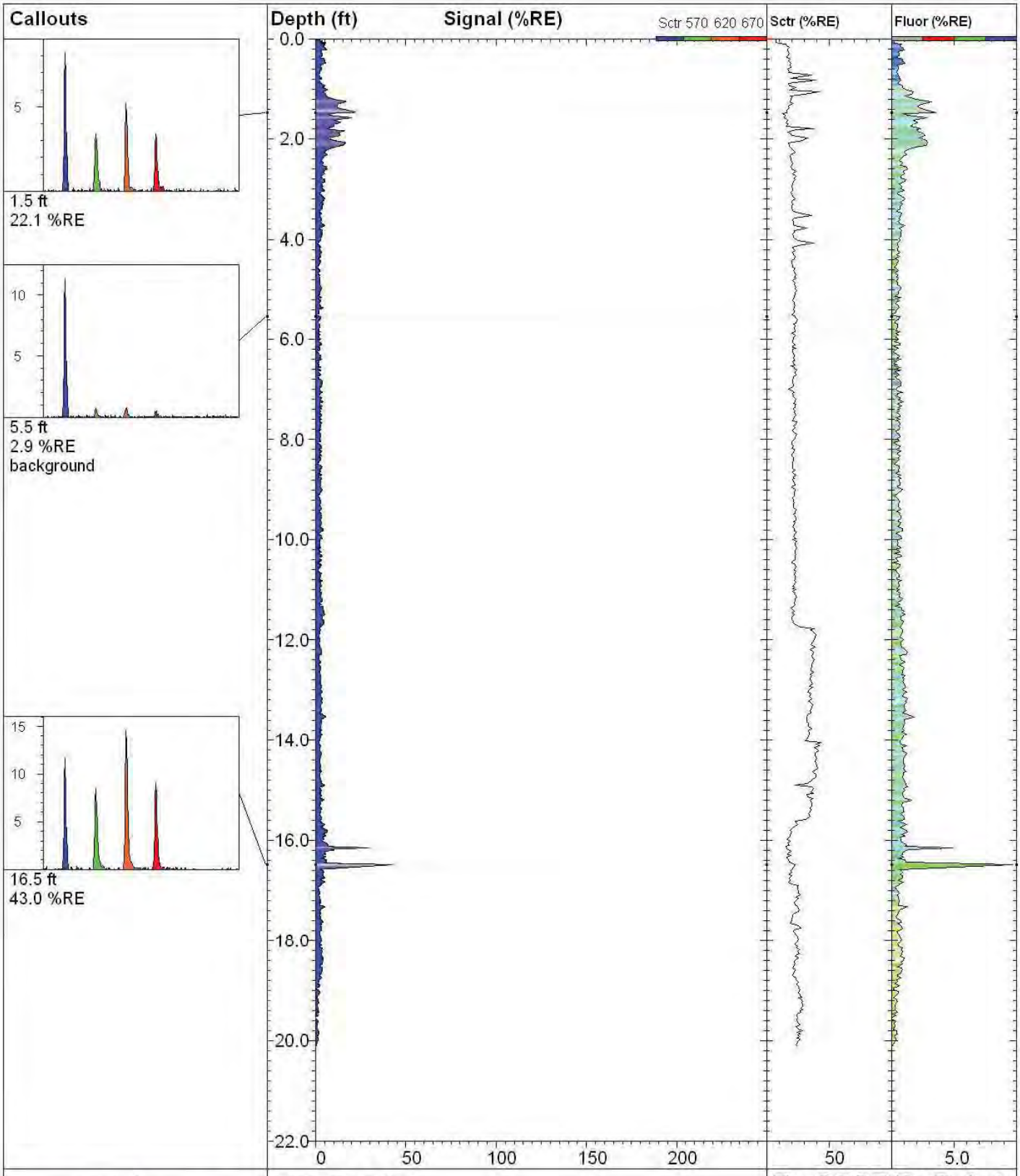
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **23.61 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **26.6 %RE @ 0.59 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 16:43 PDT**



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TGSD017

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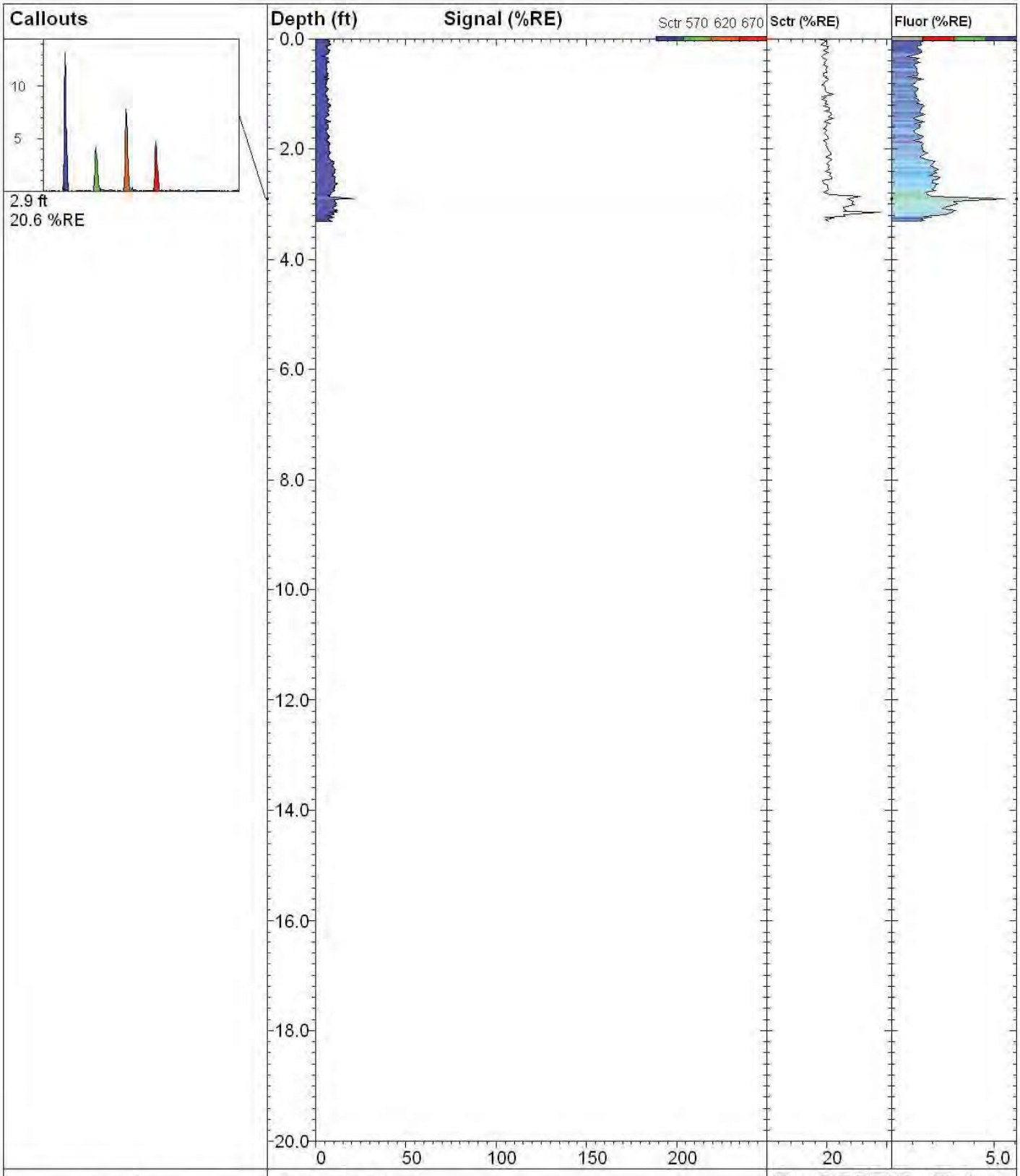
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.10 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **43.0 %RE @ 16.48 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 17:25 PDT**



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TGSD018

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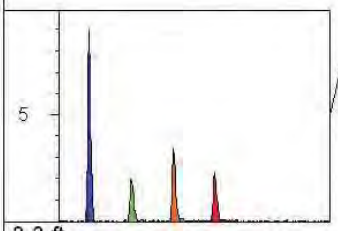
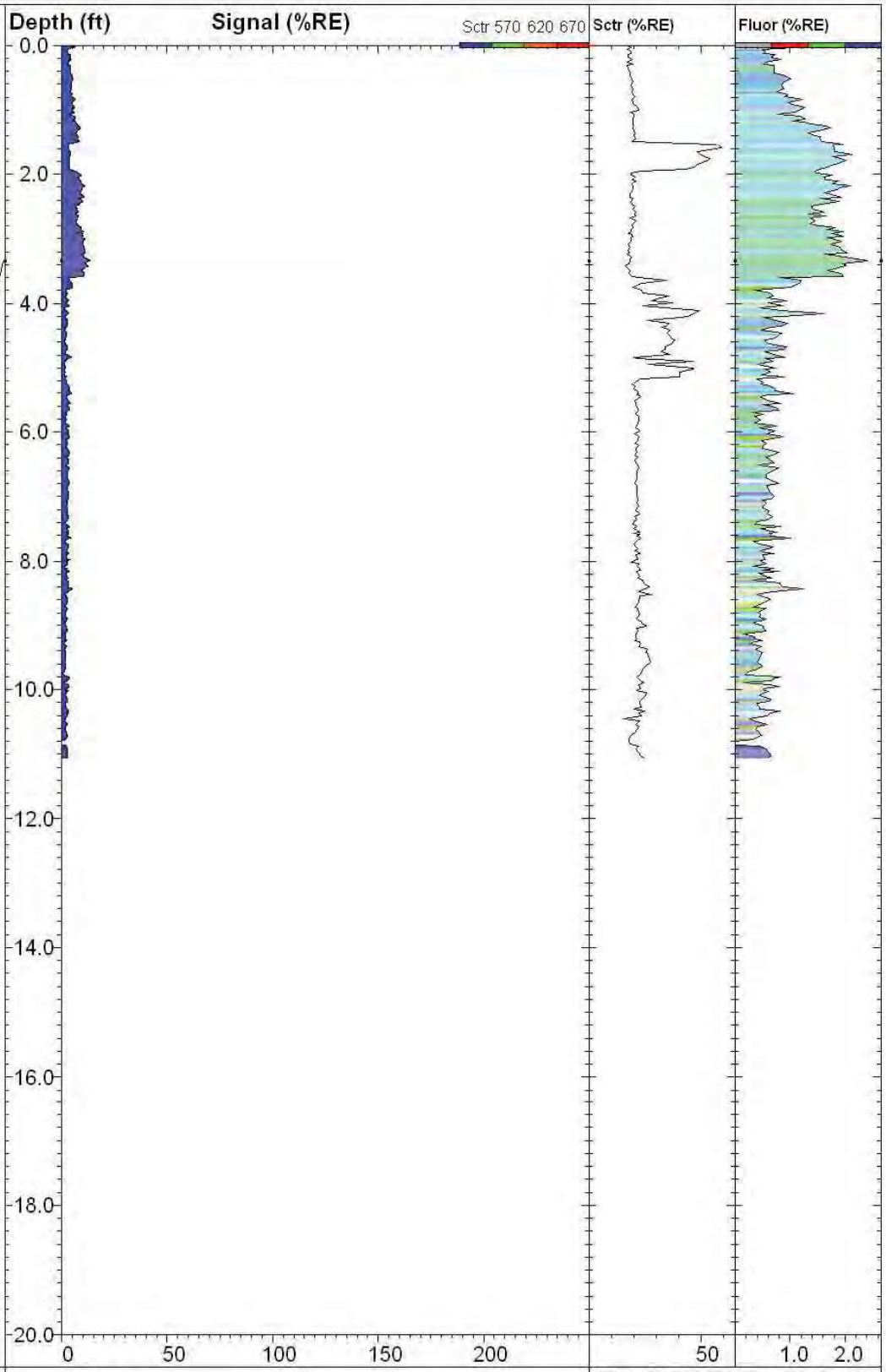
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **3.31 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **20.6 %RE @ 2.90 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 08:24 PDT**

Callouts



3.3 ft
13.3 %RE



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TGSD019

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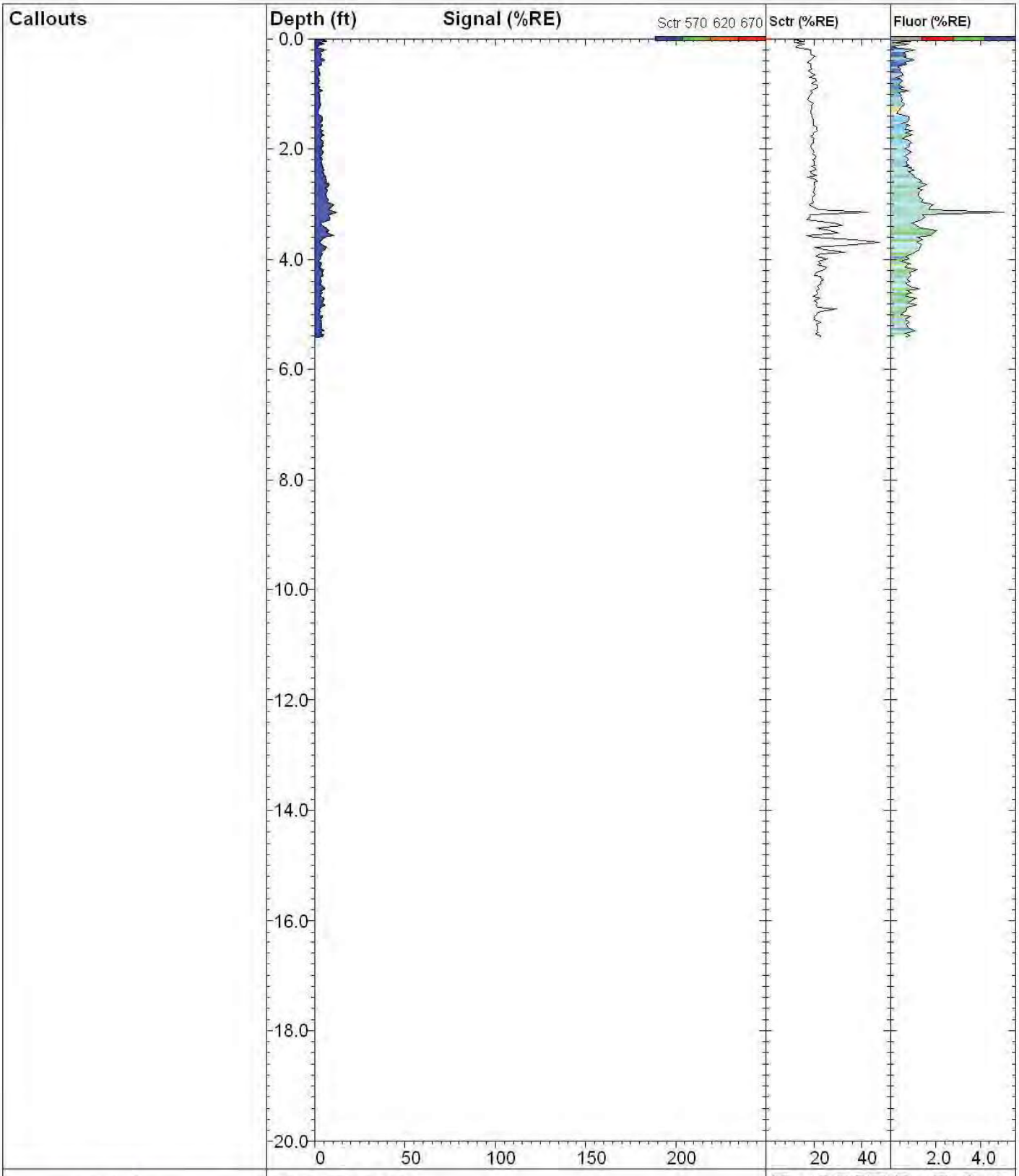
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **11.06 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **13.3 %RE @ 3.33 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 09:51 PDT**



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TGSD020

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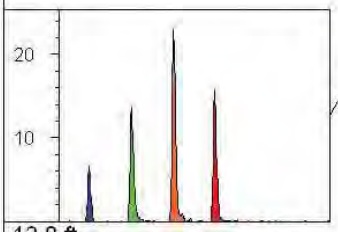
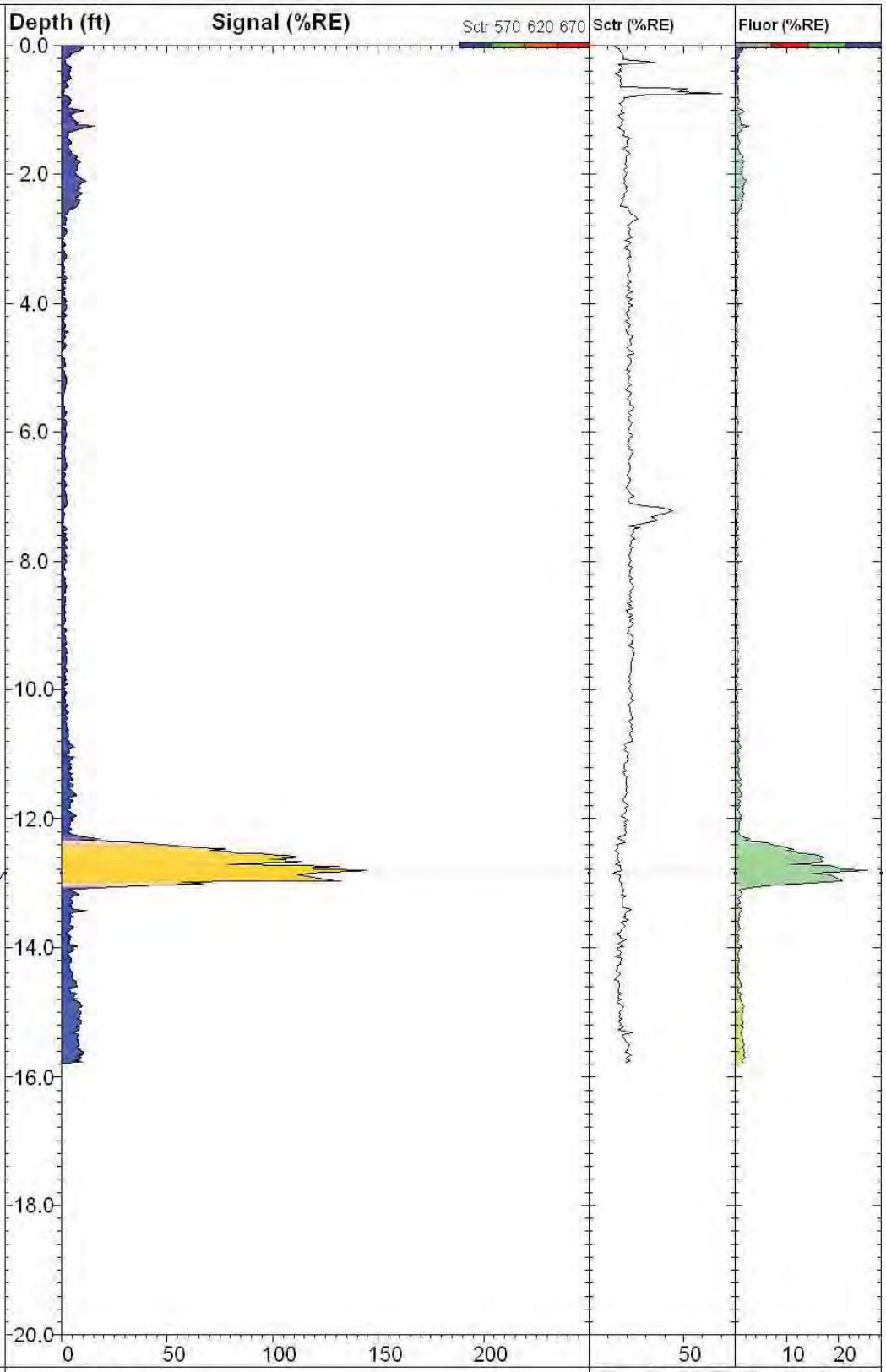
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.43 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **11.8 %RE @ 3.15 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 10:22 PDT**

Callouts



12.8 ft
121.1 %RE



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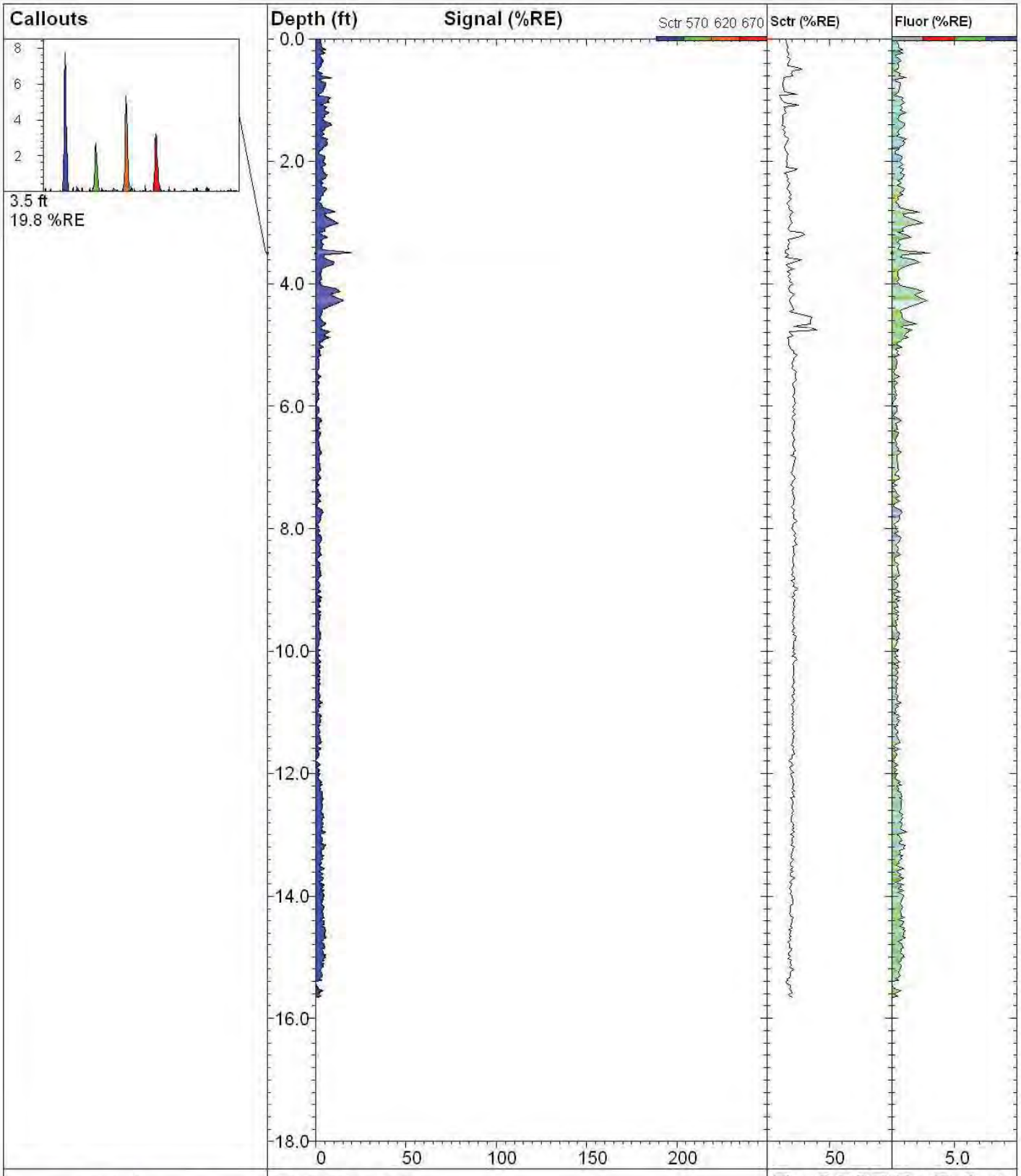
TGSD021

TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **15.77 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **145.0 %RE @ 12.81 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 15:01 PDT**



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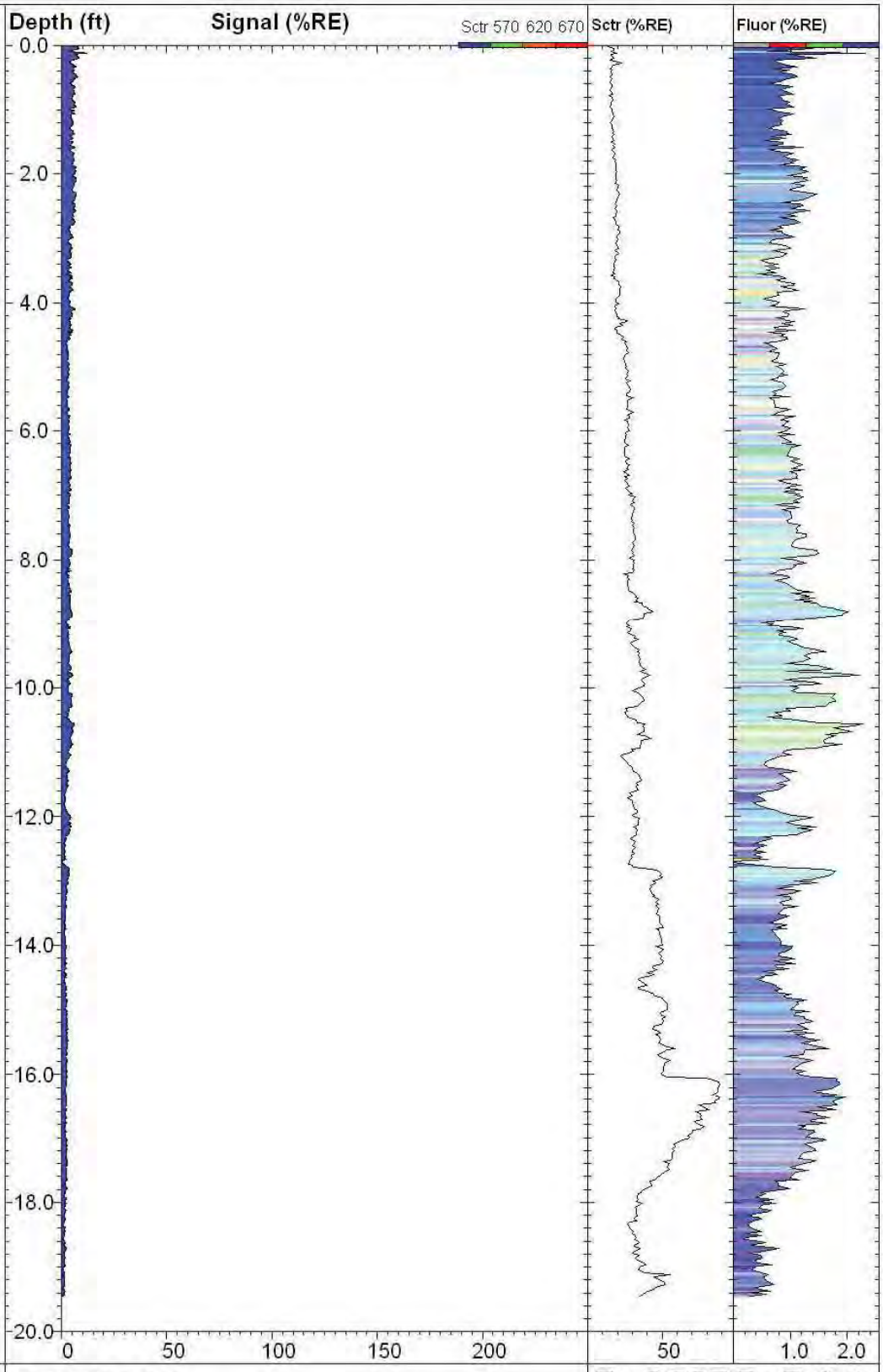
TGSD022

TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **15.66 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **19.8 %RE @ 3.49 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 18:03 PDT**

Callouts



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TGSD023

TarGOST By Dakota
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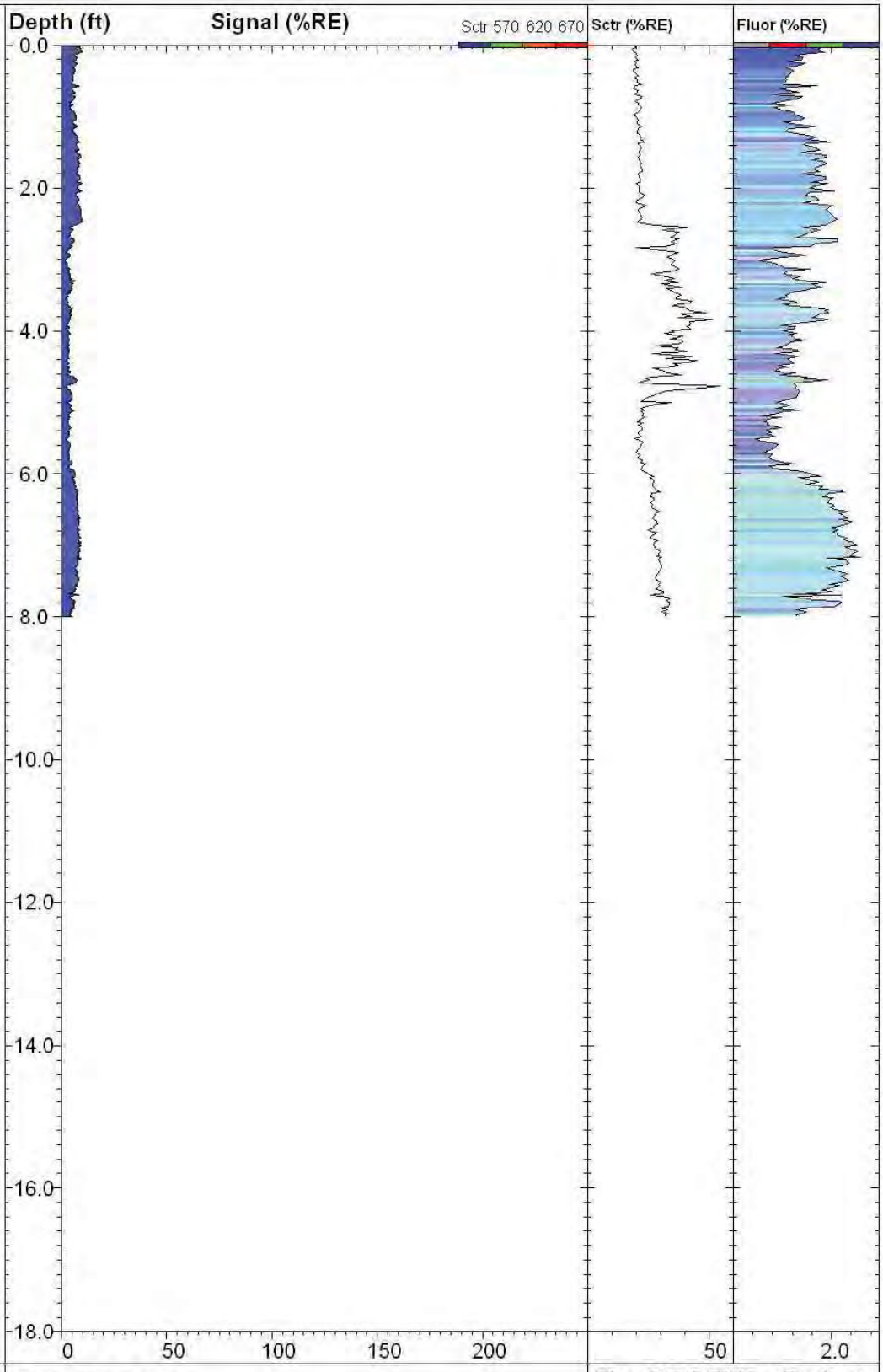
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **19.45 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **12.0 %RE @ 0.12 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-18 10:05 PDT**

Callouts



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TGSD024

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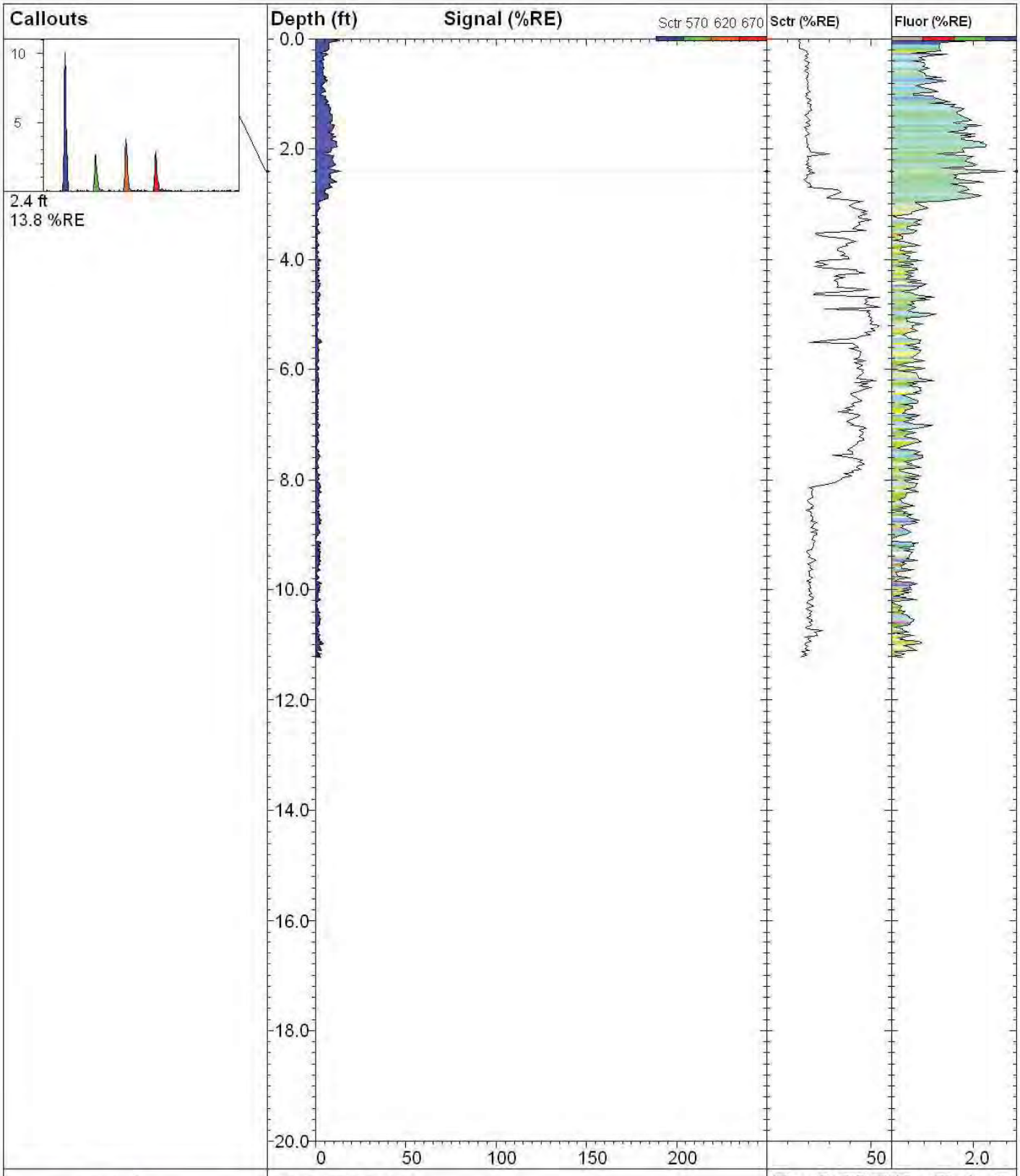
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **7.99 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **10.3 %RE @ 0.00 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-18 09:27 PDT**



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TGSD025

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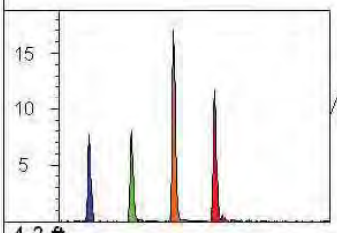
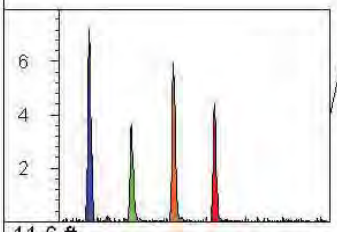
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **11.22 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **13.8 %RE @ 2.41 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 16:30 PDT**

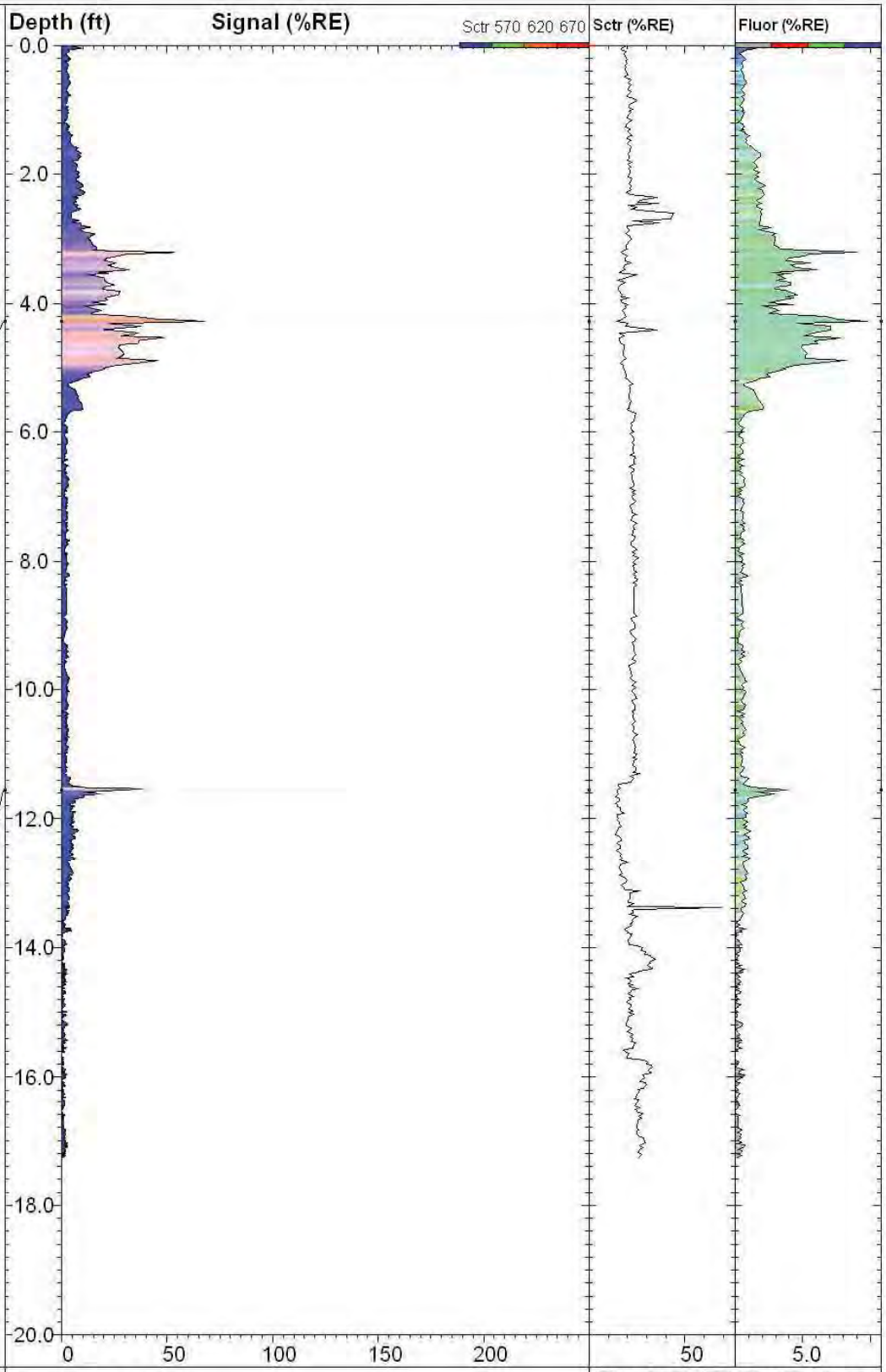
Callouts



4.3 ft
68.1 %RE



11.6 ft
25.7 %RE



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TGSD026

TarGOST By Dakota
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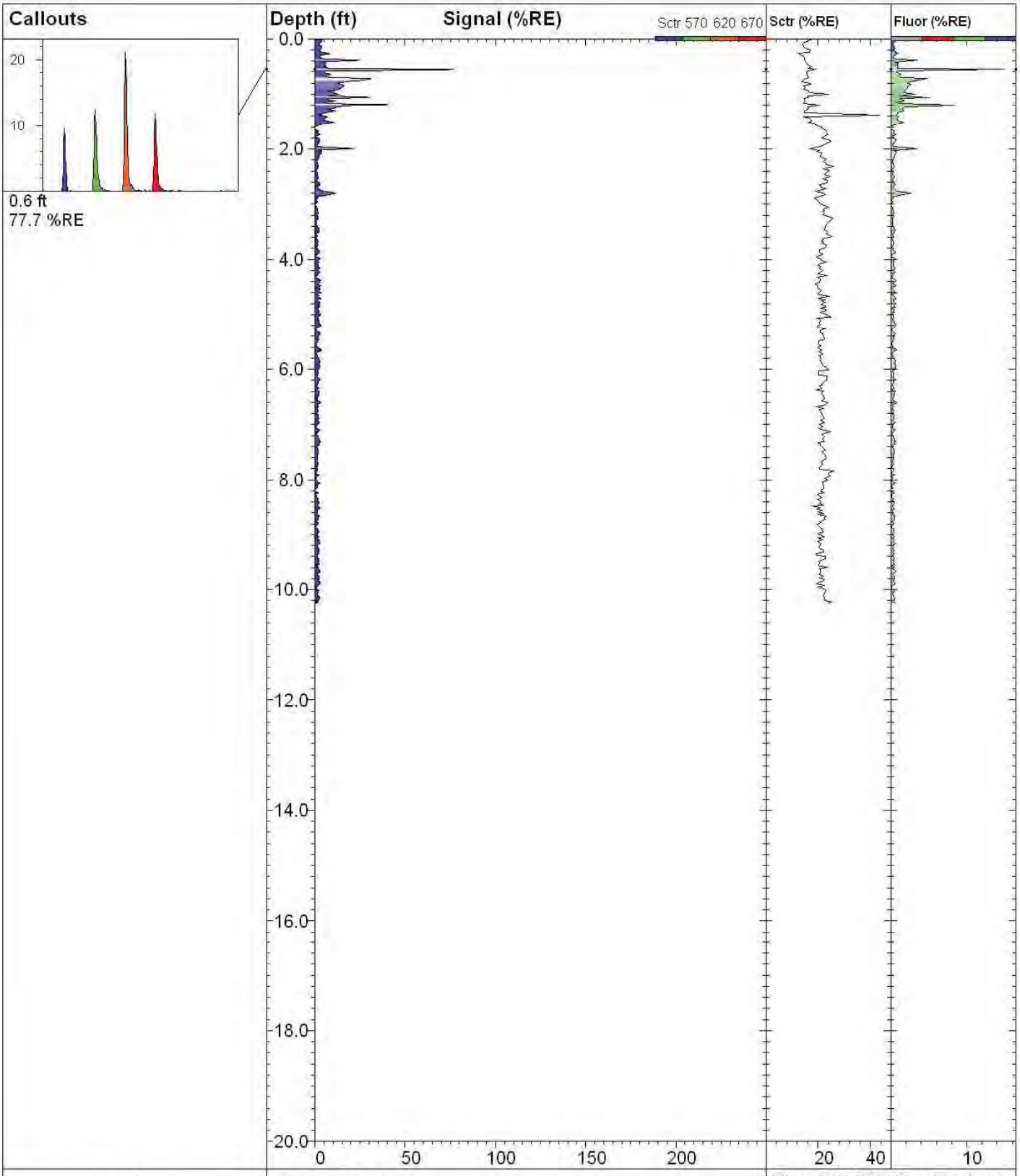
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **17.27 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **68.1 %RE @ 4.28 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 15:55 PDT**



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TGSD027

TarGOST By Dakota
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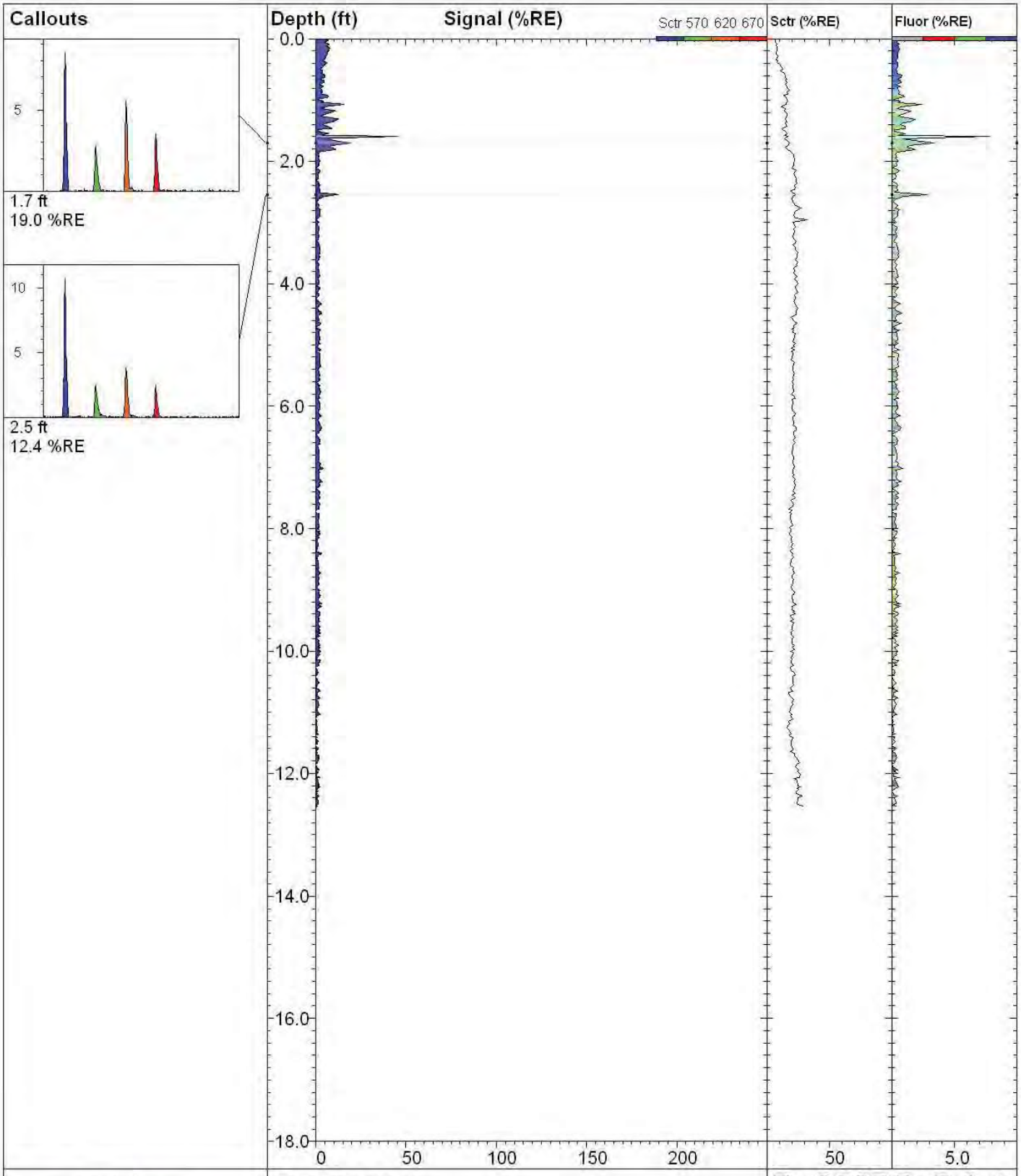
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **10.24 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **77.7 %RE @ 0.56 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 12:59 PDT**



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TGSD028

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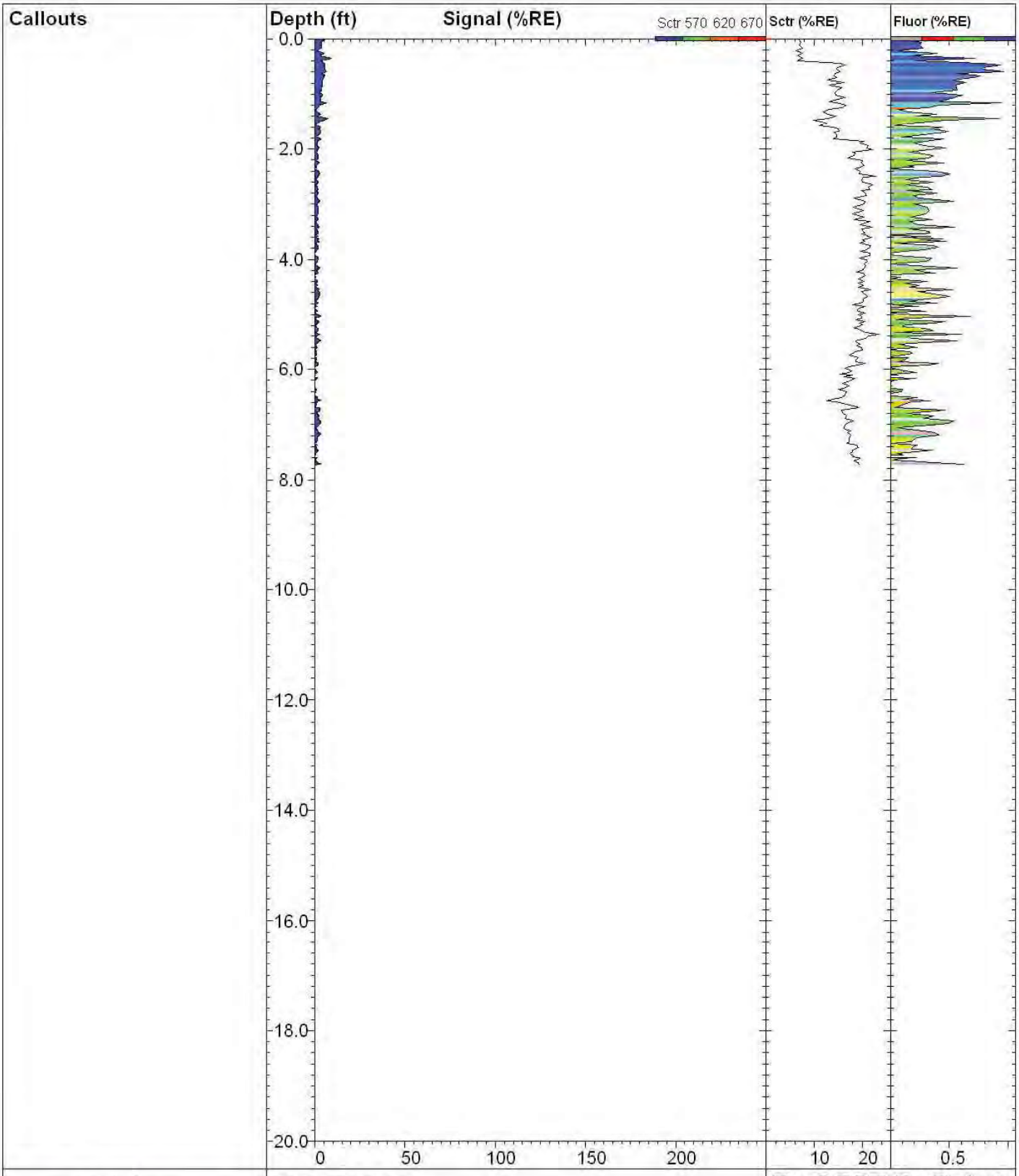
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **12.54 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **46.6 %RE @ 1.60 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 15:31 PDT**



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TGSD029

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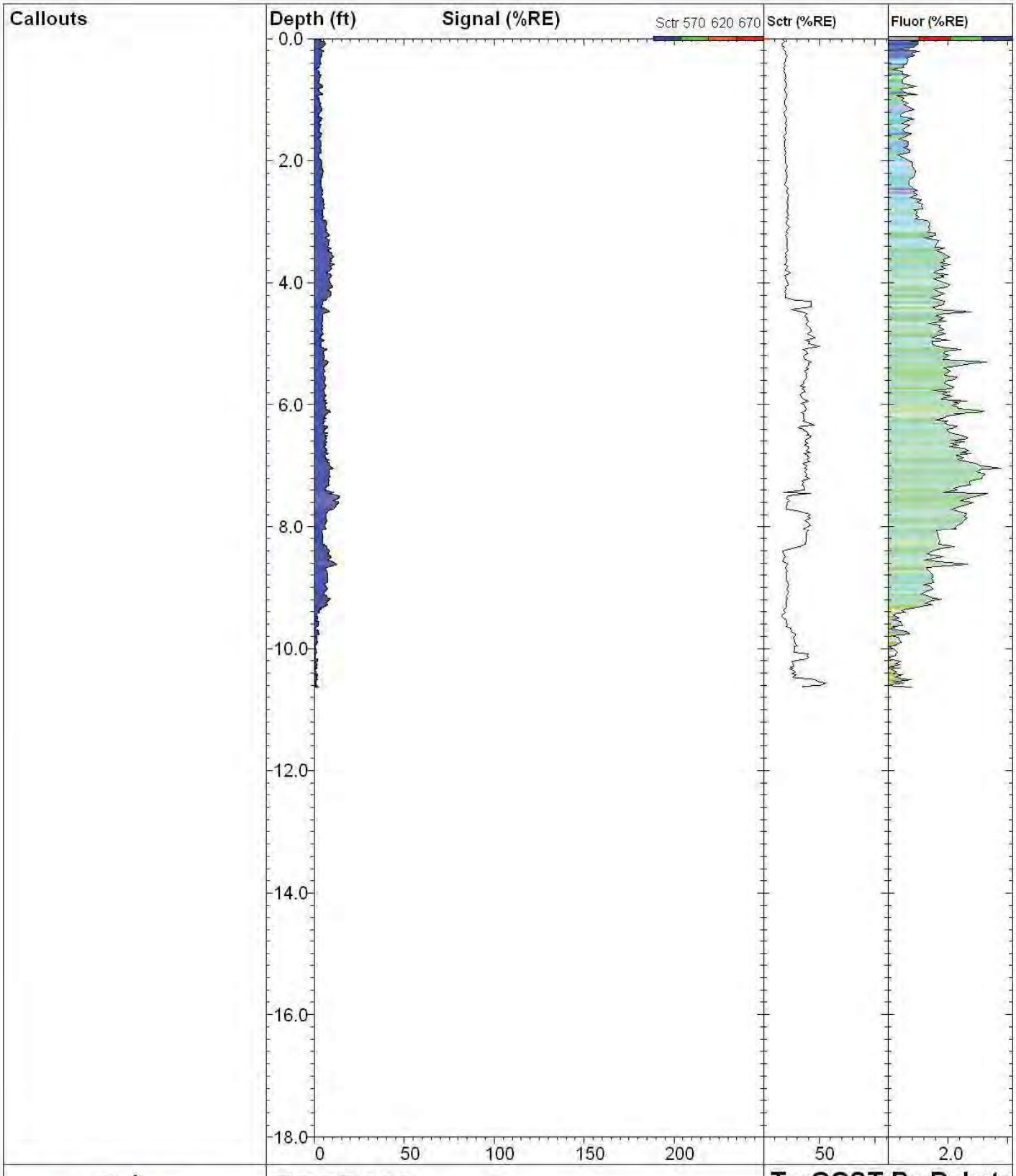
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **7.73 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **9.4 %RE @ 0.36 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 14:20 PDT**



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TGSD030

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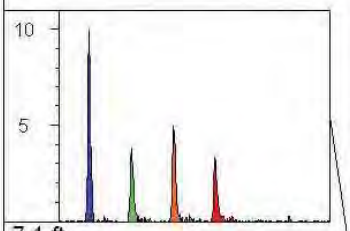
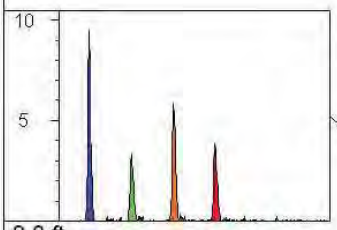
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **10.63 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **13.9 %RE @ 7.49 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-17 17:15 PDT**

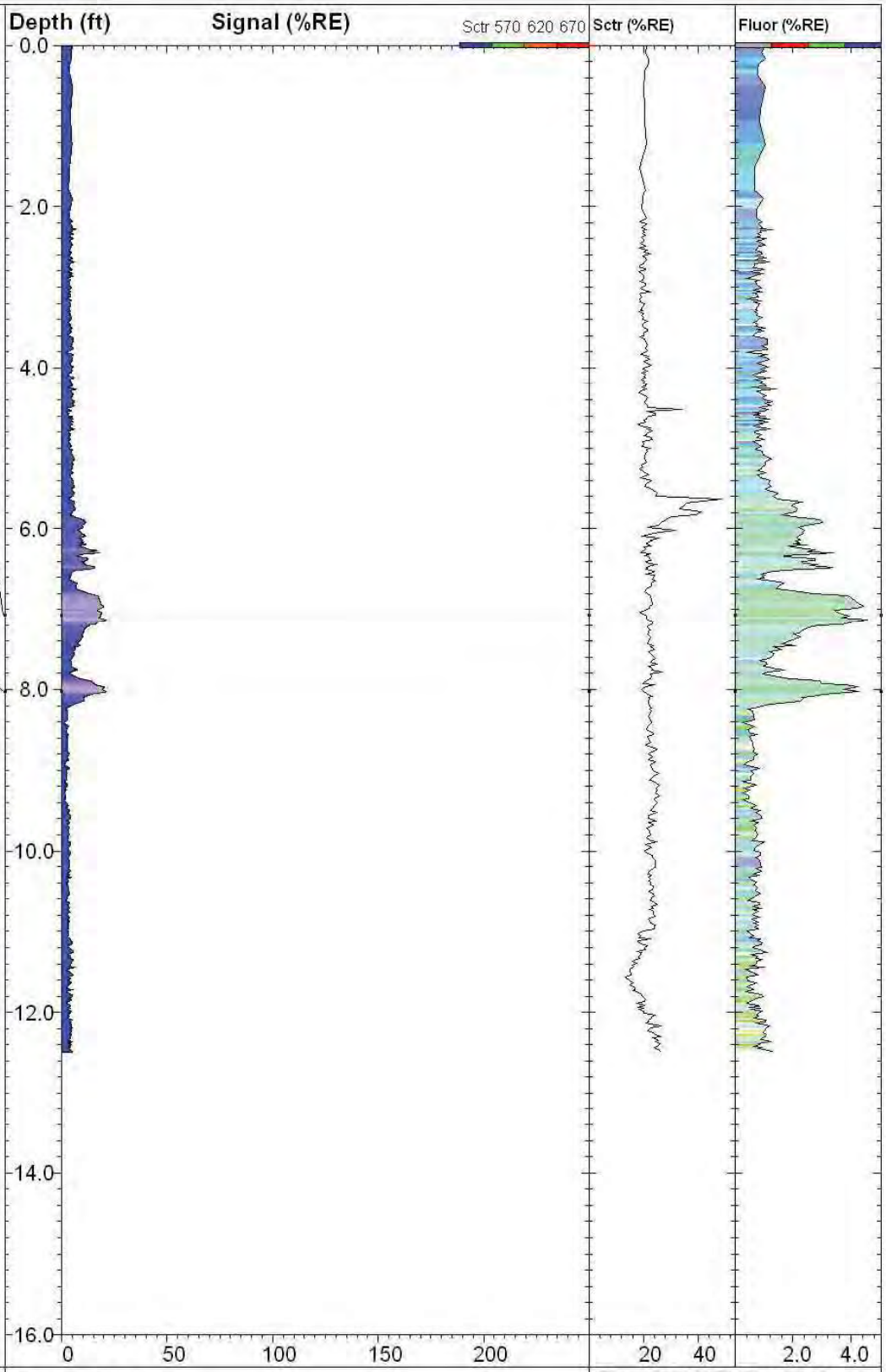
Callouts



7.1 ft
18.6 %RE



8.0 ft
21.2 %RE



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TGSD031

TarGOST By Dakota
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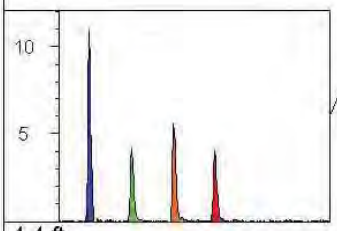
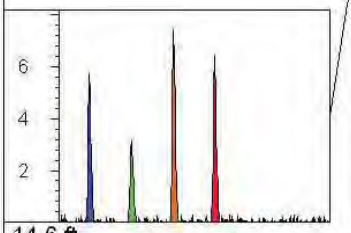
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **12.49 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **21.4 %RE @ 7.13 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-17 13:33 PDT**

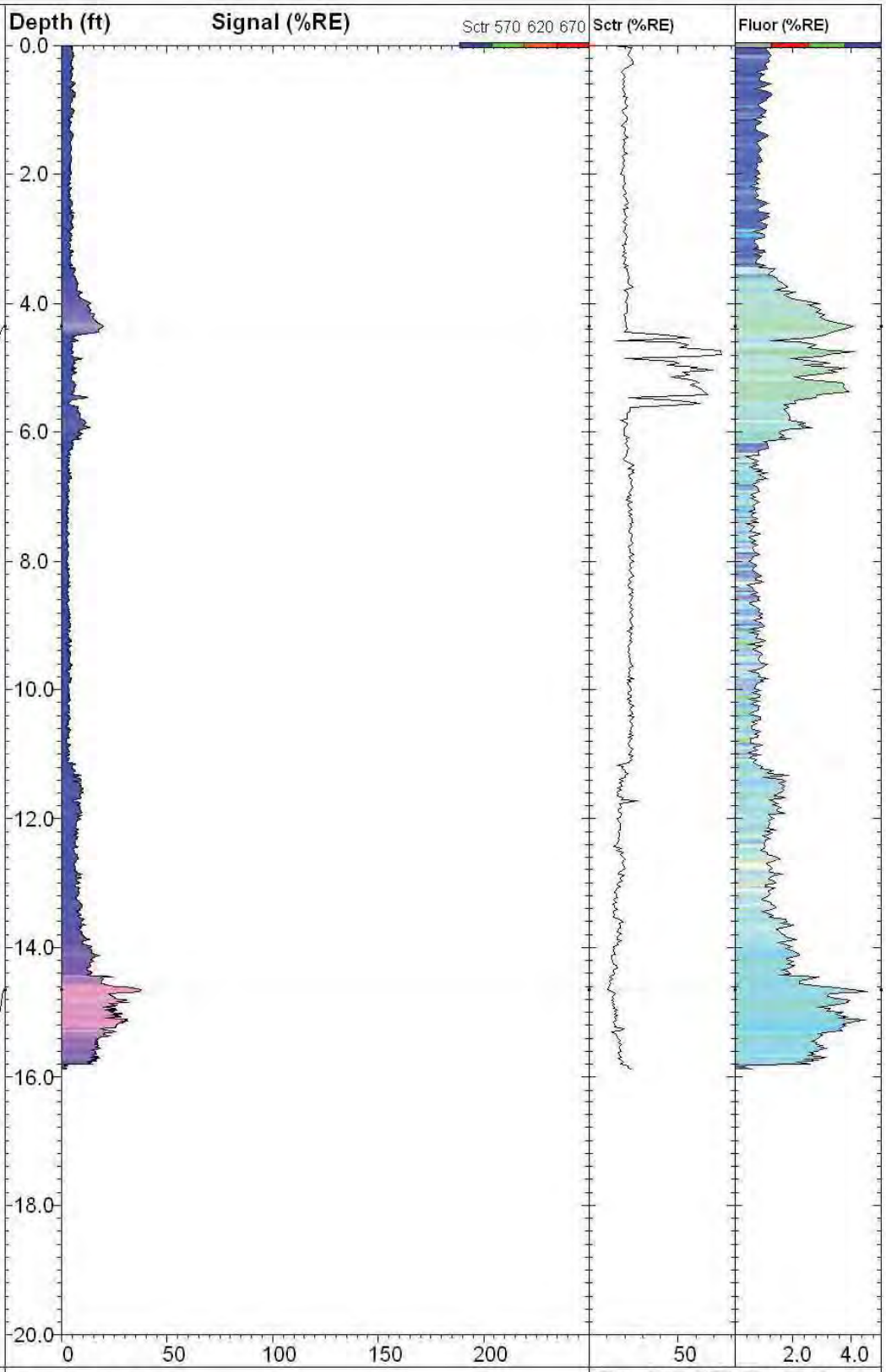
Callouts



4.4 ft
19.8 %RE



14.6 ft
37.8 %RE



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TGSD032

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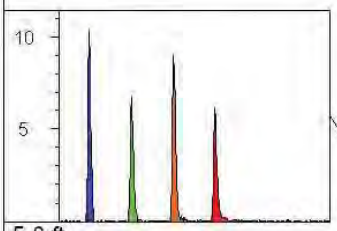
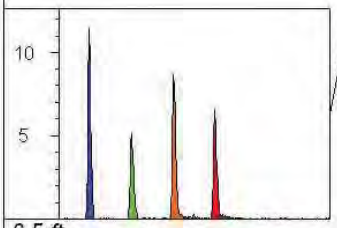
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **15.87 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **37.8 %RE @ 14.65 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-18 10:53 PDT**

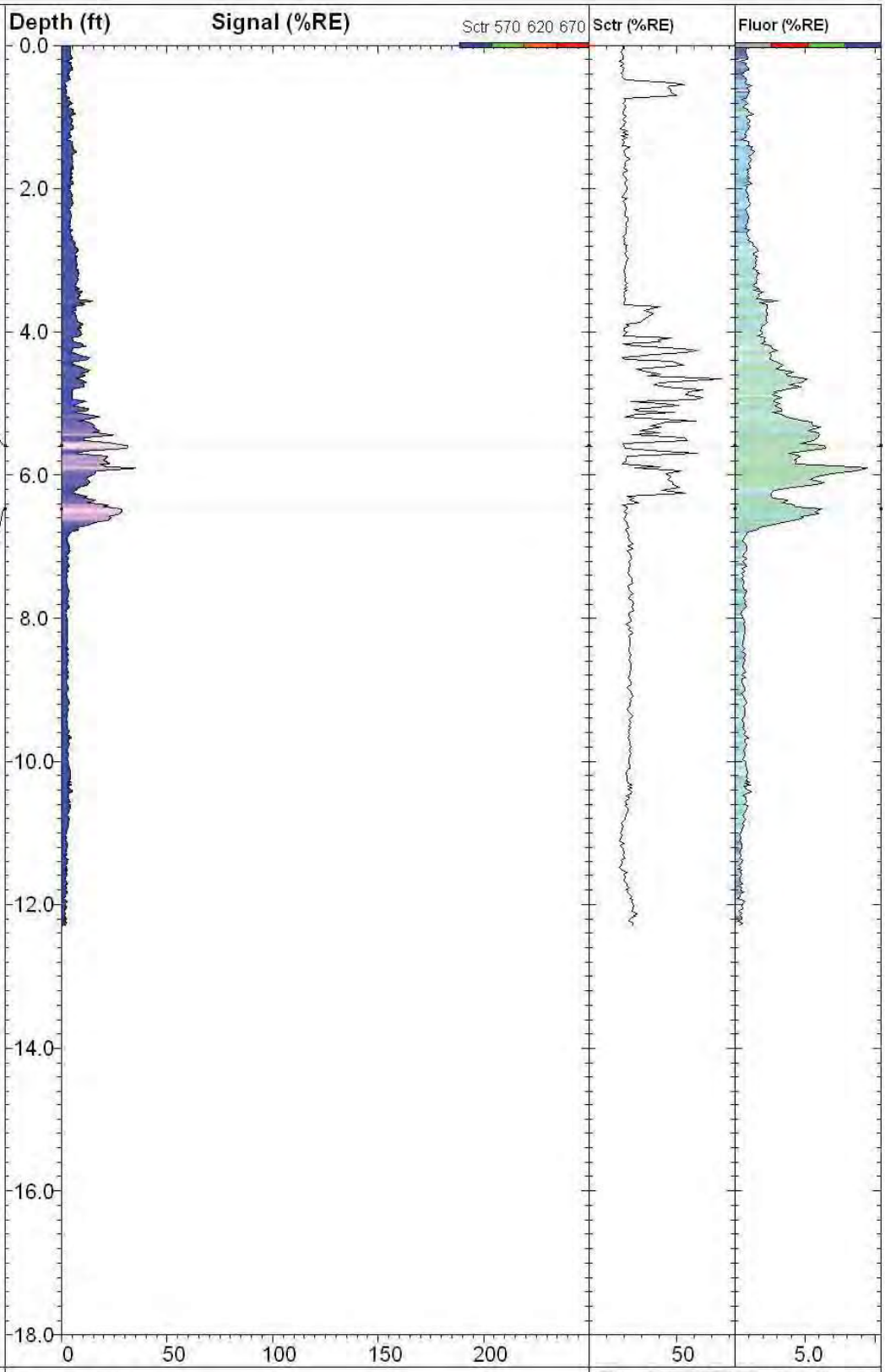
Callouts



5.6 ft
31.4 %RE



6.5 ft
28.2 %RE



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TGSD033

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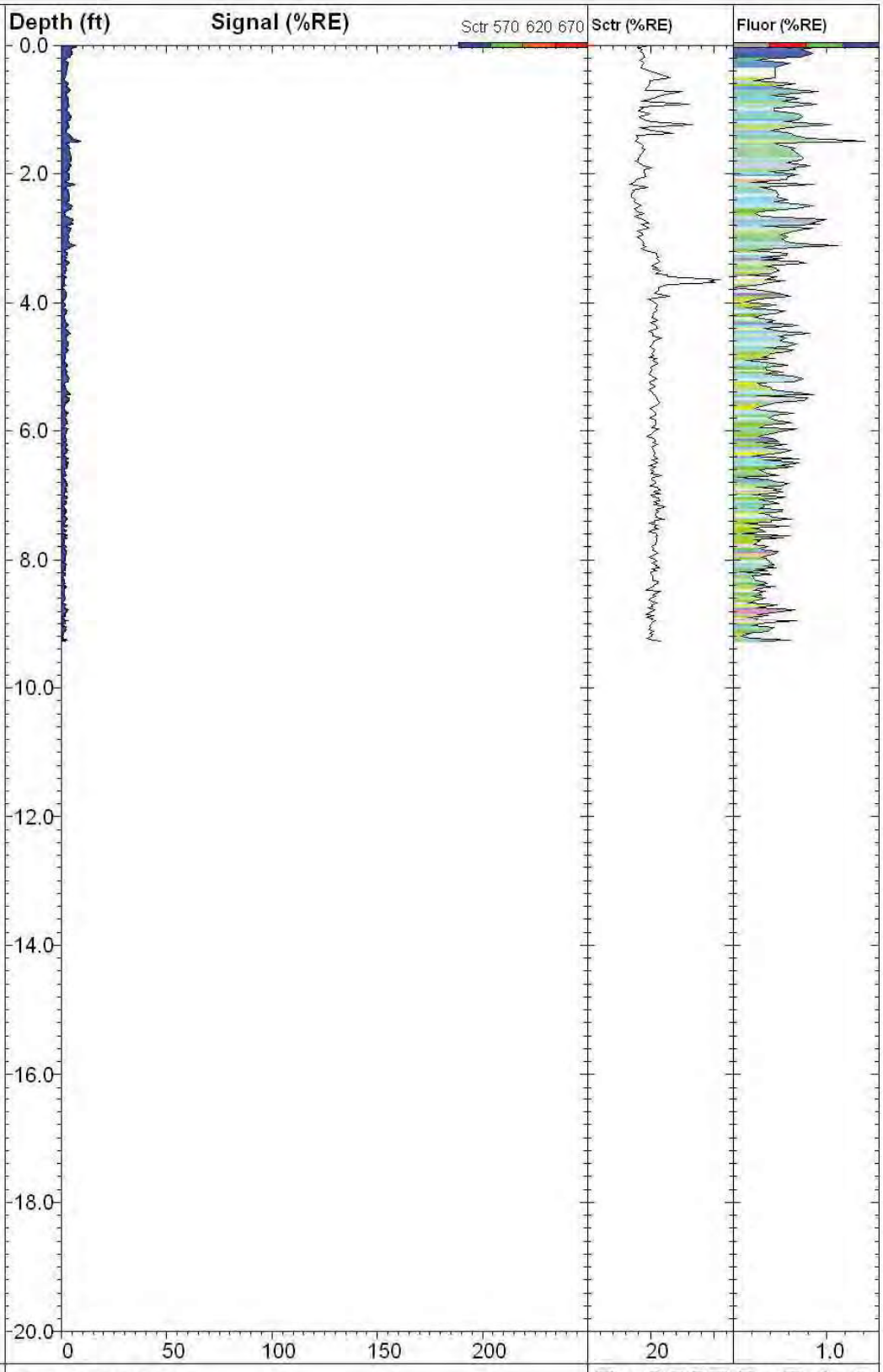
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **12.30 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **35.8 %RE @ 5.91 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-18 14:16 PDT**

Callouts



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TGSD034

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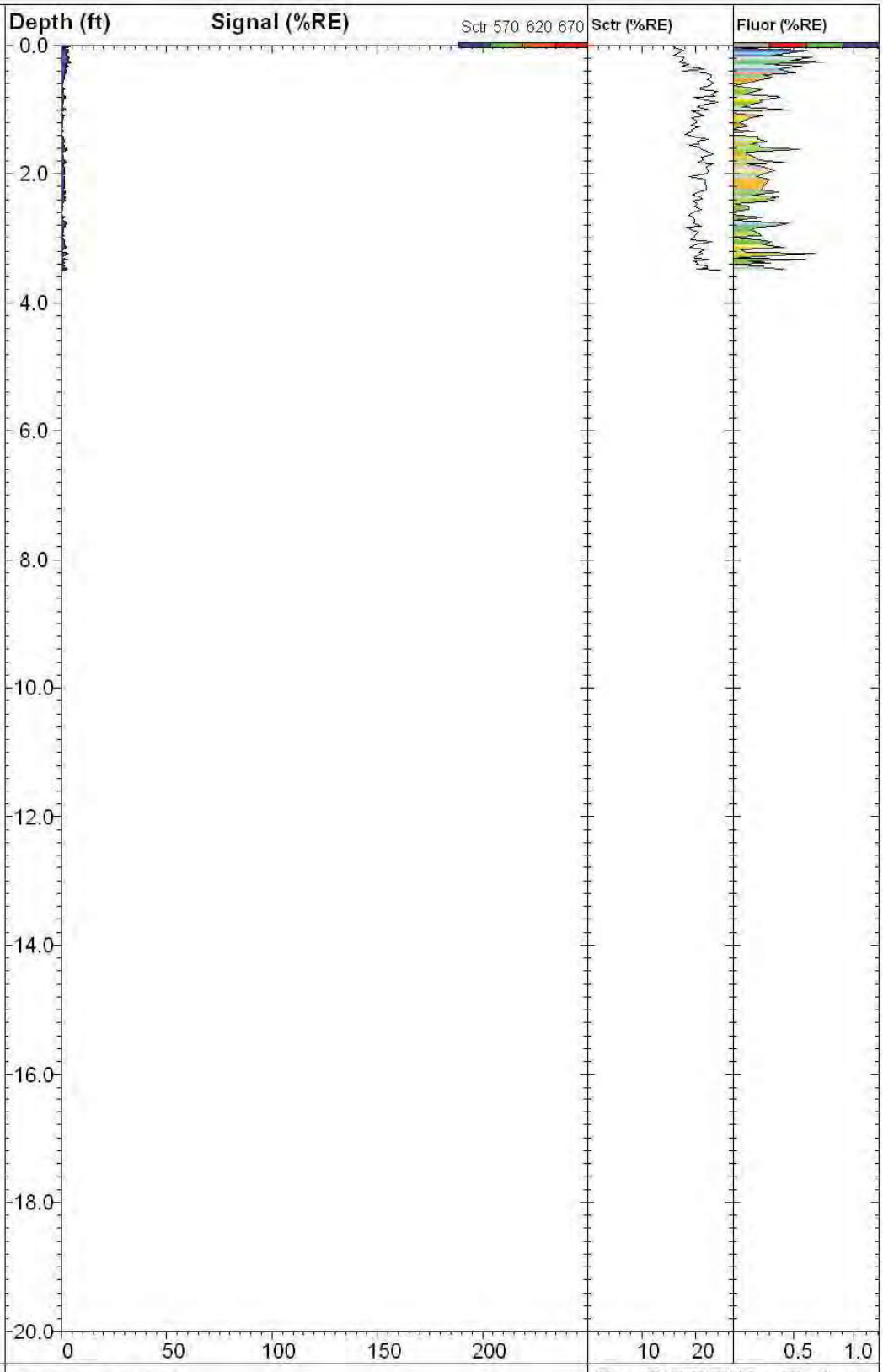
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **9.28 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **9.4 %RE @ 1.49 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 12:11 PDT**

Callouts



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TGSD035

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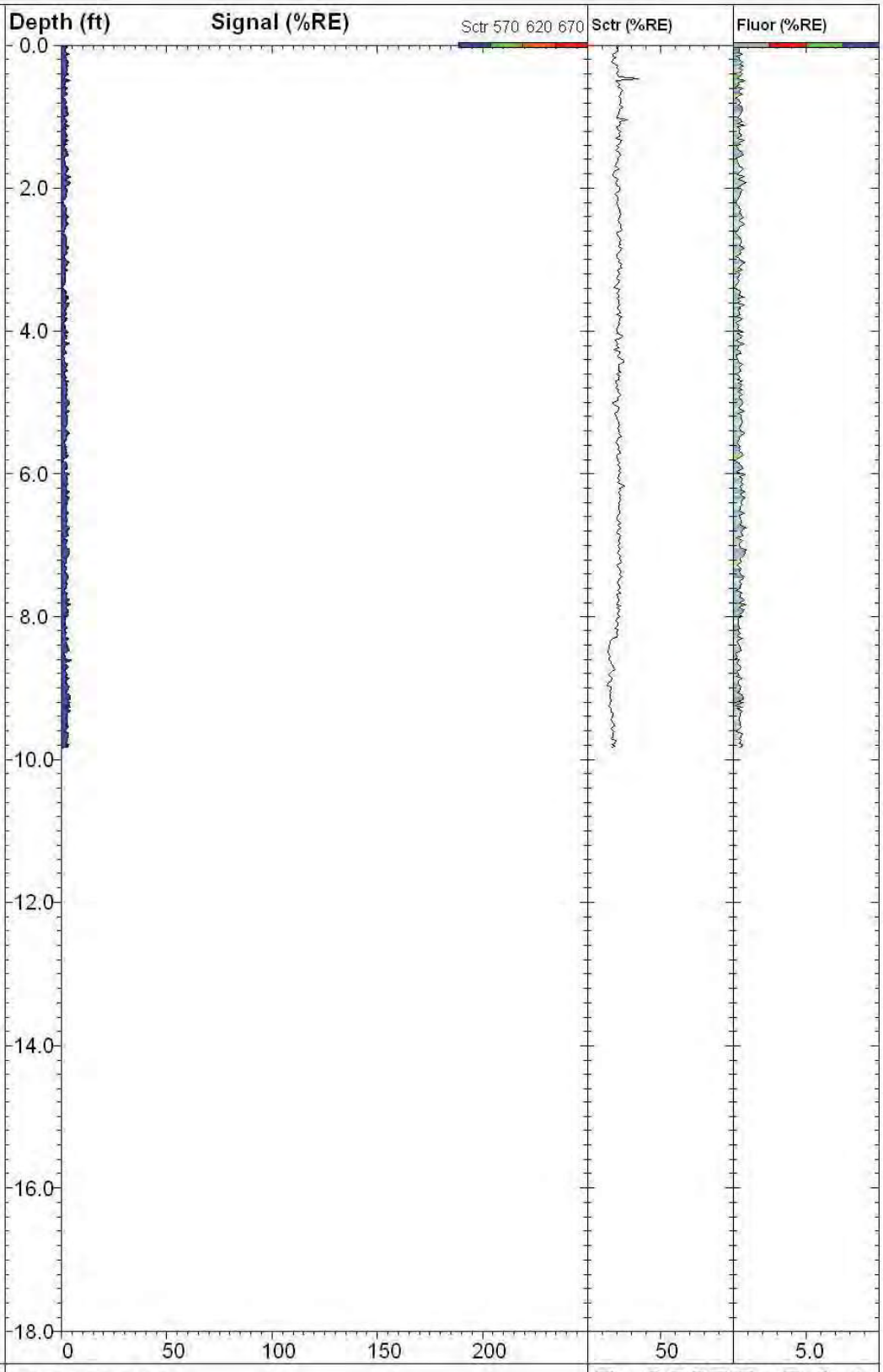
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **3.50 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **6.6 %RE @ 0.00 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 13:40 PDT**

Callouts



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TGSD036

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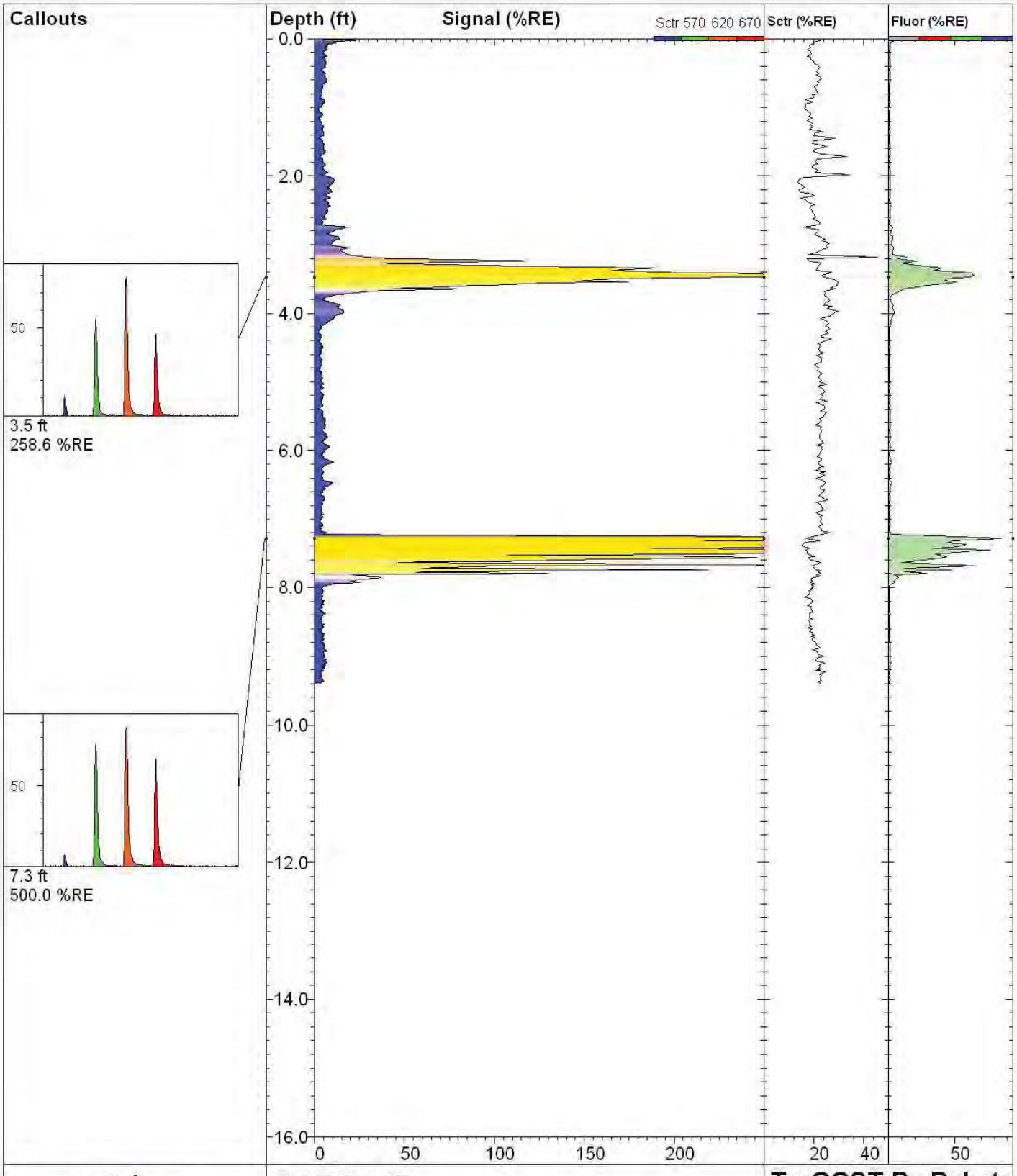
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **9.84 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **4.7 %RE @ 8.62 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 12:42 PDT**



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TGSD037

TarGOST By Dakota
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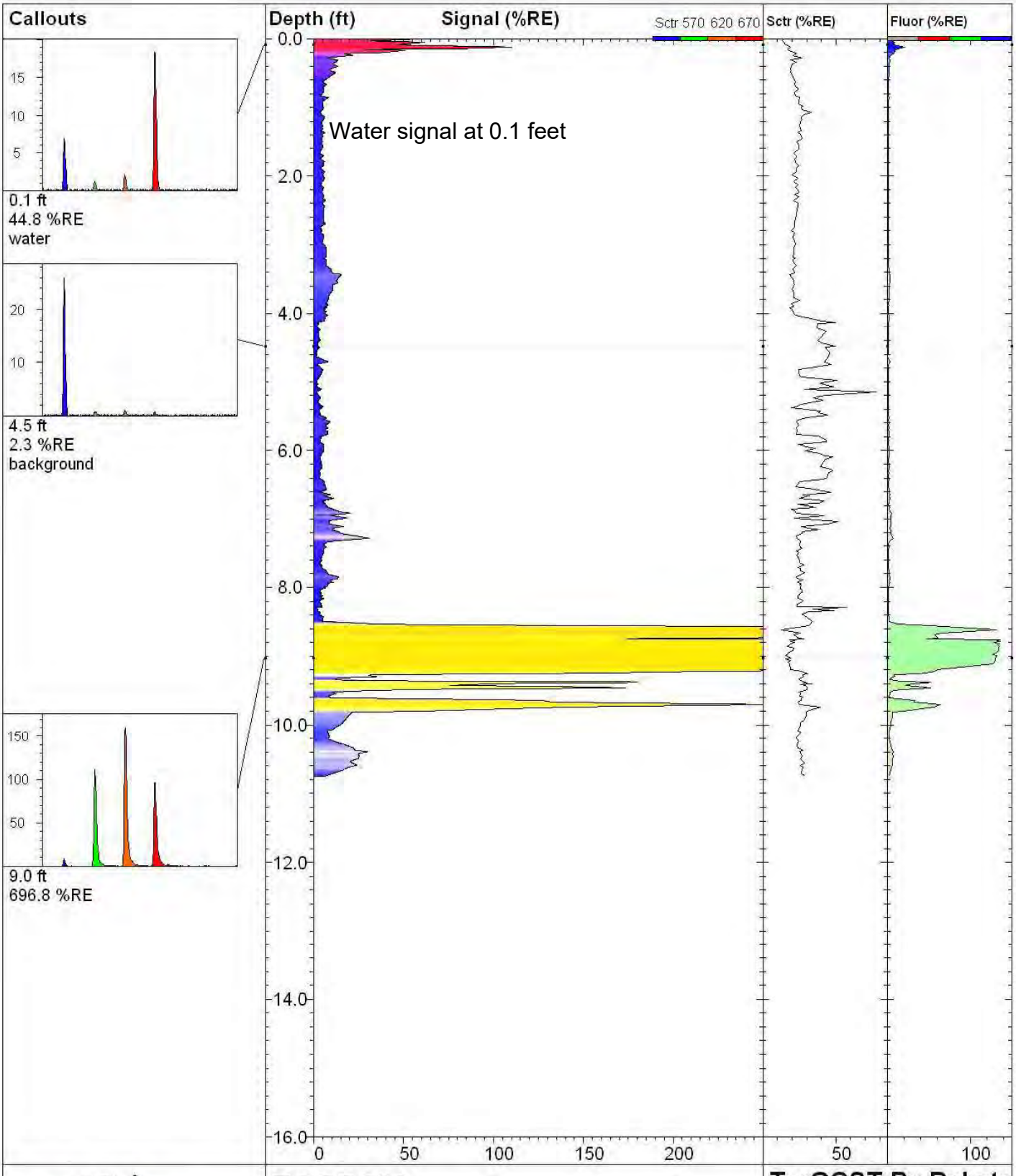
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **9.39 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **500.0 %RE @ 7.29 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-17 12:14 PDT**



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TGSD038

TarGOST By Dakota
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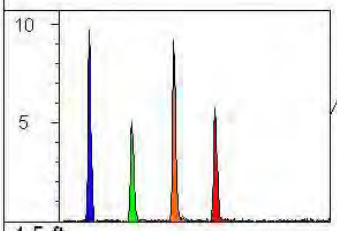
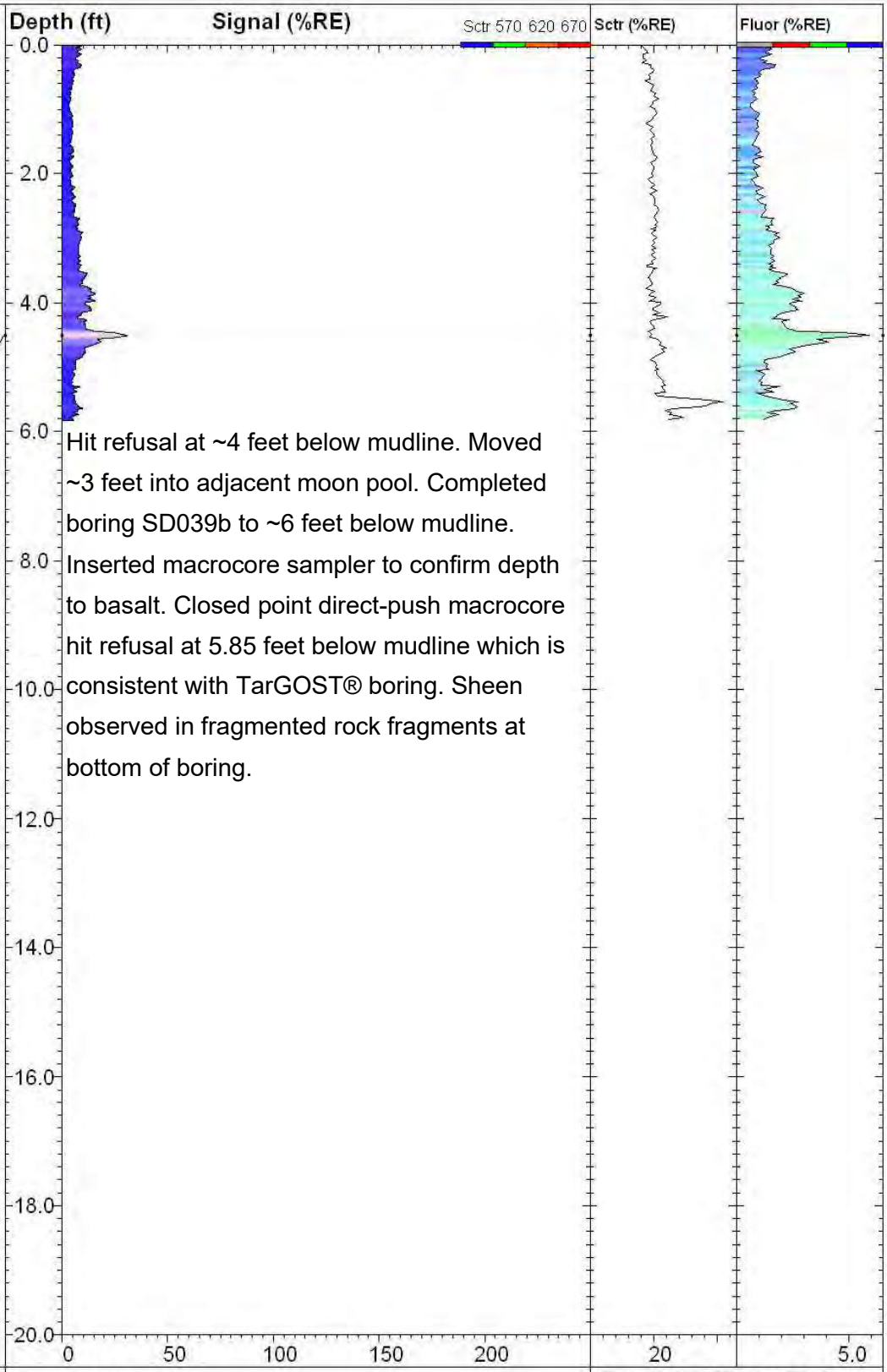
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **10.75 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **1030.5 %RE @ 8.62 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-17 11:38 PDT**

Callouts



4.5 ft
30.9 %RE



Hit refusal at ~4 feet below mudline. Moved ~3 feet into adjacent moon pool. Completed boring SD039b to ~6 feet below mudline. Inserted macrocore sampler to confirm depth to basalt. Closed point direct-push macrocore hit refusal at 5.85 feet below mudline which is consistent with TarGOST® boring. Sheen observed in fragmented rock fragments at bottom of boring.

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TGSD039b

TarGOST By Dakota
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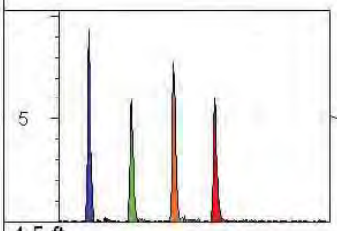
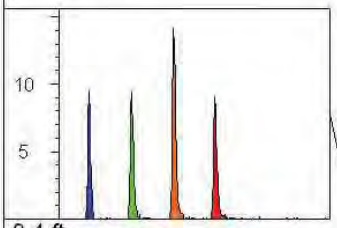
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **5.83 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **30.9 %RE @ 4.51 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-18 11:59 PDT**

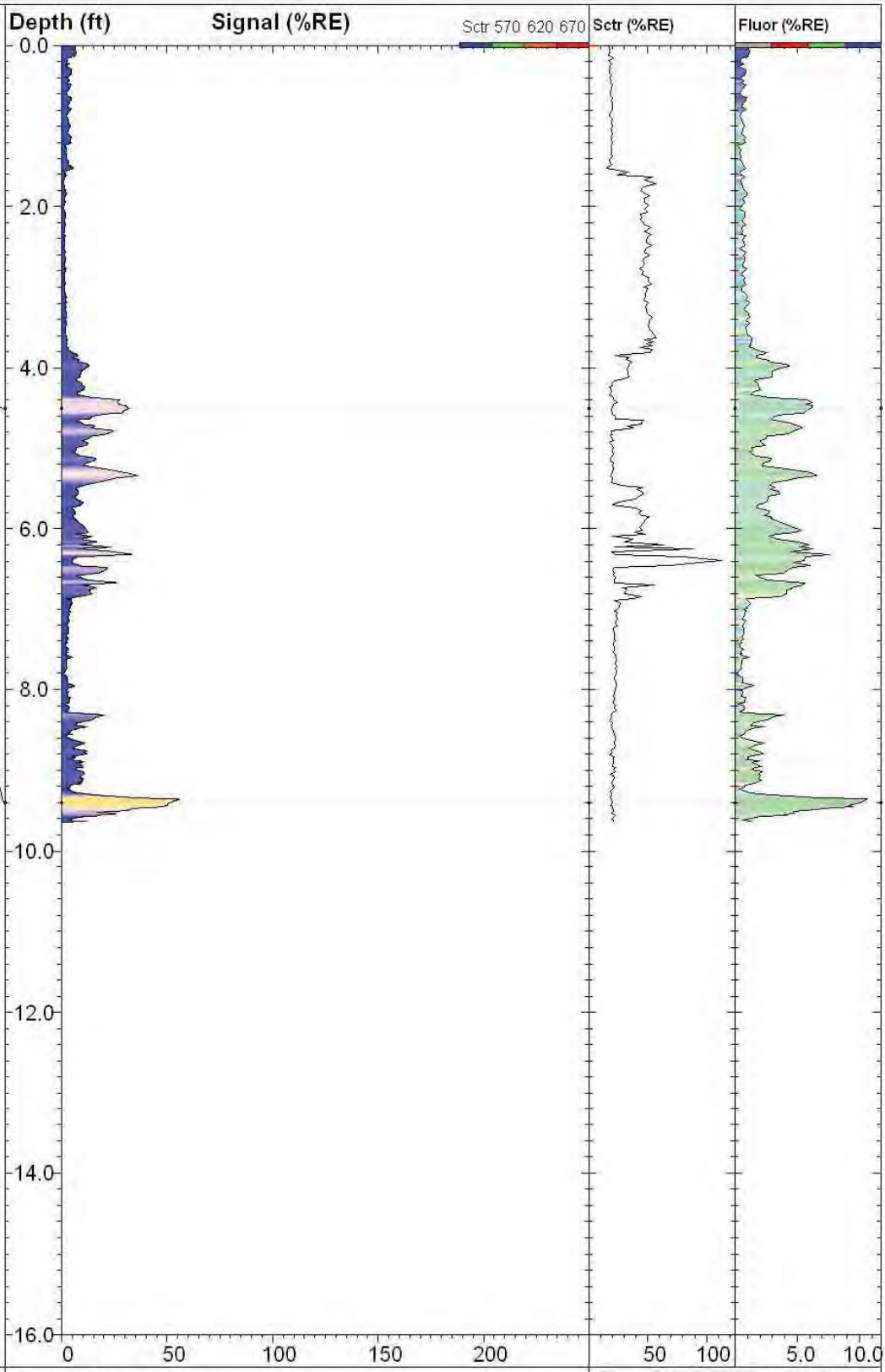
Callouts



4.5 ft
31.8 %RE
background



9.4 ft
50.9 %RE



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TGSD040

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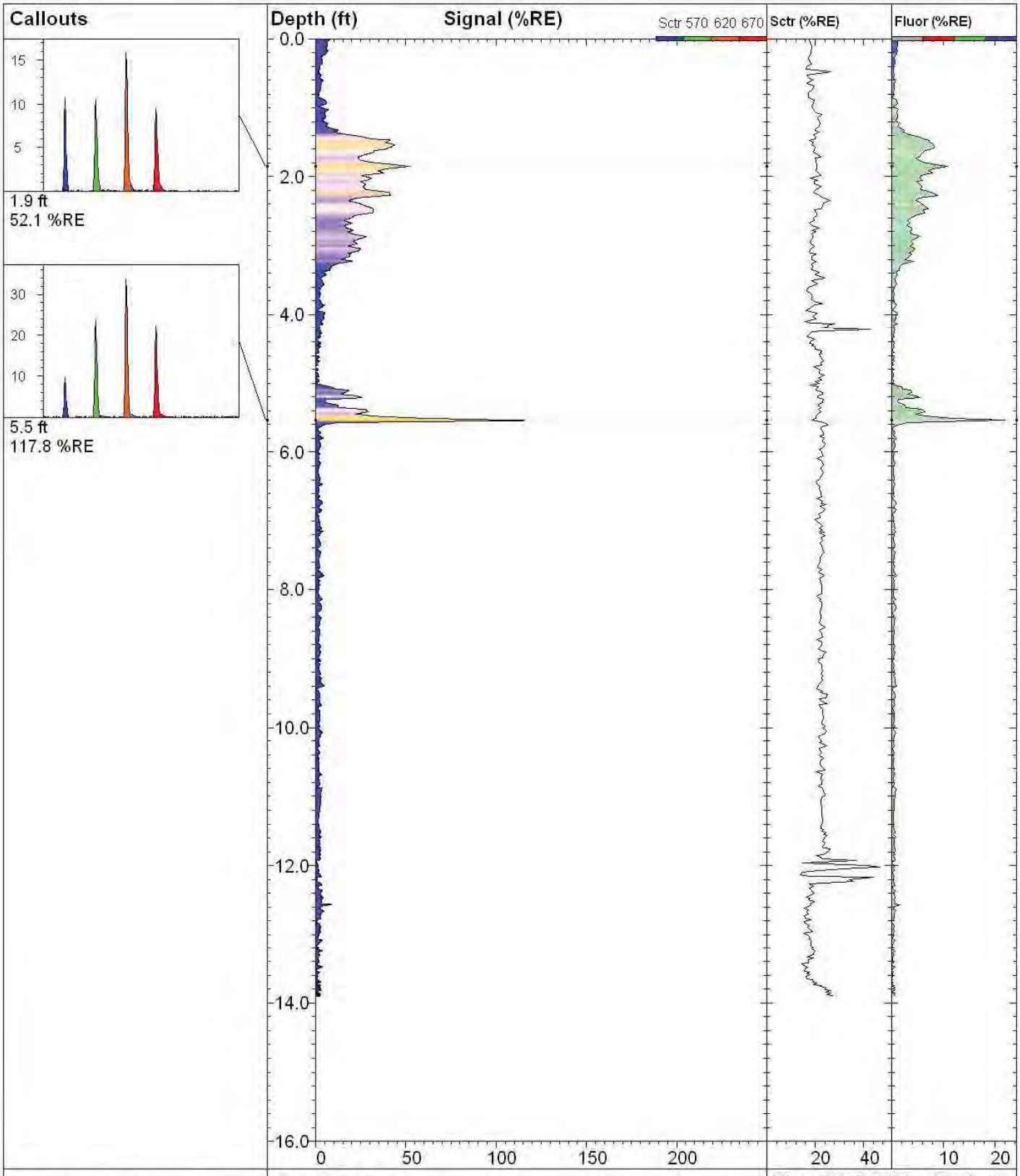
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **9.64 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **56.0 %RE @ 9.36 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-17 14:29 PDT**



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TGSD041

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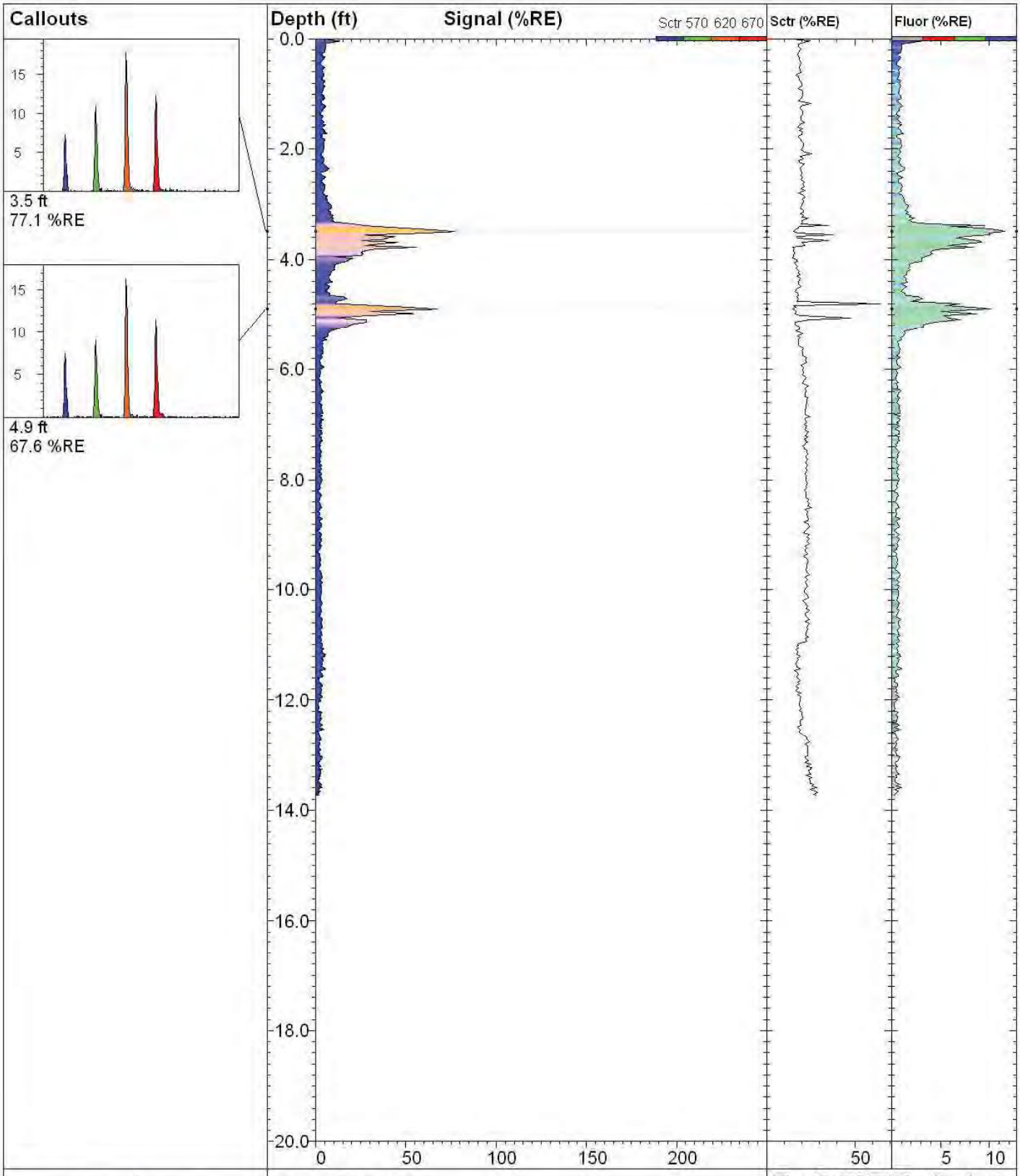
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **13.90 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **117.8 %RE @ 5.54 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-17 15:43 PDT**



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TGSD042

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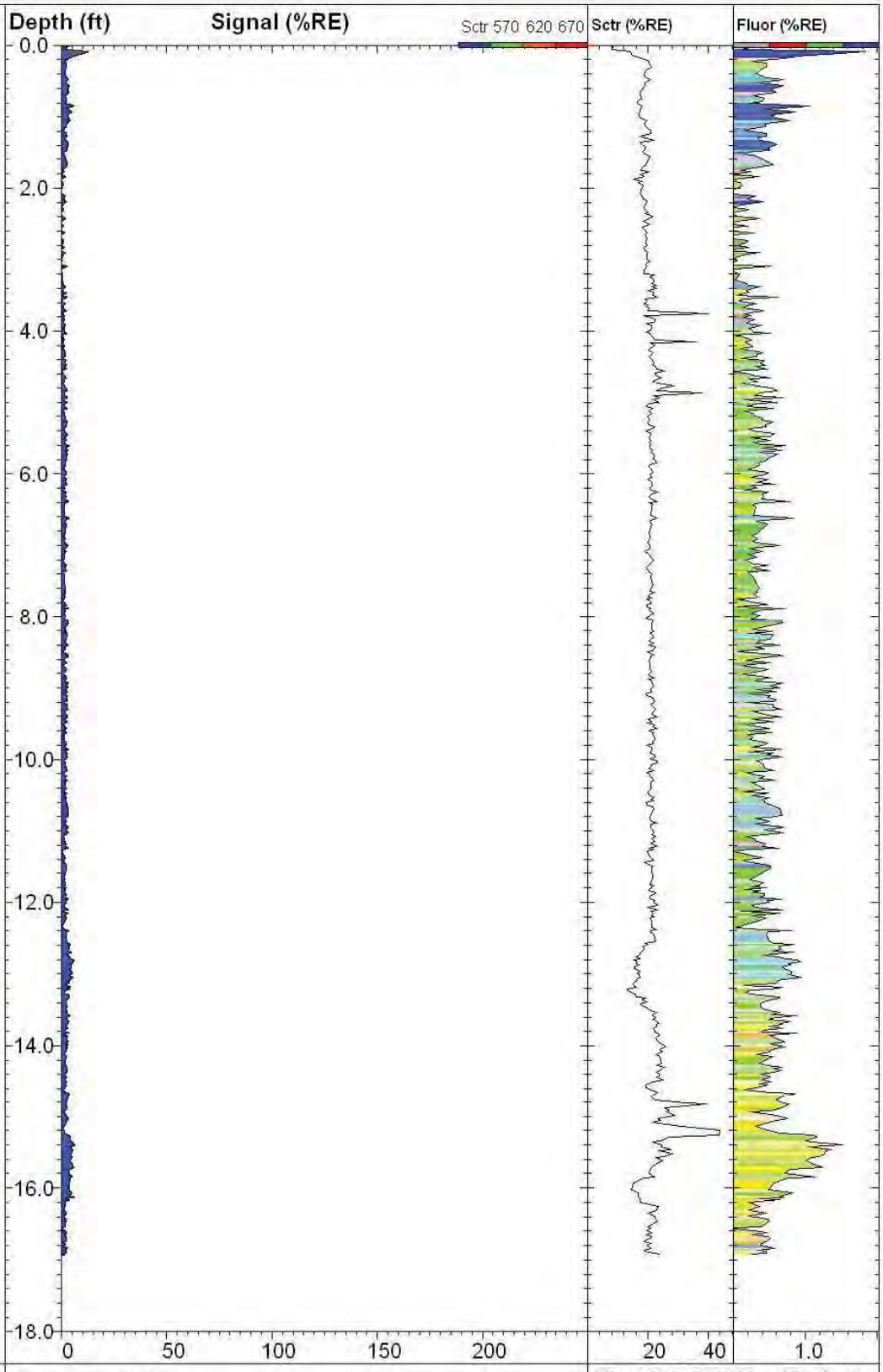
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **13.73 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **77.1 %RE @ 3.50 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-18 13:23 PDT**

Callouts



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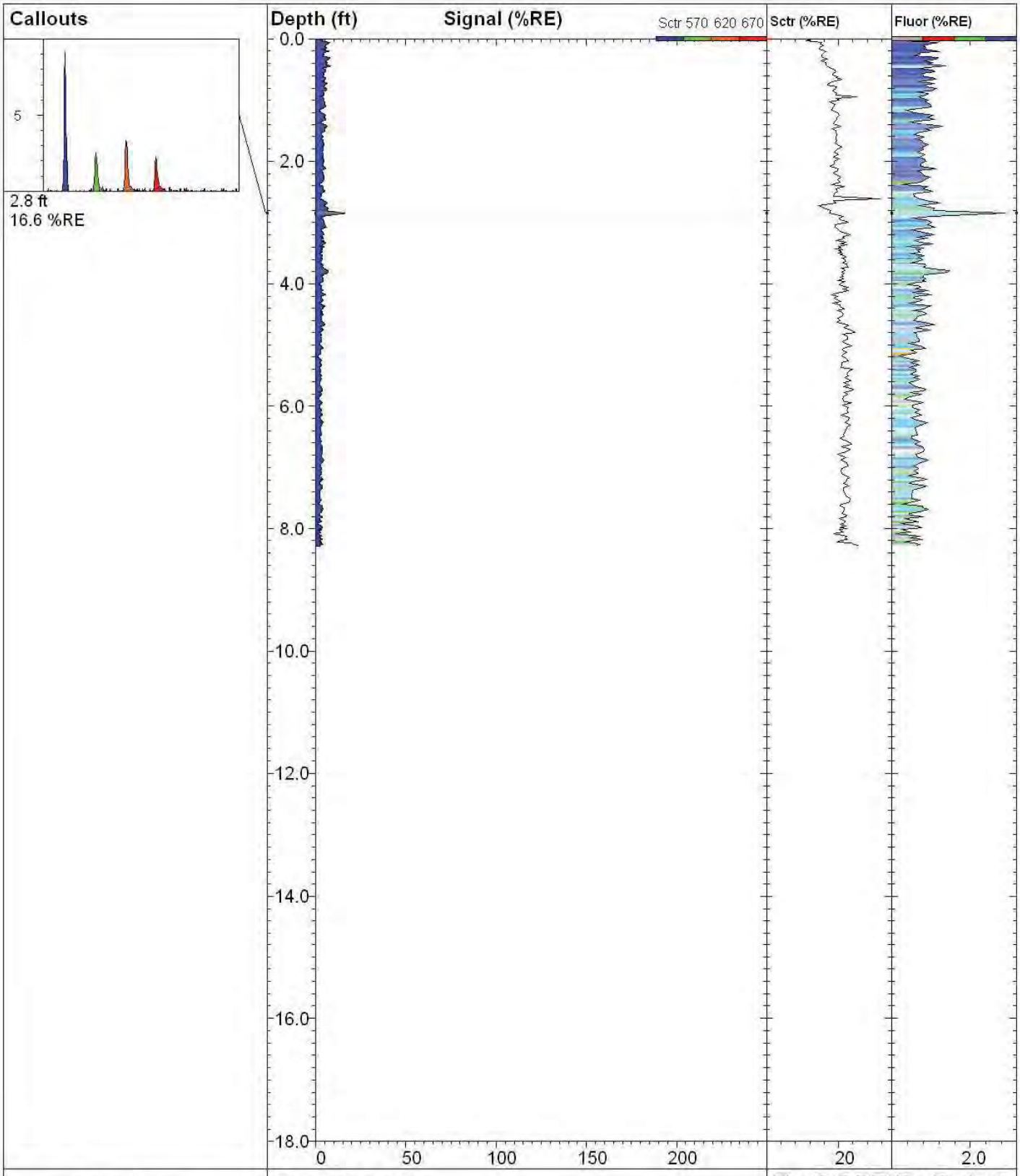
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **16.93 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **12.9 %RE @ 0.09 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-17 16:27 PDT**



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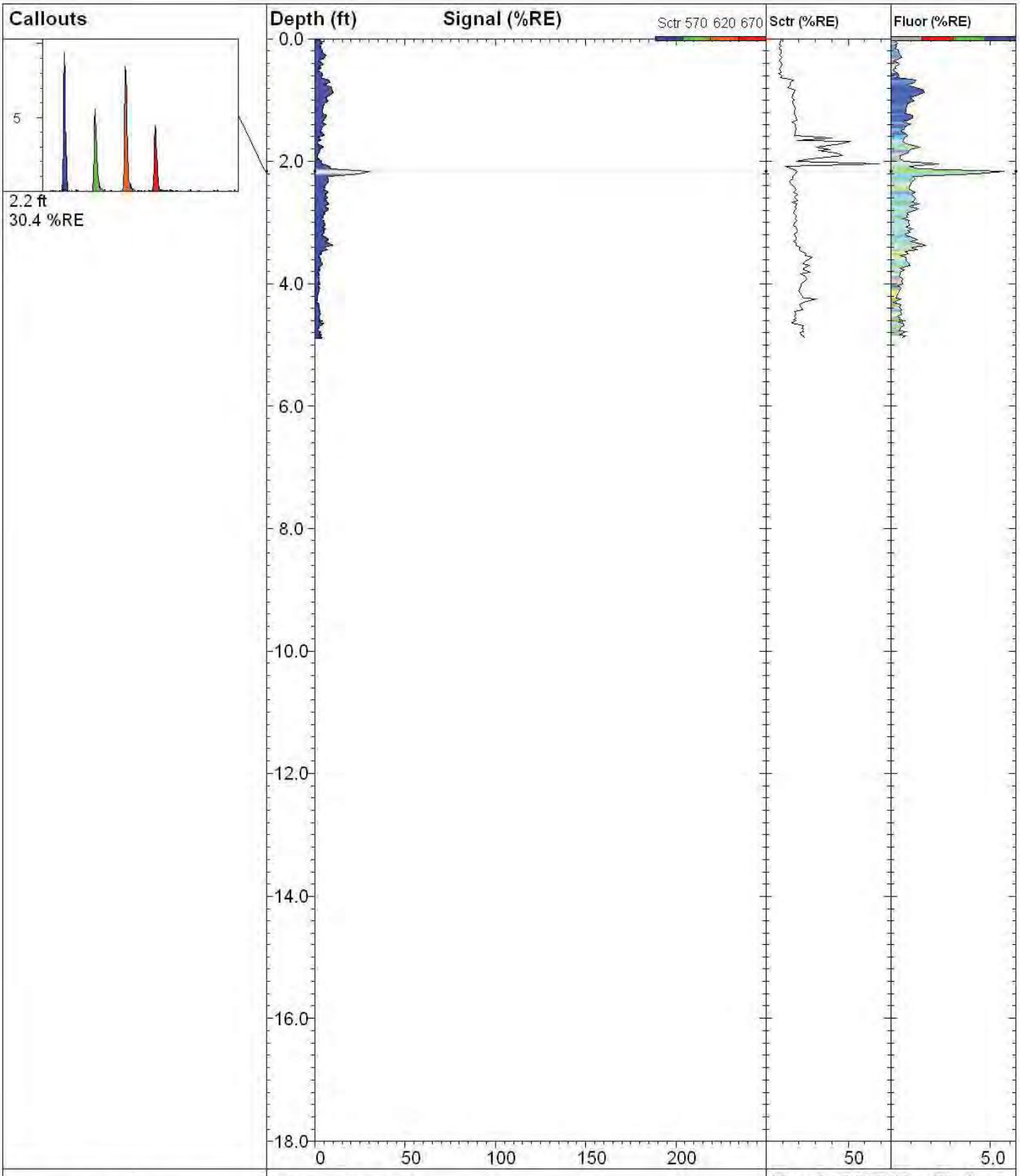
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **8.29 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **16.6 %RE @ 2.85 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-18 14:54 PDT**



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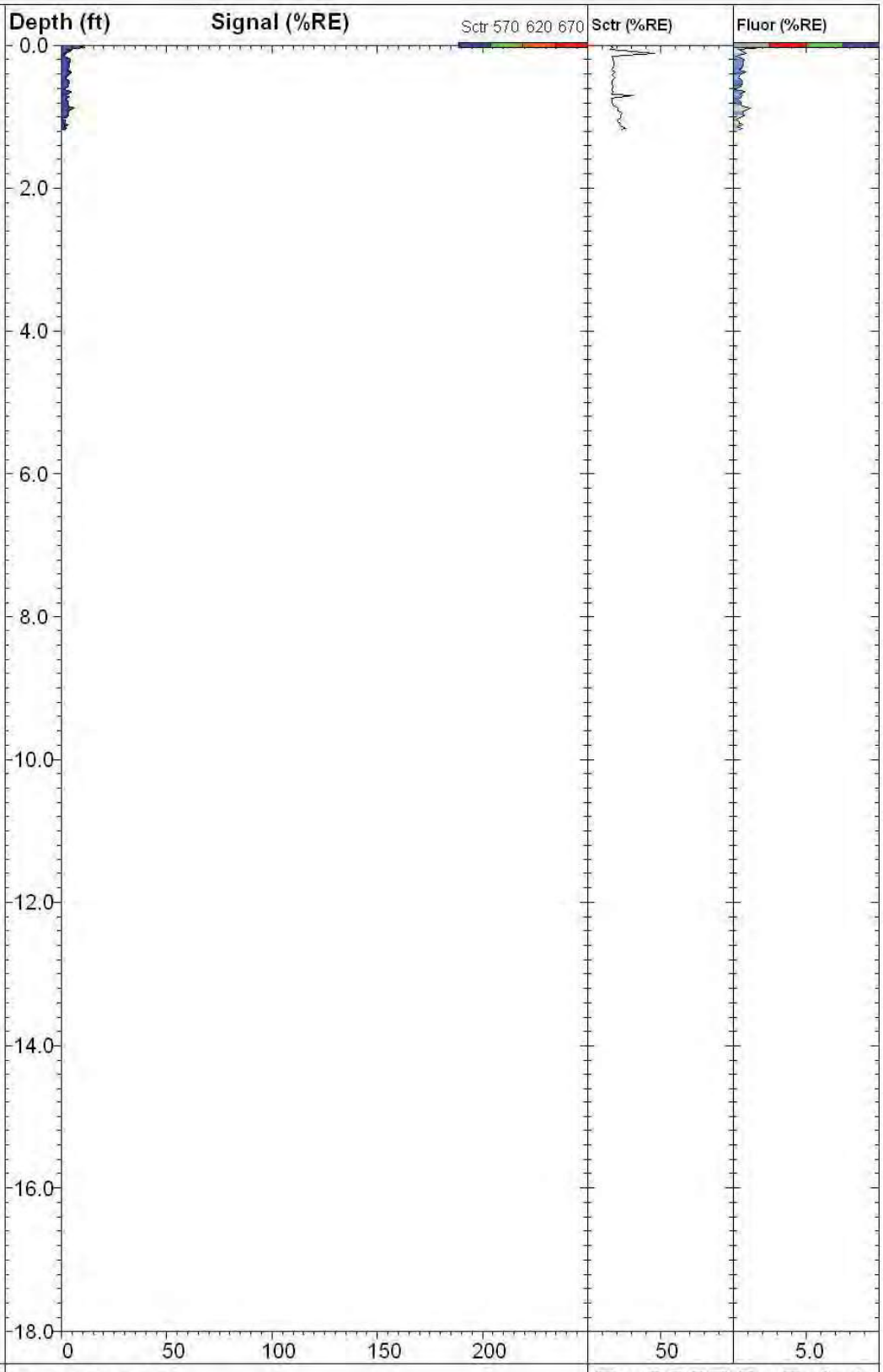
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **4.89 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **30.4 %RE @ 2.17 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-18 15:39 PDT**

Callouts



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TGSD046

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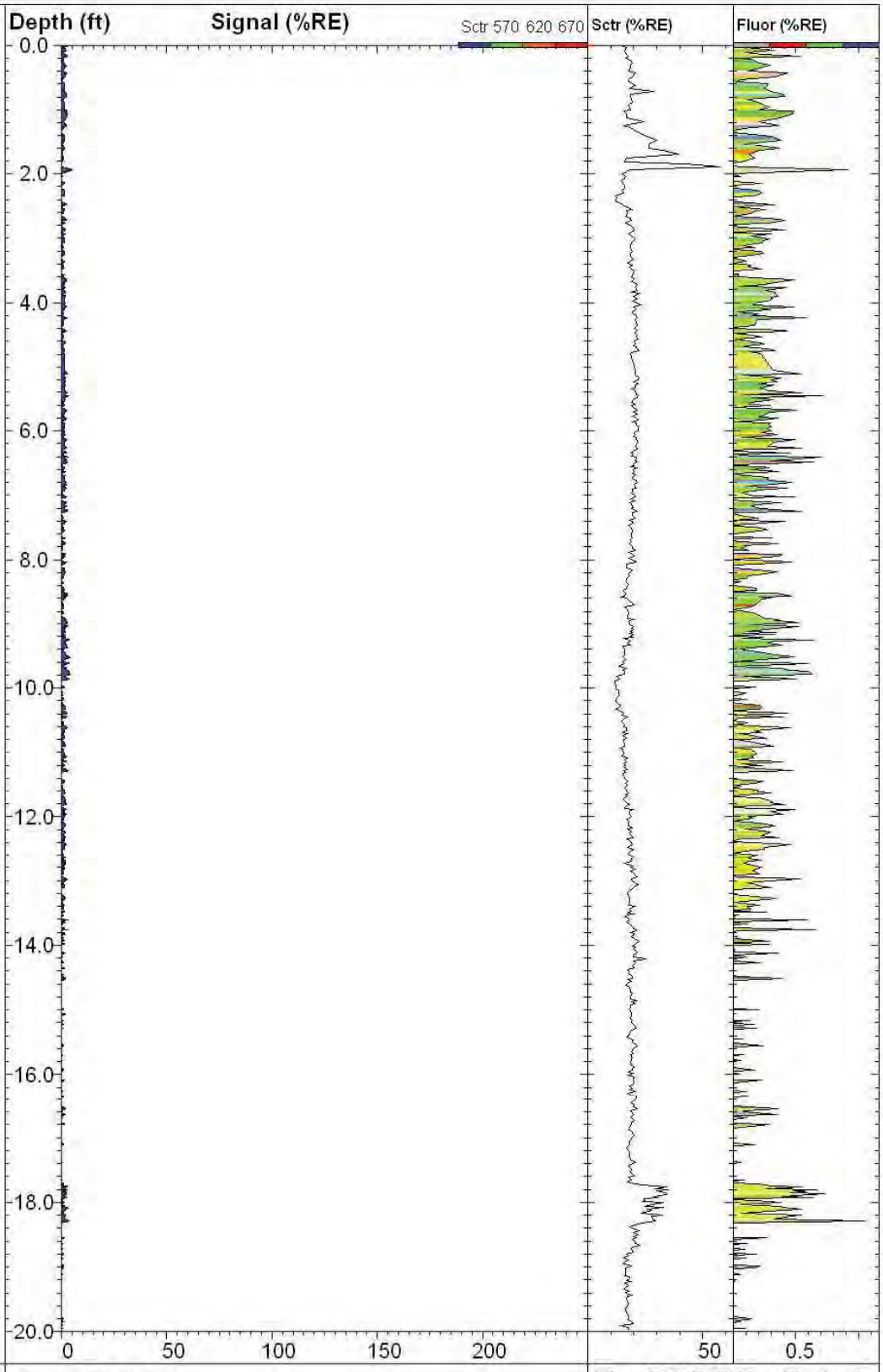
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **1.17 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **11.1 %RE @ 0.03 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 13:33 PDT**

Callouts



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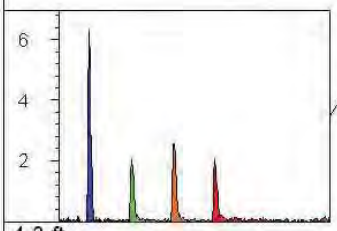
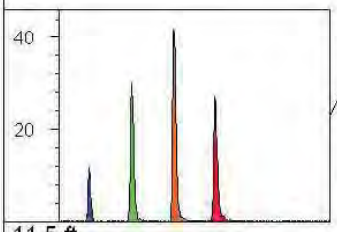
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **20.03 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.1 %RE @ 1.94 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 14:40 PDT**

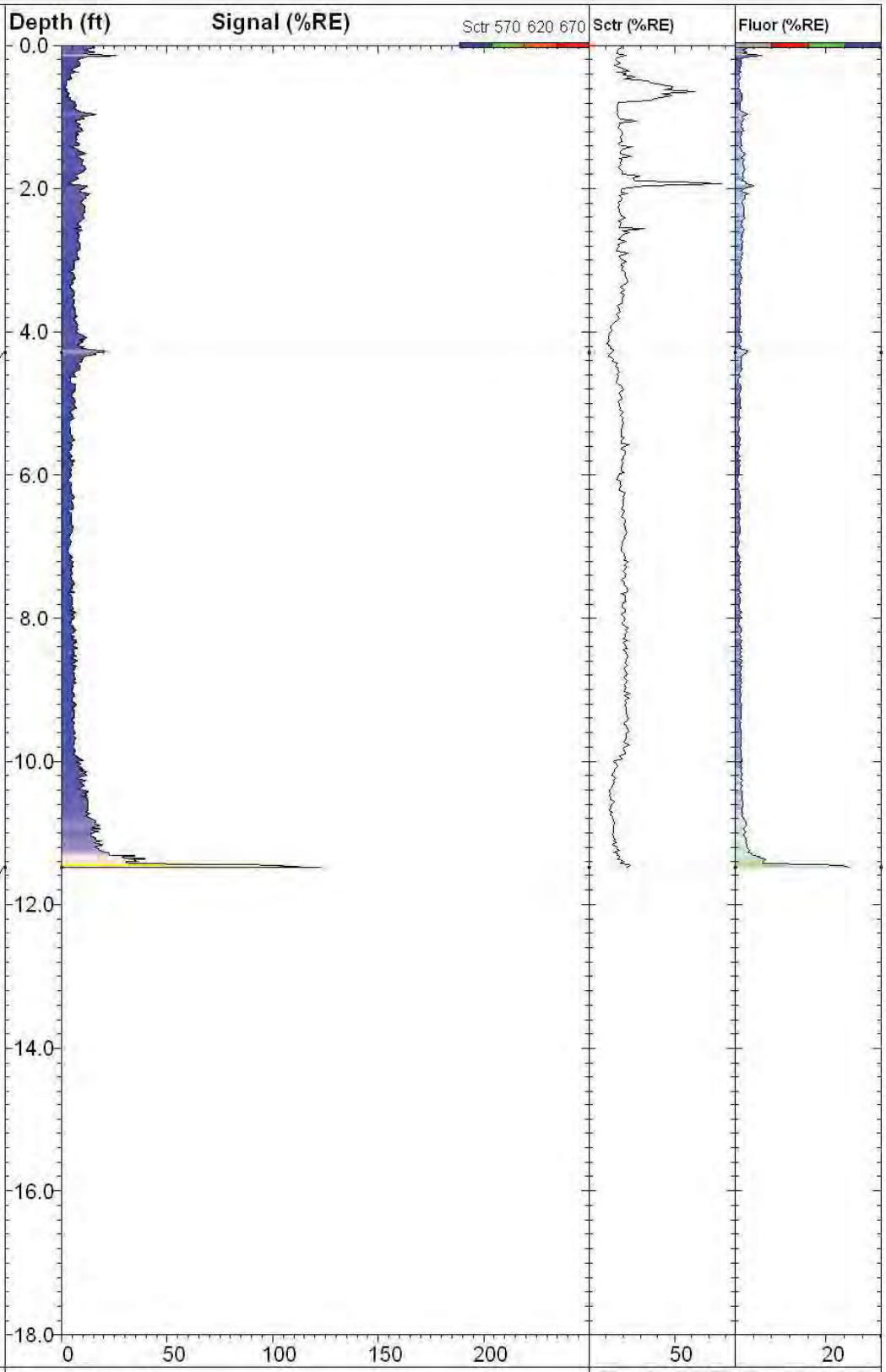
Callouts



4.3 ft
19.7 %RE



11.5 ft
127.5 %RE
product @ refusal



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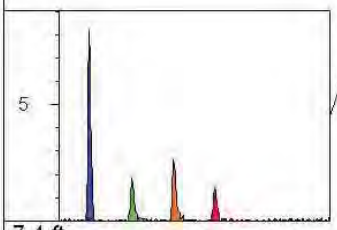
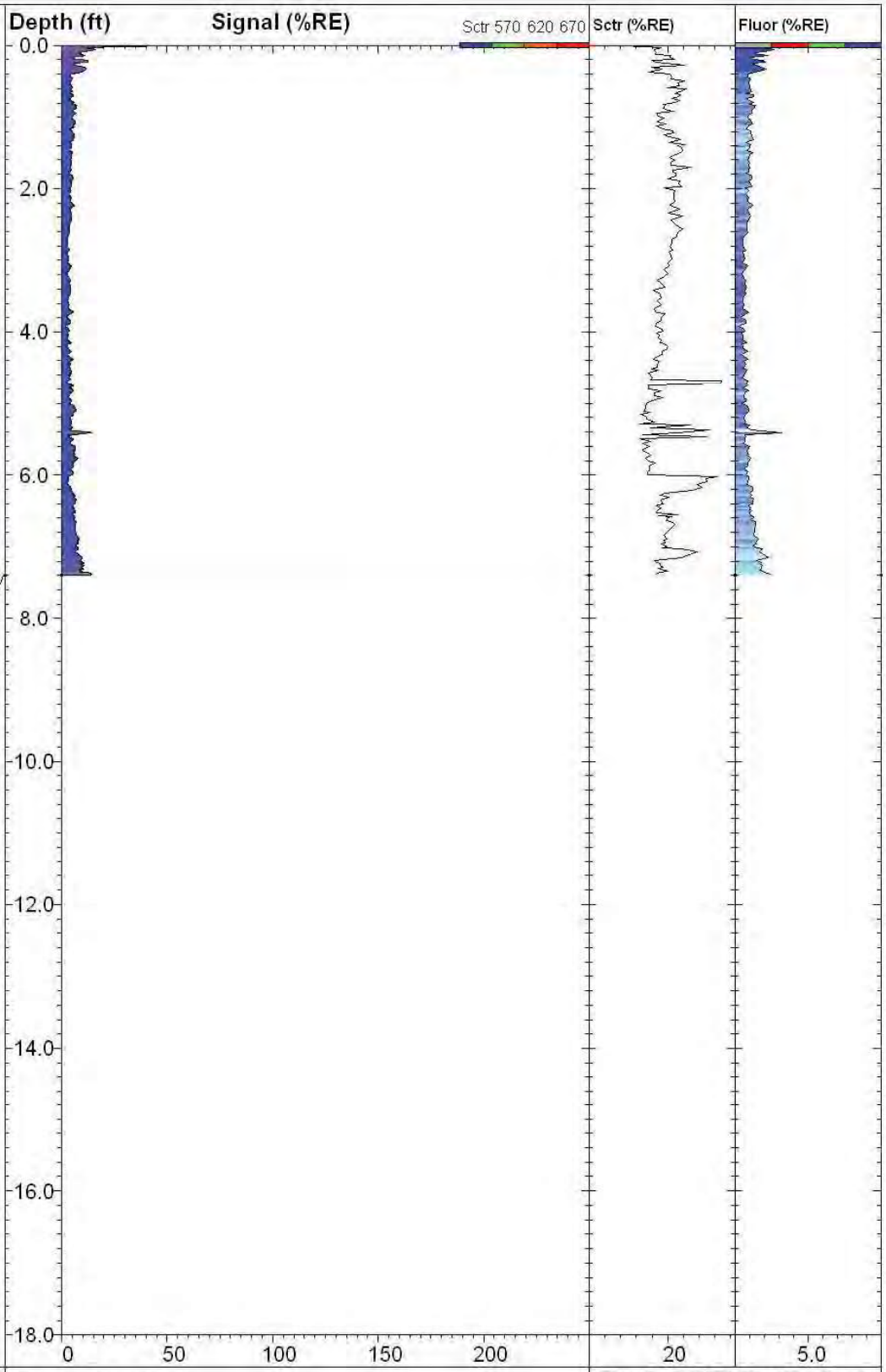
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **11.48 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **127.5 %RE @ 11.48 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-19 09:12 PDT**

Callouts



7.4 ft
13.8 %RE



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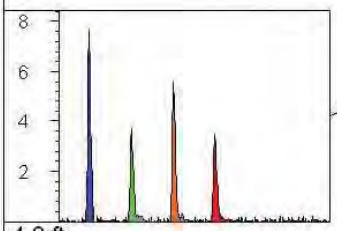
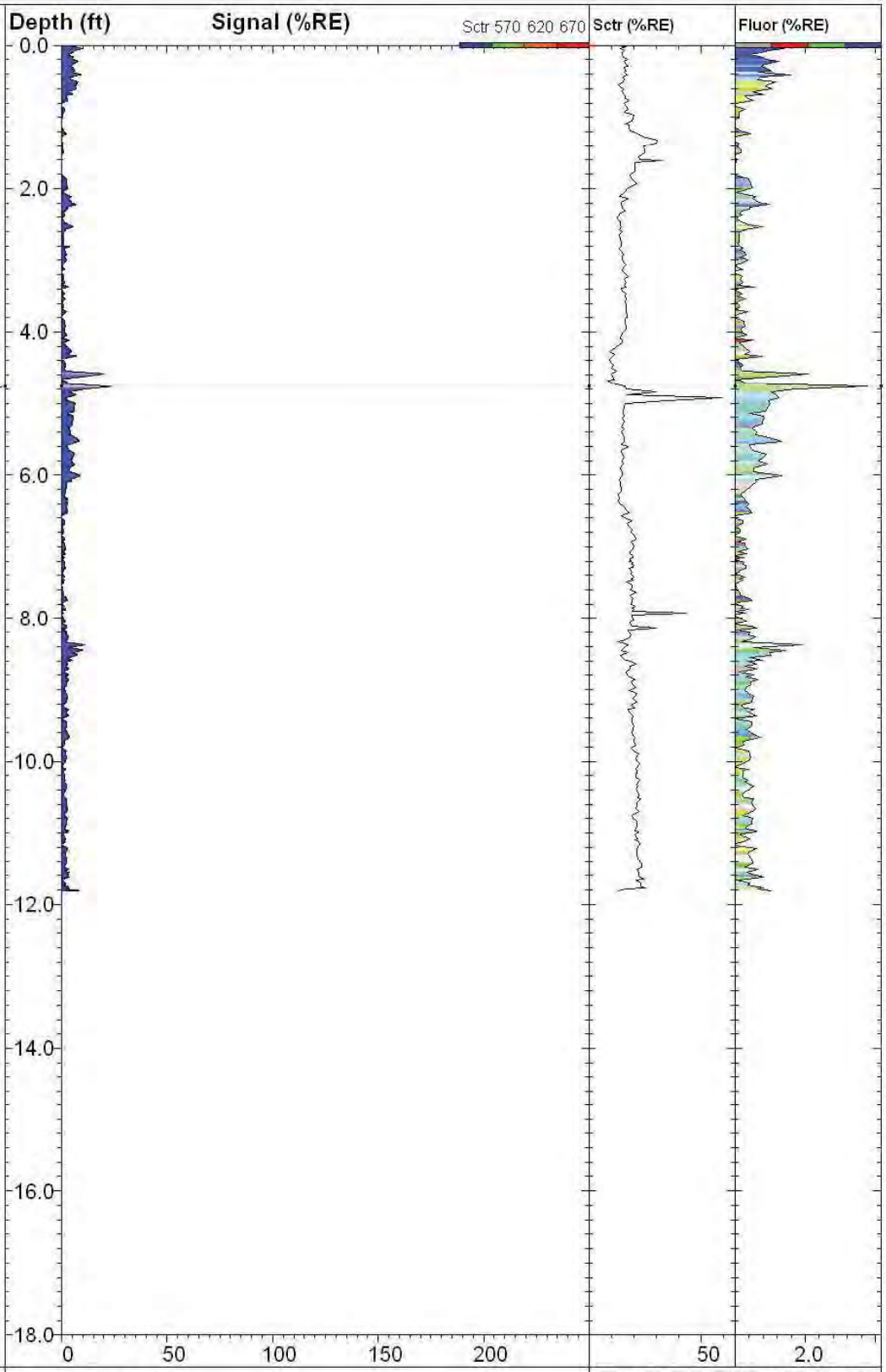
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **7.39 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **102.9 %RE @ 0.00 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-19 09:41 PDT**

Callouts



4.8 ft
23.7 %RE



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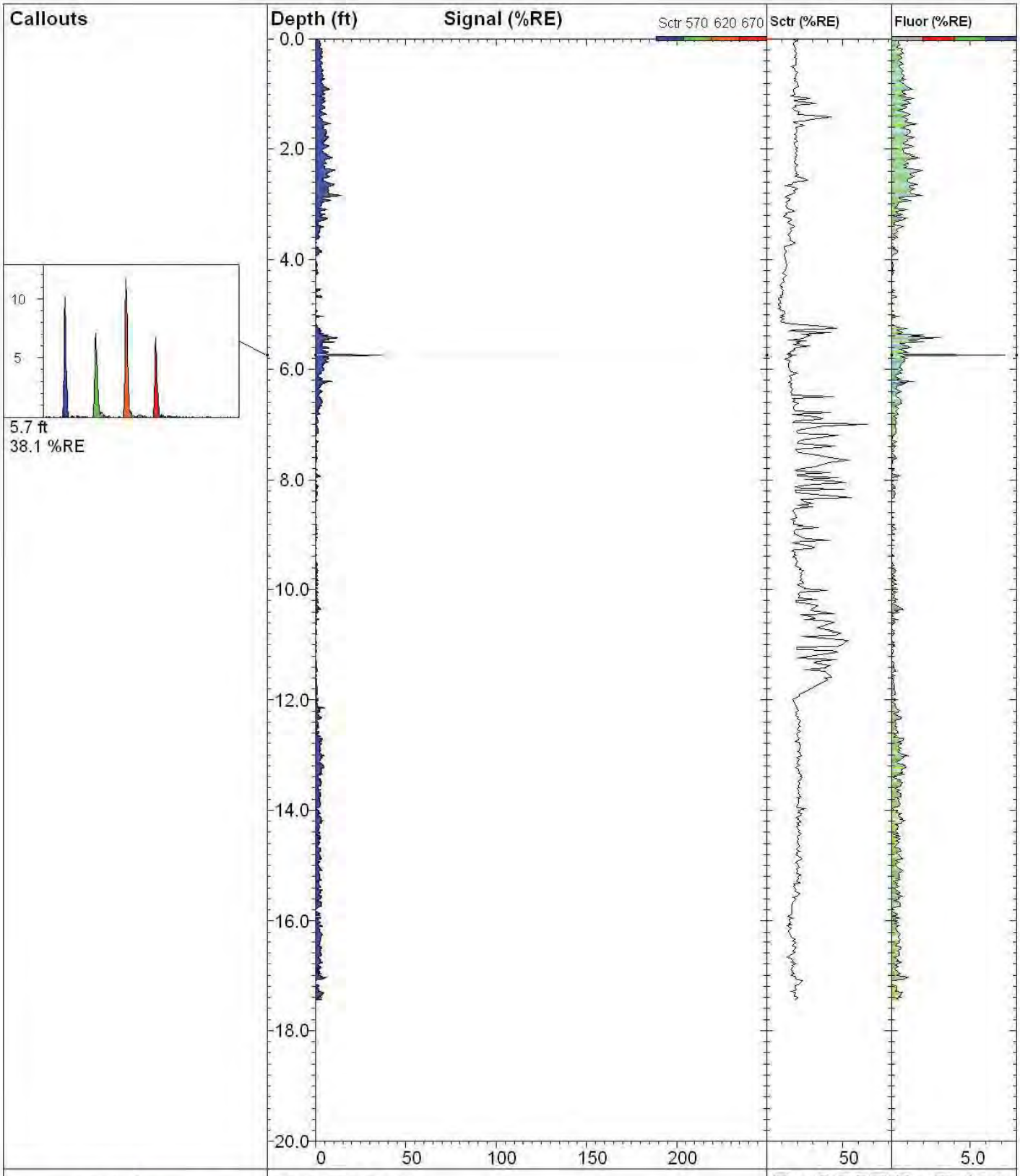
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **11.82 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **23.7 %RE @ 4.77 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-19 12:45 PDT**



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TGSD051

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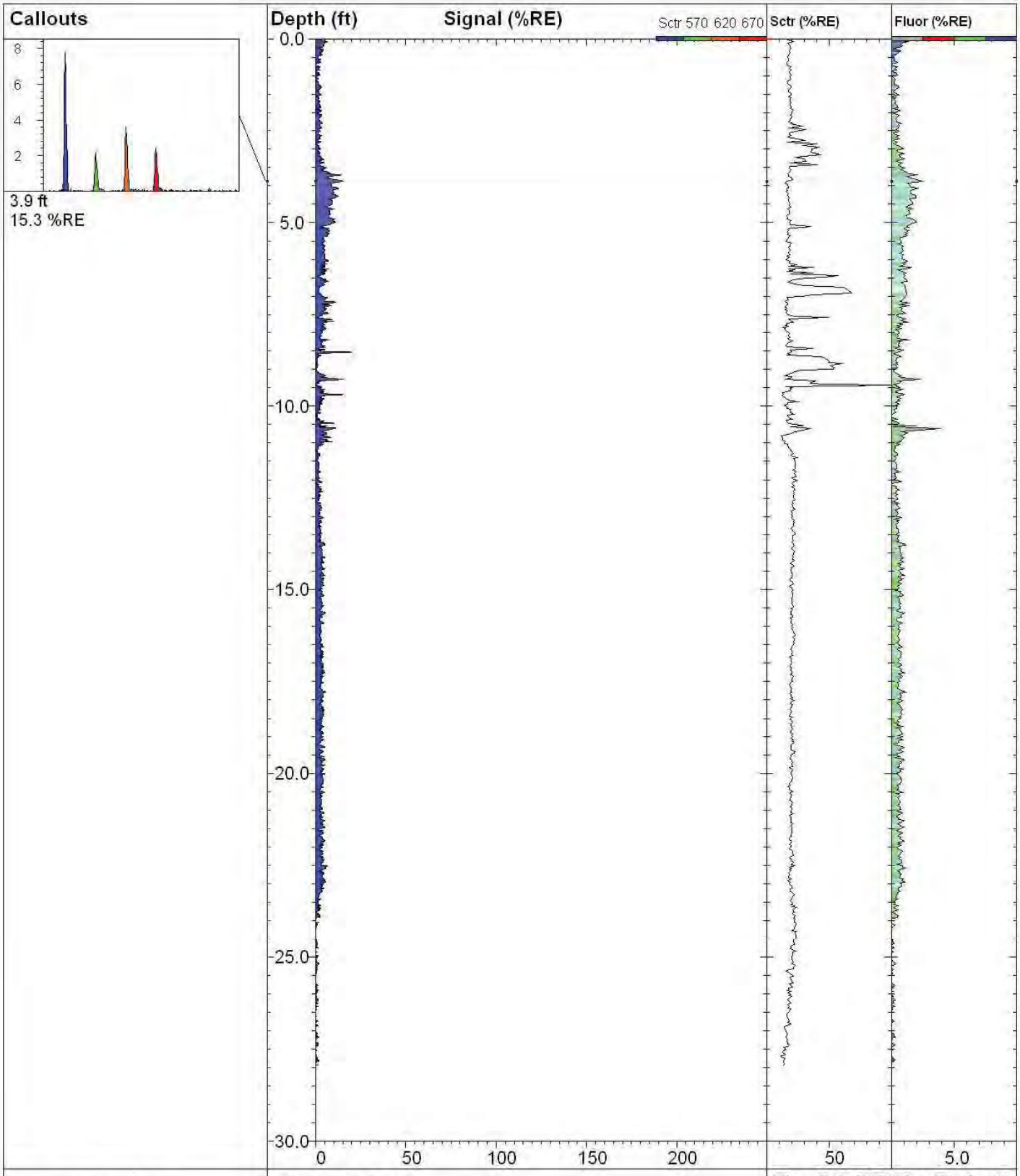
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **17.44 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **38.1 %RE @ 5.75 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 13:49 PDT**



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TGSD052

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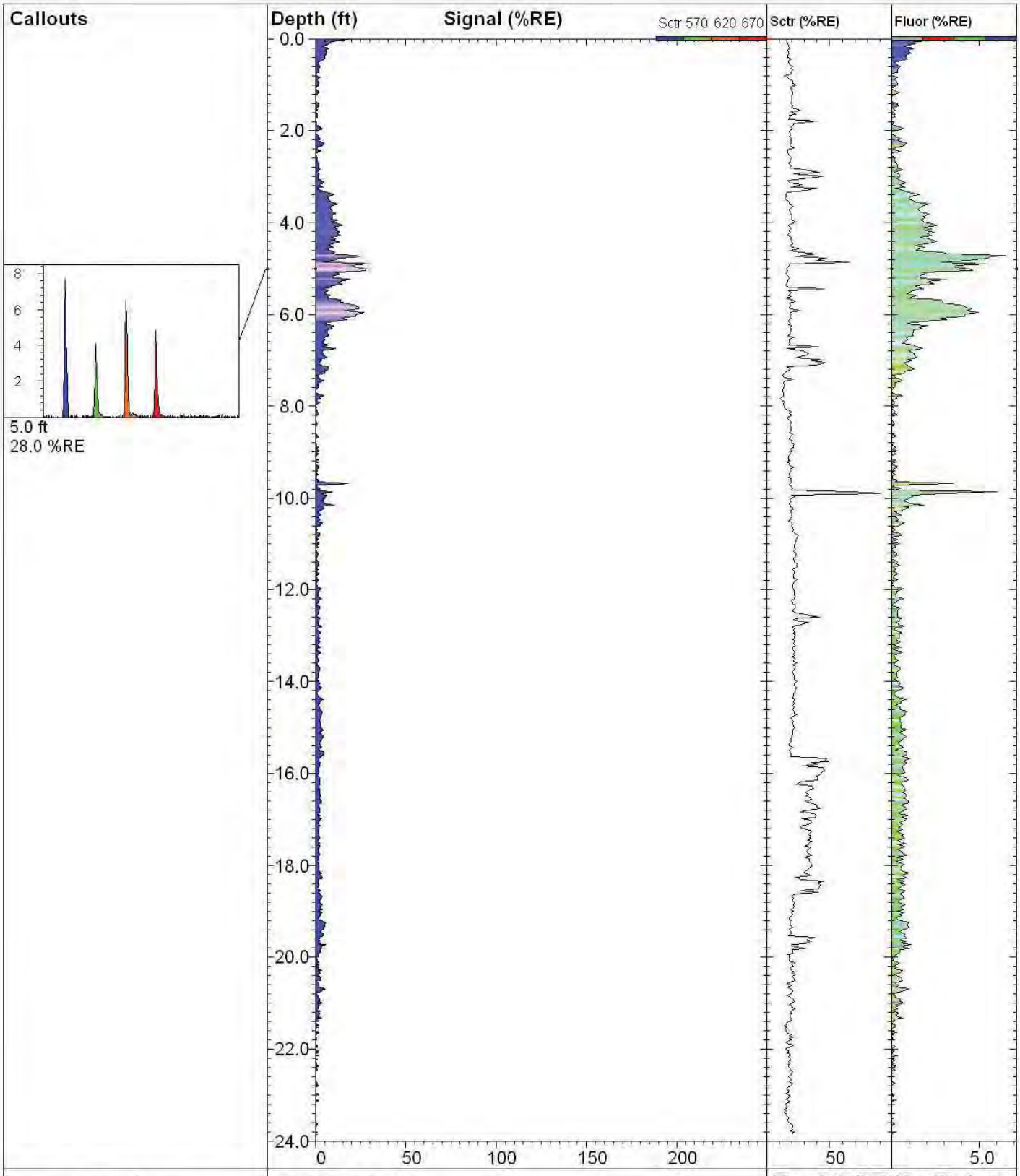
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **27.93 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **20.3 %RE @ 8.54 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 14:38 PDT**



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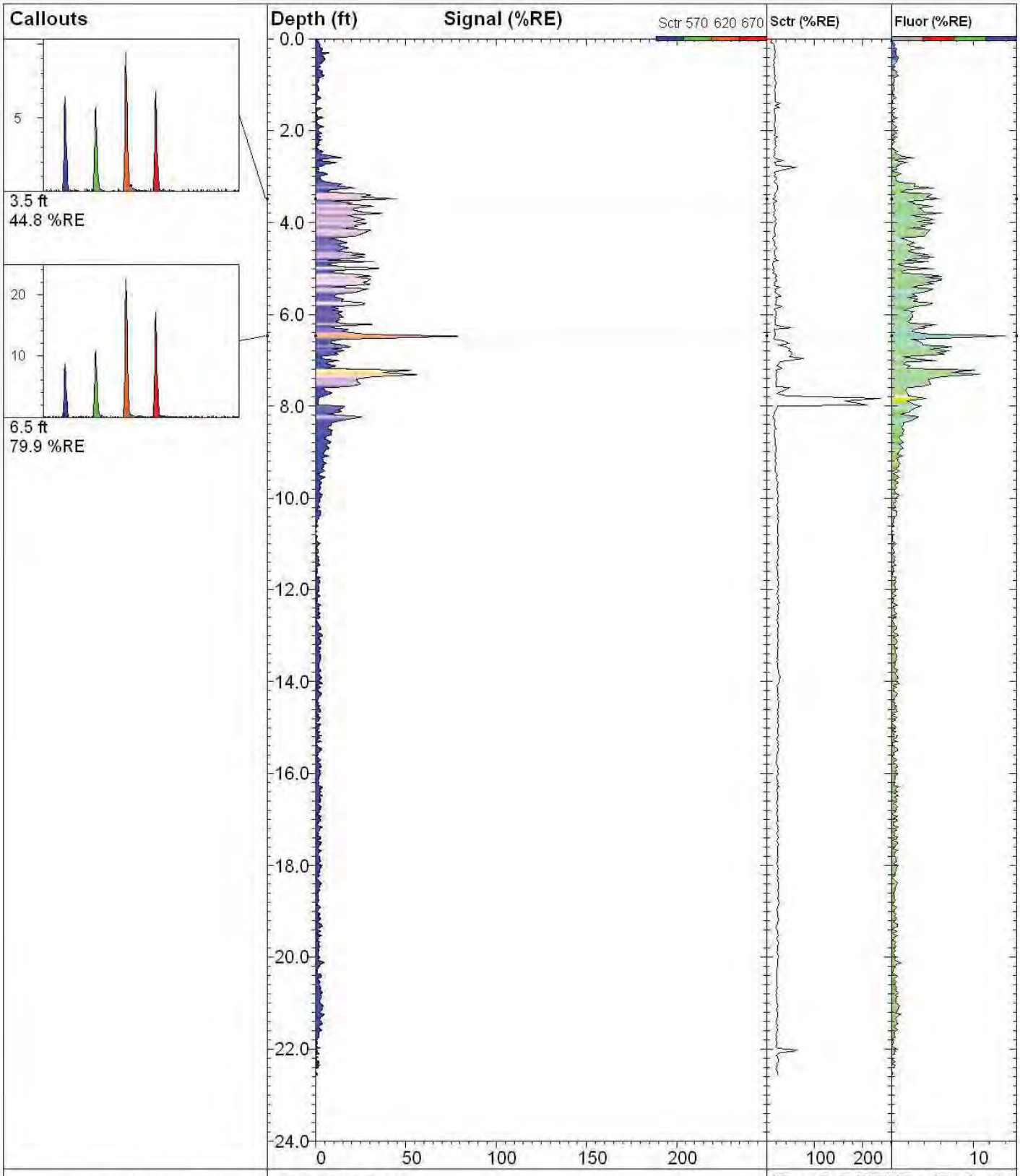
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **23.84 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **29.6 %RE @ 4.89 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-19 13:34 PDT**



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TGSD054

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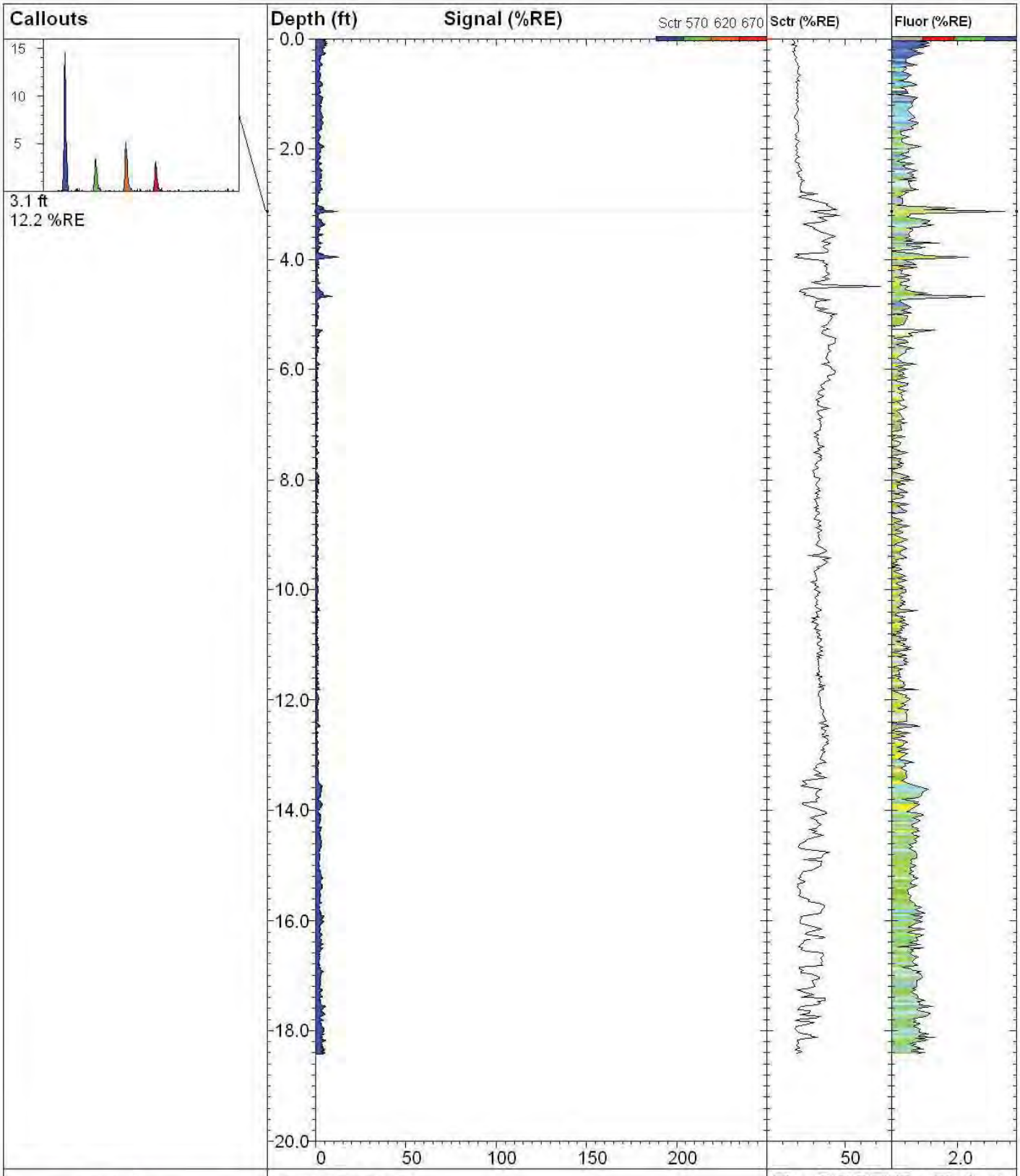
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **22.56 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **79.9 %RE @ 6.48 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-19 14:17 PDT**



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TGSD055

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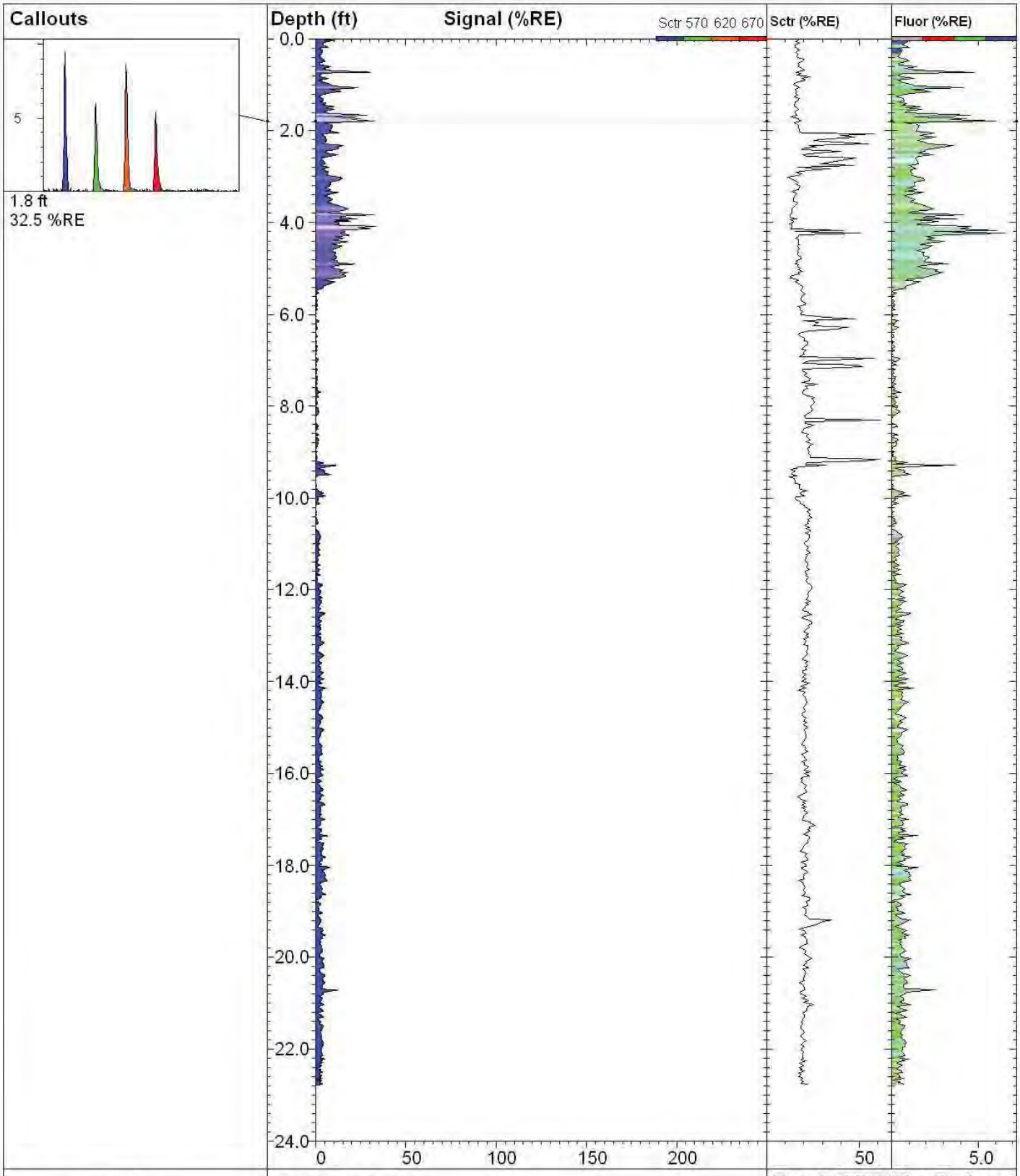
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **18.42 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **13.2 %RE @ 3.96 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 13:02 PDT**



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TGSD056

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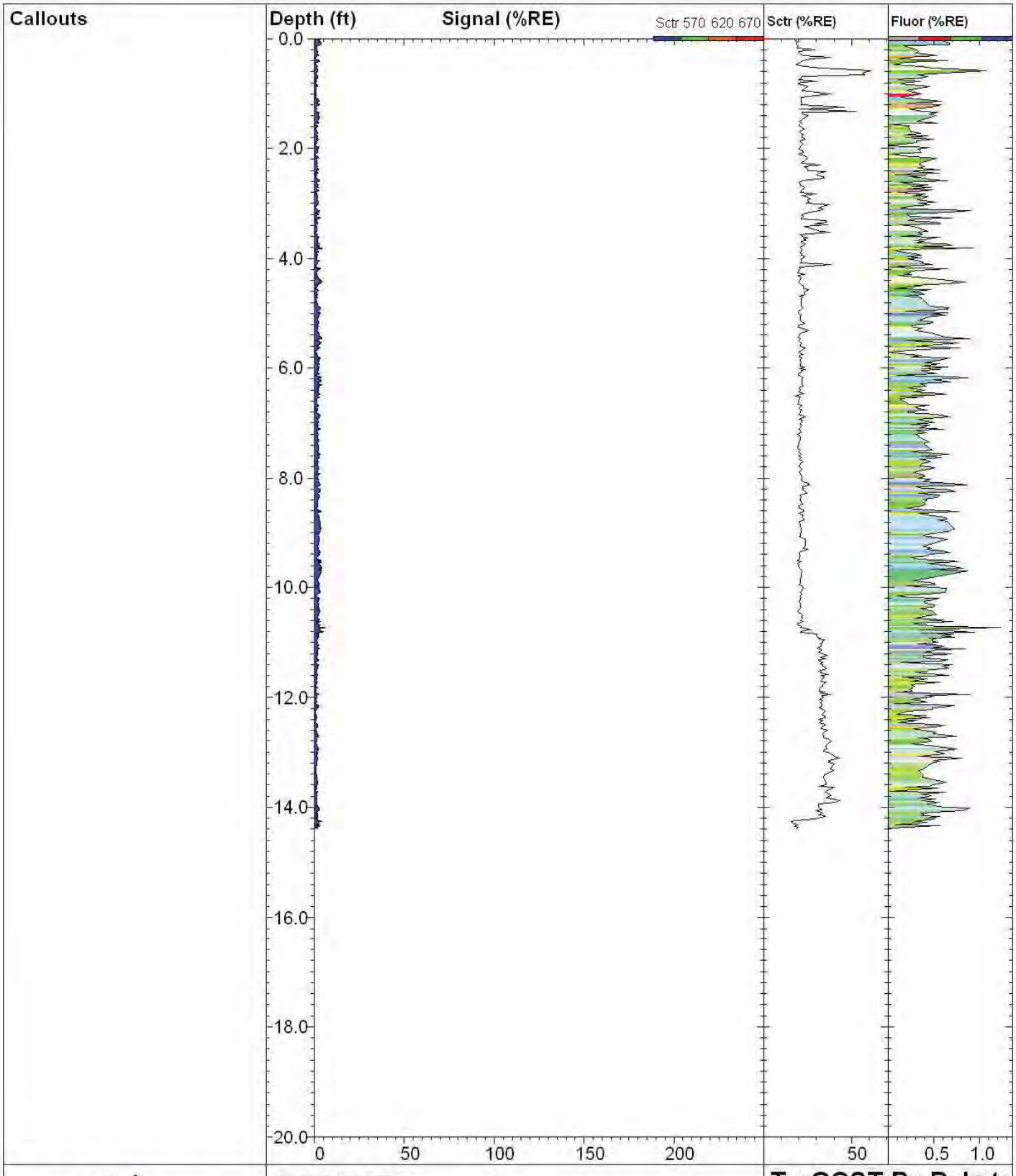
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **22.77 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **33.9 %RE @ 4.08 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-19 14:59 PDT**



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TGSD058

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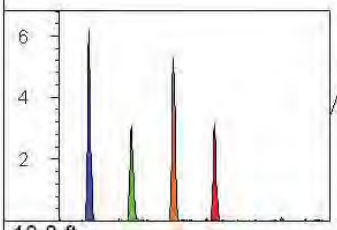
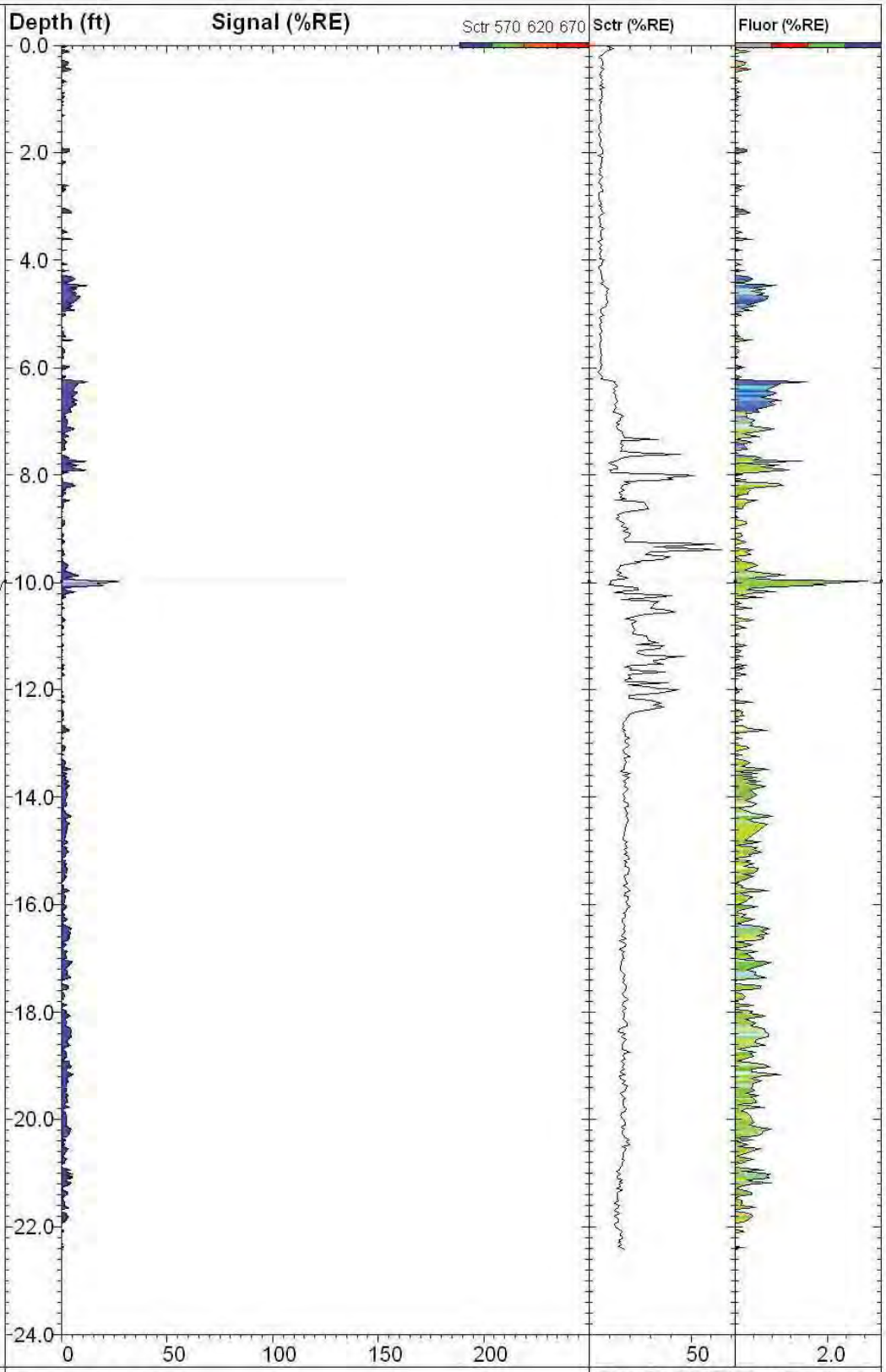
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **14.39 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.9 %RE @ 10.73 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 12:13 PDT**

Callouts



10.0 ft
27.0 %RE



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TGSD059

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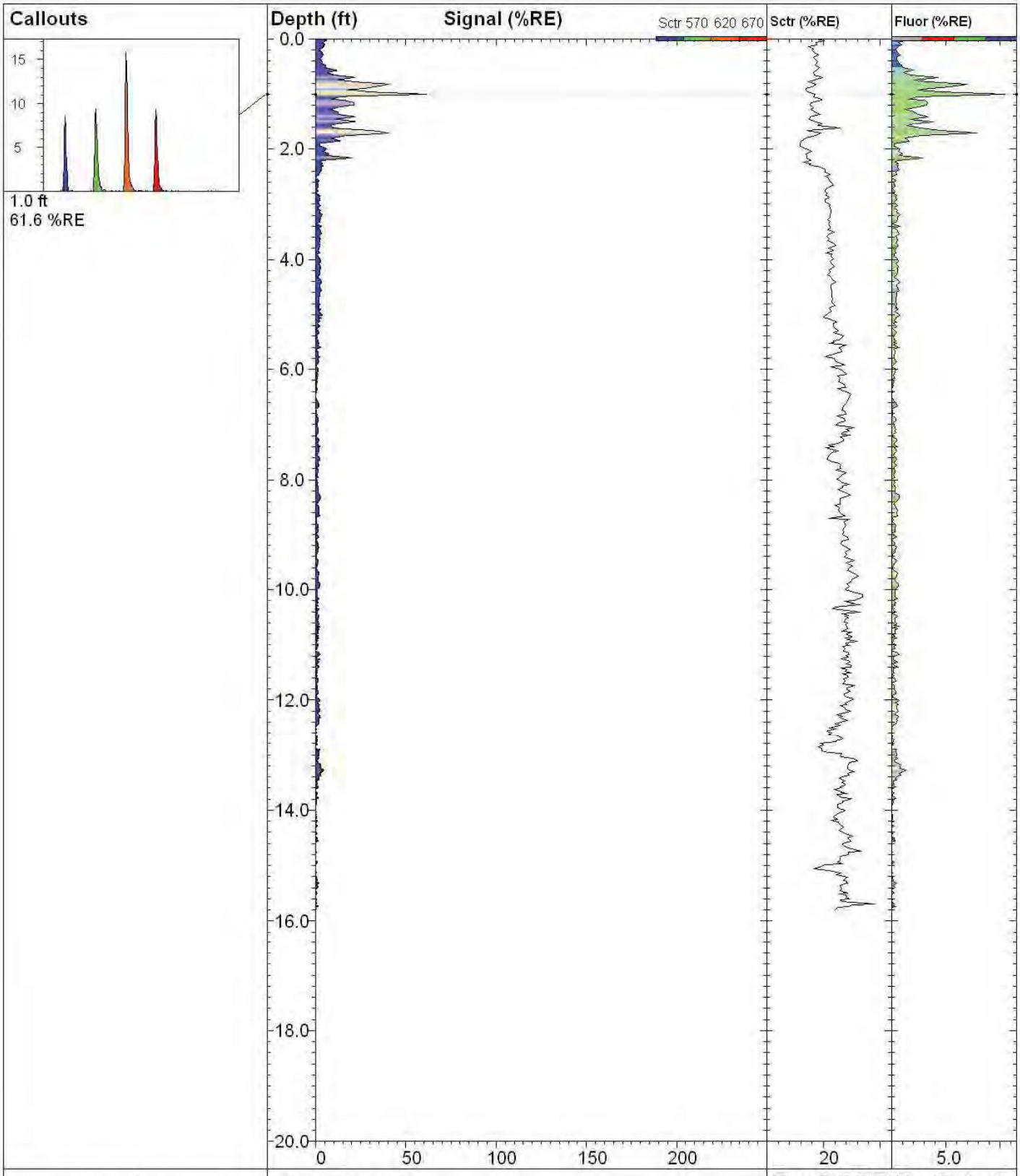
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **22.43 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **27.0 %RE @ 9.98 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-19 15:49 PDT**



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TGSD060

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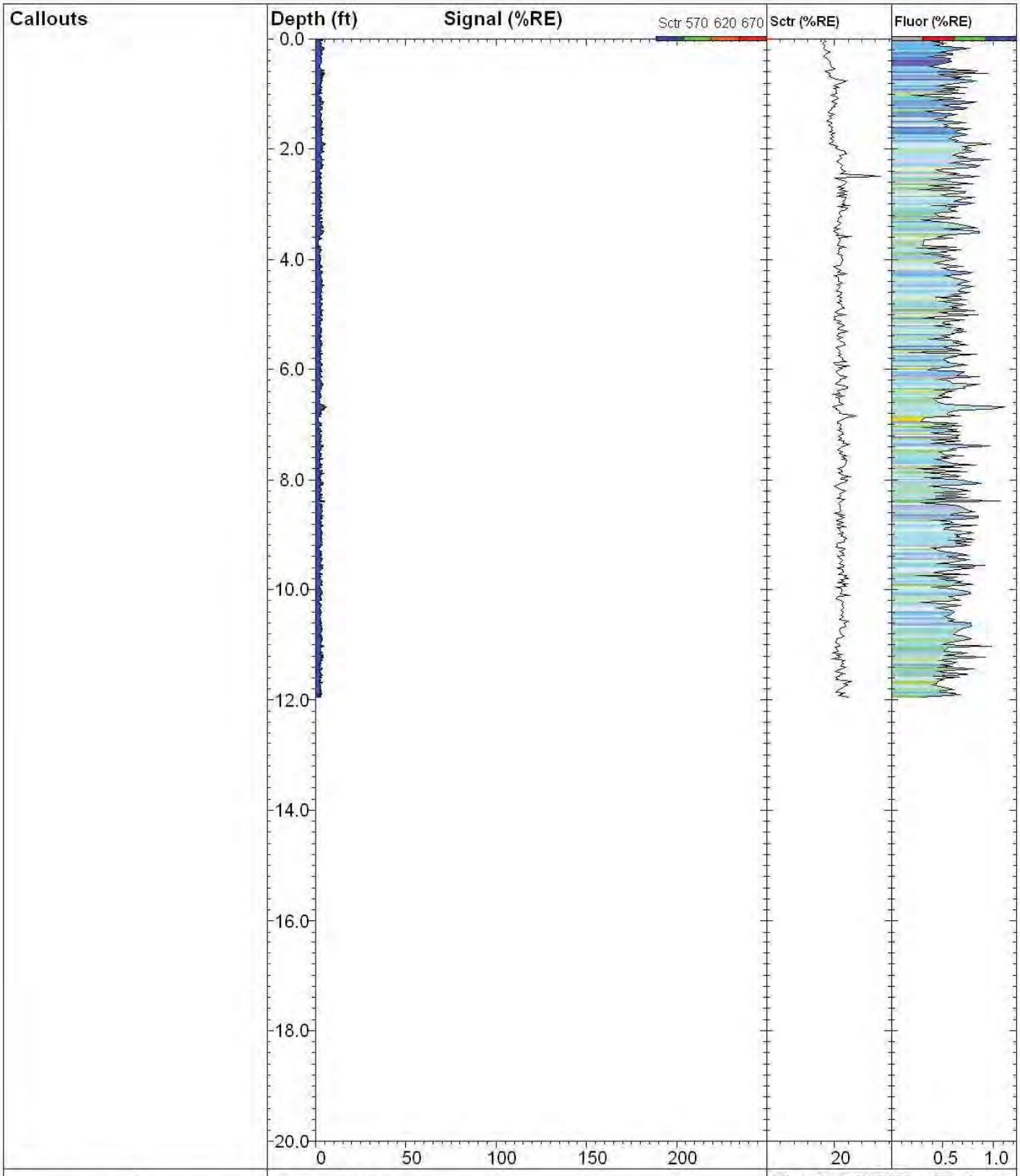
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **15.79 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **61.6 %RE @ 1.00 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-19 16:36 PDT**



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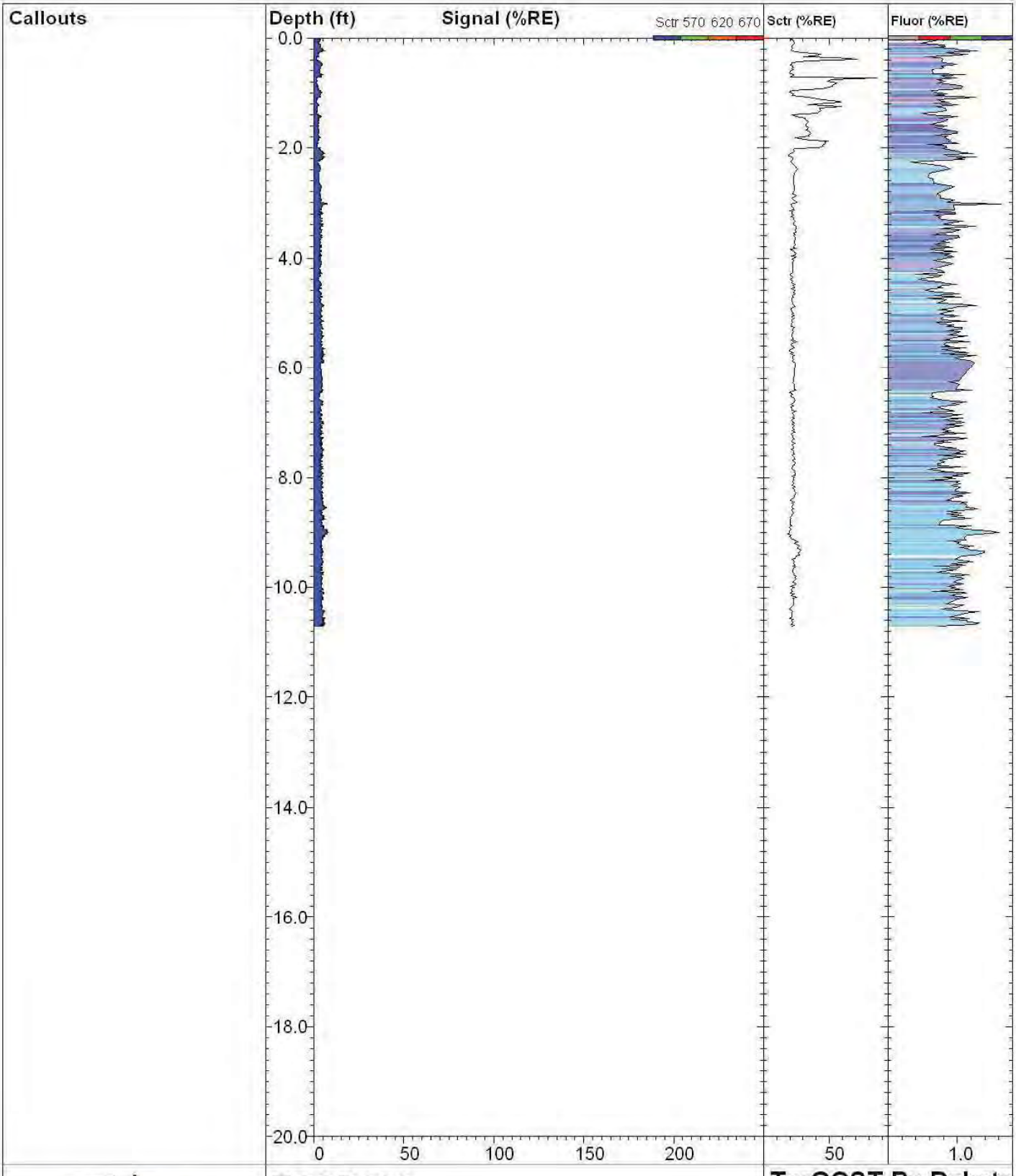
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **11.94 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.7 %RE @ 6.68 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 11:13 PDT**



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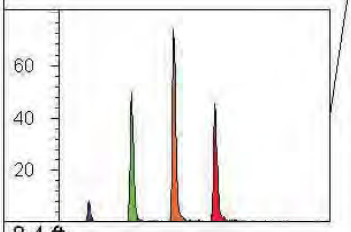
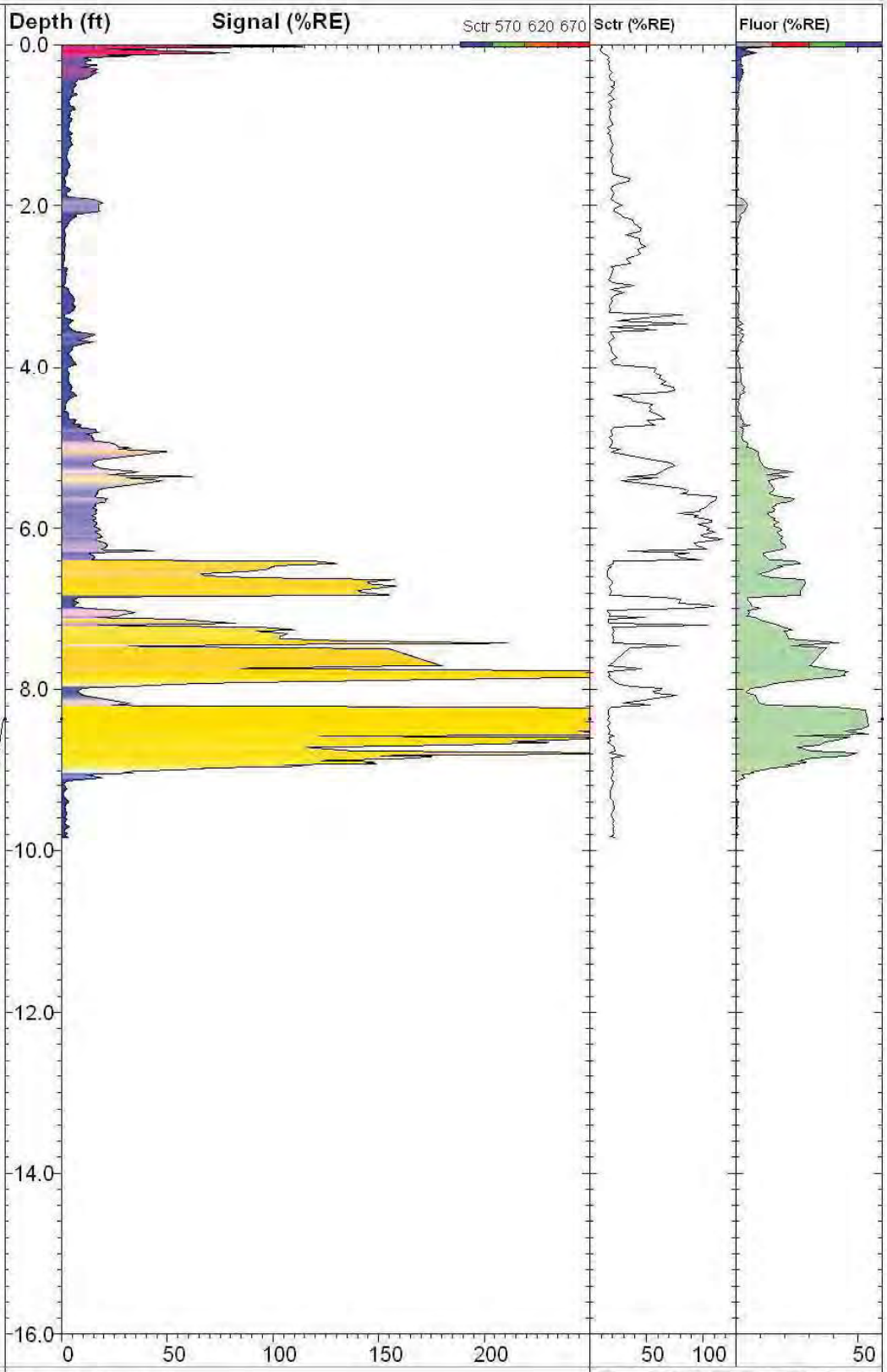
Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **10.71 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **8.1 %RE @ 9.00 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 09:03 PDT**

Callouts



8.4 ft
331.5 %RE



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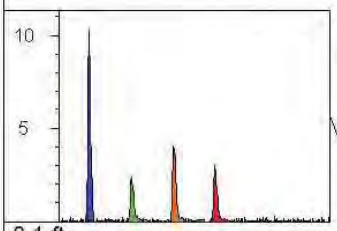
FARGO, ND 701.237.4908
WWW.DAKOTATECHNOLOGIES.COM

TGSD063

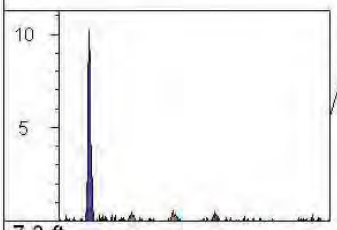
TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **9.84 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **352.3 %RE @ 8.38 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-17 15:08 PDT**

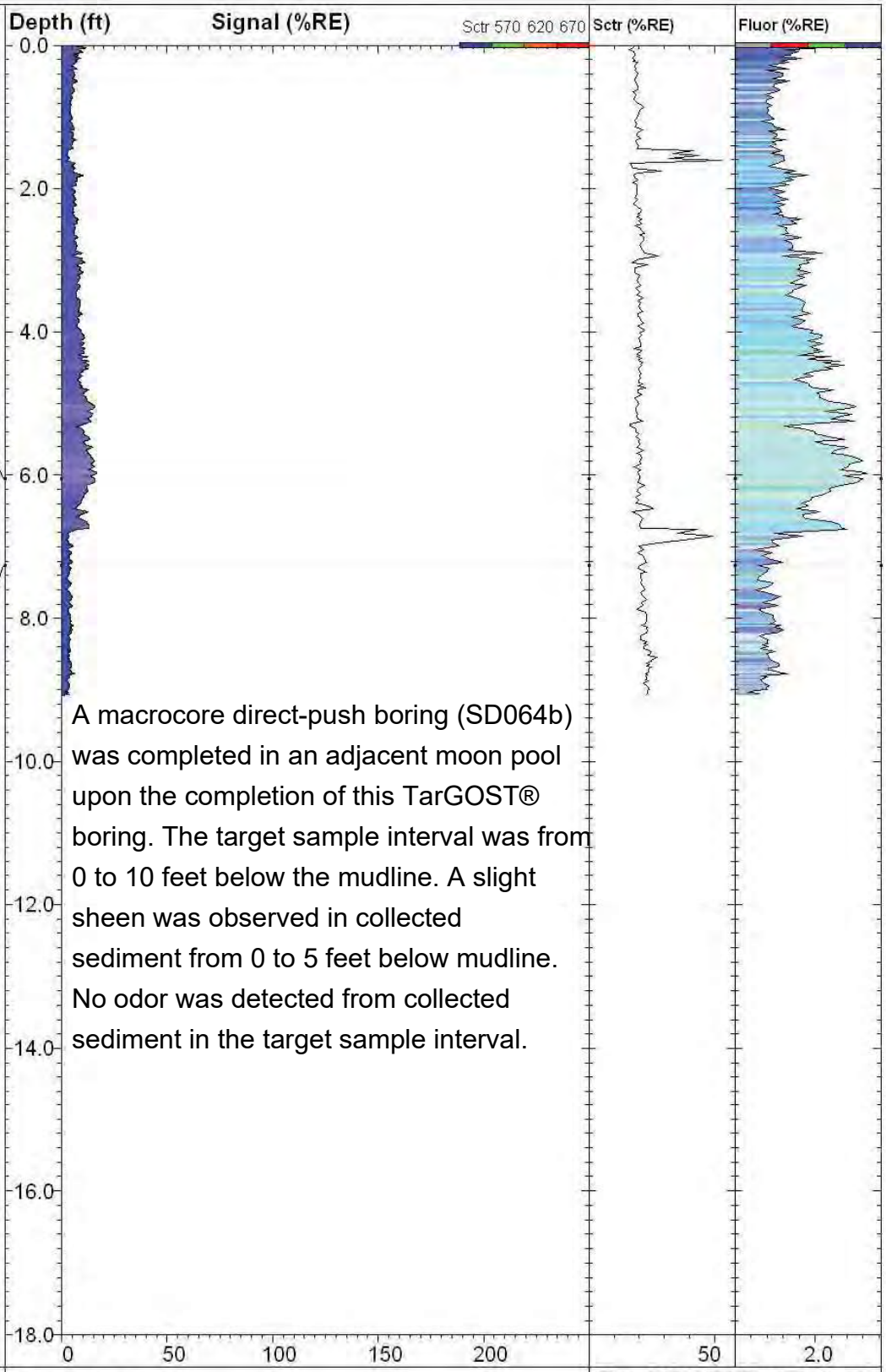
Callouts



6.1 ft
15.8 %RE



7.3 ft
2.9 %RE
background



A macrocore direct-push boring (SD064b) was completed in an adjacent moon pool upon the completion of this TarGOST® boring. The target sample interval was from 0 to 10 feet below the mudline. A slight sheen was observed in collected sediment from 0 to 5 feet below mudline. No odor was detected from collected sediment in the target sample interval.

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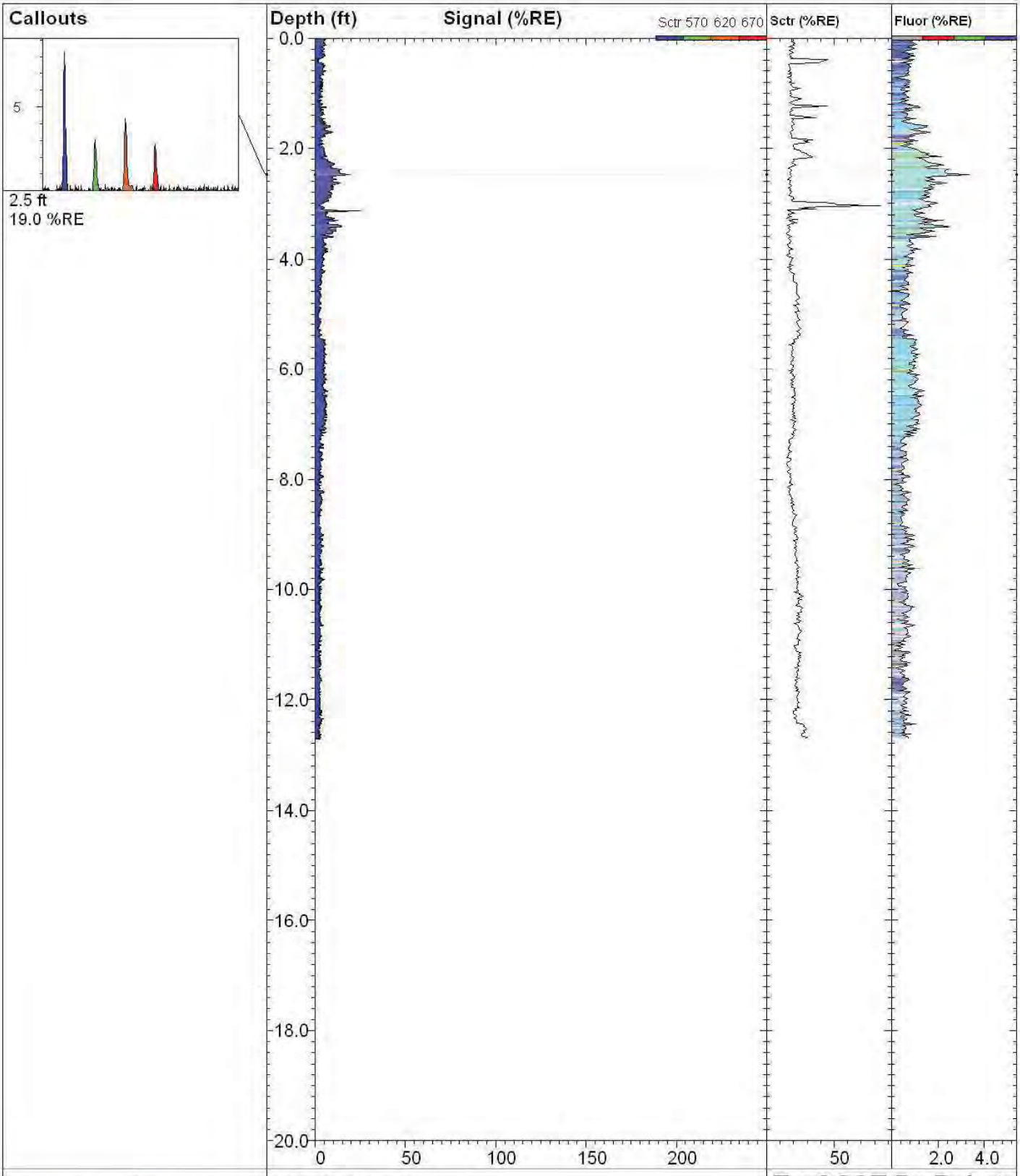
TGSD064

TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **9.07 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **16.8 %RE @ 5.98 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-19 10:18 PDT**



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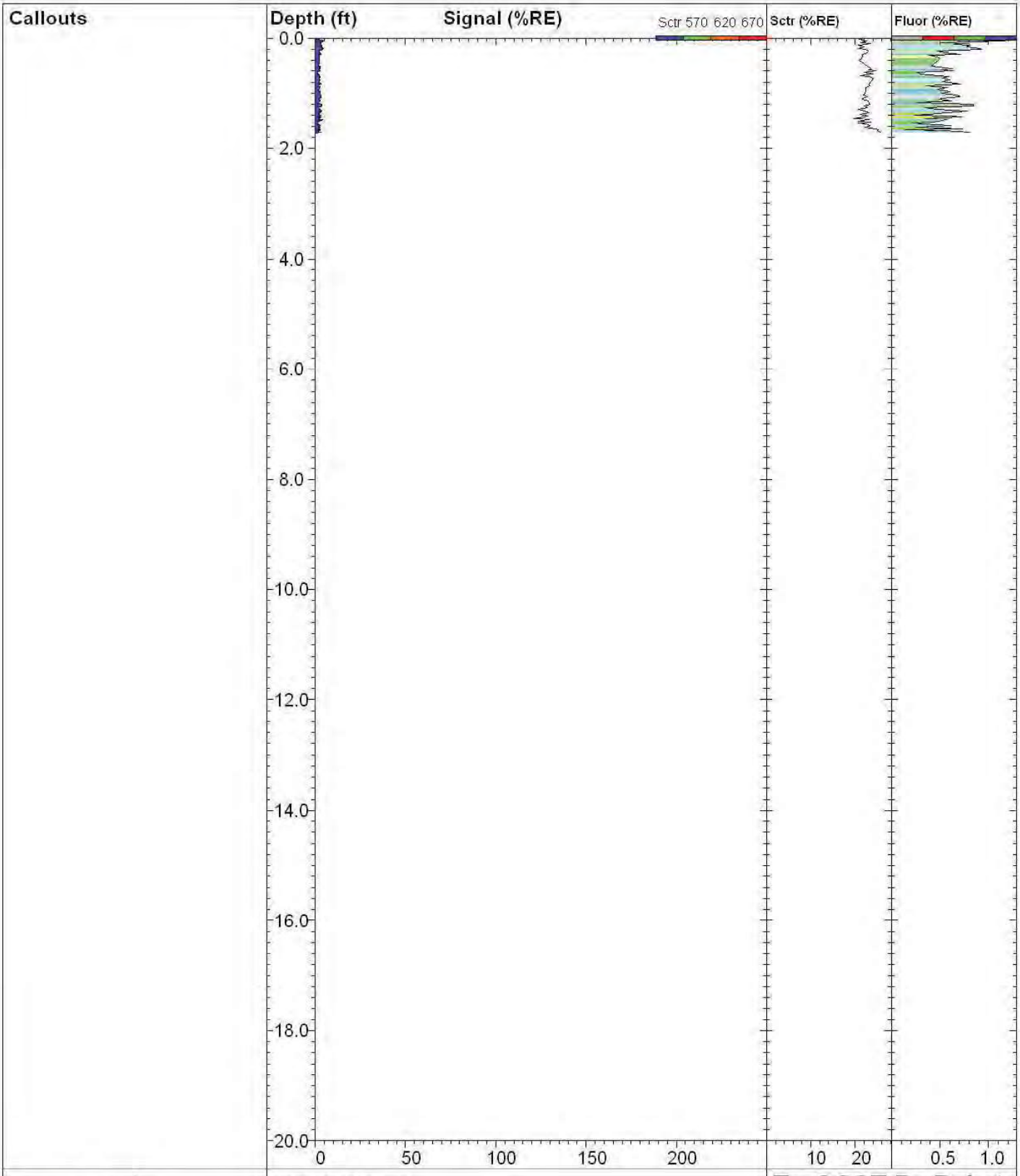
TGSD065

TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **12.72 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **25.4 %RE @ 3.13 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-20 10:07 PDT**



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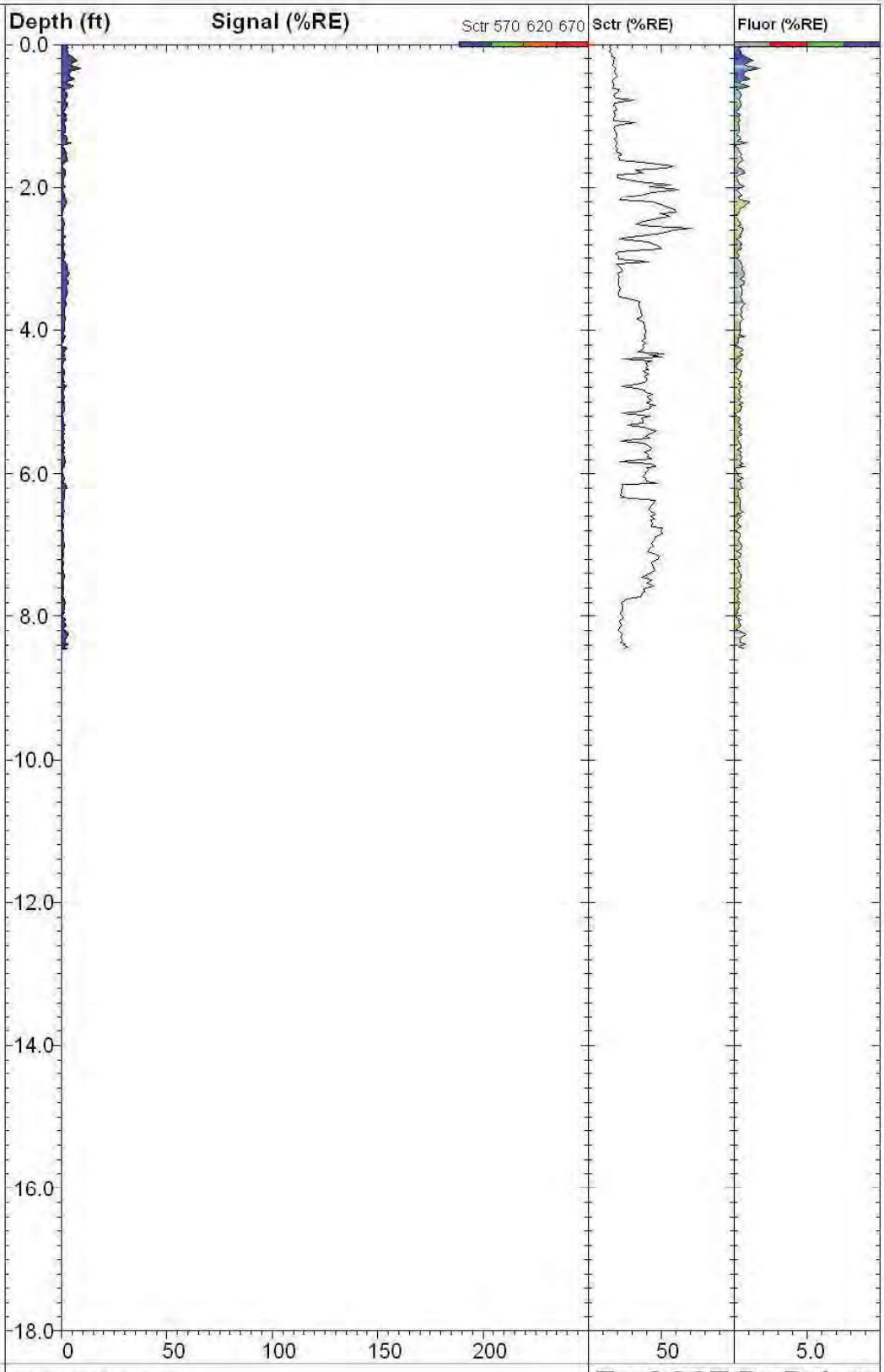
TGSD066

TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **1.72 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **5.2 %RE @ 0.05 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-21 11:17 PDT**

Callouts



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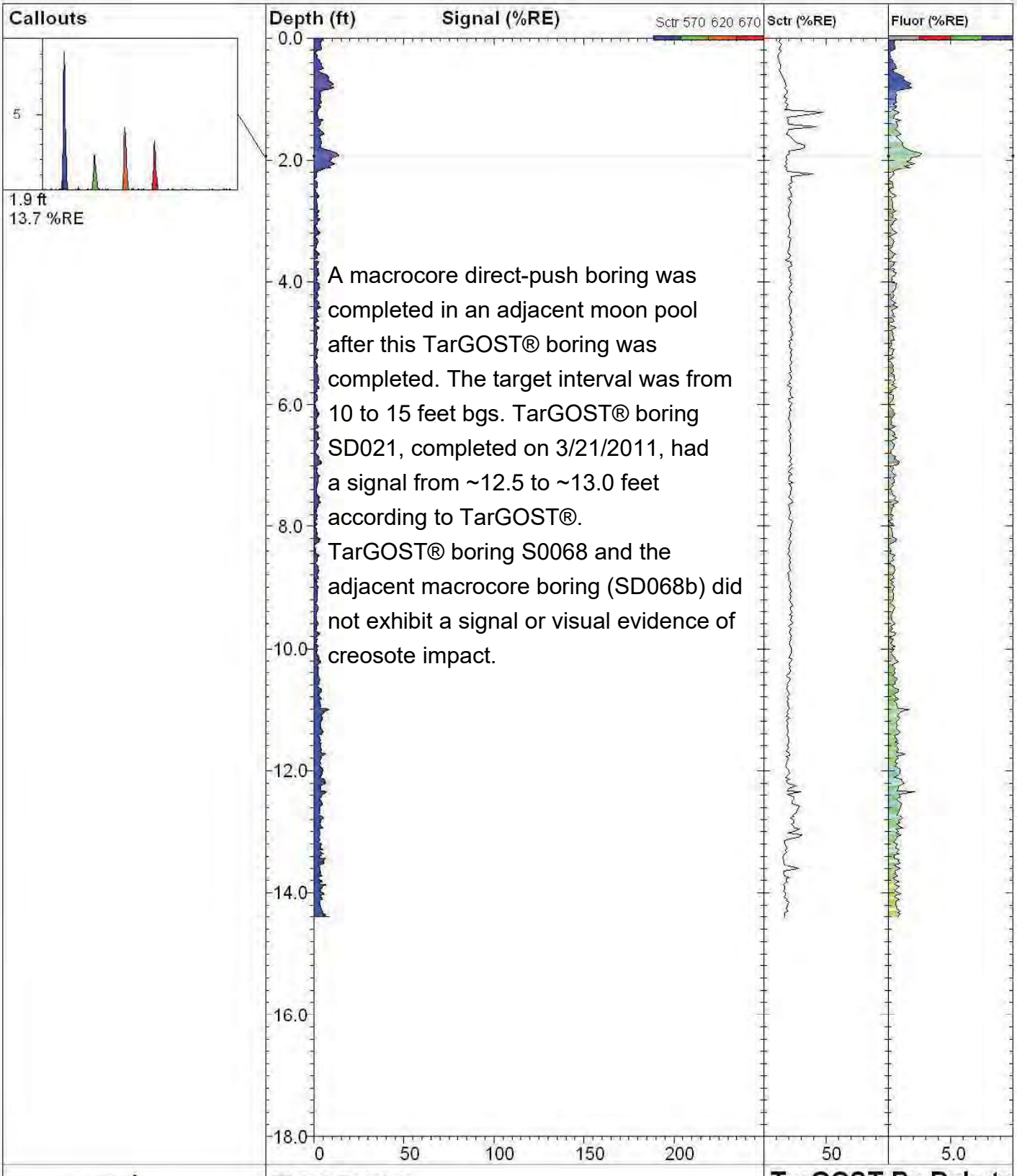
TGSD067

TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **8.46 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **9.1 %RE @ 0.33 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 16:38 PDT**



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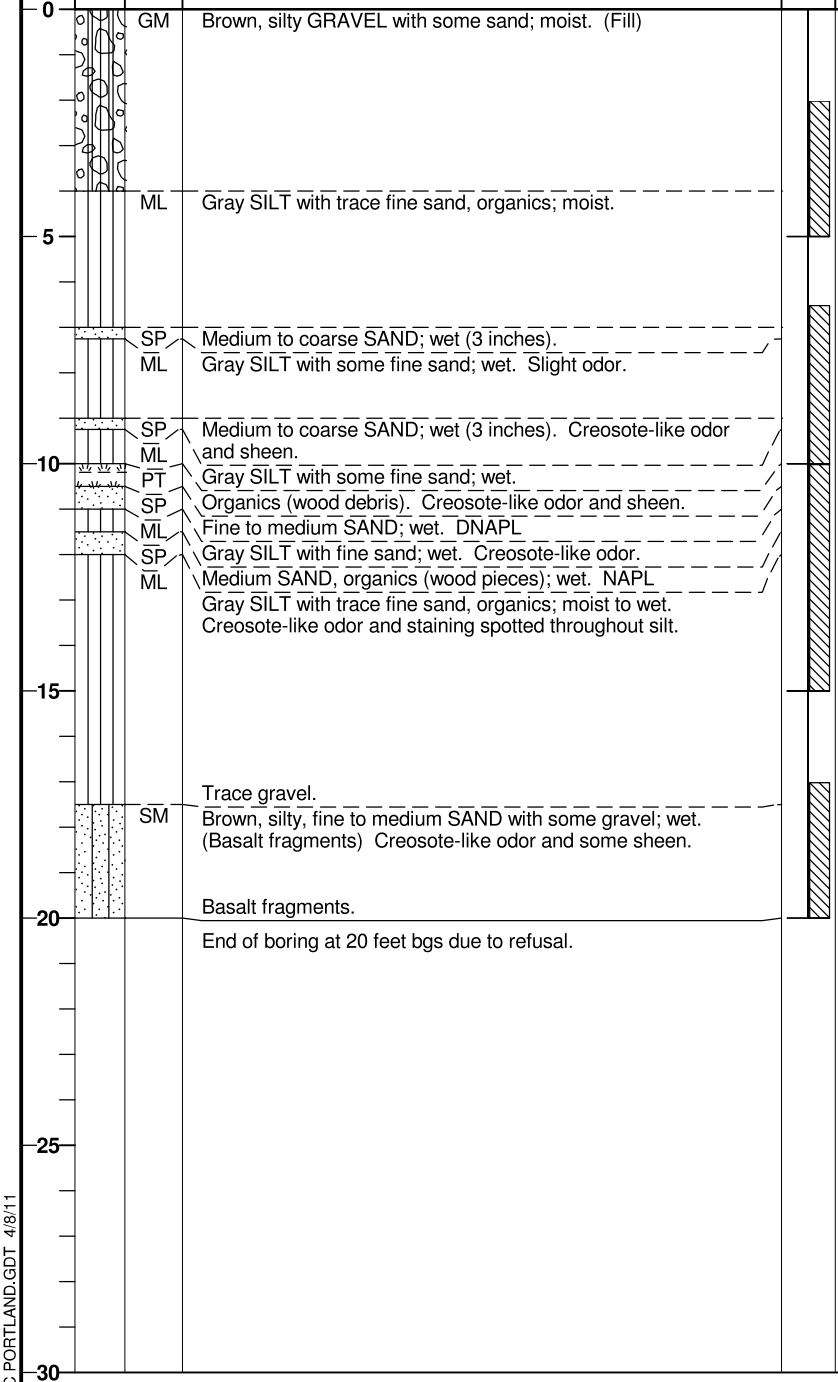
TGSD068

TarGOST By Dakota
www.DakotaTechnologies.com

Site: **Port of St. Helens**	*Y Coord.(Lat-N) / System:* **Unavailable / NA**	*Final depth:* **14.39 ft**
Client / Job: **AMEC /**	*X Coord.(Lng-E) / Fix:* **Unavailable / NA**	*Max signal:* **13.7 %RE @ 1.93 ft**
Operator / Unit: **SDA / TG1002**	*Elevation:* **Unavailable**	*Date & Time:* **2011-03-22 17:02 PDT**

Boring Logs



BORING METHOD: Direct Push

BOREHOLE DIAMETER: 2.0 (in)

DRILL RIG: Geoprobe

CONTRACTOR: Cascade Drilling

LOGGED BY: K. Harrington

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

START CARD/TAG ID: NA

DRILLING DATES: 3/14/2011 - 3/14/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING S016B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0			No recovery from 0 to 10 feet bgs. Targeting interval from 10 to 25 feet bgs.						
10		ML	Gray SILT; moist. Slight creosote-like odor on smeared section of macrocore, brown staining from organics (wood waste).						
15		SP	Gray, fine to medium SAND with organics (wood fragments); wet. Creosote present in sand.						
		MH	Gray SILT, highly plastic; wet. NAPL smeared on outside of core.						
20			NAPL staining in matrix at 18 feet bgs.						
			Free oil from 19 to 20 feet bgs.						
			NAPL from 22 to 25 feet bgs.						
25		GM	Brown, silty, coarse GRAVEL.						
			End of boring at 25 feet bgs due to refusal.						
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor, K. Harrington

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/15/2011 - 3/15/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING S020B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0			No recovery from 0 to 10 feet bgs. Targeting interval from 10 to 15 feet bgs.						
10		ML	Gray to black, sandy SILT, fine to coarse sand; wet.						
		SM	Silty SAND layer (3-4 inches). Black staining with creosote-like odor						
		ML	Grades to gray SILT, organics (wood particles), moist. Slight creosote-like odor.						
15			End of boring at 15 feet bgs.						
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor, K. Harrington

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/15/2011 - 3/15/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING S022B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0			No recovery from 0 to 8 feet bgs. Targeting interval from 8 to 15 feet bgs.						
5									
		ML	Medium to dark gray with minor brown mottling SILT with trace clay. Moderate creosote-like odor, no sheen.						
10		ML	Gray with brown mottling, sandy SILT. Strong creosote-like odor, sheen.						
15			End of boring at 15 feet bgs.						
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor, R, Johnston

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/18/2011 - 3/18/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
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LOG OF BORING S032B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SW	Gray to brown, fine to coarse SAND, with some fine gravel (to 3/4-inch diameter); wet.						
5		MH	Gray, clayey SILT with some gravel; high plasticity wet. No creosote-like odor or staining.						
			End of boring at 6 feet below mudline.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/23/2011 - 3/23/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
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LOG OF BORING SD001B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		MH	Clayey SILT with some rounded gravel on surface, highly plastic. Angular gravel at bottom of core. Competent basalt fragments.						
			End of boring at 1.5 feet bgs due to refusal.						
5									
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/23/2011 - 3/23/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING SD007B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0			No recovery from 0 to 1.5 feet bgs. Targeting interval from 1.5 to 6.5 feet bgs.						
		SM	Gray SILT and SAND, some organics (wood waste, small, 1/4-inch wood chips) present throughout. No creosote-like odor or staining.						
5			End of boring at 6.5 feet bgs due to refusal below mudline.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/22/2011 - 3/22/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING SD009B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0			No recovery from 0 to 2 feet bgs. Targeting interval from 2 to 7 feet bgs.						
		SM	Soft/loose, gray to black SILT and SAND; wet. Creosote-like odor and staining visible. Sheen observed when soil placed in water.						
5									
			End of boring at 7 feet bgs due to refusal below mudline.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/22/2011 - 3/22/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING SD010B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0			No recovery from 0 to 2 feet bgs. Targeting interval from 2 to 7 feet bgs.						
		MH	Gray to black SILT, high plasticity, organics (wood debris) present throughout. No creosote-like odor, only organic odor detected.						
5		SM	SAND and SILT.						
			End of boring at 7 feet below mudline.						
10									
15									
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/21/2011 - 3/21/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

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7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING SD012B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		ML	Grayish-brown SILT with some fine sand, organics (wood debris). No significant odor, slight sheen.						
5		SM	Gray, fine to coarse SAND with some silt. Slight sheen.						
		ML	SILT with some fine sand. No odor.						
10			Basalt fragments at 9.7 feet bgs. End of boring at 9.7 feet bgs due to refusal below mudline. Note: Angled boring - depth to mudline = 12.9 feet from boring surface.						
15									
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor, K. Harrington

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/19/2011 - 3/19/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

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7376 SW Durham Road
Portland, Oregon
USA 97224
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Fax (503) 620-7892

LOG OF BORING SD064B

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0			No recovery from 0 to 10 feet bgs. Targeting interval from 10 to 15 feet bgs.						
10		MH	Soft, gray-brown SILT, high plasticity. Organic odor. No creosote-like odor or staining.						
		GM	GRAVEL and organics (wood debris).						
15			End of boring at 15 feet below mudline.						
20									
25									
30									

BORING METHOD: Direct Push
BOREHOLE DIAMETER: 2.0 (in)
DRILL RIG: Geoprobe
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 3/22/2011 - 3/22/2011

REMARKS:

DIRECT PUSH BORING 9-61M-112202.GPJ AMEC PORTLAND.GDT 4/8/11

Port of St. Helens / Former Pope & Talbot Site

9-61M-112202

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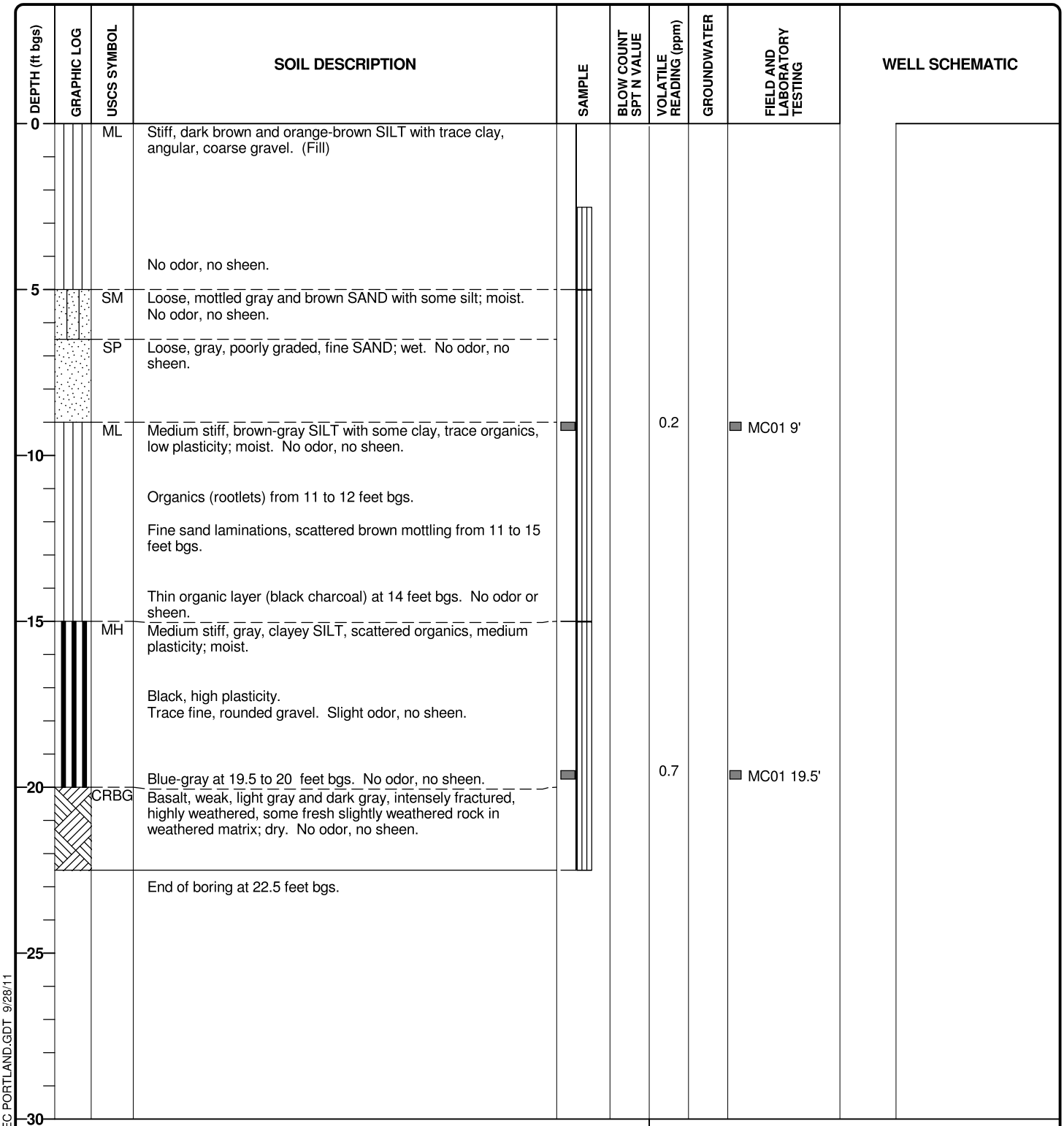
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING SD068B



BORING METHOD: Sonic
BOREHOLE DIAMETER: 4.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: NA
CASING ELEVATION: NA
START CARD/TAG ID: NA
DRILLING DATES: 7/21/2011 - 7/21/2011

REMARKS:
Vertical boring.
Collected with conventional sonic core.

Port of St. Helens

9-61M-112202.05

AMEC
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Portland, Oregon
USA 97224
Tel (503) 639-3400
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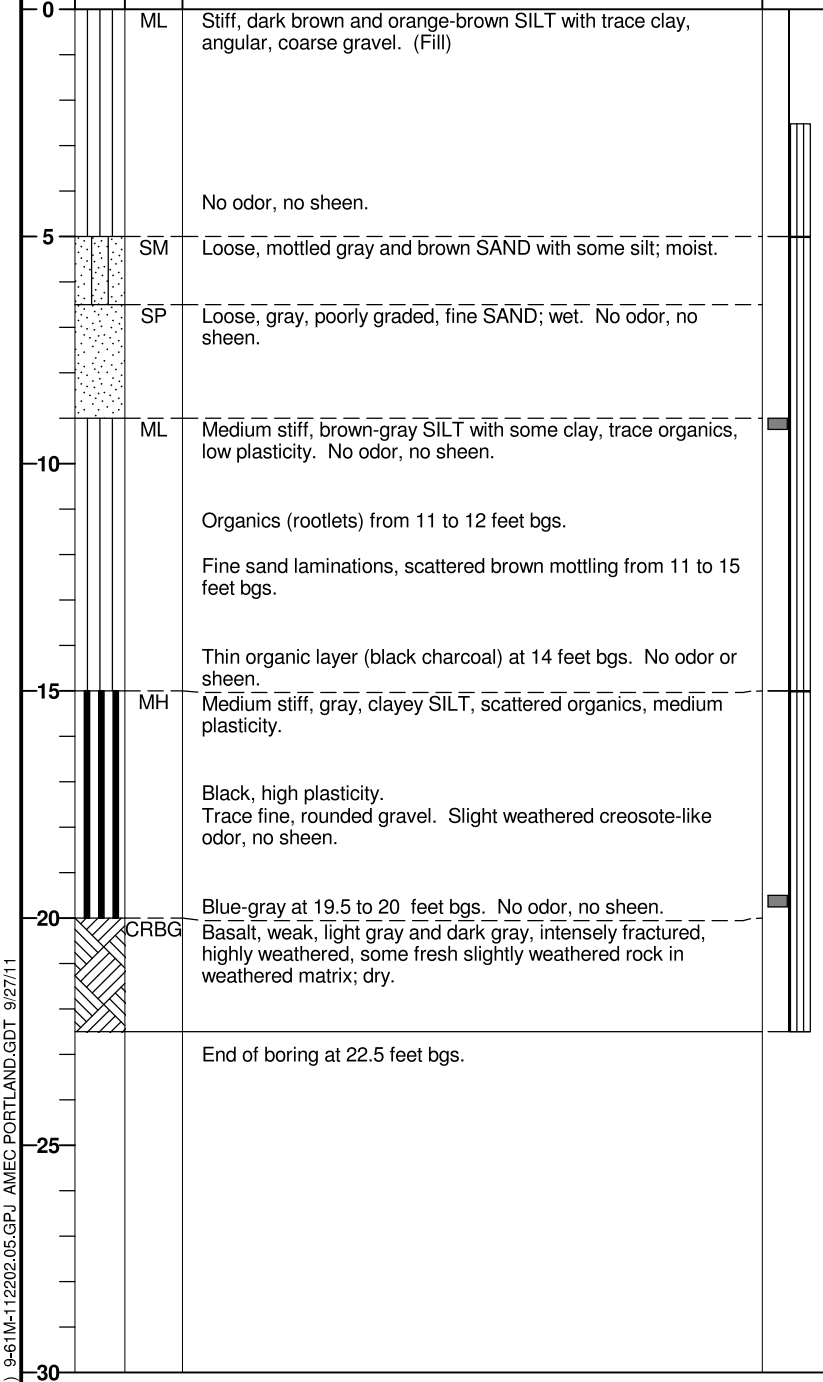
LOG OF BORING MC-01

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	ML	Stiff, dark brown and orange-brown SILT with trace clay, angular, coarse gravel. (Fill)		
		No odor, no sheen.		
5	SM	Loose, mottled gray and brown SAND with some silt; moist.		
	SP	Loose, gray, poorly graded, fine SAND; wet. No odor, no sheen.		
	ML	Medium stiff, brown-gray SILT with some clay, trace organics, low plasticity. No odor, no sheen.	0.2	MC1 9'
10		Organics (rootlets) from 11 to 12 feet bgs.		
		Fine sand laminations, scattered brown mottling from 11 to 15 feet bgs.		
		Thin organic layer (black charcoal) at 14 feet bgs. No odor or sheen.		
15	MH	Medium stiff, gray, clayey SILT, scattered organics, medium plasticity.		
		Black, high plasticity. Trace fine, rounded gravel. Slight weathered creosote-like odor, no sheen.		
		Blue-gray at 19.5 to 20 feet bgs. No odor, no sheen.	0.7	MC1 19.5'
20	CRBG	Basalt, weak, light gray and dark gray, intensely fractured, highly weathered, some fresh slightly weathered rock in weathered matrix; dry.		
		End of boring at 22.5 feet bgs.		
25				
30				

BORING METHOD: Sonic
BOREHOLE DIAMETER: 4.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: NA
CASING ELEVATION: NA
DRILLING DATES: 7/21/2011 - 7/21/2011

REMARKS:
Vertical boring.

Collected with conventional sonic core.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/27/11

Port of St. Helens

9-61M-112202.05

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING MC-1

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	ML	Very soft, gray SILT with occasional fine sand, trace clay; wet. No odor, no sheen.		
	SM	Organics (30%) and rock at 0.5 feet bgs.		
	ML	Loose, gray, silty, fine SAND; wet.		
		Soft, gray-brown SILT with occasional fine sand, trace clay, low plasticity; wet.		MC01A 2'
		Fine, silty SAND lenses (0.1 to 0.5 feet thick) within silt from 2.5 to 4.5 feet bgs. No odor, no sheen.	0.4	MC01A 4'
5	ML-MH	Medium stiff, gray SILT with some clay, low to medium plasticity; moist. No odor, no sheen.		
		Brown and gray.		
10	MH	Stiff, gray to gray-green, clayey SILT, medium plasticity; moist. No odor, no sheen.	1.4	MC01A 10.5'
		End of boring at 10.5 feet bgs.		
		First attempt ended at 3.5 feet bgs.		
15				
20				
25				
30				

SAMPLE

BLOW COUNT SPT N VALUE

GROUNDWATER

WELL SCHEMATIC

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

START CARD/TAG ID: NA

DRILLING DATES: 7/20/2011 - 7/20/2011

REMARKS:

Boring angle = 44 degrees. Angled depth depicted on log.

Collected with conventional sonic core.

Port of St. Helens

9-61M-112202.05

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LOG OF BORING MC-01A

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING
0	ML	Very soft, gray SILT with occasional fine sand, trace clay; wet. No odor, no sheen.					
	SM	Organics (30%) and rock at 0.5 feet bgs.					
	ML	Loose, gray, silty, fine SAND; wet.					
		Soft, gray-brown SILT with occasional fine sand, trace clay, low plasticity; wet. Fine, silty SAND lenses (0.1 to 0.5 feet thick) within silt from 2.5 to 4.5 feet bgs.					MC1A 2'
					0.4		MC1A 4'
5	ML-MH	Medium stiff, gray SILT with some clay, low to medium plasticity; moist. No odor, no sheen.					
		Brown and gray.					
10	MH	Stiff, gray to gray-green, clayey SILT, medium plasticity; moist. No odor, no sheen.			1.4		MC1A 10.5'
		End of boring at 10.5 feet bgs.					
		First attempt ended at 3.5 feet bgs.					
15							
20							
25							
30							

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/20/2011 - 7/20/2011

REMARKS:
Boring angle = 44 degrees. Angled depth depicted on log.

Collected with conventional sonic core.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/27/11

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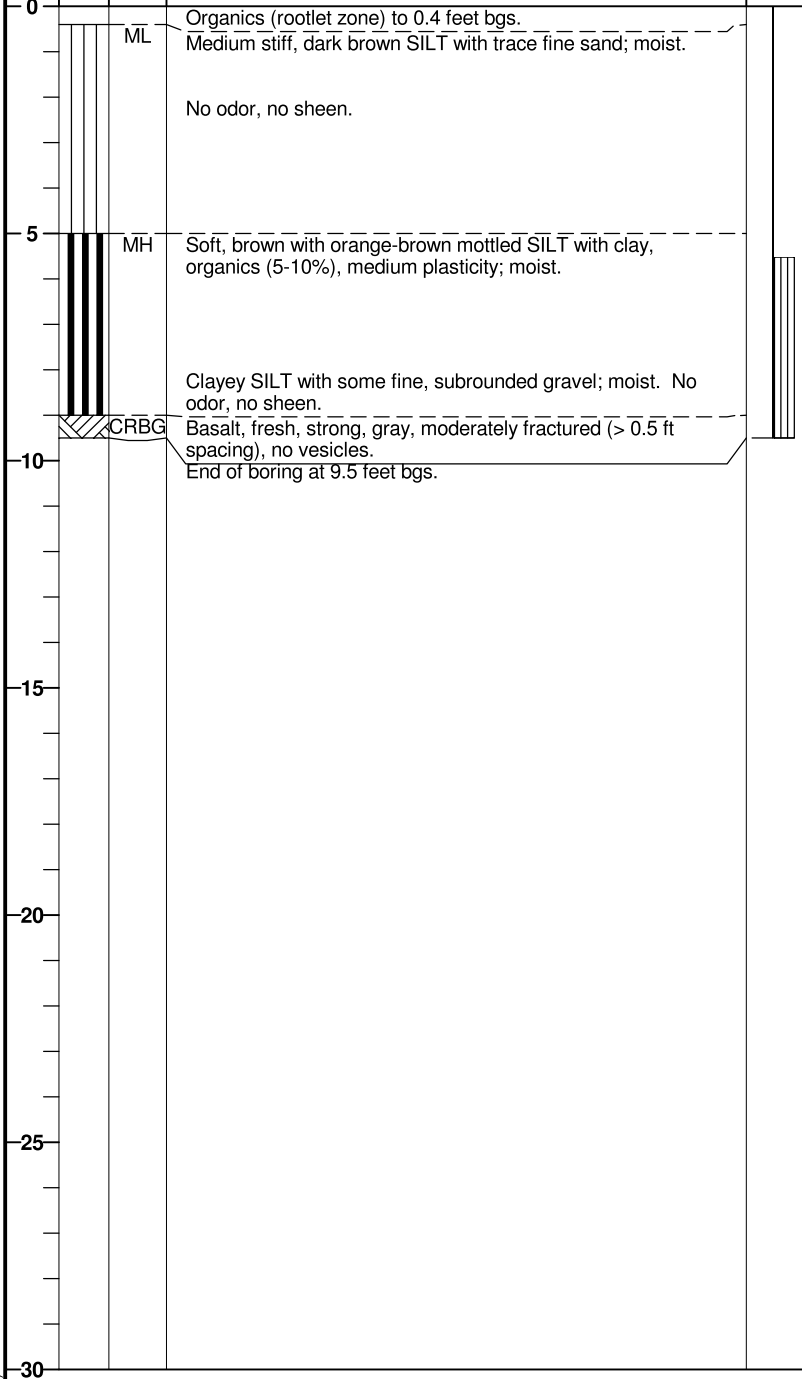
LOG OF BORING MC-1A



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/20/2011 - 7/20/2011

REMARKS:
Vertical boring.

Collected with conventional sonic core.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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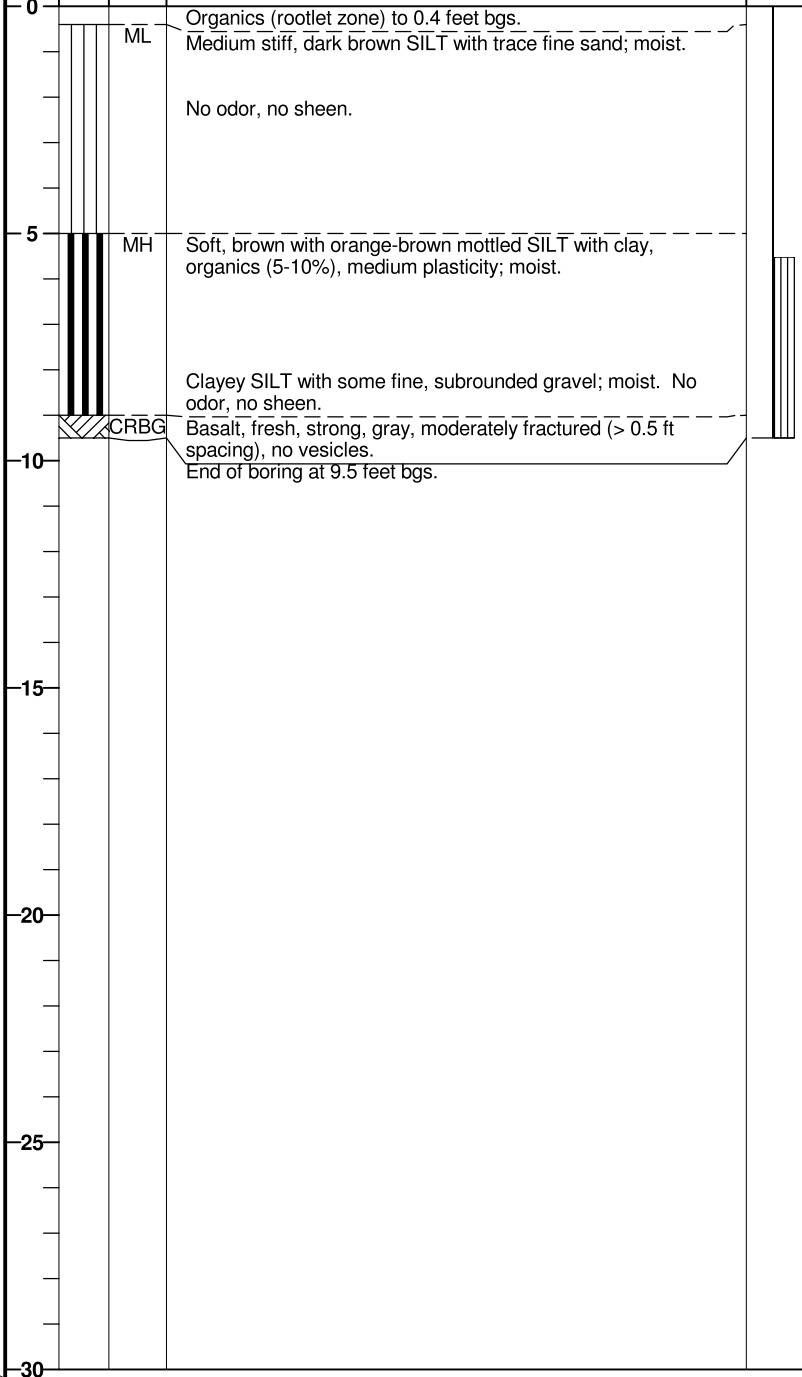
LOG OF BORING MC-02



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/20/2011 - 7/20/2011

REMARKS:
Vertical boring.

Collected with conventional sonic core.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/27/11

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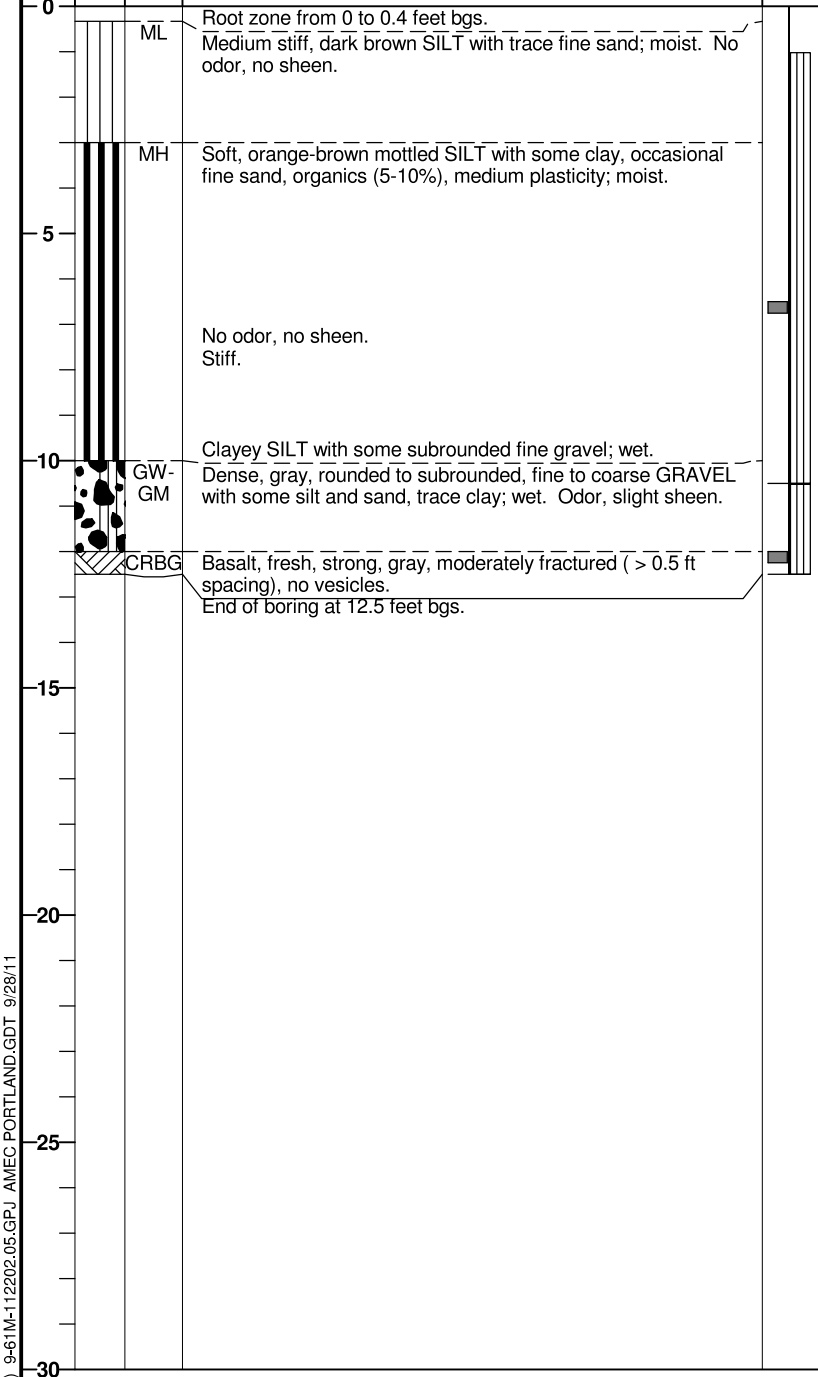
LOG OF BORING MC-2



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0		Root zone from 0 to 0.4 feet bgs.		
	ML	Medium stiff, dark brown SILT with trace fine sand; moist. No odor, no sheen.		
	MH	Soft, orange-brown mottled SILT with some clay, occasional fine sand, organics (5-10%), medium plasticity; moist.		
5			0.6	MC02A 6.5'
		No odor, no sheen. Stiff.		
		Clayey SILT with some subrounded fine gravel; wet.		
10	GW-GM	Dense, gray, rounded to subrounded, fine to coarse GRAVEL with some silt and sand, trace clay; wet. Odor, slight sheen.		
	CRBG	Basalt, fresh, strong, gray, moderately fractured (> 0.5 ft spacing), no vesicles.	1.5	MC02A 12'
		End of boring at 12.5 feet bgs.		
15				
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/20/2011 - 7/20/2011

REMARKS:
Boring angle = 59 degrees. Angled depth depicted on log.

Collected with conventional sonic core.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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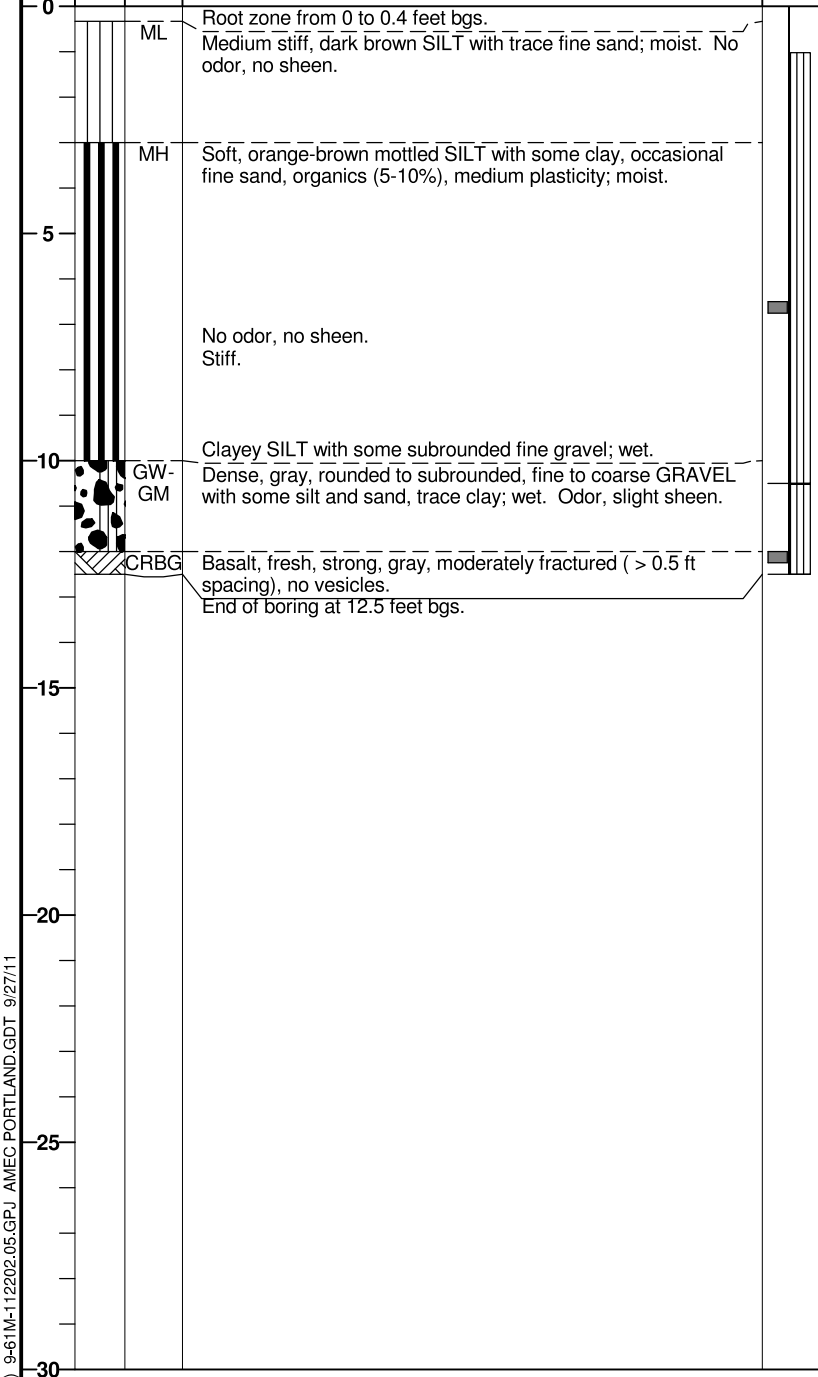
LOG OF BORING MC-02A



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0		Root zone from 0 to 0.4 feet bgs.		
	ML	Medium stiff, dark brown SILT with trace fine sand; moist. No odor, no sheen.		
	MH	Soft, orange-brown mottled SILT with some clay, occasional fine sand, organics (5-10%), medium plasticity; moist.		
5		No odor, no sheen. Stiff.	0.6	MC2 6.5'
10		Clayey SILT with some subrounded fine gravel; wet.		
	GW-GM	Dense, gray, rounded to subrounded, fine to coarse GRAVEL with some silt and sand, trace clay; wet. Odor, slight sheen.		
	CRBG	Basalt, fresh, strong, gray, moderately fractured (> 0.5 ft spacing), no vesicles.	1.5	MC2 12'
		End of boring at 12.5 feet bgs.		
15				
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/20/2011 - 7/20/2011

REMARKS:
Boring angle = 59 degrees. Angled depth depicted on log.

Collected with conventional sonic core.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/27/11

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LOG OF BORING MC-2A

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	ML	Soft, dark gray, clayey SILT, trace fine sand, low plasticity. No odor, no sheen.	0.1	MC04 0-0.3' Tot PAHs = 2.7 ppm Targ PAHs = < 0.5 ppm EDRO = 7.0 ppm
		No odor, no sheen.	0.7	MC04 3.3' Tot PAHs = 0.76 ppm Targ PAHs = < 0.10 ppm EDRO = 2.1 ppm
5		Trace rounded gravel at 5.5 feet bgs. No recovery from 6 to 8 feet bgs.		
		Some rounded gravel, trace sand, trace cobbles at 8.5 feet bgs. No odor, no sheen.	0.5	MC04 9.5' Tot PAHs = 0.26 ppm Targ PAHs = < 0.10 ppm EDRO = 1.3 ppm
10	CRBG	Basalt, fresh, strong, gray, aphanitic, intensely fractured, (0.1 ft fracture spacing), minor amounts of manganese mineralization, no vesicles. No odor, no sheen.		
		End of boring at 12 feet bgs.		
15				
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/12/2011 - 7/12/2011

REMARKS:
Sonic with vibracore from 0 to 9 feet bgs; split core from 9 to 12 feet bgs.

Mudline is 10 feet below water.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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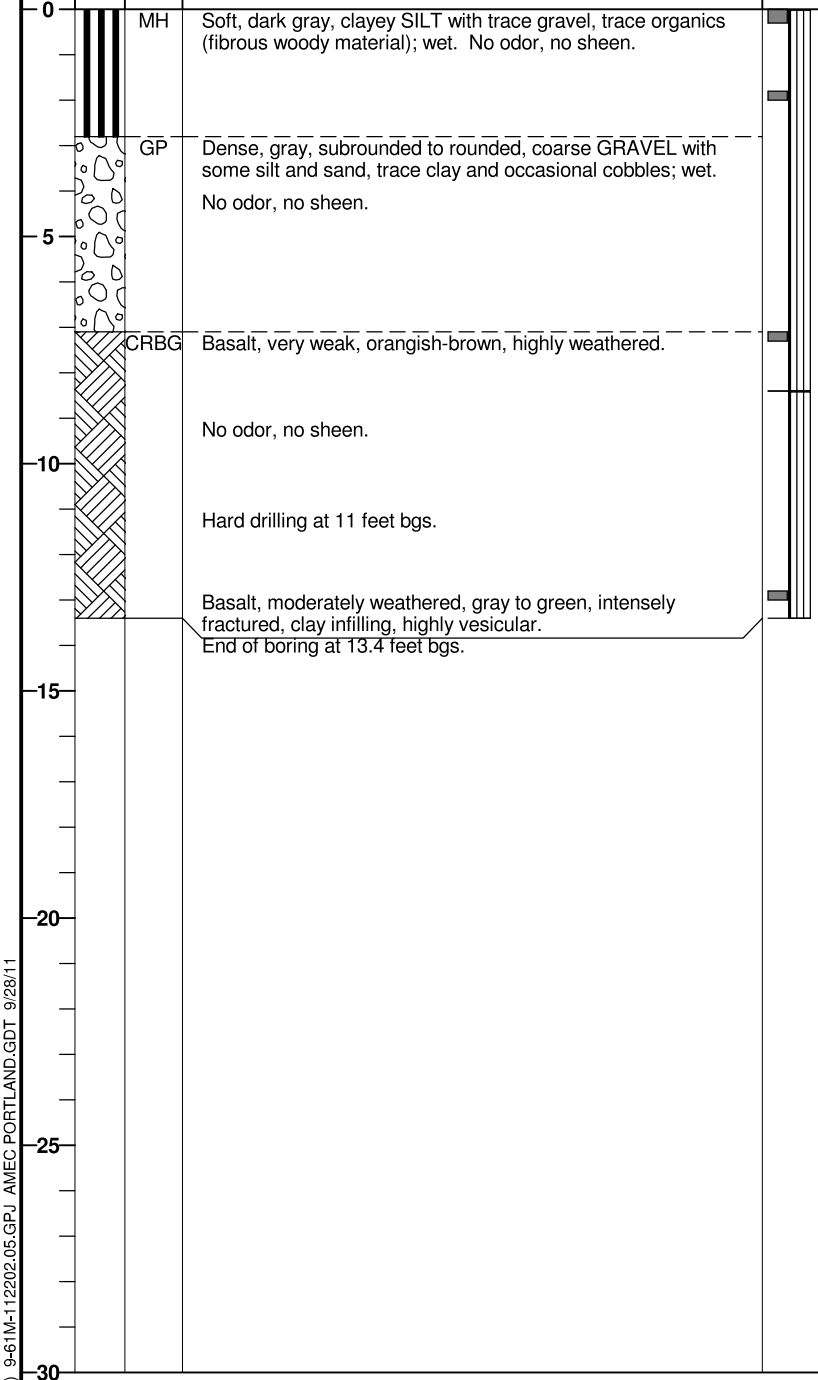
LOG OF BORING MC-04

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/12/2011 - 7/12/2011

REMARKS:
Mudline is 8.4 feet below water.

Collected sonic cores with split spoon core barrel with Lexan liner.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

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LOG OF BORING MC-03

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING	WELL SCHEMATIC
0		GP	Gray, angular, fine GRAVEL with some sand. (Fill)						
		SP	Poorly graded, fine SAND with trace cobbles. (Fill)						
		GP	Dense, gray, silty, rounded to subrounded, fine GRAVEL; moist. (Fill)			0.4			
5		SP	Loose, brown, poorly graded, fine SAND; moist. (Fill)						
10						0.4			
			Gray.						
15			Wet. Strong odor, heavy sheen. NAPL (< 1 mm thick layer) in jar with water.			40			
		ML	Soft, gray SILT with trace clay. Sand laminations with NAPL and heavy sheen from 16 to 17 feet bgs. NAPL in micropore from 17 to 17.5 feet bgs.			41			
20			End of boring at 20 feet bgs.						
25									
30									

BORING METHOD: Sonic

BOREHOLE DIAMETER: 6.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

START CARD/TAG ID: NA

DRILLING DATES: 7/19/2011 - 7/19/2011

REMARKS:

No well completed due to presence of potentially mobile NAPL at 15 to 17.5 feet bgs. Moved well location to east.

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9-61M-112202.05

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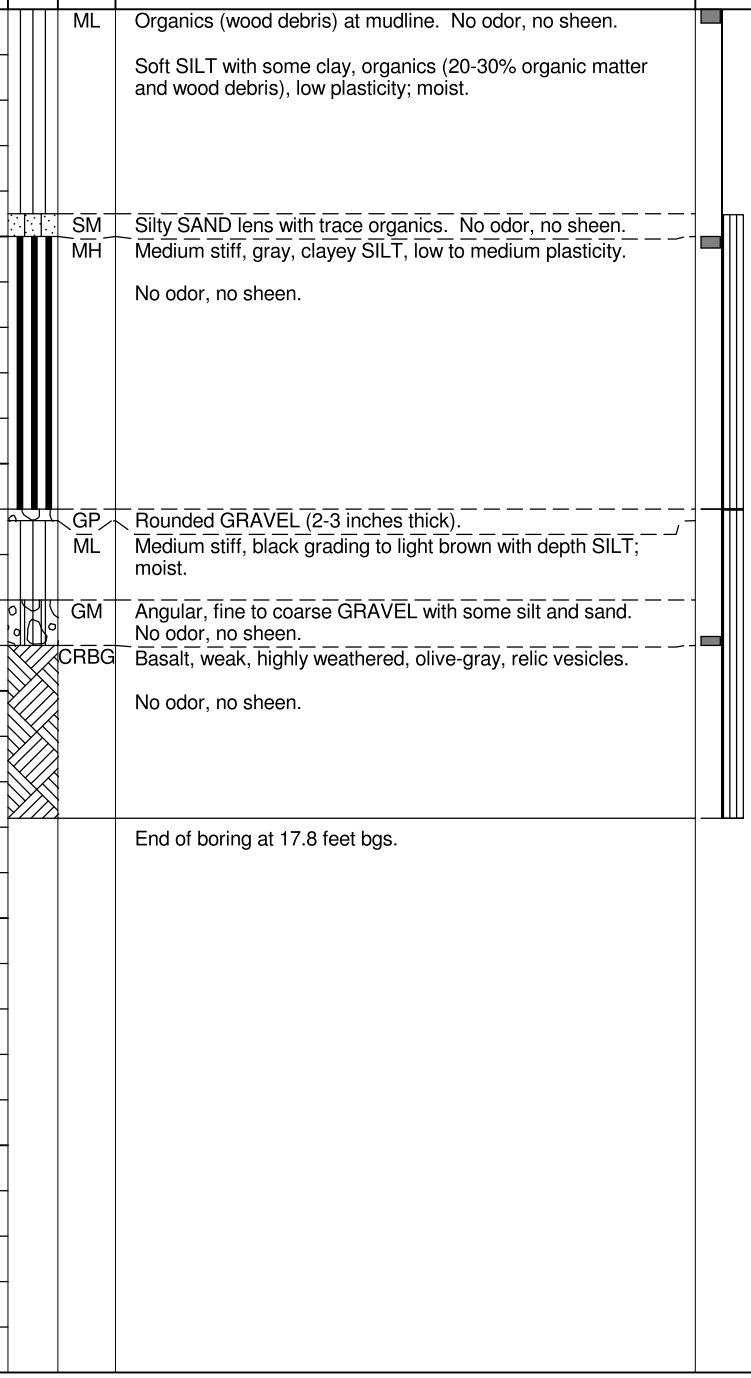
LOG OF BORING MW-22 (Abandoned)

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/27/11



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING
0	ML	Organics (wood debris) at mudline. No odor, no sheen. Soft SILT with some clay, organics (20-30% organic matter and wood debris), low plasticity; moist.		0.1		SB1 0-0.3' Tot PAHs = 6.8 ppm Targ PAHs = 0.97 ppm EDRO = 19 ppm
5	SM	Silty SAND lens with trace organics. No odor, no sheen.				
	MH	Medium stiff, gray, clayey SILT, low to medium plasticity. No odor, no sheen.		0.2		SB1 5' Tot PAHs = 32 ppm Targ PAHs = < 5.0 ppm EDRO = 84 ppm
10	GP	Rounded GRAVEL (2-3 inches thick).				
	ML	Medium stiff, black grading to light brown with depth SILT; moist.				
	GM	Angular, fine to coarse GRAVEL with some silt and sand. No odor, no sheen.		0.3		SB1 13.8' Tot PAHs = 3.1 ppm Targ PAHs = 0.50 ppm EDRO = 6.4 ppm
15	CRBG	Basalt, weak, highly weathered, olive-gray, relic vesicles. No odor, no sheen.				
		End of boring at 17.8 feet bgs.				
20						
25						
30						

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/14/2011 - 7/14/2011

REMARKS:
Vibracore from 0 to 11 feet bgs; conventional sonic core from 11 to 17.8 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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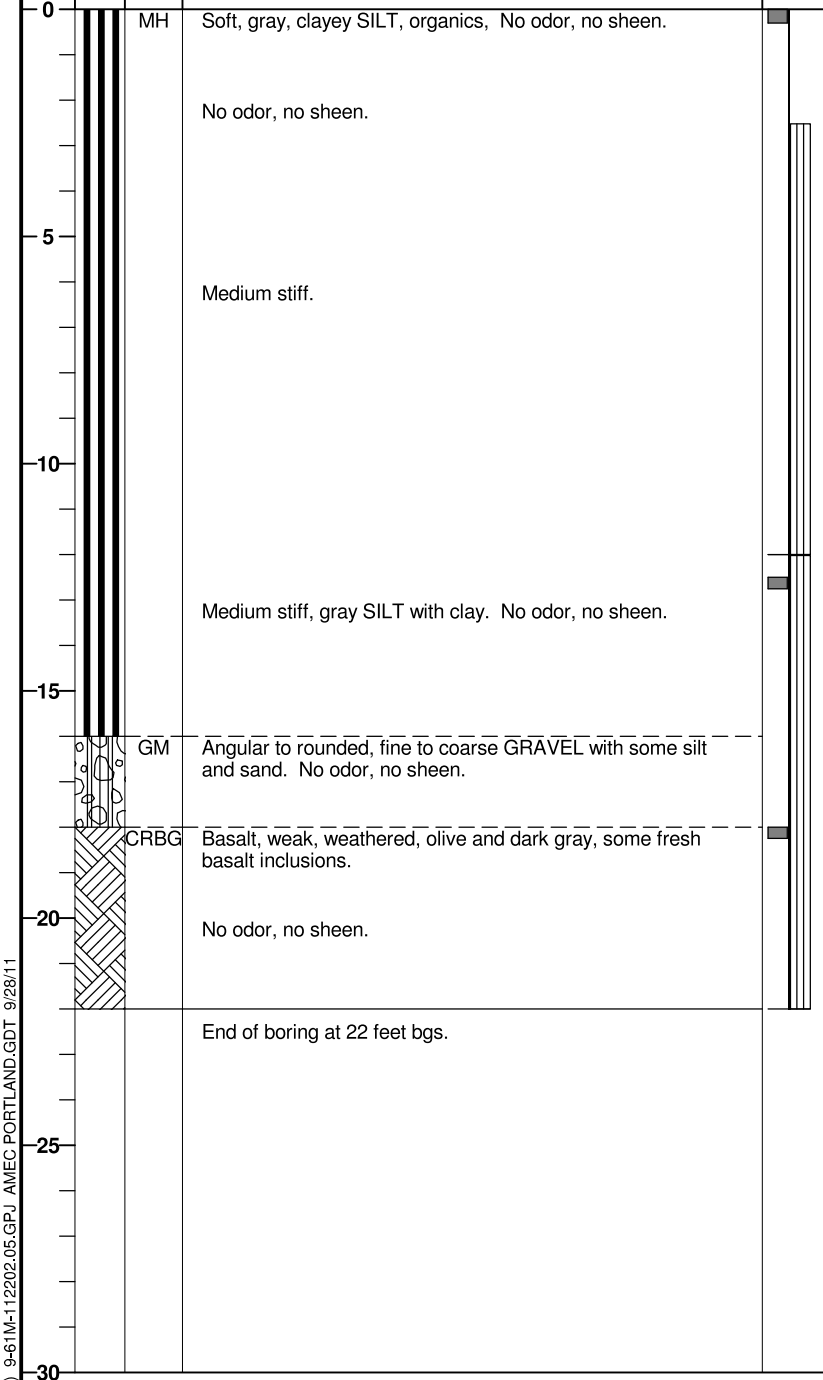
LOG OF BORING SB-01



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	MH	Soft, gray, clayey SILT, organics, No odor, no sheen.	0.1	SB3 0-0.3' Tot PAHs = 5.8 ppm Targ PAHs = 0.70 ppm EDRO = 16 ppm
		No odor, no sheen.		
5		Medium stiff.		
10		Medium stiff, gray SILT with clay. No odor, no sheen.	0.1	SB3 12.5' Tot PAHs = 0.83 ppm Targ PAHs = < 0.20 ppm EDRO = 2.3 ppm
15	GM	Angular to rounded, fine to coarse GRAVEL with some silt and sand. No odor, no sheen.		
	CRBG	Basalt, weak, weathered, olive and dark gray, some fresh basalt inclusions.	0.2	SB3 18' Tot PAHs = 1.2 ppm Targ PAHs = 0.16 ppm EDRO = 3.6 ppm
20		No odor, no sheen.		
		End of boring at 22 feet bgs.		
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/14/2011 - 7/14/2011

REMARKS:
Van Veen sampler from 0 to 0.3 feet bgs.

Vibracore from 0 to 12 feet bgs; conventional sonic core from 12 to 22 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

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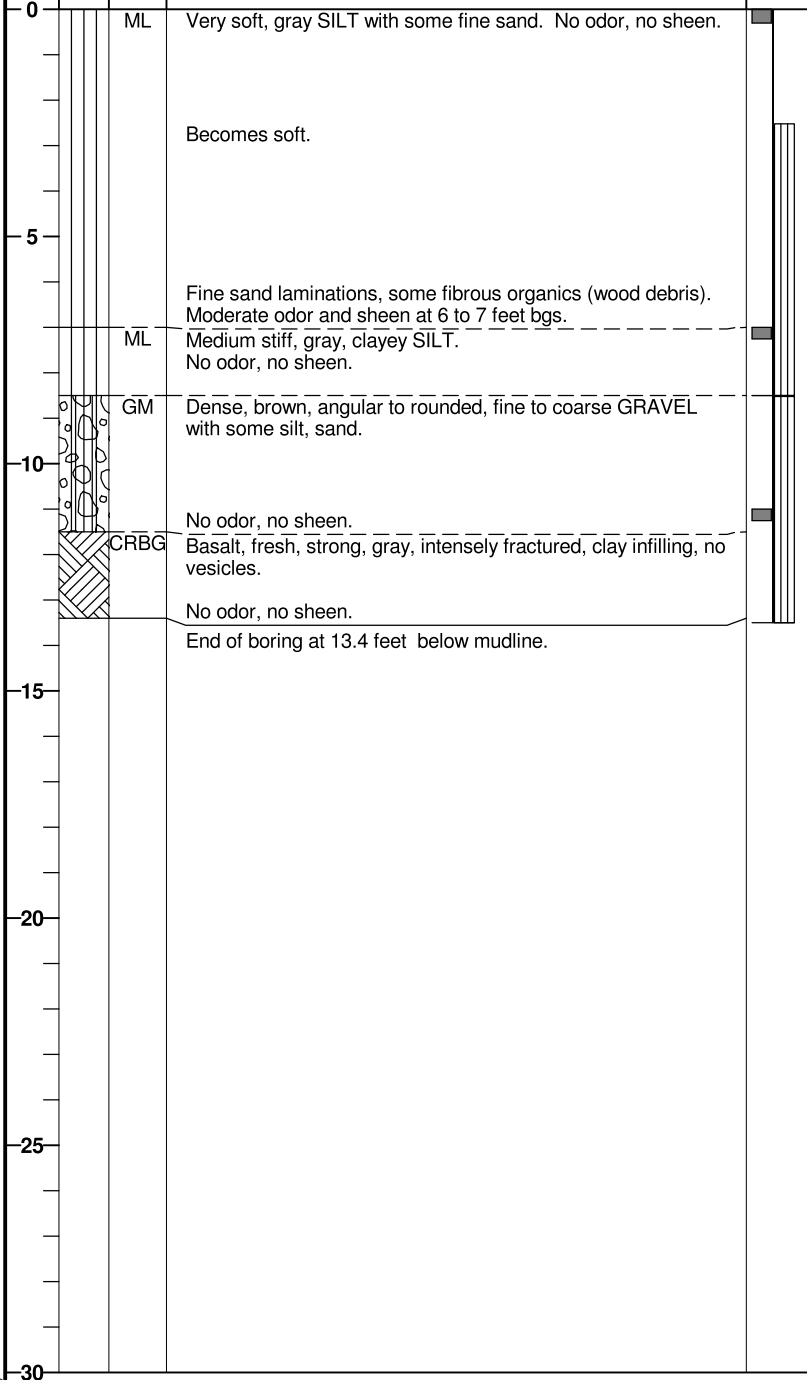
LOG OF BORING SB-02



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/14/2011 - 7/14/2011

REMARKS:
Vibracore from 0 to 12 feet bgs; conventional sonic core from 12 to 22 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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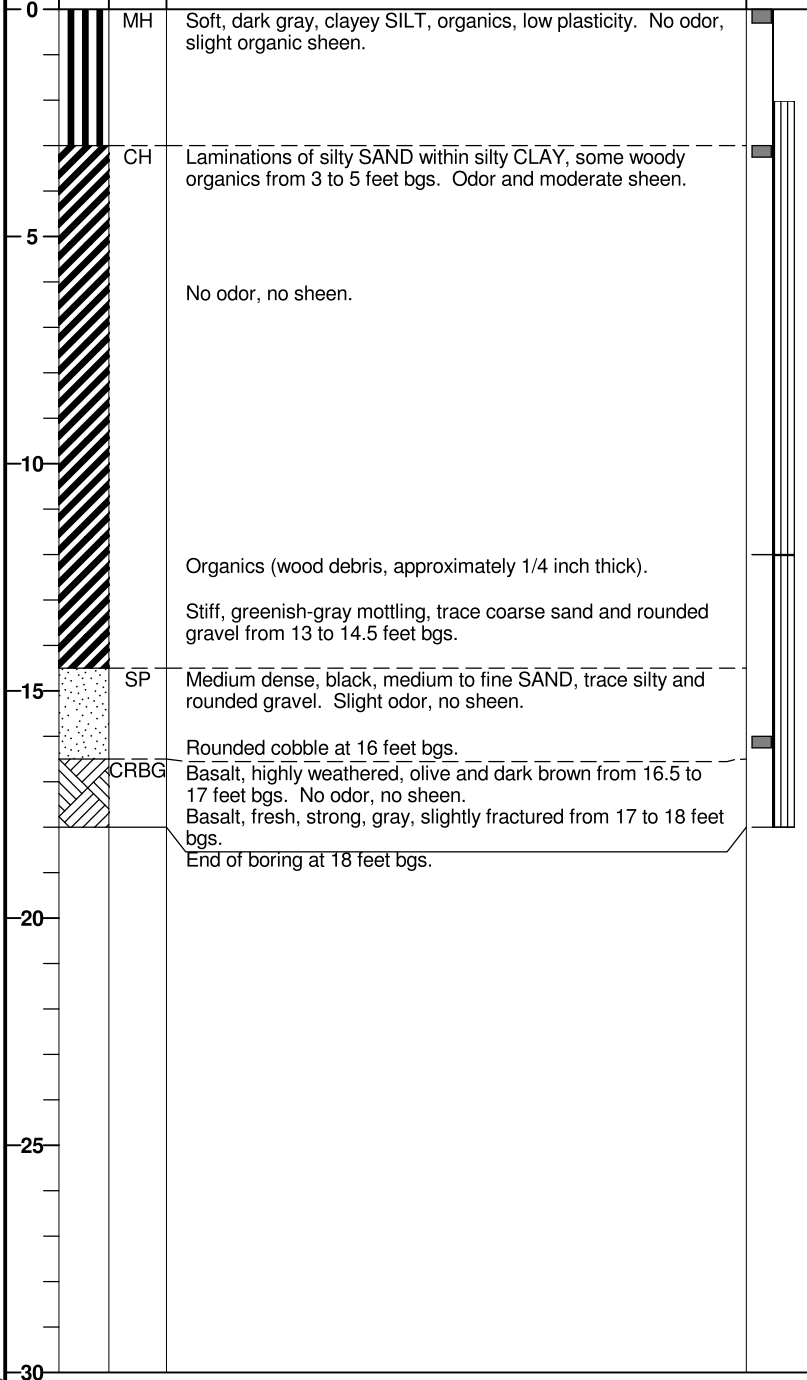
LOG OF BORING SB-03

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	MH	Soft, dark gray, clayey SILT, organics, low plasticity. No odor, slight organic sheen.	0.0	SB4 0-0.3' Tot PAHs = 14 ppm Targ PAHs = 1.5 ppm EDRO = 34 ppm
	CH	Laminations of silty SAND within silty CLAY, some woody organics from 3 to 5 feet bgs. Odor and moderate sheen.	2.1	SB4 3' Tot PAHs = 2,700 ppm Targ PAHs = < 500 ppm EDRO = 7,100 ppm
5		No odor, no sheen.		
10		Organics (wood debris, approximately 1/4 inch thick). Stiff, greenish-gray mottling, trace coarse sand and rounded gravel from 13 to 14.5 feet bgs.		
15	SP	Medium dense, black, medium to fine SAND, trace silty and rounded gravel. Slight odor, no sheen. Rounded cobble at 16 feet bgs.	1.0	SB4 16' Tot PAHs = 4.6 ppm Targ PAHs = < 1.0 ppm EDRO = 14 ppm
	CRBG	Basalt, highly weathered, olive and dark brown from 16.5 to 17 feet bgs. No odor, no sheen. Basalt, fresh, strong, gray, slightly fractured from 17 to 18 feet bgs. End of boring at 18 feet bgs.		
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/14/2011 - 7/14/2011

REMARKS:
Vibracore from 0 to 12 feet bgs; conventional sonic core from 12 to 18 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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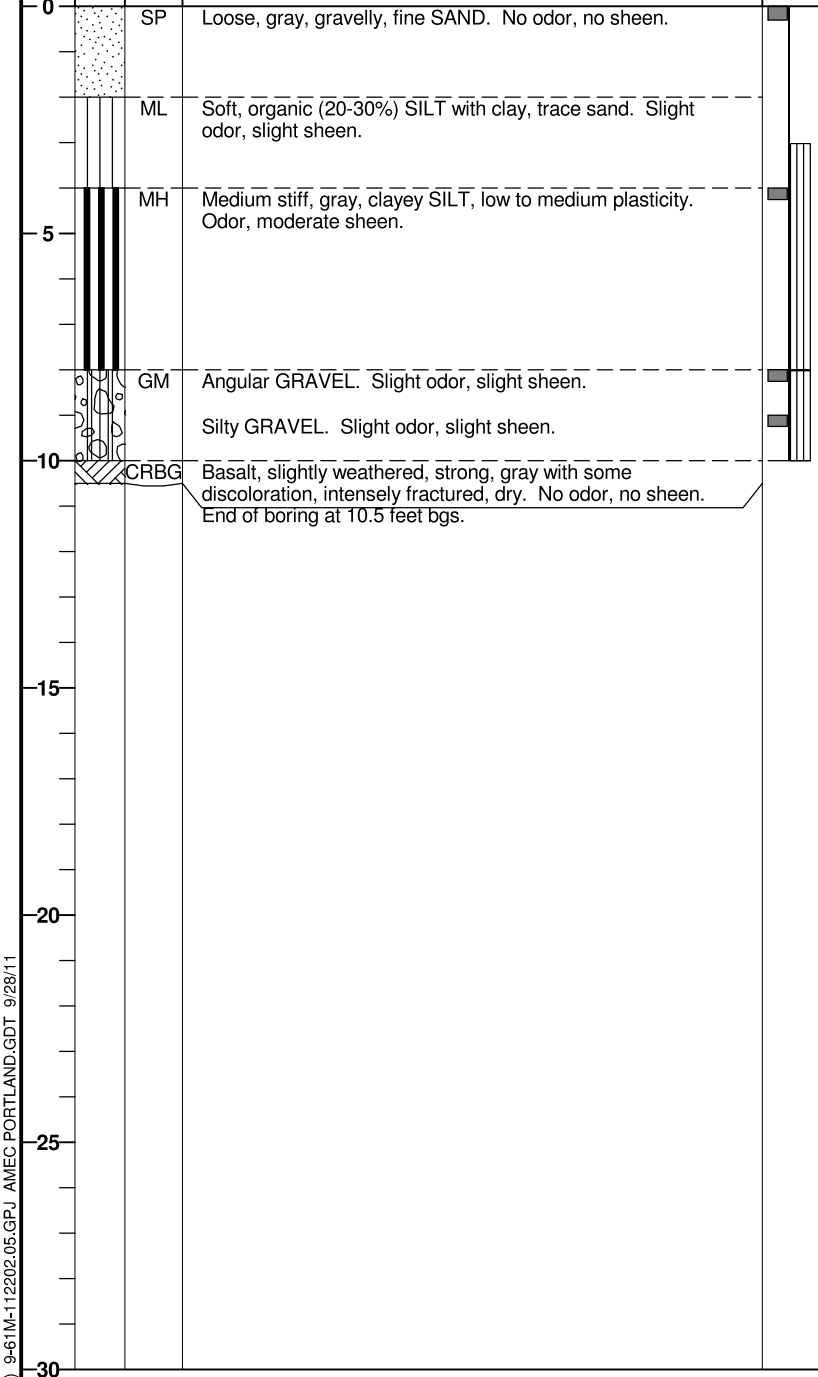
LOG OF BORING SB-04



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	SP	Loose, gray, gravelly, fine SAND. No odor, no sheen.	0.3	SB5 0-0.3' Tot PAHs = 6.0 ppm Targ PAHs = < 10 ppm EDRO = 40 ppm
	ML	Soft, organic (20-30%) SILT with clay, trace sand. Slight odor, slight sheen.		
	MH	Medium stiff, gray, clayey SILT, low to medium plasticity. Odor, moderate sheen.	3.1	SB5 4' Tot PAHs = 7,400 ppm Targ PAHs = 1,000 ppm EDRO = 19,000 ppm
5				
	GM	Angular GRAVEL. Slight odor, slight sheen.	0.8	SB5 8' Tot PAHs = 77 ppm
		Silty GRAVEL. Slight odor, slight sheen.	1.9	Targ PAHs = < 10 ppm EDRO = 240 ppm SB5 9' Tot PAHs = 310 ppm Targ PAHs = 36 ppm EDRO = 750 ppm
10	CRBG	Basalt, slightly weathered, strong, gray with some discoloration, intensely fractured, dry. No odor, no sheen. End of boring at 10.5 feet bgs.		
15				
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/14/2011 - 7/14/2011

REMARKS:
Vibracore from 0 to 8 feet bgs; conventional sonic core from 8 to 10.5 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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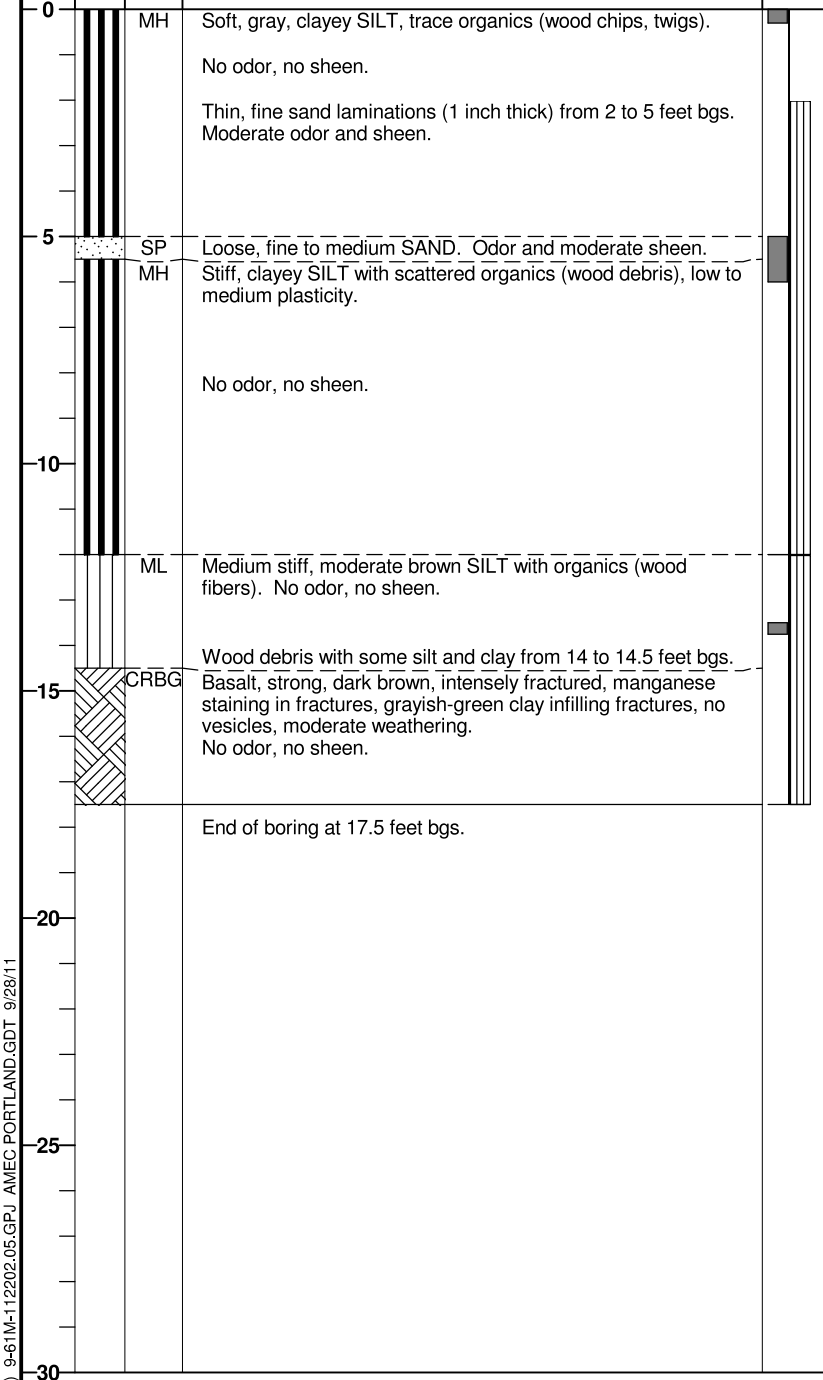
LOG OF BORING SB-05



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	MH	Soft, gray, clayey SILT, trace organics (wood chips, twigs). No odor, no sheen. Thin, fine sand laminations (1 inch thick) from 2 to 5 feet bgs. Moderate odor and sheen.	0.1	SB6 0-0.3' Tot PAHs = 11 ppm Targ PAHs = < 2.0 ppm EDRO = 30 ppm
5	SP	Loose, fine to medium SAND. Odor and moderate sheen.		
	MH	Stiff, clayey SILT with scattered organics (wood debris), low to medium plasticity. No odor, no sheen.	0.8	SB6 6-7' Tot PAHs = 810 ppm Targ PAHs = < 50 ppm EDRO = 2,200 ppm
10	ML	Medium stiff, moderate brown SILT with organics (wood fibers). No odor, no sheen. Wood debris with some silt and clay from 14 to 14.5 feet bgs.	0.3	SB6 13.5' Tot PAHs = 3.4 ppm Targ PAHs = 0.46 ppm EDRO = 8.8 ppm
15	CRBG	Basalt, strong, dark brown, intensely fractured, manganese staining in fractures, grayish-green clay infilling fractures, no vesicles, moderate weathering. No odor, no sheen.		
		End of boring at 17.5 feet bgs.		
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/14/2011 - 7/14/2011

REMARKS:
Vibracore from 0 to 12 feet bgs; conventional sonic core from 12 to 17.5 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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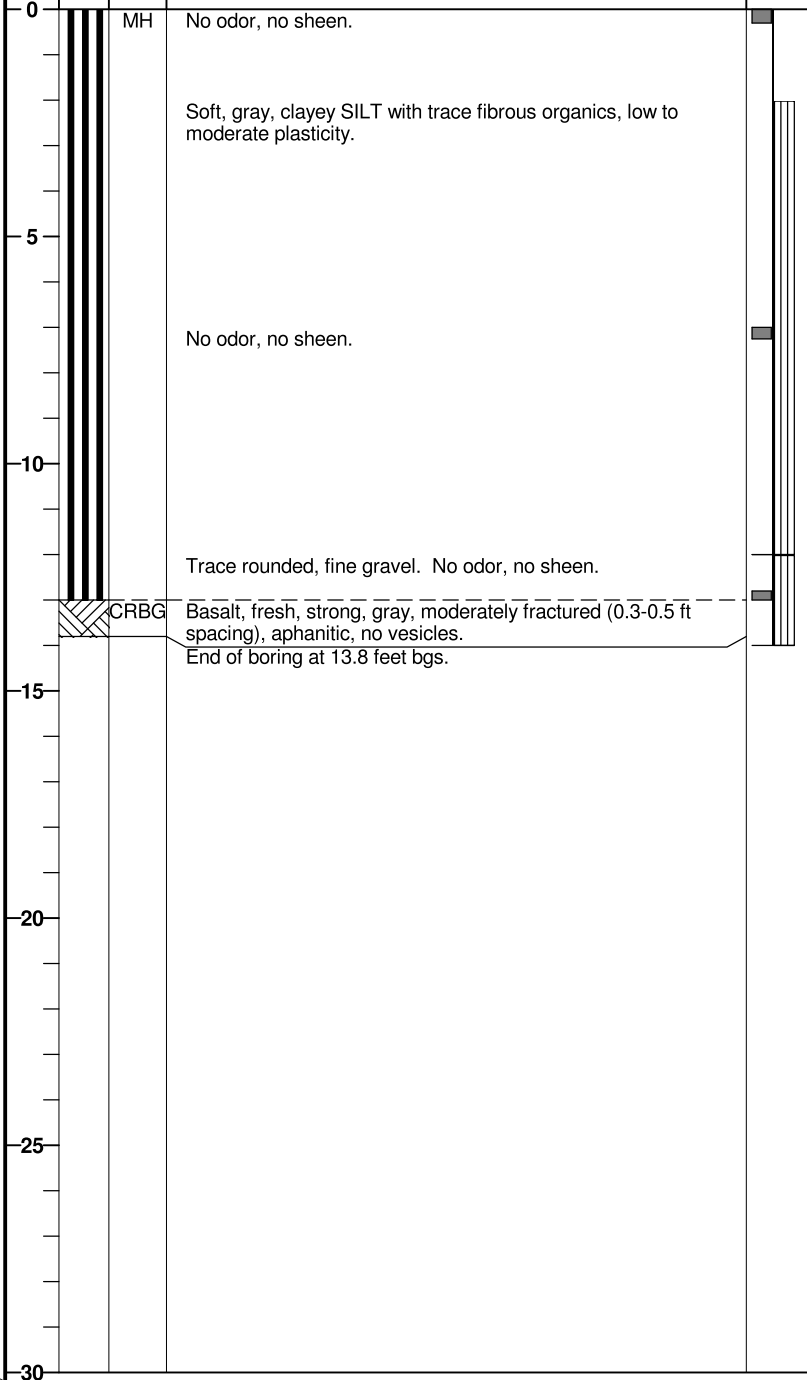
LOG OF BORING SB-06



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/13/2011 - 7/13/2011

REMARKS:
Mudline is 8.2 feet below water.
Vibracore from 0 to 12 feet bgs; conventional sonic core from 12 to 13.8 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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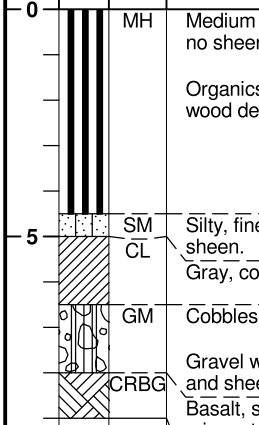
LOG OF BORING SB-07

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING
0	MH	Medium stiff, gray, clayey SILT, minor consolidation. No odor, no sheen. Organics (woody debris), Minor staining and slight sheen in wood debris.		0.0		SB8 0-0.3' Tot PAHs = 6.0 ppm Targ PAHs = < 1.0 ppm EDRO = 18 ppm
5	SM	Silty, fine SAND layer (6 inches thick). Slight odor, slight sheen.		0.1		SB8 4.5' Tot PAHs = 680 ppm Targ PAHs = 110 ppm EDRO = 1,600 ppm
	CL	Gray, cobbly, gravelly, silty CLAY.				
	GM	Cobbles with silt and clay from 6.5 to 7.5 feet bgs. Gravel with trace cobbles from 7.5 to 8 feet bgs. Slight odor and sheen.		0.1		SB8 8' Tot PAHs = 650 ppm Targ PAHs = 5.0 ppm EDRO = 1,900 ppm
	CRBG	Basalt, strong, gray, moderately fractured (0.3-0.5 ft spacing), minor staining at fracture faces, no vesicles. Slight odor, slight sheen.				
10		End of boring at 9 feet bgs.				
15						
20						
25						
30						

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/13/2011 - 7/13/2011

REMARKS:
Van Veen Sampler from 0 to 0.3 feet bgs.
Vibracore from 0 to 6.5 feet bgs; conventional sonic core from 6.5 to 9 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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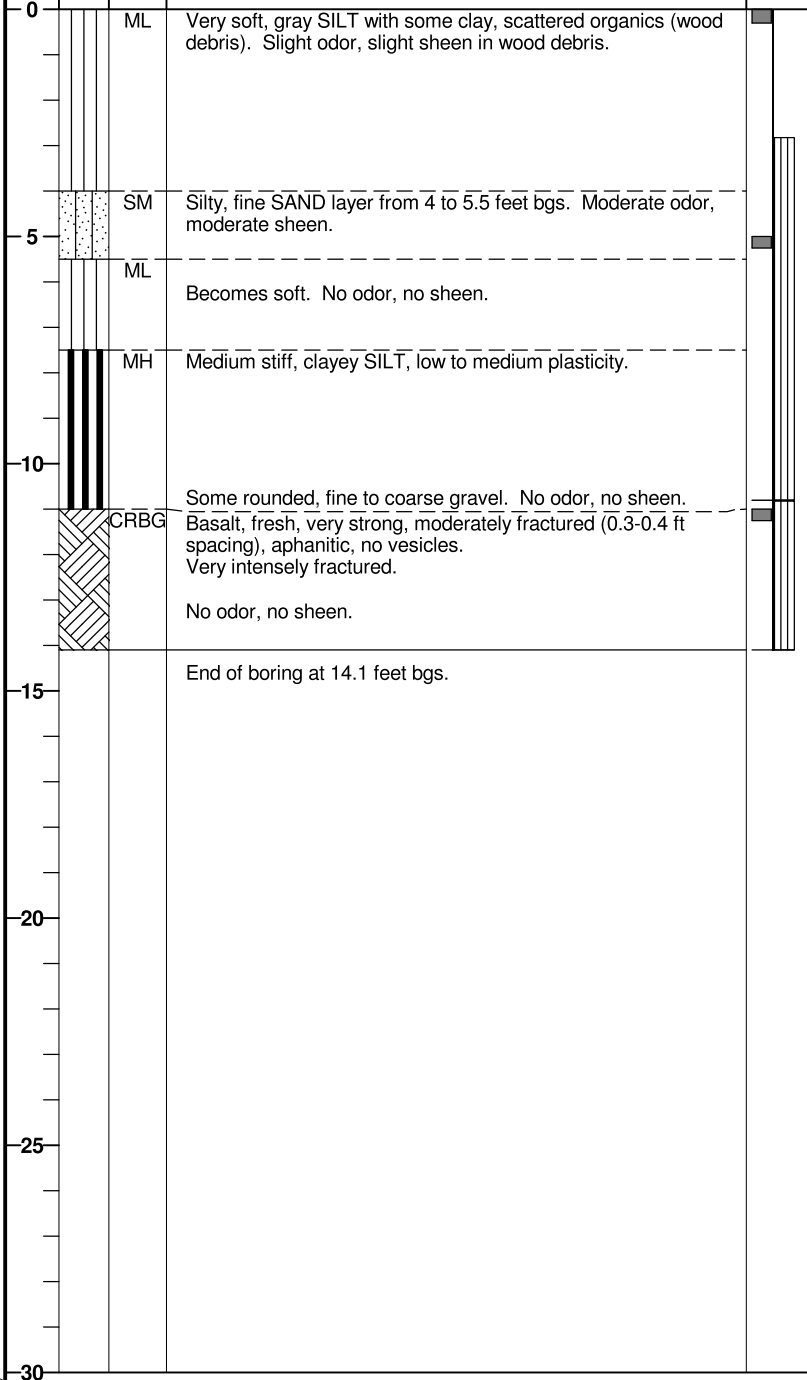
LOG OF BORING SB-08



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	ML	Very soft, gray SILT with some clay, scattered organics (wood debris). Slight odor, slight sheen in wood debris.	0.1	SB9 0-0.3' Tot PAHs = 110 ppm Targ PAHs = 9.5 ppm EDRO = 250 ppm
	SM	Silty, fine SAND layer from 4 to 5.5 feet bgs. Moderate odor, moderate sheen.		
5			1.1	SB9 5' Tot PAHs = 1,900 ppm Targ PAHs = 210 ppm EDRO = 4,300 ppm
	ML	Becomes soft. No odor, no sheen.		
	MH	Medium stiff, clayey SILT, low to medium plasticity.		
10		Some rounded, fine to coarse gravel. No odor, no sheen.	0.3	SB9 11' Tot PAHs = 1.8 ppm Targ PAHs = < 0.50 ppm EDRO = 4.0 ppm
	CRBG	Basalt, fresh, very strong, moderately fractured (0.3-0.4 ft spacing), aphanitic, no vesicles. Very intensely fractured. No odor, no sheen.		
15		End of boring at 14.1 feet bgs.		
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/14/2011 - 7/14/2011

REMARKS:
Mudline is 7.2 feet below water.
Vibracore from 0 to 10.8 feet bgs; conventional sonic core from 10.8 to 14.1 feet bgs.

Tot PAHs = Total PAHS, Targ PAHS = Targeted PAHs, EDRO = Extended diesel-range organics.

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LOG OF BORING SB-09

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING
0		MH	Soft, gray, clayey SILT with trace sand, fibrous organics. No odor, no sheen.			3.0		SB10 0-0.3' Tot PAHs = 11 ppm Targ PAHs = < 2.5 ppm EDRO = 34 ppm
			Odor, moderate sheen, NAPL at 1 foot bgs.					
			Organics (wood debris). Strong odor, heavy sheen throughout depth of sediments.			4.3		SB10 2' Tot PAHs = 1,900 ppm
						8.7		Targ PAHs = < 250 ppm EDRO = 6,000 ppm
5			Sand lamination and organics (wood debris). NAPL layer at 5.3 feet bgs.					SB10 3' Tot PAHs = 17,000 ppm
		CRBG	Basalt, fresh, strong, gray, moderately fractured (0.3-0.5 ft spacing), aphanitic, no vesicles. Odor, moderate sheen. Near vertical joint from 8 to 8.5 feet bgs. Hard drilling for entire run through basalt.			5.3		SB10 8.5' Tot PAHs = 2,100 ppm EDRO = 5,430 ppm
10			Odor, moderate sheen.					SB10 11' Tot PAHs = 1,200 ppm Targ PAHs = < 500 ppm EDRO = 4,100 ppm
			End of boring at 12 feet bgs.					
15								
20								
25								
30								

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/13/2011 - 7/13/2011

REMARKS:
Mudline is 6.5 feet below water.
Van Veen from 0-0.3 ft bgs.
Vibracore from 0 to 7.5 feet bgs; conventional sonic core from 7.5 to 12 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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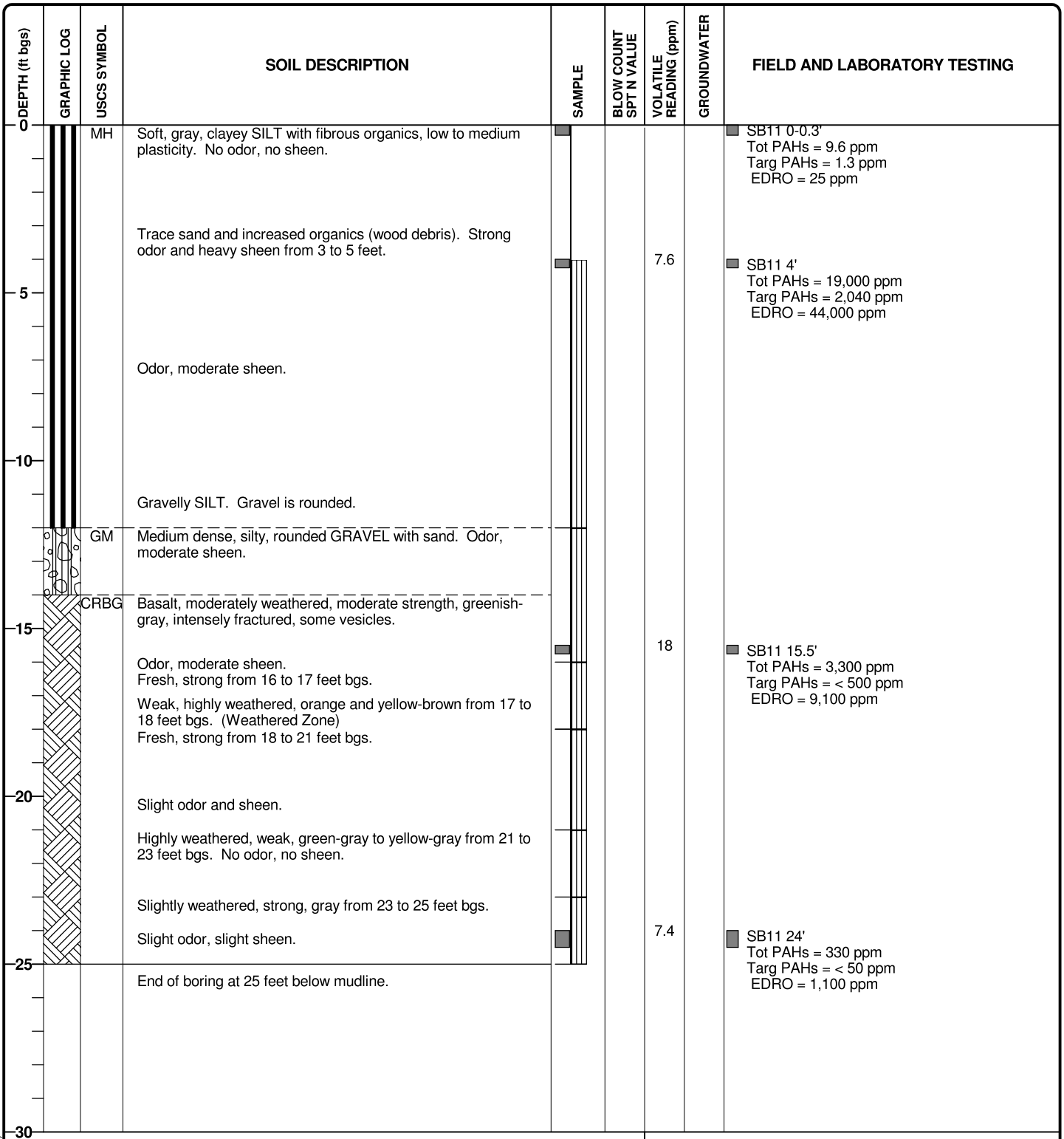
LOG OF BORING SB-10



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/13/2011 - 7/13/2011

REMARKS:
Mudline is 8 feet below water.
Vibracore from 0 to 12 feet bgs; conventional sonic core from 12 to 25 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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LOG OF BORING SB-11

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	ML	Soft SILT with trace clay, organics (wood debris). No odor, slight sheen in wood debris.	0.0	SB12 0-0.3' Tot PAHs = 48 ppm Targ PAHs = 5.3 ppm EDRO = 150 ppm
5		Organics (30-40% wood debris), trace sand. Slight odor, slight discontinuous sheen in wood debris. Medium stiff SILT, some clay.	0.1	SB12 3.5' Tot PAHs = 300 ppm Targ PAHs = < 50 ppm EDRO = 920 ppm
10	CRBG	Basalt, fresh, strong, gray, intensely fractured, aphanitic, no vesicles. Poor core quality - a lot of rock flour. No odor, no sheen. End of boring at 10.5 feet bgs.	0.1	SB12 9' Tot PAHs = 2.2 ppm Targ PAHs = 0.25 ppm EDRO = 5.8 ppm
15				
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/14/2011 - 7/14/2011

REMARKS:
Vibracore from 0 to 8.6 feet bgs; conventional sonic core from 8.6 to 10.6 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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LOG OF BORING SB-12

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING
0		ML	SILT, trace fine sand, scattered organics. No odor, slight sheen.					SB13 0-0.3' Tot PAHs = 24 ppm Targ PAHs = < 5.0 ppm EDRO = 70 ppm
		SM	Silty, fine SAND. Odor, moderate sheen.			0.3		SB13 2.5' Tot PAHs = 6,400 ppm Targ PAHs = 880 ppm EDRO = 20,000 ppm
		ML	SILT and some clay. Charcoal at the bottom of the boring.					
5		CRBG	Basalt, fresh, strong, gray, moderately fractured, minor mineralization, aphanitic, no vesicles. No odor, no sheen.			0.1		SB13 4.4' Tot PAHs = 11 ppm Targ PAHs = 1.5 ppm EDRO = 34 ppm
			End of boring at 6.1 feet bgs.					
10								
15								
20								
25								
30								

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/14/2011 - 7/14/2011

REMARKS:
Mudline is 11.1 feet below water.

Vibracore from 0 to 4.4 feet bgs; conventional sonic core from 4.4 to 6.1 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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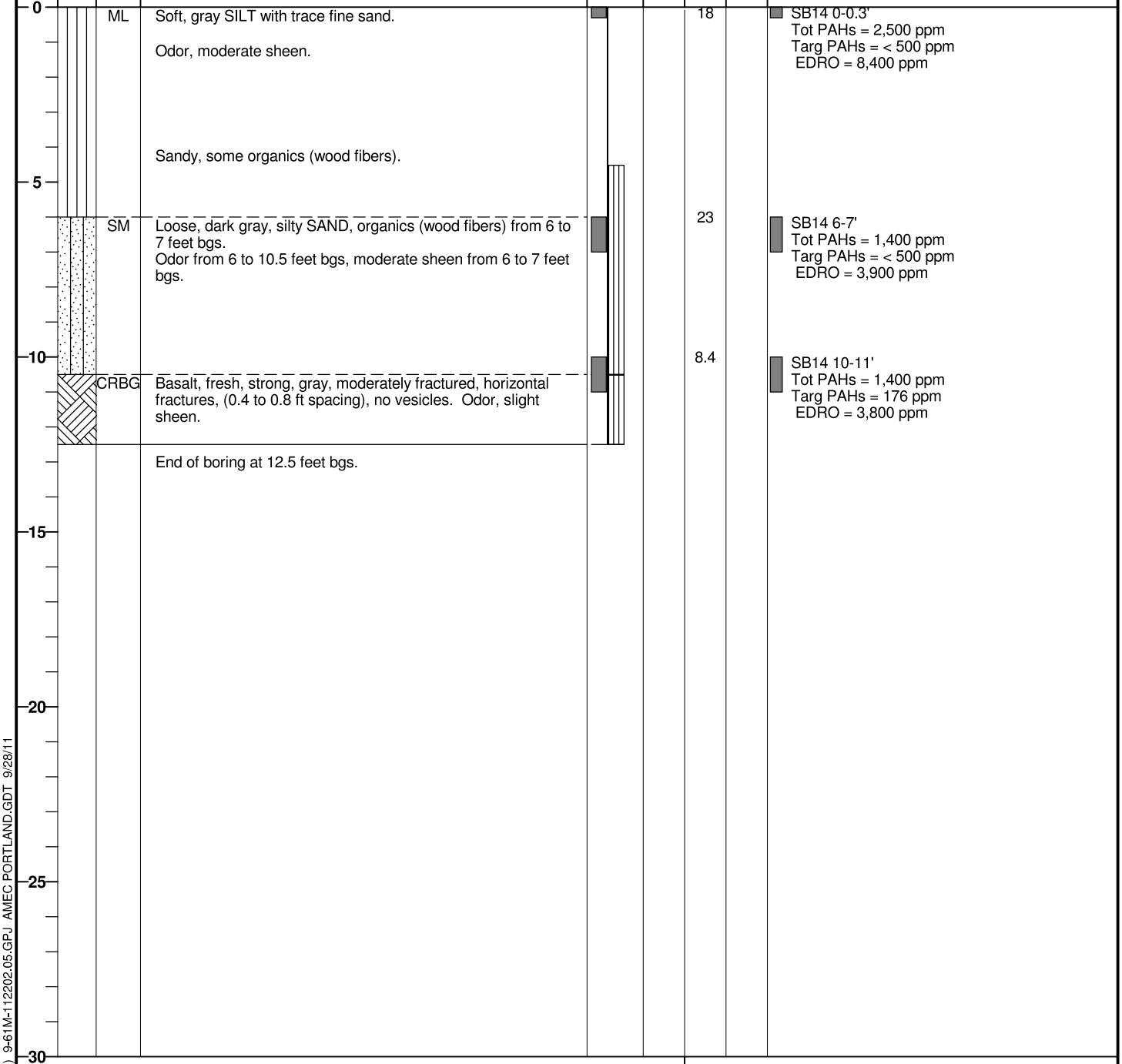
LOG OF BORING SB-13

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Vibracore from 0 to 10.5 feet bgs; conventional sonic core from 10.5 to 12.5 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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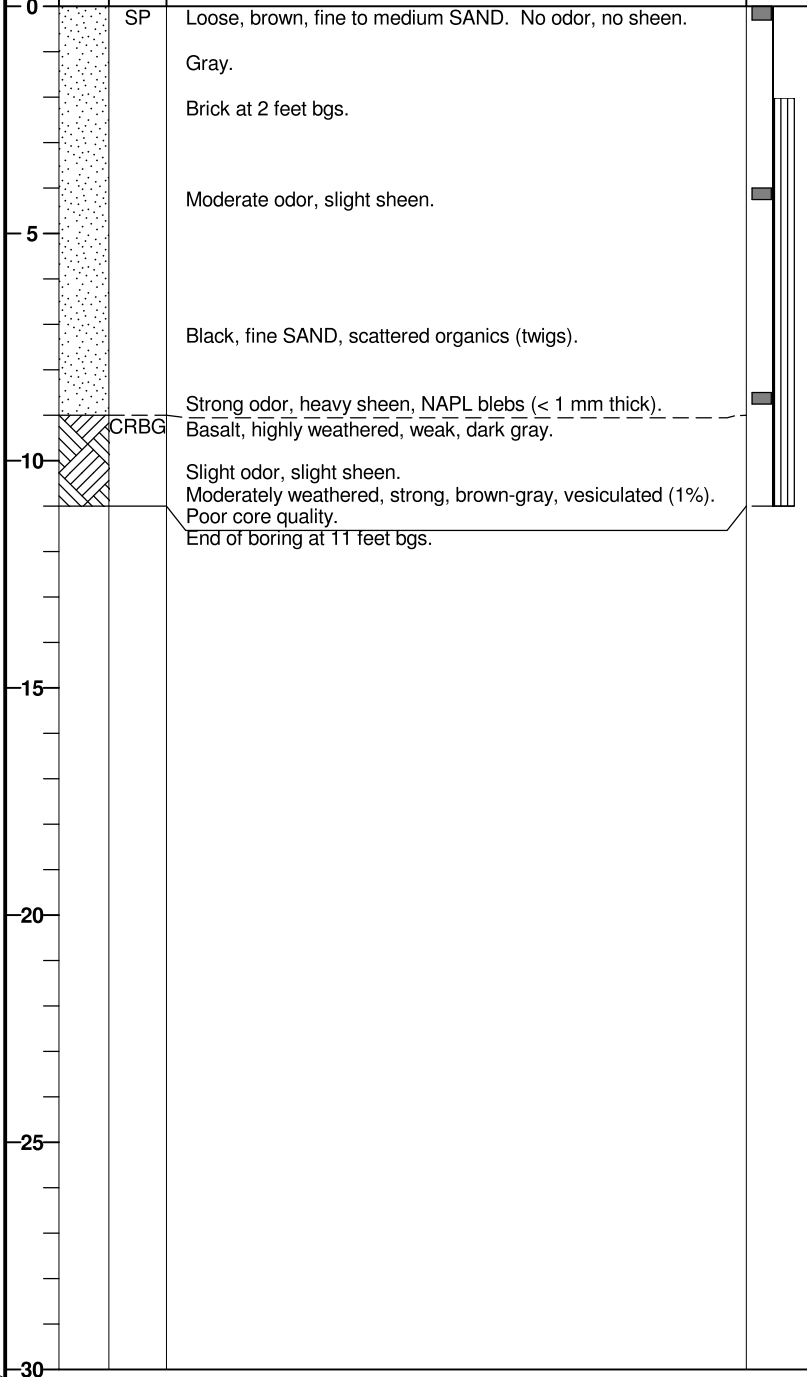
LOG OF BORING SB-14

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	SP	Loose, brown, fine to medium SAND. No odor, no sheen.		SB15 0-0.3' Tot PAHs = 13 ppm Targ PAHs = < 5.0 ppm EDRO = 39 ppm
		Gray.		
		Brick at 2 feet bgs.		
		Moderate odor, slight sheen.	6.5	SB15 4' Tot PAHs = 540 ppm Targ PAHs = < 200 ppm EDRO = 1,300 ppm
5		Black, fine SAND, scattered organics (twigs).		
		Strong odor, heavy sheen, NAPL blebs (< 1 mm thick).	102	SB15 8.5' Tot PAHs = 5,100 ppm Targ PAHs = < 1,000 ppm EDRO = 9,600 ppm
	CRBG	Basalt, highly weathered, weak, dark gray.		
10		Slight odor, slight sheen. Moderately weathered, strong, brown-gray, vesiculated (1%). Poor core quality. End of boring at 11 feet bgs.		
15				
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Conventional sonic core from 0 to 11 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/30/11

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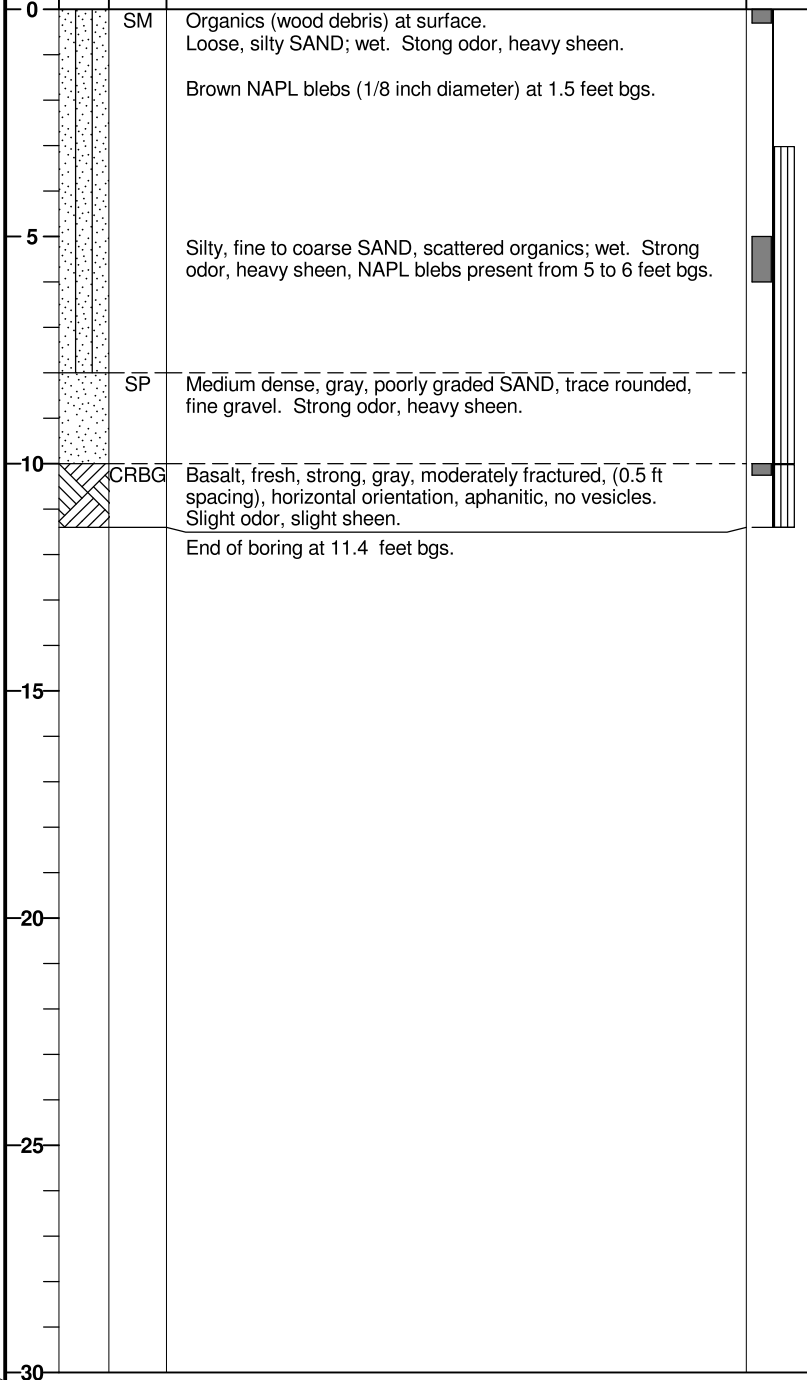
LOG OF BORING SB-15



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	SM	Organics (wood debris) at surface. Loose, silty SAND; wet. Stong odor, heavy sheen. Brown NAPL blebs (1/8 inch diameter) at 1.5 feet bgs.	1.8	SB16 0-0.3' Tot PAHs = 16 ppm Targ PAHs = < 5.0 ppm EDRO = 62 ppm
5		Silty, fine to coarse SAND, scattered organics; wet. Strong odor, heavy sheen, NAPL blebs present from 5 to 6 feet bgs.	5.6	SB16 5-6' Tot PAHs = 1,800 ppm Targ PAHs = < 500 ppm EDRO = 5,500 ppm
	SP	Medium dense, gray, poorly graded SAND, trace rounded, fine gravel. Strong odor, heavy sheen.		
10	CRBG	Basalt, fresh, strong, gray, moderately fractured, (0.5 ft spacing), horizontal orientation, aphanitic, no vesicles. Slight odor, slight sheen.	4.5	SB16 10' Tot PAHs = 350 ppm Targ PAHs = 55 ppm EDRO = 1,100 ppm
		End of boring at 11.4 feet bgs.		
15				
20				
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Vibracore from 0 to 10 feet bgs; conventional sonic core from 10 to 11.4 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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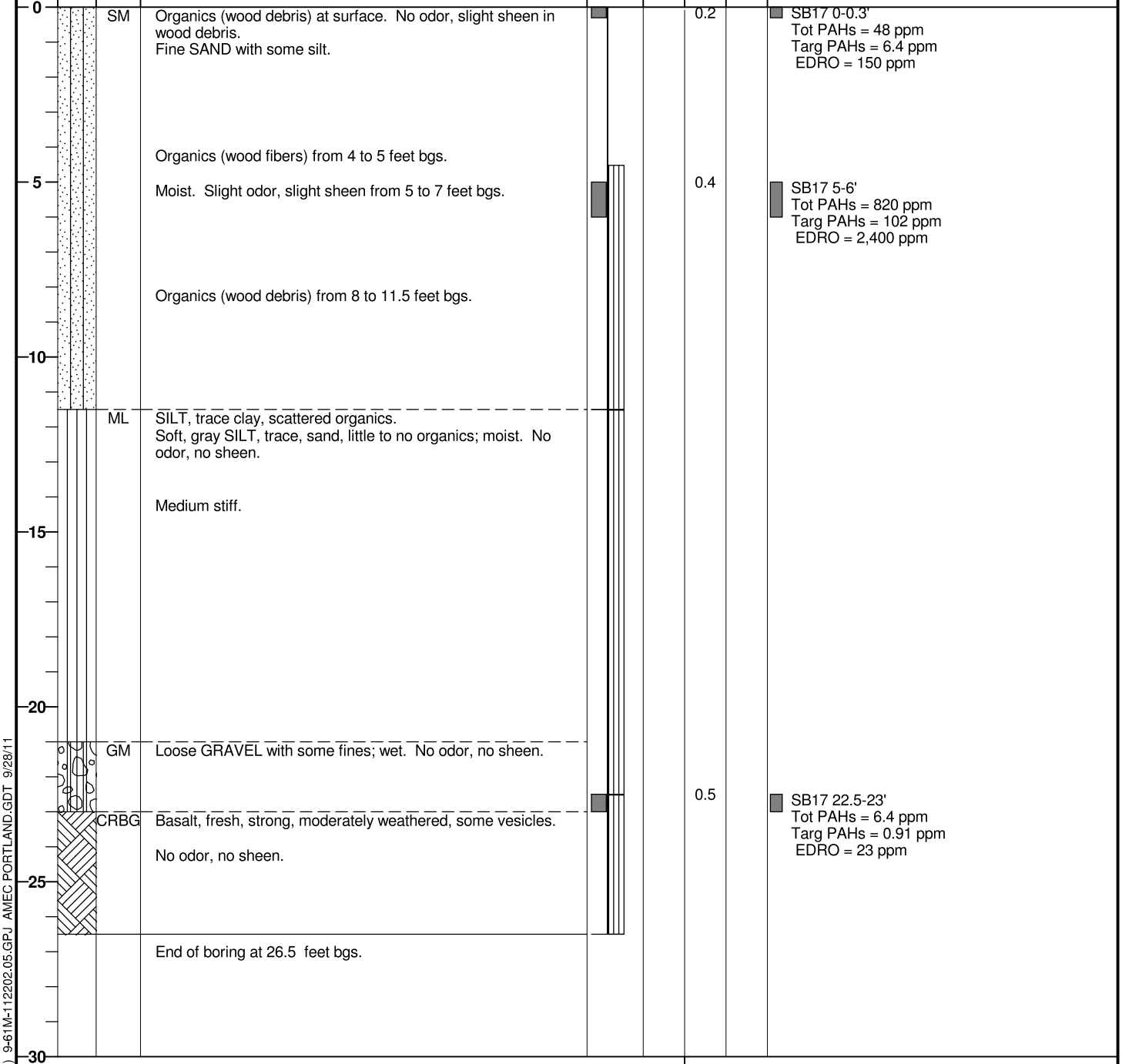
LOG OF BORING SB-16



BORING METHOD: Sonic
BOREHOLE DIAMETER: 4.0 (in)
DRILL RIG: Sonic/Vibracore
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: NA
CASING ELEVATION: NA
DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Mudline is 9.5 feet below water.

Vibracore from 0 to 11.5 feet bgs; conventional sonic core from 11.5 to 26.5 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

Port of St. Helens

9-61M-112202.05

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LOG OF BORING SB-17

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	ML	Very soft, dark gray SILT with trace fine sand, organics; wet.	1.6	SB18 0-0.3' Tot PAHs = 74 ppm Targ PAHs = 11 ppm EDRO = 180 ppm
		No odor, slight sheen.		
		Dark gray, highly organic (wood debris). Slight odor and moderate sheen (possibly biogenetic).	0.6	SB18 4' Tot PAHs = 2,000 ppm Targ PAHs = < 500 ppm EDRO = 5,500 ppm
5		No odor, no sheen.		
10		No recovery from 10 to 12 feet bgs. Metal debris from above was pushed down and did not allow sediment to be retrieved in the core.		
		Trace clay.		
15		No odor, no sheen. Metal wire found in the core at 15 feet bgs.		
		Some rounded gravel.		
		Angular gravel and organics (wood debris).		
	CRBG	Basalt, fresh, strong, gray, intensely fractured	0.8	SB18 18' Tot PAHs = 120 ppm Targ PAHs = 15 ppm EDRO = 290 ppm
20		No odor, no sheen. End of boring at 21 feet bgs.		
25				
30				

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Vibracore from 0 to 12 feet bgs; conventional sonic core from 12 to 21 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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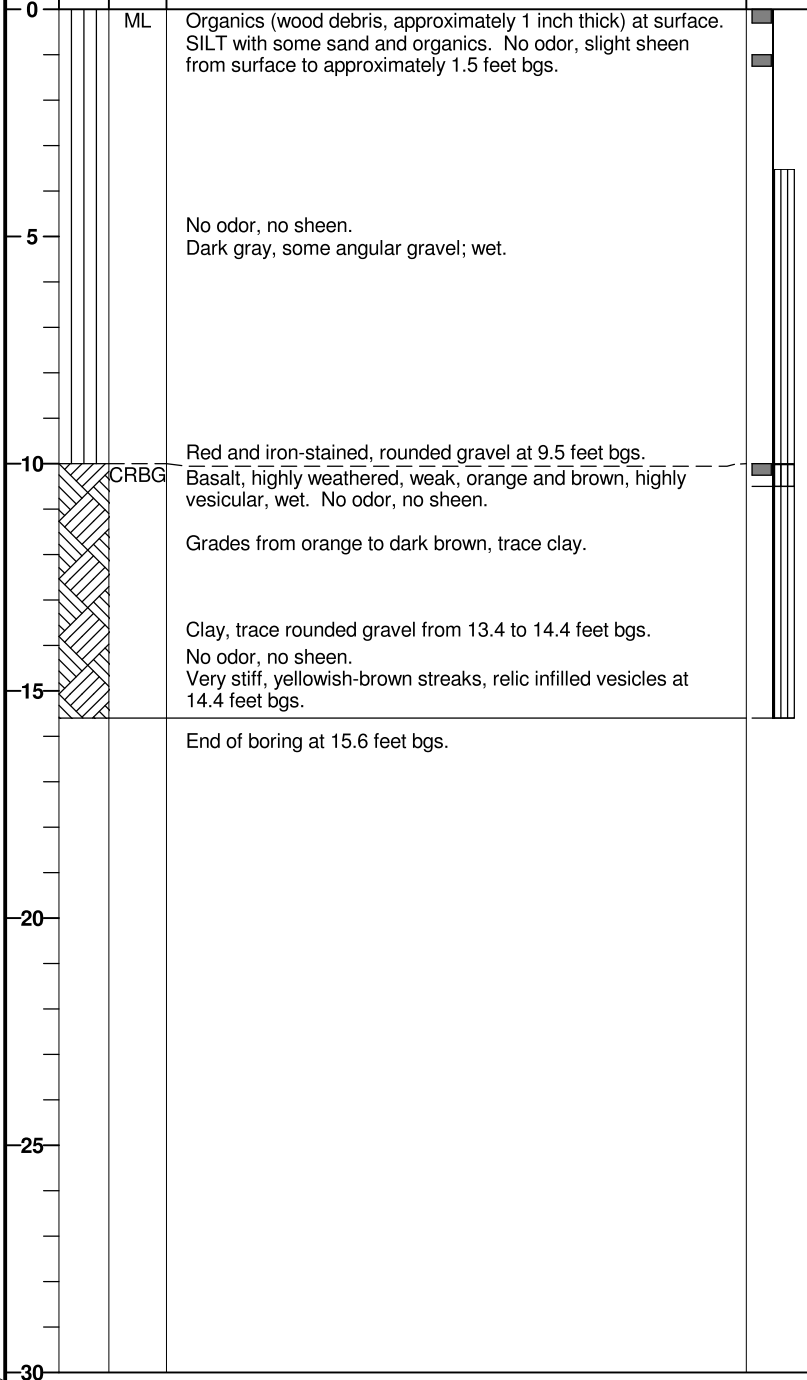
LOG OF BORING SB-18



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Vibracore from 0 to 10.6 feet bgs; conventional sonic core from 10.6 to 15.6 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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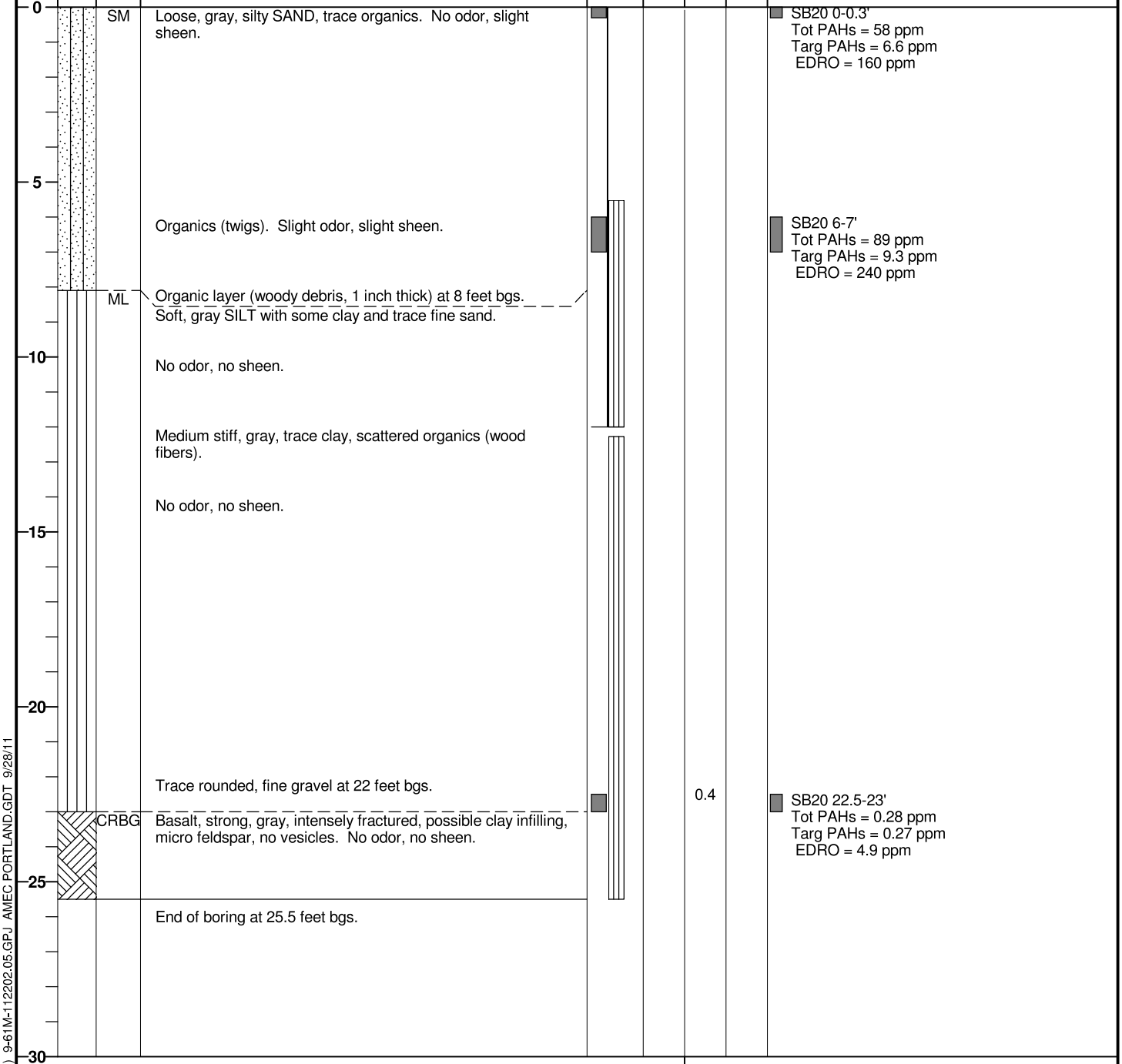
LOG OF BORING SB-19



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Vibracore from 0 to 12.2 feet bgs; conventional sonic core from 12.2 to 25.5 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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LOG OF BORING SB-20

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	VOLATILE READING (ppm)	FIELD AND LABORATORY TESTING
0	ML	Very soft, gray SILT with trace sand and clay. No odor, slight sheen.	3.3	SB21 0-0.3' Tot PAHs = 13 ppm Targ PAHs = 2.2 ppm EDRO = 420 ppm
5	SM	Loose, gray, silty SAND with some organics (wood debris and wood fibers). Slight odor and slight sheen. Wood debris increases with depth.	3.5	SB21 6-7' Tot PAHs = 240 ppm Targ PAHs = < 50 ppm EDRO = 750 ppm
10	ML	Soft to medium stiff, gray SILT.		
15		No odor, no sheen.		
20	CRBG	Basalt (Flow Top - Rubble Zone) from 20.5 to 22 feet bgs. No odor, no sheen.	2.3	SB21 20.5-21' Tot PAHs = 0.28 ppm Targ PAHs = < 0.1 ppm EDRO = 0.80 ppm
25	CRBG	Basalt, moderately weathered, moderate to weak, green-gray, very intensely fractured, aphanitic, highly vesicular. Color changes to orange and yellow-brown, highly weathered.		
30		End of boring at 26 feet bgs.		

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Vibracore from 0 to 12 feet bgs; conventional sonic core from 12 to 26 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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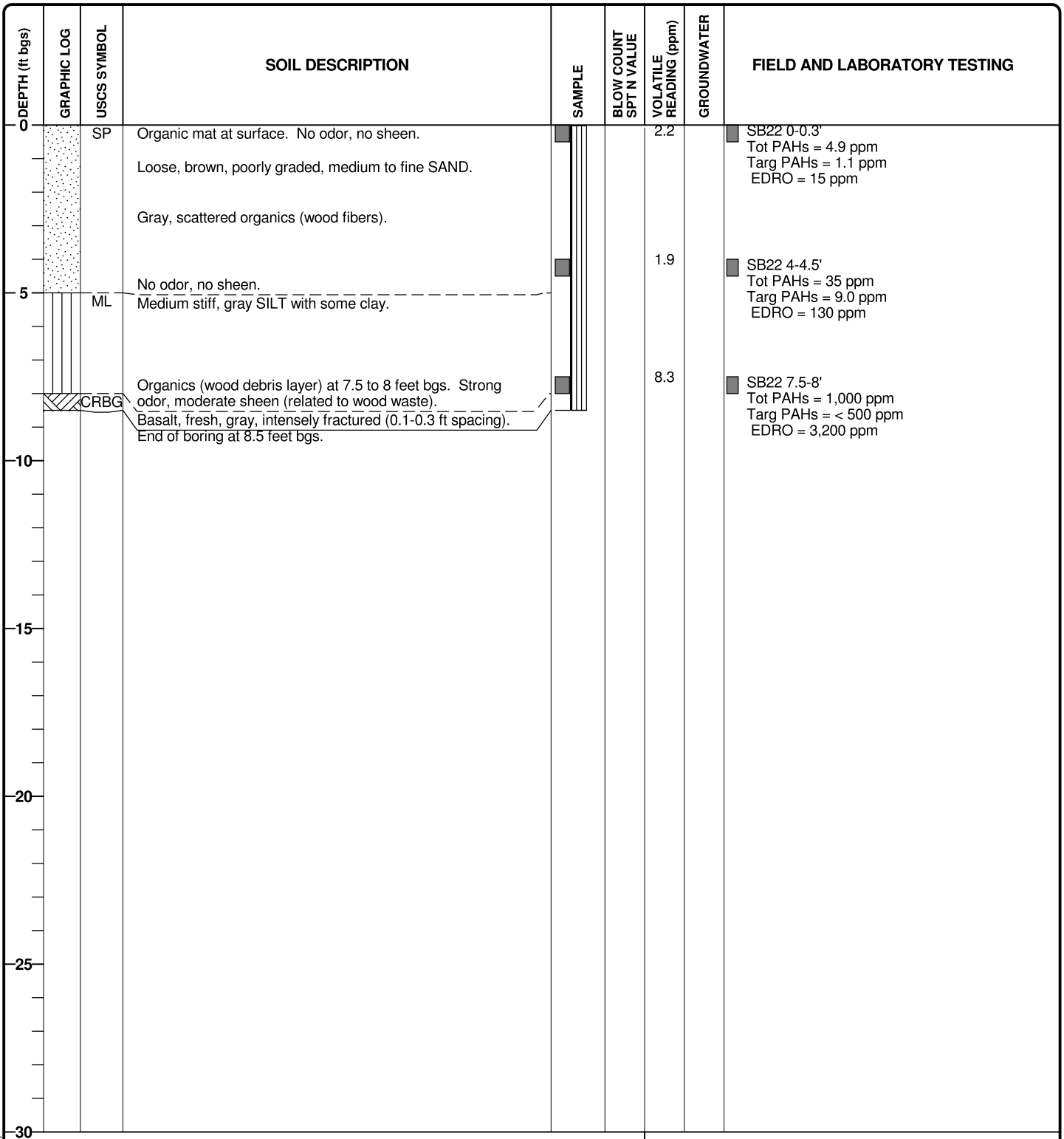
LOG OF BORING SB-21



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Mudline is 3.5 feet below water.

Conventional sonic core from 0 to 8.5 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

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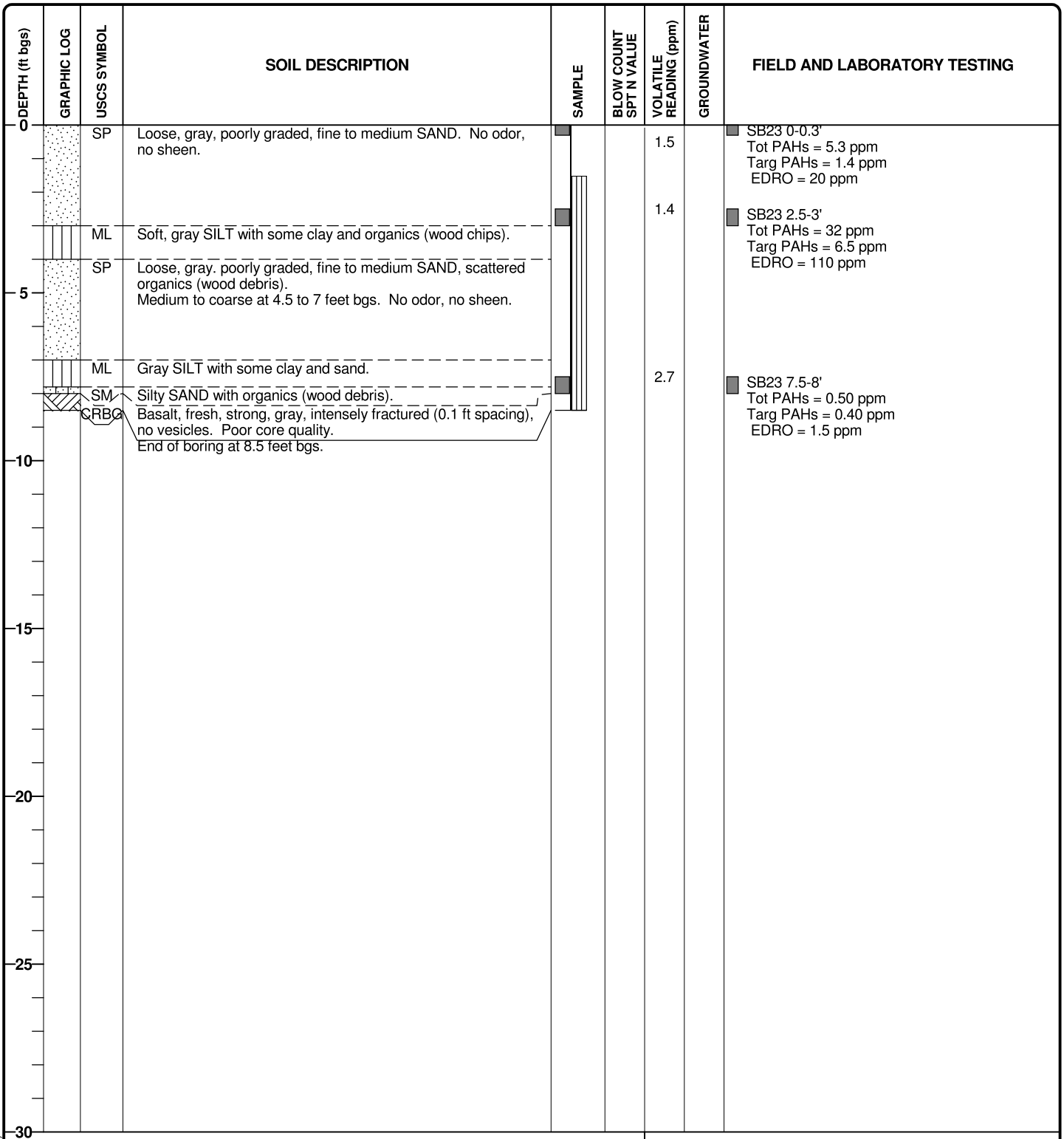
LOG OF BORING SB-22

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/15/2011 - 7/15/2011

REMARKS:
Conventional sonic core from 0 to 8.5 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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LOG OF BORING SB-23

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING
0		ML	Very soft, gray SILT with some clay, trace organics (wood debris, 10%). No odor, slight sheen.			0.1		SB24 0-0.3' Tot PAHs = 150 ppm Targ PAHs = 9.1 ppm EDRO = 520 ppm
			Becomes soft. Trace clay, white specs, scattered organics, low plasticity at 3.5 to 11 feet bgs.					
5			No odor, no sheen.			0.1		SB24 5-5.5' Tot PAHs = 0.63 ppm Targ PAHs = < 0.10 ppm EDRO = 2.2 ppm
10		CRBG CRBG	Angular basalt, cobble, rounded gravel and pebbles (0.5-0.75 inch diameter) (Rubble Zone) with minor sand and silt. No odor, no sheen.			0.2		SB24 11-11.5' Tot PAHs = 2.8 ppm Targ PAHs = 0.21 ppm EDRO = 7.5 ppm
			Basalt, fresh, strong, gray, moderately fractured, vertical joint in basalt at bottom of core, minor mineralization at joint face, no vesicles. No odor, no sheen. End of boring at 12.6 feet bgs.					
15								
20								
25								
30								

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/16/2011 - 7/16/2011

REMARKS:
Conventional sonic core from 0 to 12.6 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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LOG OF BORING SB-24

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING
0		ML	Very soft, gray SILT with trace clay, fine sand (2-3%), increasing to fine sand with depth (15%), organics (mainly wood debris, 25%). No odor, minor organic sheen. Organic layer at 1 to 1.5 feet bgs. Soft, gray SILT, some fine sand, organics decrease to trace.			0.7 0.4		SB25 0-0.3' Tot PAHs = 32 ppm Targ PAHs = 7.1 ppm EDRO = 130 ppm SB25 1.5' Tot PAHs = 130 ppm Targ PAHs = 1.9 ppm EDRO = 420 ppm
5			Some clay, trace fine sand.					
		CRBG	Basalt, fresh, strong, gray, intensely fractured, horizontal fractures (< 0.1 ft spacing), minor manganese staining of horizontal fractures, no vesicles. No odor, no sheen. End of boring at 8 feet bgs.			0.2		SB25 6.5-7' Tot PAHs = 0.65 ppm Targ PAHs = 0.11 ppm EDRO = 2.3 ppm
10								
15								
20								
25								
30								

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/16/2011 - 7/16/2011

REMARKS:
Conventional sonic core from 0 to 8 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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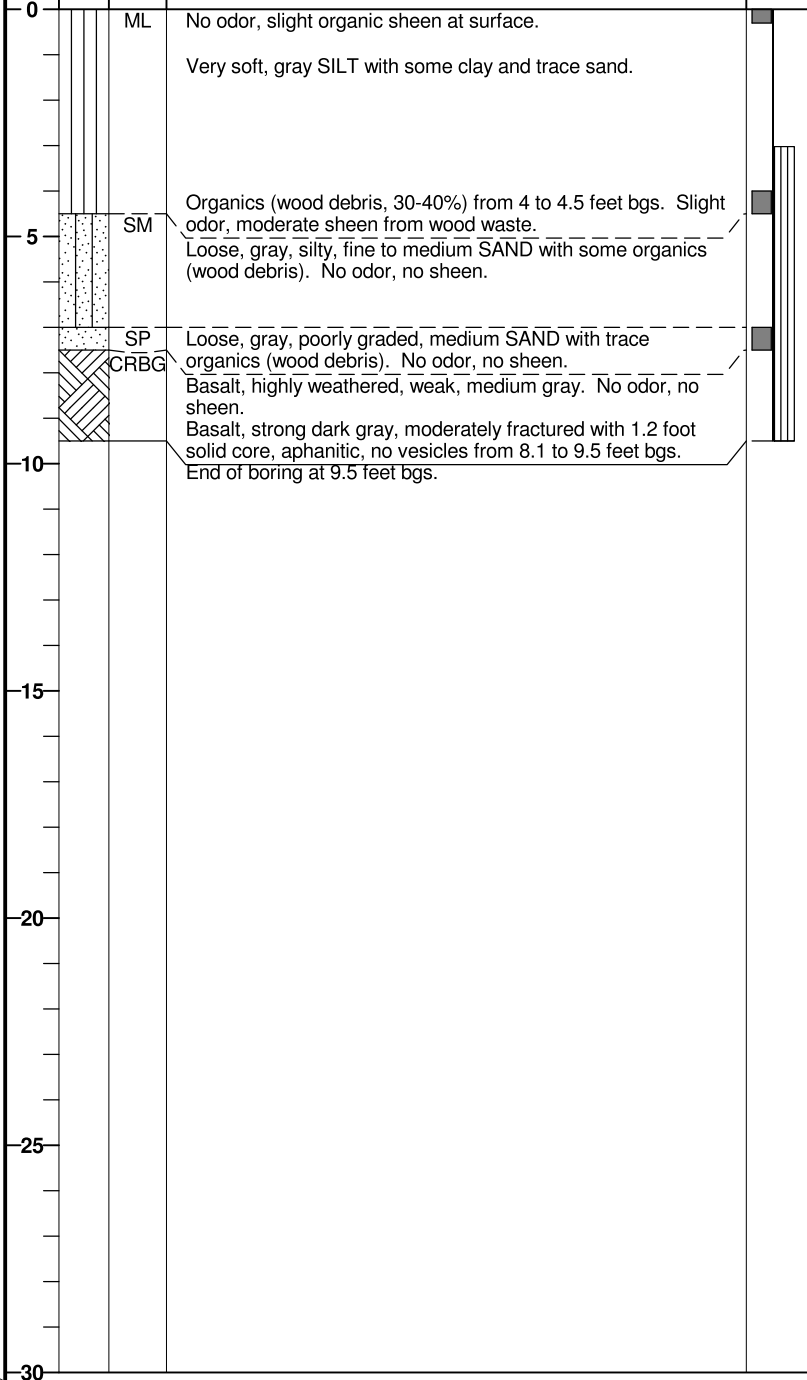
LOG OF BORING SB-25



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/16/2011 - 7/16/2011

REMARKS:
Conventional sonic core from 0 to 9.5 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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LOG OF BORING SB-26

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING
0		ML	Very soft, gray SILT, some clay, trace sand, organics (wood debris). No odor, slight sheen from wood debris.			0.5		SB27 0-0.3' Tot PAHs = 130 ppm Targ PAHs = 19 ppm EDRO = 370 ppm
			Soft.					
		SP	Loose, poorly graded, medium SAND with some organics (wood debris). No odor, slight sheen from wood.			0.6		SB27 4.5-5' Tot PAHs = 92 ppm Targ PAHs = 13 ppm EDRO = 300 ppm
5		ML	Soft, gray SILT, some clay scattered white specs. Slight odor, no sheen.					
						0.2		SB27 7.5-8' Tot PAHs = 2.4 ppm Targ PAHs = 0.23 ppm EDRO = 6.0 ppm
		CRBG	Basalt, fresh, gray, moderately fractured, no vesicles. No odor, no sheen.					
10			End of boring at 9.9 feet bgs.					
15								
20								
25								
30								

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/16/2011 - 7/16/2011

REMARKS:
Conventional sonic core from 0 to 9.9 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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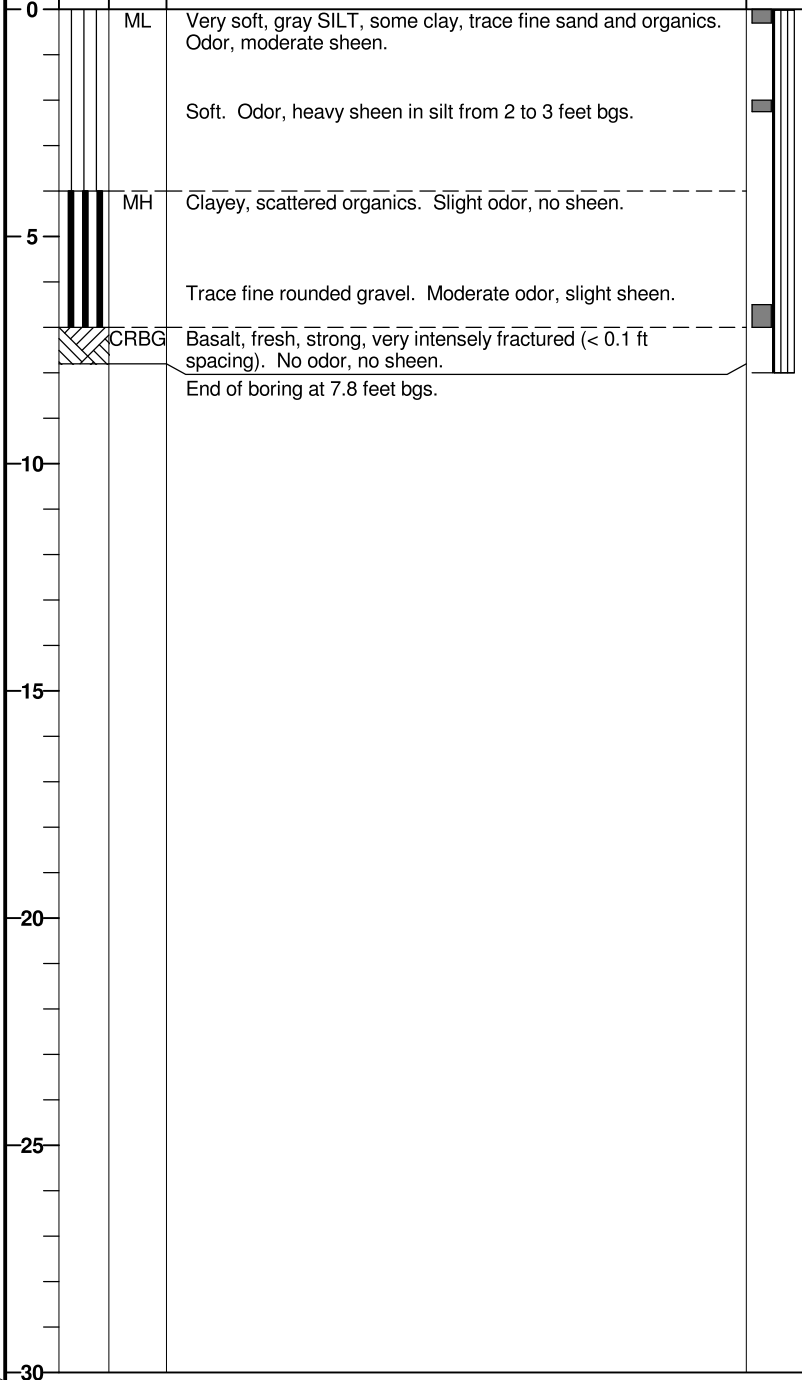
LOG OF BORING SB-27



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/16/2011 - 7/16/2011

REMARKS:
Conventional sonic core from 0 to 7.8 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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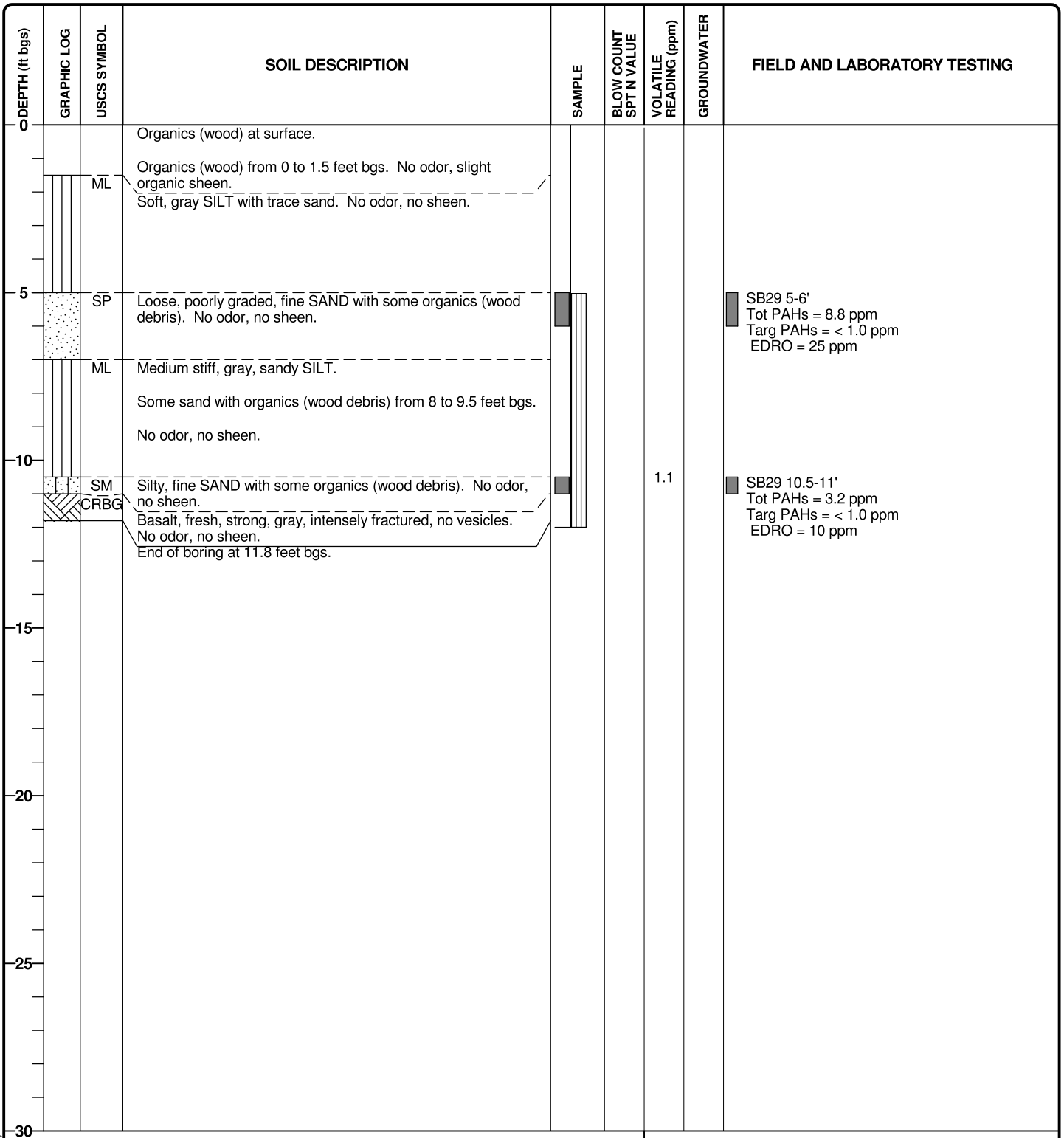
LOG OF BORING SB-28



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/16/2011 - 7/16/2011

REMARKS:
Conventional sonic core from 0 to 11.8 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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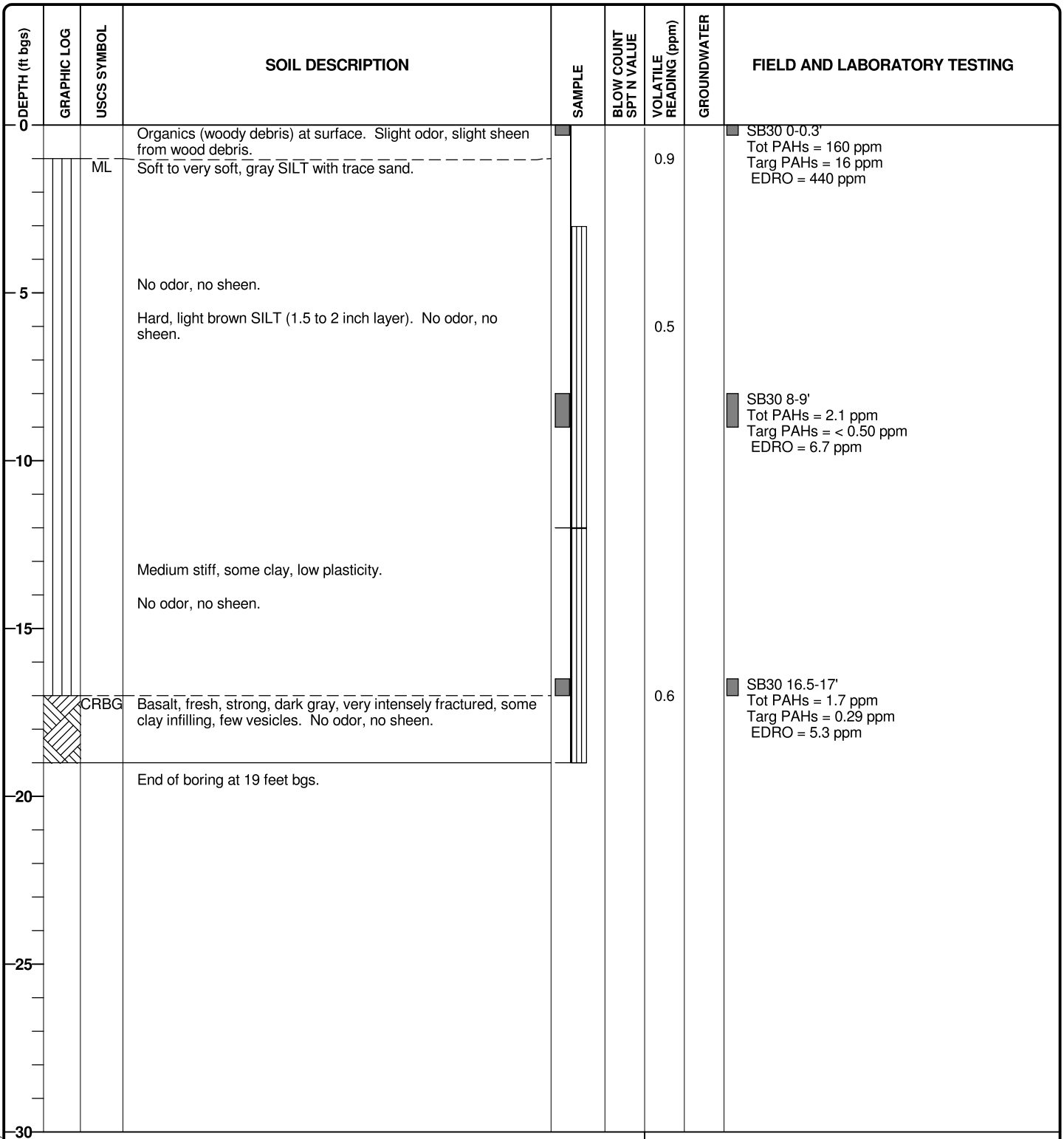
LOG OF BORING SB-29



BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Sonic/Vibracore

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/16/2011 - 7/16/2011

REMARKS:
Vibracore from 0 to 12 feet bgs; conventional sonic core from 12 to 19 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

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LOG OF BORING SB-30

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	BLOW COUNT SPT N VALUE	VOLATILE READING (ppm)	GROUNDWATER	FIELD AND LABORATORY TESTING
0		ML	Very soft, gray SILT with trace sand, organics (wood debris). No odor, no sheen. Soft from 1 to 3 feet bgs.			0.4		SB31 0-0.3' Tot PAHs = 22 ppm Targ PAHs = < 5.0 ppm EDRO = 67 ppm
			Increased organics (wood debris) at 3 feet bgs.			0.2		SB31 2.5-3' Tot PAHs = 46 ppm Targ PAHs = 5.0 ppm EDRO = 150 ppm
5		CRBG	Basalt, fresh, strong, moderately fractured. Basalt, intensely fractured with clay infilling, silt with clay layer (approximately 4 inches thick). No odor, no sheen. Silt with clay layer (approximately 4 inches thick).					
			End of boring at 8 feet bgs.					
10								
15								
20								
25								
30								

BORING METHOD: Sonic

BOREHOLE DIAMETER: 4.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/16/2011 - 7/16/2011

REMARKS:
Conventional sonic core from 0 to 8 feet bgs.

Tot PAHs = Total PAHs, Targ PAHs = Targeted PAHs, EDRO = Extended diesel-range organics.

ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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LOG OF BORING SB-31

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SM	Dark gray, silty SAND with organics (pulverized wood debris, 30-40% fine wood fragments), wet, NAPL (~2-3 mm diameter), slight sheen, creosote odor. (Fill) Silt increases with depth from 2-4 feet bgs.						
			No recovery from 4-8 feet bgs.						
5									
			Top six inches, sluff from above, not logged.						
		ML	Soft, gray, SILT with some clay, trace fine sand, trace wood debris (> 5%), moist, no sheen, no odor.						
10									
15									
		SM	Brown, silty SAND. (Weathered basalt)						
		ML	Soft, gray, sandy SILT with gravel, angular, basalt cobbles (to 3-inch diameter), wet, no sheen, no odor. (Weathered basalt)						
20									
		CL	Stiff, gray CLAY with cobbles, subangular, basalt cobble fragments (to 4-inch diameter), moist grading to dry. (Weathered basalt)						
25									
			End of boring at 26.0 feet bgs.						
30									

BORING METHOD: Sonic

BOREHOLE DIAMETER:

DRILL RIG: Track-Mounted Sonic Rig

CONTRACTOR: Cascade Drilling

LOGGED BY: G. Taylor, J. Eledge

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 10/14/2013 - 10/14/2013

REMARKS:

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

Port of St. Helens
Dock Area Investigation

9-61M-112202

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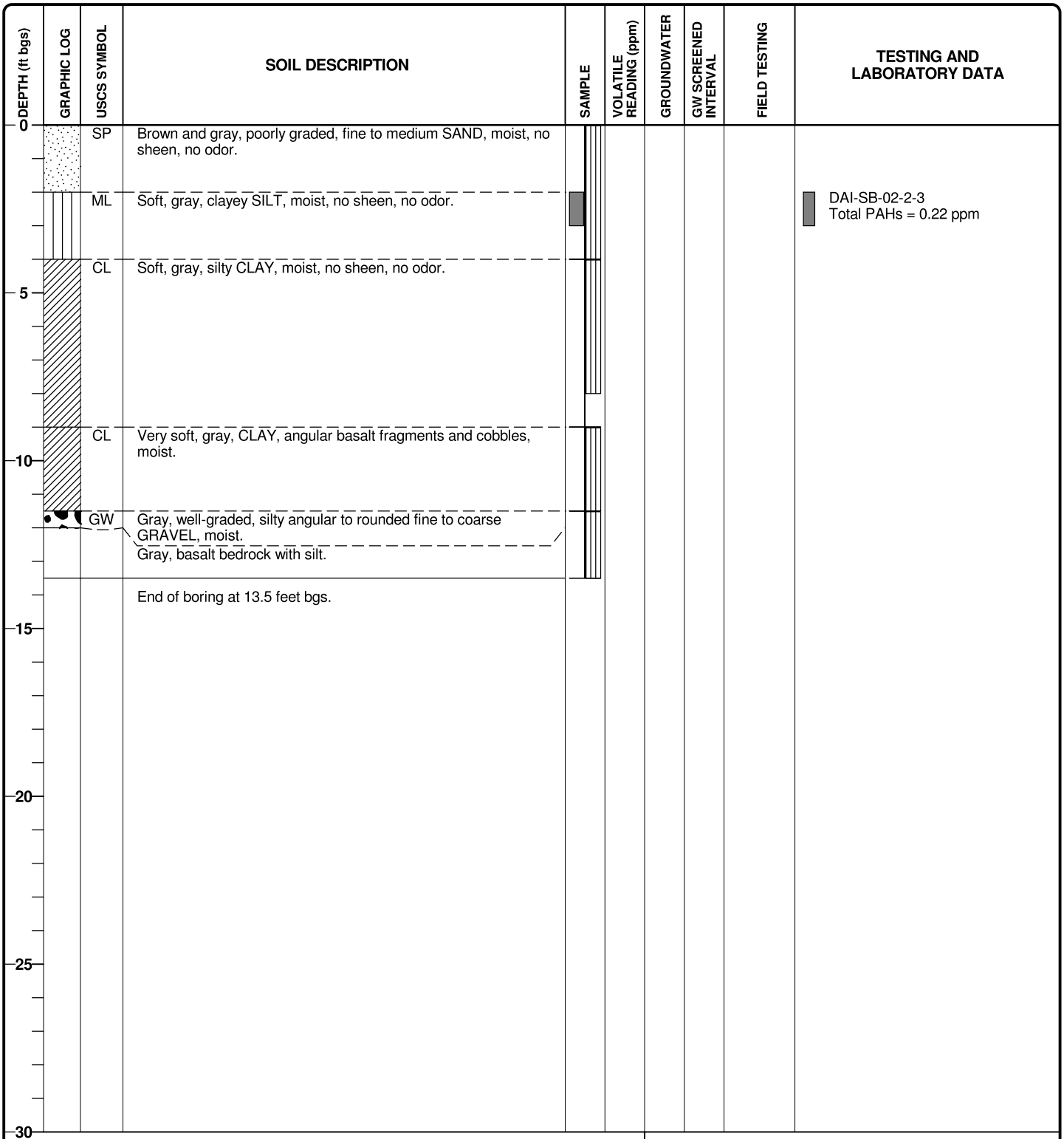
LOG OF BORING DAI-SB-01



BORING METHOD: Sonic
BOREHOLE DIAMETER:
DRILL RIG: Track-Mounted Sonic Rig
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor, J. Eledge

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 10/14/2013 - 10/14/2013

REMARKS:

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

Port of St. Helens
Dock Area Investigation

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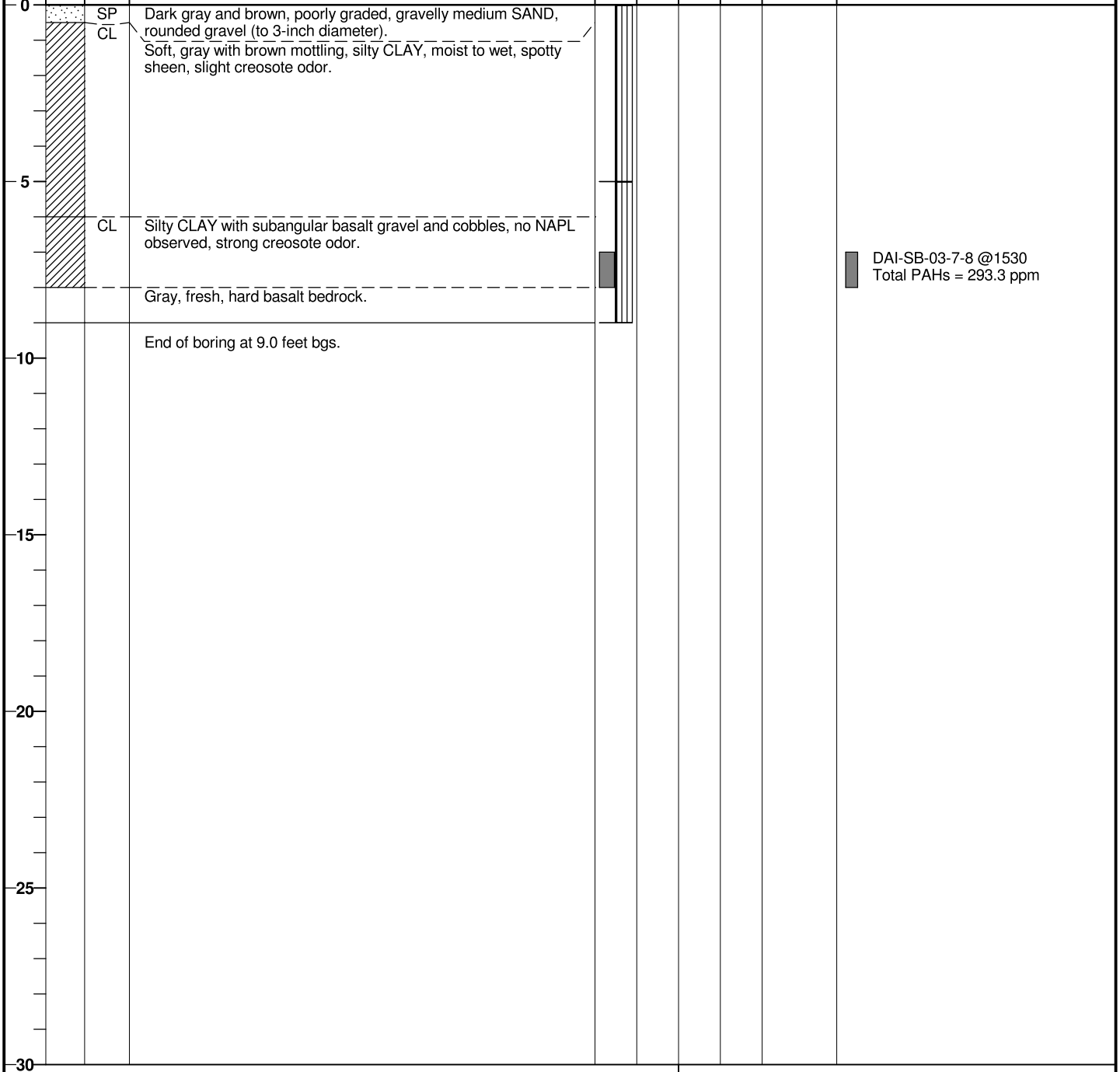
LOG OF BORING DAI-SB-02



BORING METHOD: Sonic

BOREHOLE DIAMETER:

DRILL RIG: Track-Mounted Sonic Rig

CONTRACTOR: Cascade Drilling

LOGGED BY: G. Taylor, J. Eledge

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 10/14/2013 - 10/14/2013

REMARKS:

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

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LOG OF BORING DAI-SB-03

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		CL	Soft, gray, silty CLAY with interbedded fine to medium sand lenses, trace rounded gravel (<= 2-inch diameter), no sheen, no odor.						
		CL	Very soft, gray, silty CLAY, moist, no sheen, no odor.						DAI-SB-04-4-5 @0940 Total PAHs = 1 ppm
5			Basalt bedrock.						
			End of boring at 6.0 feet bgs.						
10									
15									
20									
25									
30									

BORING METHOD: Sonic
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Sonic Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor, M. Roskamp
DRILLING DATES: 10/15/2013 - 10/15/2013

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LOG OF BORING DAI-SB-04

DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	TESTING AND LABORATORY DATA
0	GP	GRAVEL and metal debris on surface. Heavy sheen and creosote odor. (Fill)	
	ML	Very soft, dark gray, clayey SILT, treated wood debris, wet, some creosote odor. (Fill) Decreased organics and decreased moisture with depth from 2-7.5 feet bgs.	
5			
	SM	Medium dense, dark gray, silty fine to medium SAND with organics (pulverized wood debris), wet, strong creosote odor. (Fill) Pulverized wood debris (70%) layer from 8-9 feet bgs. Increased sand content, NAPL (~2-3 mm diameter) releasing from wood debris, sheen and heavy creosote odor from 10-13.5 feet bgs.	
10			
	ML	Soft, dark gray, clayey SILT, trace organics, moist, no sheen, faint creosote odor.	DAI-SB-05-15-15.5 @1130 Total PAHs = 14.32 ppm
15			
20			
	ML	Dark gray, gravelly SILT, trace clay, trace organics, rounded gravel (to 2-inch diameter), moist.	DAI-SB-05-22-23 Total PAHs = 0.17 ppm
		Refusal at 23.0 feet bgs.	
25			
30			

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor
DRILLING DATES: 10/16/2013 - 10/16/2013

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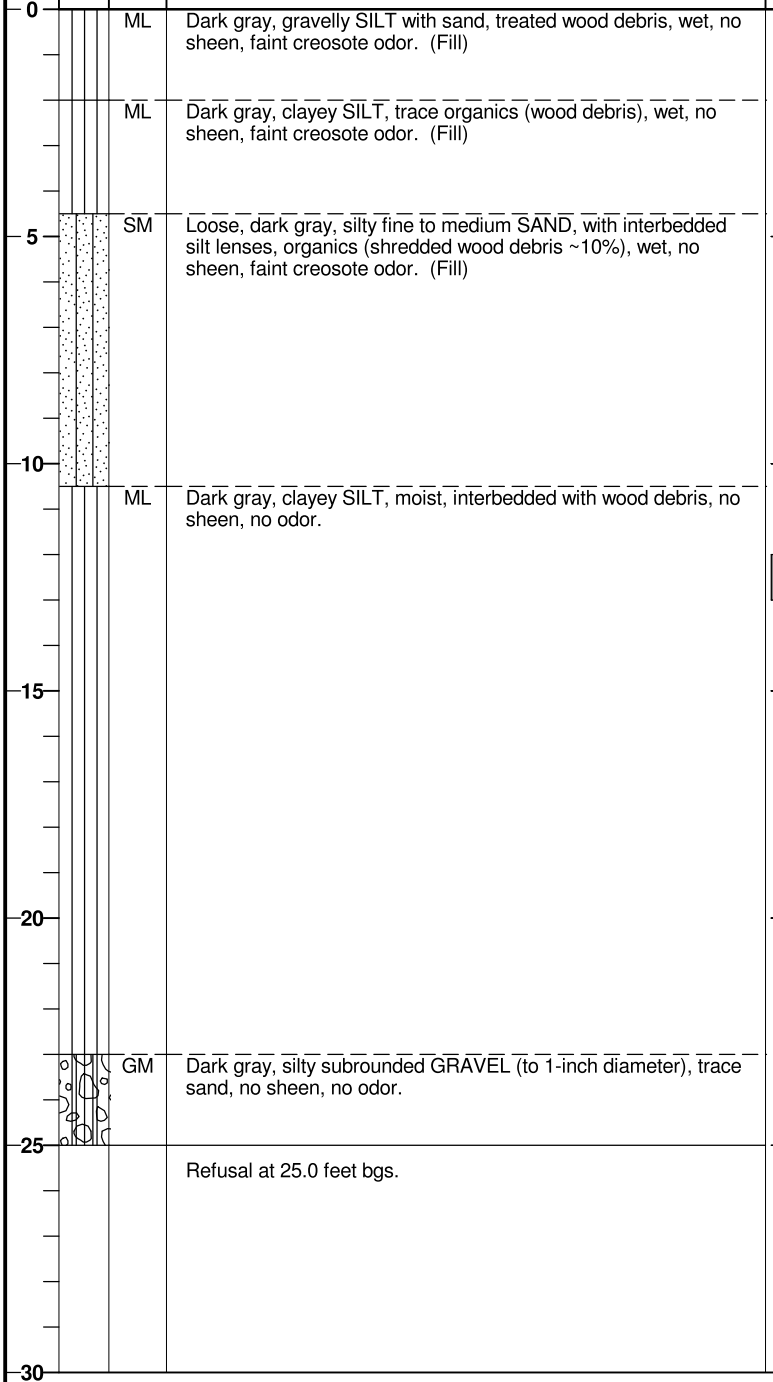
LOG OF BORING DAI-SB-05



DEPTH (ft bgs)	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0	ML	Dark gray, gravelly SILT with sand, treated wood debris, wet, no sheen, faint creosote odor. (Fill)						
	ML	Dark gray, clayey SILT, trace organics (wood debris), wet, no sheen, faint creosote odor. (Fill)						
5	SM	Loose, dark gray, silty fine to medium SAND, with interbedded silt lenses, organics (shredded wood debris ~10%), wet, no sheen, faint creosote odor. (Fill)						
10	ML	Dark gray, clayey SILT, moist, interbedded with wood debris, no sheen, no odor.						DAI-SB-06-12-13 Total PAHs = 0 ppm
15								
20								
25	GM	Dark gray, silty subrounded GRAVEL (to 1-inch diameter), trace sand, no sheen, no odor.						
30		Refusal at 25.0 feet bgs.						

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor
DRILLING DATES: 10/16/2013 - 10/16/2013

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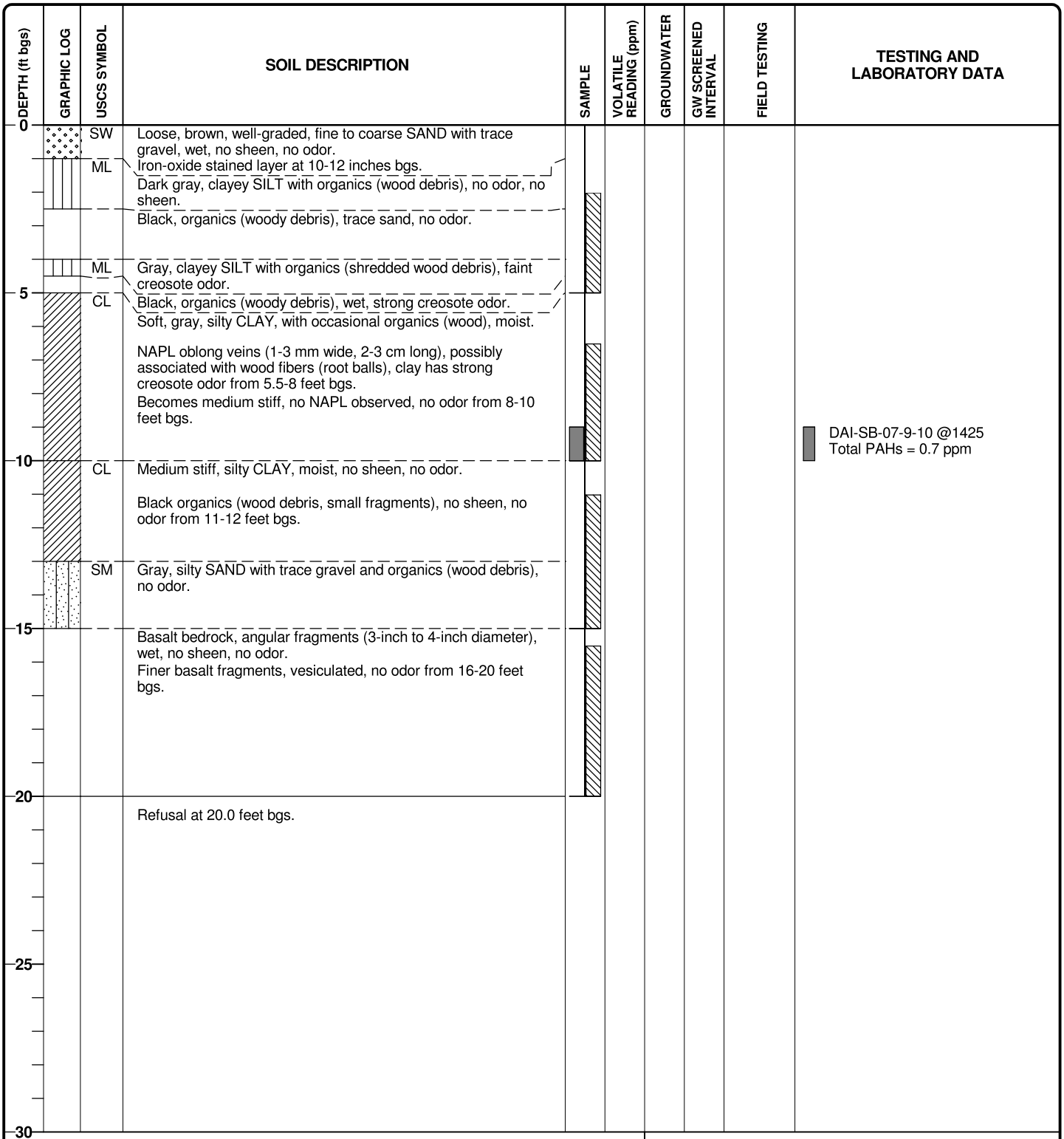
LOG OF BORING DAI-SB-06



BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor, J. Eledge
DRILLING DATES: 10/16/2013 - 10/16/2013

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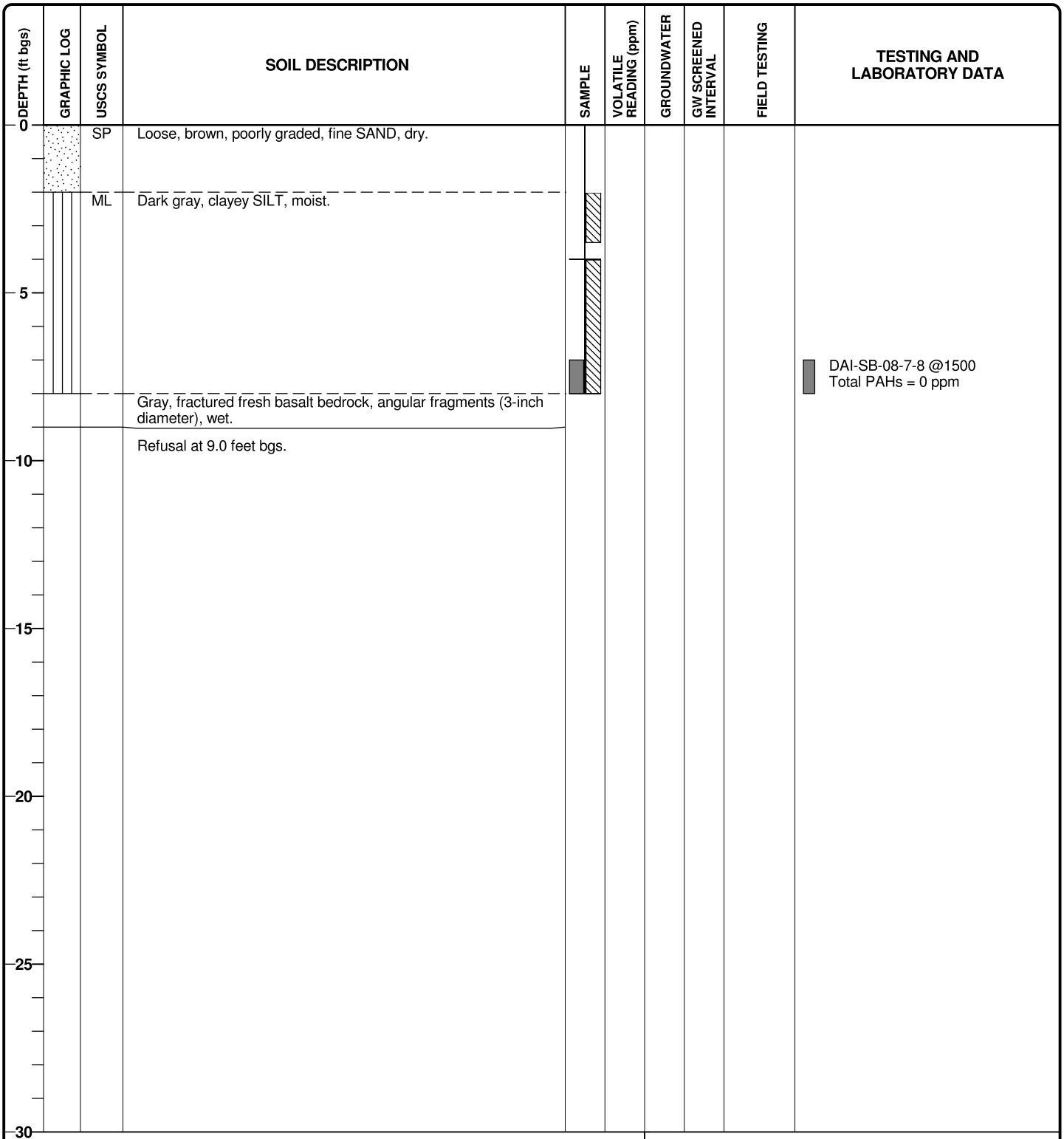
LOG OF BORING DAI-SB-07



BORING METHOD: Direct Push

BOREHOLE DIAMETER:

DRILL RIG: Track-Mounted Geoprobe Rig

CONTRACTOR: Pacific Soil & Water

LOGGED BY: G. Taylor, J. Eledge

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 10/16/2013 - 10/16/2013

REMARKS:

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

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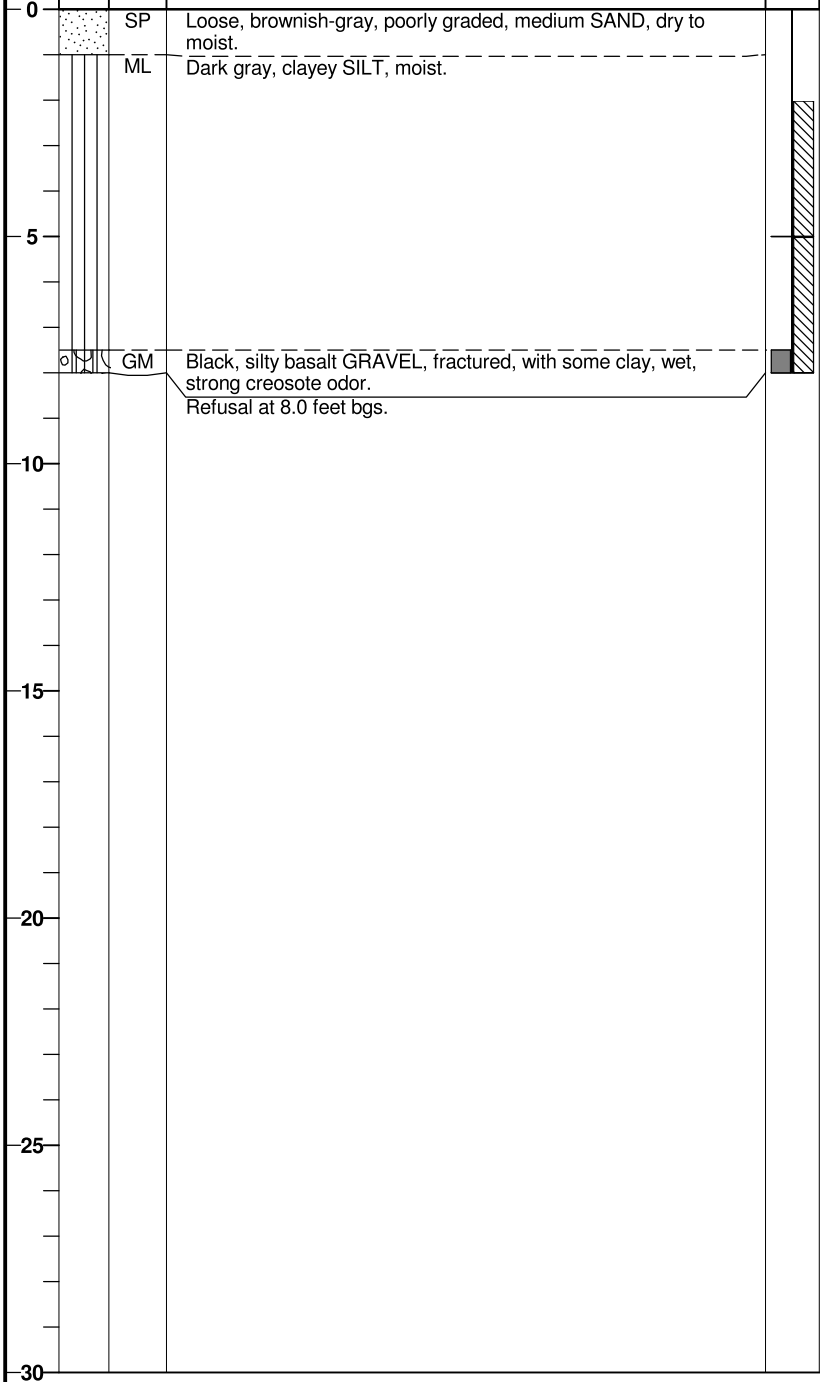
LOG OF BORING DAI-SB-08



BORING METHOD: Direct Push

BOREHOLE DIAMETER:

DRILL RIG: Track-Mounted Geoprobe Rig

CONTRACTOR: Pacific Soil & Water

LOGGED BY: G. Taylor, J. Eledge

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 10/16/2013 - 10/16/2013

REMARKS:

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

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LOG OF BORING DAI-SB-09

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SP	Poorly graded, medium SAND, moist, no odor. (Fill)						
			Grades to rust colored, coarse.						
5		ML	Dark gray, SILT with organics (treated wood fragments), strong creosote odor. (Fill)						
		ML	Gray, clayey SILT, strong creosote odor. (Fill)						
			Organics (occasional lumber fragments, fine wood fibers and rootlets) from 5.5-13 feet bgs. NAPL veins (1-3 mm wide, 2-3 cm long) from 7.5-13 feet bgs.						
10									
		GP	Silty subangular basalt GRAVEL, fragments, wet, NAPL present, strong creosote odor.						DAI-SB-10-13.5-14 @1600 Total PAHs = 1,650.07 ppm
			Refusal at 14.0 feet bgs.						
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor, J. Eledge
DRILLING DATES: 10/16/2013 - 10/16/2013

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LOG OF BORING DAI-SB-10

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SP	Medium dense, brown, poorly graded, medium SAND, dry. (Fill)						
			Gray and rust colored SILT lens (~4 inches thick), trace gravel, dry.						
5		ML	Dark brown to black, clayey SILT with organics (wood debris, large treated lumber fragments), trace sand, moist, slight creosote odor. (Fill)						
		ML	Gray, clayey SILT, organics (rootlets), moist.						
10			NAPL present in veins (micropores ~2-3 mm in diameter) associated with rootlet cavities, sheen and strong creosote odor. Refusal at 12.0 feet bgs on basalt bedrock. Sheen observed on basalt surface.						
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor
DRILLING DATES: 10/17/2013 - 10/17/2013

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

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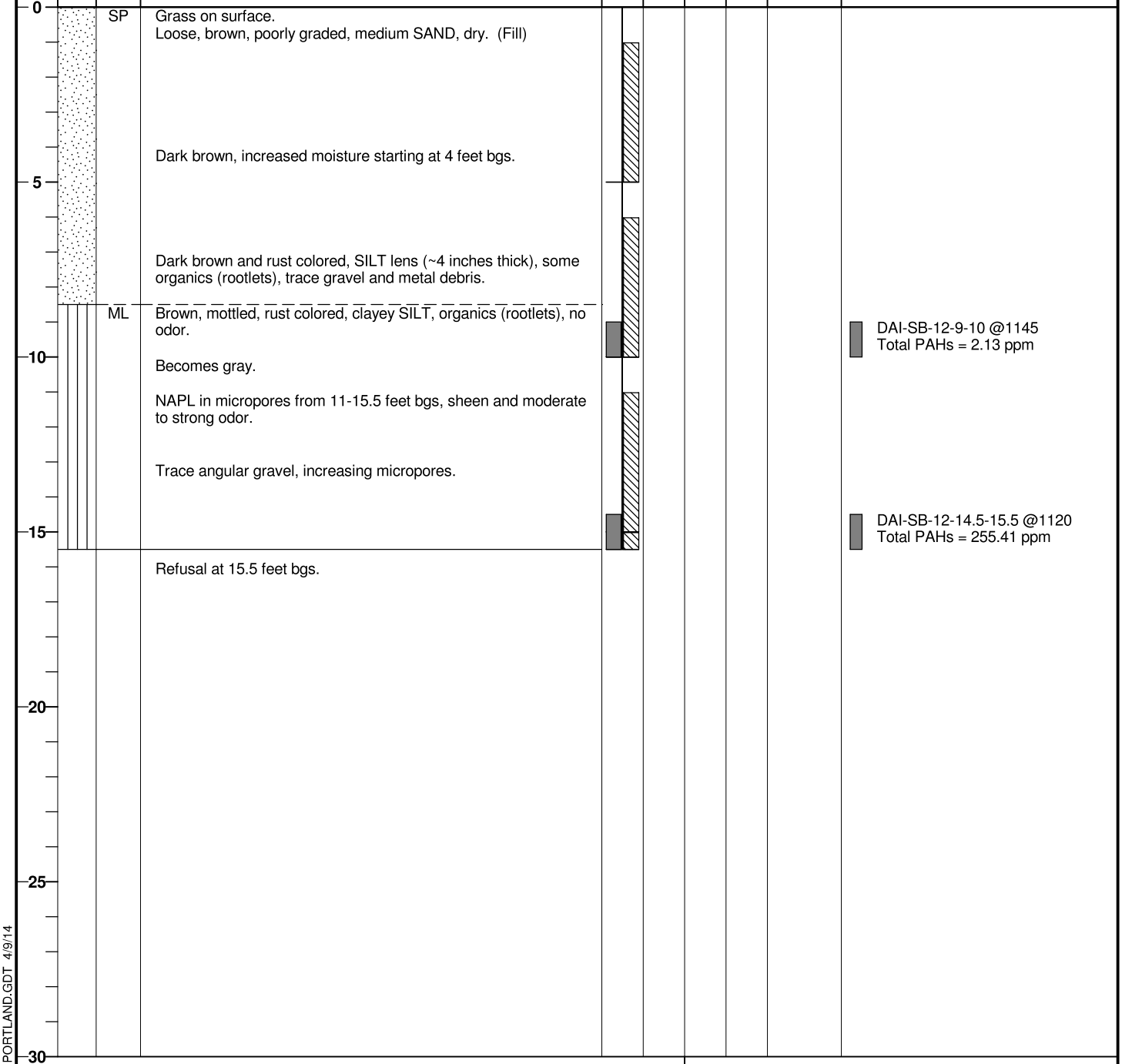
LOG OF BORING DAI-SB-11



BORING METHOD: Direct Push

BOREHOLE DIAMETER:

DRILL RIG: Track-Mounted Geoprobe Rig

CONTRACTOR: Pacific Soil & Water

LOGGED BY: G. Taylor

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 10/17/2013 - 10/17/2013

REMARKS:

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

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LOG OF BORING DAI-SB-12

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SP	Loose, brown, poorly graded, medium SAND, dry. (Fill)						
			SILT lens (~2 inches thick).						
5		ML	Black grading to gray and mottled brown, clayey SILT, moist. Becomes rust colored.						
			NAPL filled micropore (~4 mm diameter) at 9 feet bgs.						
10			Black, no NAPL observed, faint creosote odor.						DAI-SB-13-13-14 @1235 Total PAHs = 109.47 ppm
			Basalt bedrock, metal debris, NAPL, heavy sheen.						
15			Refusal at 14.5 feet bgs.						
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor
DRILLING DATES: 10/17/2013 - 10/17/2013

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LOG OF BORING DAI-SB-13

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SP	Loose, brown, medium SAND, dry. (Fill)						
5		ML	Dark brown to black, clayey SILT, organic debris (rootlets and wood debris to 6 feet bgs), moist. (Fill)						
10			Gray and mottled brown.						
			Black, increased moisture, faint creosote odor.						DAI-SB-14-13-14 @1310 Total PAHs = 23.24 ppm
15			Refusal at 14.0 feet bgs on basalt contact with metal debris. Sheen and faint creosote odor.						
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor
DRILLING DATES: 10/17/2013 - 10/17/2013

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

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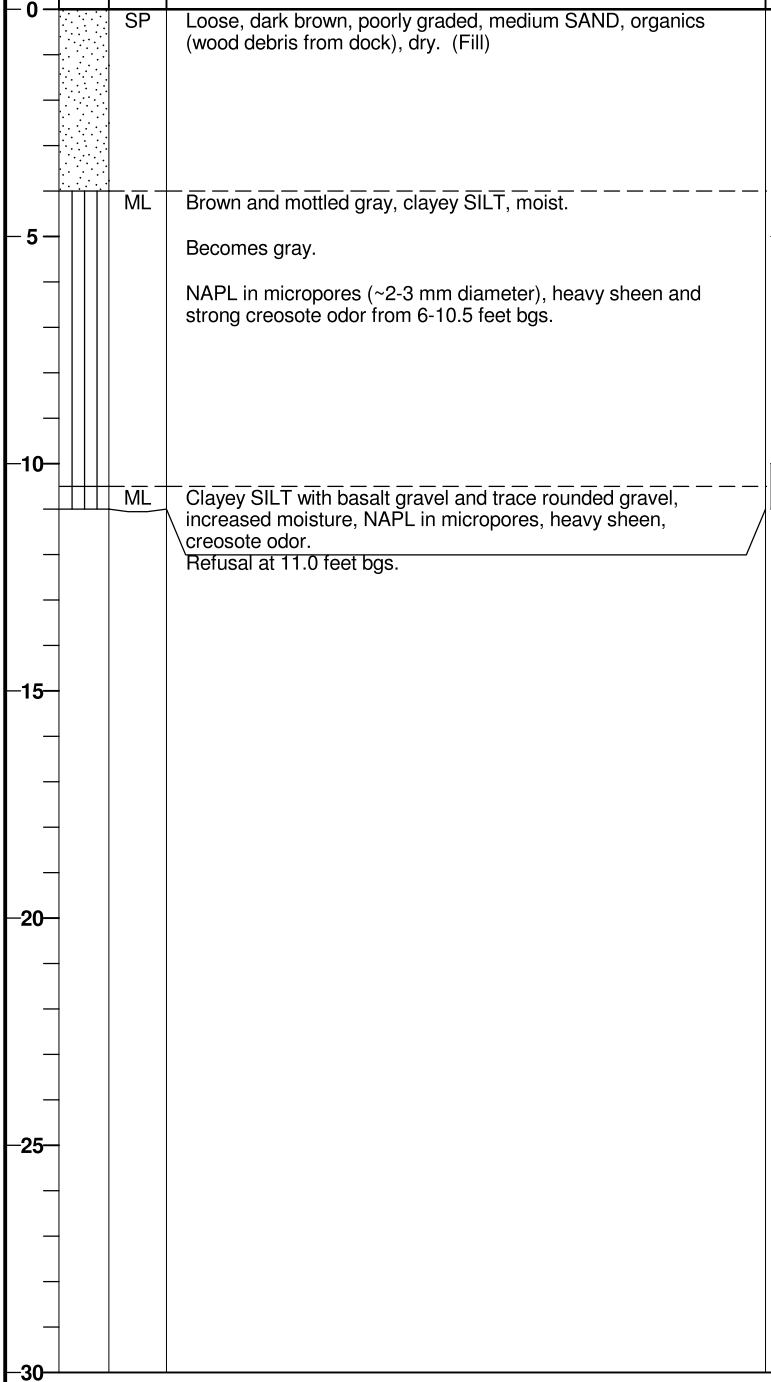
LOG OF BORING DAI-SB-14



BORING METHOD: Direct Push

BOREHOLE DIAMETER:

DRILL RIG: Track-Mounted Geoprobe Rig

CONTRACTOR: Pacific Soil & Water

LOGGED BY: G. Taylor

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 10/17/2013 - 10/17/2013

REMARKS:

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

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LOG OF BORING DAI-SB-15

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SP	Loose, gray, poorly graded, medium SAND, organic debris (sticks, roots, wood), dry. (Fill)						
		ML	Rust colored, clayey SILT with rusted metal debris, moist. (Fill)						
		ML	Dark gray, clayey SILT, trace organics (rootlets), moist.						
			NAPL in micropores, isolated voids containing NAPL, heavy sheen and creosote odor from 5-9 feet bgs.						
5									
		ML	Dark gray, clayey SILT with angular basalt gravel, NAPL in micropores, wet.						DAI-SB-16-9-10 @1420 Total PAHs = 456.83 ppm
10			Refusal at 10.0 feet bgs in basalt.						
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor
DRILLING DATES: 10/17/2013 - 10/17/2013

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/9/14

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LOG OF BORING DAI-SB-16

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SP	Loose, light brown to gray, poorly graded, medium SAND with organics, dry. (Fill)						
		ML	Rust colored, clayey SILT with rusted metal debris, moist. (Fill)						
		ML	Dark gray, clayey SILT, trace organics (rootlets), moist.						
5			NAPL in micropores, isolated voids containing NAPL, heavy sheen and creosote odor from 6-11 feet bgs.						
10		ML	Dark gray, clayey SILT with angular basalt gravel, NAPL in micropores within matrix, wet.						DAI-SB-17-11-12 @1500 Total PAHs = 474.94 ppm
			Refusal at 12.0 feet bgs in basalt.						
15									
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor
DRILLING DATES: 10/17/2013 - 10/17/2013

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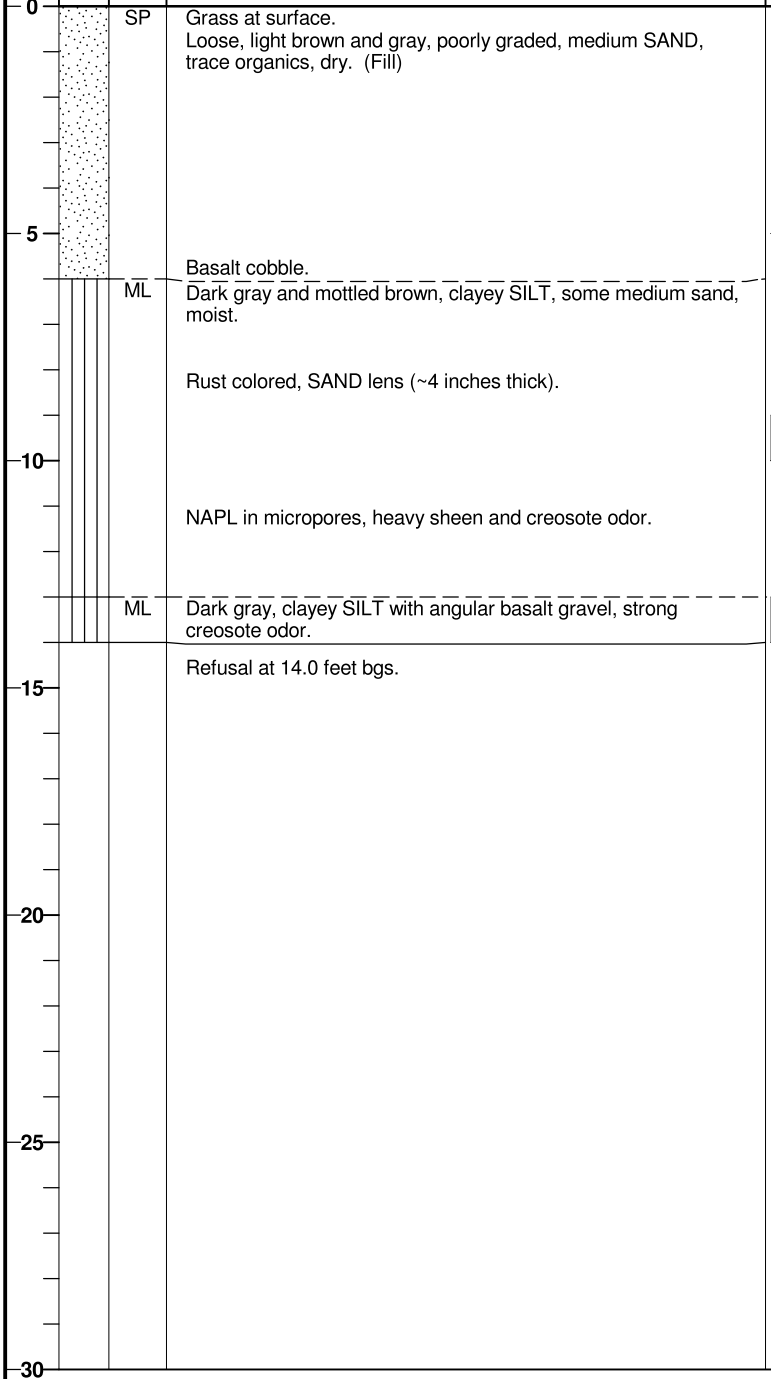
LOG OF BORING DAI-SB-17



BORING METHOD: Direct Push

BOREHOLE DIAMETER:

DRILL RIG: Track-Mounted Geoprobe Rig

CONTRACTOR: Pacific Soil & Water

LOGGED BY: G. Taylor

ELEVATION REFERENCE: NA

GROUND SURFACE ELEVATION: NA

DRILLING DATES: 10/17/2013 - 10/17/2013

REMARKS:

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/16/14

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LOG OF BORING DAI-SB-18

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SP	Grass at surface. Loose, light brown, poorly graded, medium SAND, trace organics, dry. (Fill)						
			Organics (wood debris).						
5		ML	Clayey SILT with organics (non-treated wood, 70%).						
		ML	Gray and mottled brown, clayey SILT with medium sand, moist.						
		ML	Dark gray, clayey SILT, moist.						
10			NAPL in micropores, heavy sheen and strong creosote odor starting at 11 feet bgs.						
		ML	Dark gray, clayey SILT with angular basalt gravel fragments, NAPL micropores within matrix, wet, heavy sheen and creosote odor.						DAI-SB-19-13-14 Total PAHs = 424.14 ppm
15			Refusal at 14.0 feet bgs.						
20									
25									
30									

BORING METHOD: Direct Push
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Geoprobe Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Pacific Soil & Water
LOGGED BY: G. Taylor
DRILLING DATES: 10/17/2013 - 10/17/2013

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/16/14

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LOG OF BORING DAI-SB-19

DEPTH (ft bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
0		SP	Loose, brown, poorly graded, fine SAND. (Fill)						
		CL	Soft, black, CLAY (30-40%) and organics, some silt, moist, slight organic odor. (Fill)						
		CL	Soft, black and mottled brown, silty CLAY, trace fine sand.						
5									
			Very soft, wet, slight creosote odor. Trace subrounded gravel (to 1-inch diameter).		0.0				DAI-SB-20-8-8.5 @1330 Total PAHs = 11.02 ppm
			Basalt bedrock.						
10			End of boring at 9.5 feet bgs.						
15									
20									
25									
30									

BORING METHOD: Sonic
ELEVATION REFERENCE: NA
BOREHOLE DIAMETER:
REMARKS:
DRILL RIG: Track-Mounted Sonic Rig
GROUND SURFACE ELEVATION: NA
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor, M. Roskamp
DRILLING DATES: 10/15/2013 - 10/15/2013

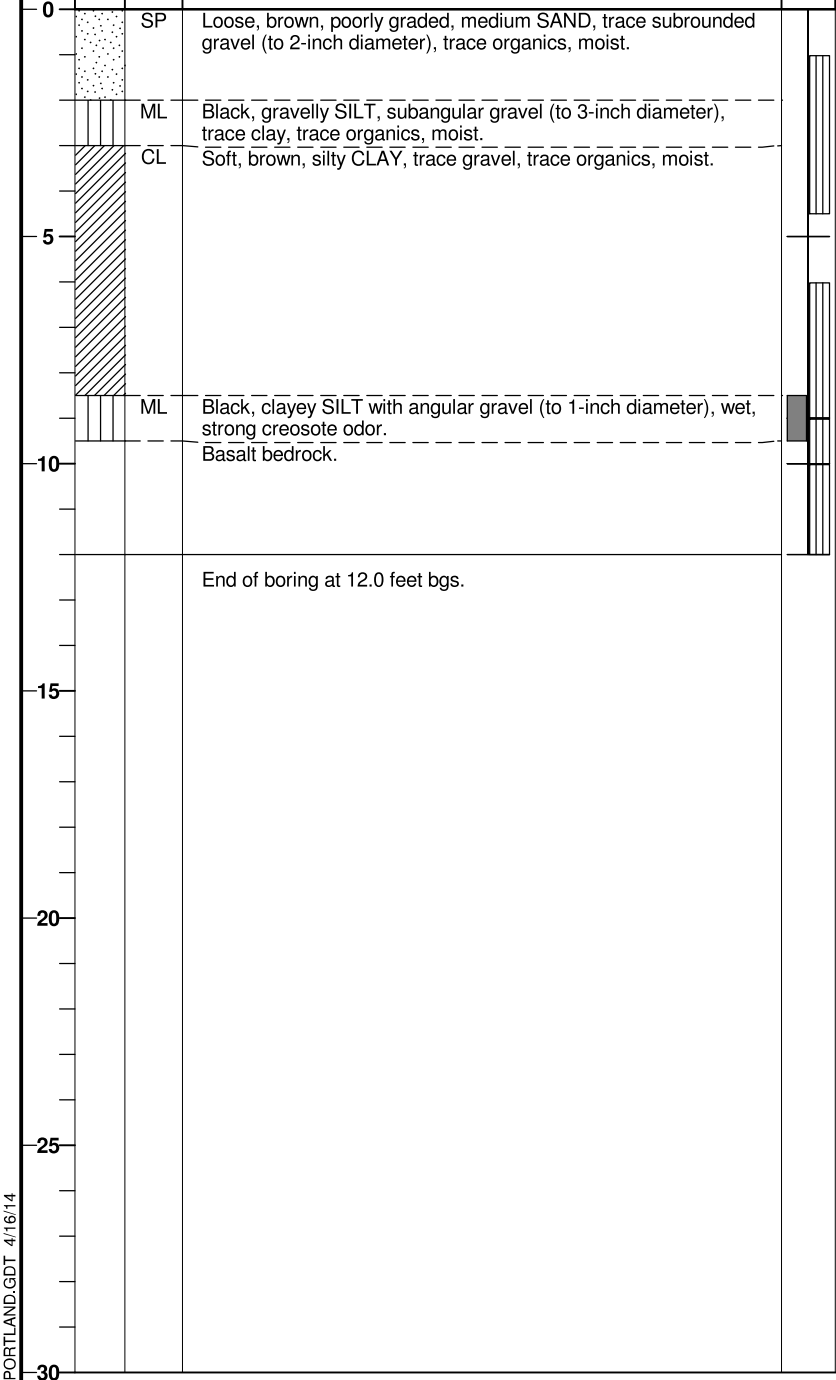
DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/16/14

Port of St. Helens
Dock Area Investigation

9-61M-112202

AMEC Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING DAI-SB-20



GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	VOLATILE READING (ppm)	GROUNDWATER	GW SCREENED INTERVAL	FIELD TESTING	TESTING AND LABORATORY DATA
	SP	Loose, brown, poorly graded, medium SAND, trace subrounded gravel (to 2-inch diameter), trace organics, moist.						
	ML	Black, gravelly SILT, subangular gravel (to 3-inch diameter), trace clay, trace organics, moist.						
	CL	Soft, brown, silty CLAY, trace gravel, trace organics, moist.						
	ML	Black, clayey SILT with angular gravel (to 1-inch diameter), wet, strong creosote odor.						DAI-SB-21-8.5-9.5 @1433 Total PAHs = 0.66 ppm
		Basalt bedrock.						
		End of boring at 12.0 feet bgs.						

BORING METHOD: Sonic
BOREHOLE DIAMETER:
DRILL RIG: Track-Mounted Sonic Rig
CONTRACTOR: Cascade Drilling
LOGGED BY: G. Taylor, M. Roskamp

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: NA
DRILLING DATES: 10/15/2013 - 10/15/2013

REMARKS:

DIRECT PUSH BORING 9-61M-12202.GPJ AMEC PORTLAND.GDT 4/16/14

Port of St. Helens
Dock Area Investigation

9-61M-112202

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LOG OF BORING DAI-SB-21

Dock Area Investigation Pot Hole and Hand Auger Observations
Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Dock Area Investigation Pot Hole and Hand Auger Observations

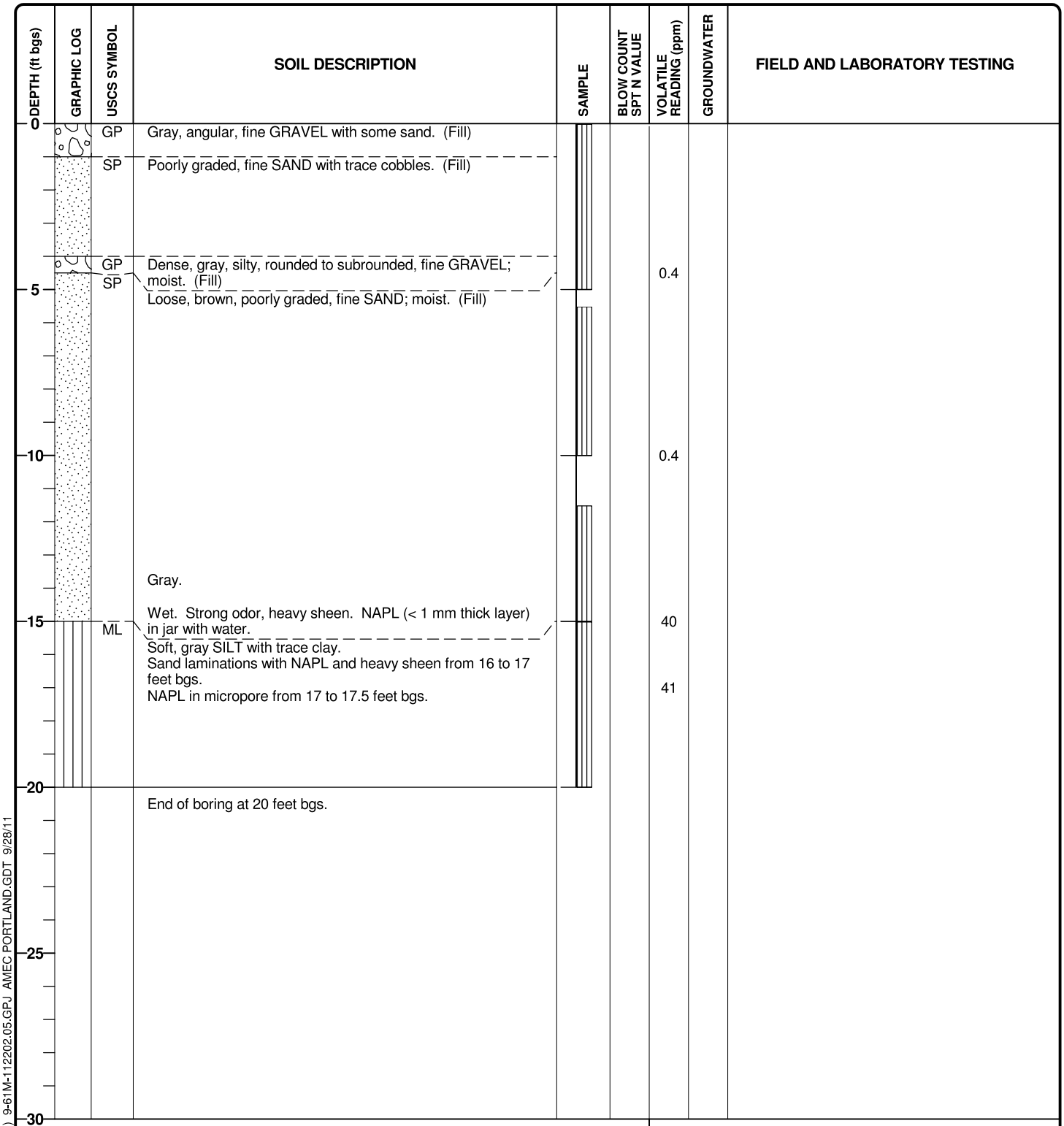
Location ID	Date	Location	Field Personnel	Excavation Method	Total Depth (ft)	Observations	NAPL Observed?	Sample Collected?
DAI-PH-01	10/14/2013	East end of dock at low water line - approximately 25 feet west of eastern edge.	JE	Hand Shovel	1.5	0-3 inches: Gray fine to medium silty sand and cobbles with a few scattered treated timber fragments exuding visible sheen (~ 10% woody debris). 3-18 inches: Soft gray clayey silt, no timber debris or sheen observed. No odor in soil.	Sheen associated with lumber fragments only.	No
DAI-PH-02	10/14/2013	East end of dock at low water line - approximately 50 feet west of eastern edge.	JE	Hand Shovel	1.5	0-4 inches: Gray silty sand and cobbles with a few scattered small treated timber fragments with no visible sheen (< 5% woody debris). 4-18 inches: Soft gray clayey silt, no timber debris or sheen observed. No odor in soil.	No NAPL or sheen observed.	No
DAI-PH-03	10/14/2013	East end of dock at low water line - approximately 75 feet west of eastern edge.	JE	Hand Shovel	1.5	0-8 inches: Sandy gravel and cobbles with abundant treated timber debris exuding visible sheen and some metal debr (~75% woody debris). 8-18 inches: Soft gray clayey silt, no timber debris or sheen observed. No odor in soil.	Sheen associated with lumber fragments only.	No
DAI-PH-04	10/14/2013	East end of dock at low water line - approximately 100 feet west of eastern edge.	JE	Hand Shovel	0.92	0-2 inches: Gravel and cobbles and large pieces of treated lumber exposed at sediment surface. 2-7 inches: Abundant treated lumber debris exuding visible sheen (~75% woody debris). 7-11 inches: Soft gray clayey silt, no timber debris or sheen observed. Difficult to observe below 8 inches because hol began caving due to water intrusion.	Sheen associated with lumber fragments only.	No
DAI-PH-05	10/14/2013	East half of dock - approximately 125 feet west of eastern dock edge,15 feet lateral feet up bank from low water line.	JE	Hand Shovel	1.5	0-6 inches: Sandy cobbles and gravel and some treated lumber with no visible sheen (< 10% woody debris). 6-18 inches: Soft gray clayey silt, no timber debris or sheen observed. No odor in soil.	No NAPL or sheen observed.	
DAI-HA-01	10/14/2013	East end of dock, approximately 15 up bank from high water line.	JE	Hand Auger	2	0-2 inches: Grass, vegetated layer and organic debris. 2-9 inches: Brown, fine to medium sand, no treated lumber debris, sheen or odor observed. 9-24 inches: Soft gray silty clay with occasional natural wood debris (< 5%). No treated lumber debris, sheen or odor observed.	No NAPL or sheen observed.	No
DAI-PH-06/PWS-01	10/14/2013	East end of dock - approximately 40 feet west of eastern edge, approximately 20 feet up bank of high water line in freshwater seep area	JE, KH	Hand Shovel	1.5	0-4 inches: Sandy silt with surface algae layer and wood debris (~85% debris). No sheen or odor associated with woo debris. 4-18 inches: Soft to medium stiff gray silty clay with occasional gravel and natural wood debris (< 5%). No treated lumber debris, sheen or odor observed.	No NAPL or sheen observed.	DAI-PWS-01,8-11 in 15:15
DAI-PWS-02	10/14/2013	Central upland portion of dock - approximately 3 feet west-northwest of sonic boring SB-03.	JE, KH	Hand Shovel	1.5	0-4 inches: Gray-brown sandy gravel and cobbles with silt, occasional leaf litter and rootlets (~2-5% organic debris) 5 - 18 inches: Gray silty clay with occasional gravel and cobbles. No odor or sheen observed.	No NAPL or sheen observed.	DAI-PWS-02,8-11 in 16:00
DAI-HA-02	10/15/2013	West end of dock approx. 15 feet up bank from low water line - approximately 5 feet west of sonic boring SB-01.	JE, RJ, GT	Hand Auger	6.5	0-0.5 ft: Gray brown fine to medium sand. 0.5 to 2.5 ft: lumber debris (~85%) with silty sand. Moderate creosote odor and some sheen observed exuding from lumber debris. 2.5 to 6.5 ft: Loose clayey silt with abundant lumber debris (60 - 85%). NAPL blebs observed on water infiltrating into borehole. Boring ended at 6.5 feet due to poor recovery - lumber debris.	NAPL and sheen associated with lumber debris.	No
DAI-PH-07	10/15/2013	West end of dock near low water line - approximately 25 feet south southeast of sonic boring SB-01.	JE	Hand Shovel	1.5	0-1.5 ft: Gray brown silty sand with abundant lumber debris (70-85%). Mild creosote odor, no sheen observed. Digging terminated at 1.5 feet - hole caving due to water infiltration.	No NAPL or sheen observed.	No
DAI-PH-08	10/15/2013	West edge of dock. 12 feet up bank from low water line - near low water line - approximately 10 feet southwest of sonic boring SB-01.	JE	Hand Shovel	2	0-2 ft: Gray brown silty sand with abundant lumber debris (75-85%). Strong creosote odor and sheen observed. Refusal at 2 feet due to lumber debris.	Sheen associated with lumber fragments.	No
DAI-PH-09	10/15/2013	West portion of dock, approximately 40 feet east-northeast of sonic boring SB-01.	JE	Hand Shovel	2	0-2 ft: Gray brown silty sand with abundant lumber debris (75-85%). Mild creosote odor observed 0-1.5 feet. Strong creosote odor and sheen observed 1.5 - 2 feet. Refusal at 2 feet due to lumber debris.	Sheen associated with lumber fragments.	
DAI-PH-10	10/15/2013	West portion of dock, on low water "island" approximately 3 feet east of direct-push boring SB-06.	JE	Hand Shovel	2	0-11 inches: Gray silty sand with abundant lumber debris (75-85%). Mild creosote odor, no sheen observed. 11-24 inches: Gray, soft clayey silt and occasional lumber debris (10-15%) Moderate creosote odor, slight sheen observed. Refusal at 2 feet due to lumber debris.	Sheen associated with lumber fragments.	No
DAI-PH-11	10/15/2013	West-central portion of dock, near low water line, approximately 25 feet east of sonic boring SB-02.	JE	Hand Shovel	2	0-1 ft: Gray silty sand with abundant lumber debris (75-85%). Mild creosote odor, no sheen observed. 1-2 ft: Gray, silty clay silt trace to no lumber debris (< 5%). No creosote odor or sheen observed.	No NAPL or sheen observed.	No
DAI-PH-12	10/15/2013	West portion of dock, near low water line, approximately 40 feet west-northwest of direct-push boring SB-06.	JE	Hand Shovel	2.5	0-2 ft: Gray brown silty sand with abundant lumber debris (75-85%). Strong creosote odor. NAPL blebs observed on water infiltrating into borehole. Refusal at 2.5 feet due to lumber debris.	NAPL and sheen associated with lumber debris.	No
DAI-PH-13	10/15/2013	West-central portion of dock, approximately 20 feet up bank from low water line, approximately 10 feet southeast of sonic boring SB-02.	JE	Hand Shovel	2.5	0-8 inches; Brown fine to medium sand (< 5% debris). No odor. 8-10 inches: Gray fine to medium sand (< 5% debris). No odor. 10-24 inches: Gray sandy silt with large lumber debris fragments (55-65% debris). Mild creosote odor, no sheen. 24-30 inches: Gray clayey silt (< 5% debris). No odor.	No NAPL or sheen observed.	No
DAI-PH-14	10/15/2013	West-central portion of dock, approximately 20 feet up bank from low water line, approximately 25 feet southwest of sonic boring SB-02.	JE	Hand Shovel	2	0-8 inches; Brown fine to medium sand (< 5% debris). No odor. 8-10 inches: Gray fine to medium sand (< 5% debris). No odor. 10-12 inches: Gray sandy silt with pulverized lumber debris fragments (75-85% debris). No odor or sheen. 12-24inches: Gray silty sand (< 5% debris). No odor.	No NAPL or sheen observed.	No

Dock Area Investigation Pot Hole and Hand Auger Observations
Supplemental RI Report
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Dock Area Investigation Pot Hole and Hand Auger Observations

Location ID	Date	Location	Field Personnel	Excavation Method	Total Depth (ft)	Observations	NAPL Observed?	Sample Collected?
DAI-PH-15	10/15/2013	West-central portion of dock, approximately near low water line, approximately 25 feet south-southeast of sonic boring SB-02.	JE	Hand Shovel	2.5	0-2.5 feet: Gray sandy silt with lumber debris (45-65%). Mild creosote odor. Slight sheen observed on water infiltratin into excavation.	Sheen associated with lumber fragments.	No
DAI-PH-16	10/15/2013	West edge of dock, approx. 20 feet up bank from low water line, approximately 5 feet north-northwest of direct-push boring SB-07.	JE	Hand Shovel	2	0-1 ft: Brown fine to medium sand. No odor (< 5% debris). 1-2 ft: Gray sandy silt with occasionally lumber debris (20-30%). Mild creosote odor. Slight sheen on water infiltration into excavation. Refusal on large piece of lumber at 2 feet.	Sheen associated with lumber fragments.	No
DAI-HA-03	10/15/2013	East-central area of dock upland edge, approximately 30 feet west northwest of sonic boring SB-04.	JE, GT, RJ	Hand Auger	4	0-0.5 ft:Gray brown silty clay with lumber debris (25-30% debris). No odor or sheen. 0.5 - 4.0 ft: Gray brown silty clay (< 5% debris). No odor. Refusal at 4 feet on hard object.	No NAPL or sheen observed.	No
DAI-PH-17/PWS-03	10/16/2013	East-central area of dock near low water line, approximately 13 feet southeast of direct-push boring SB-08.	JE	Hand Shovel	1.5	0-4 inches: Gray silty sand with natural and lumber wood fragments (15-20% debris). No sheen or odor. 4 -18 inches: Gray silty clay with trace fine sand (< 5% debris). No odor or sheen. Note: excavation located approximately 3 feet from a standing piling. Large pieces of partially buried treated lumber (beams) located 6 and 20 feet from excavation.	No NAPL or sheen observed.	DAI-PWS-03, 8-11 in 11:20
DAI-PH-18	10/16/2013	Central area of dock near low water line, approximately 10 feet south of direct-push boring SB-09.	JE	Hand Shovel	1.7	0-5 inches: Brown fine to medium sand with trace lumber debris (~5%). No sheen or odor. 5-9 inches: Gray silty clay with trace lumber debris (~ 5%). No sheen or odor. 9-20 inches: Brown fine to medium sand (< 5% debris). Sheen and NAPL blebs on water infusing into hole. Excavation discontinued at 1.7 feet due to hole caving from water intrusion. *Note: excavation located approximately 2 feet from a standing piling and 3-5 feet from large pieces of submerged treated lumber.*	NAPL and sheen associated with lumber debris.	No
DAI-PH-19	10/16/2013	West central area of dock near low water line, approximately 12 feet southeast of direct-push boring SB-09.	JE	Hand Shovel	2	0-3 inches: Gray sandy silt with gravel and cobbles (2-3 in diameter), (< 5% debris). No sheen or odor. 2-24 inches: Medium stiff gray silty clay, low moisture content (< 5% debris). No sheen or odor.	No NAPL or sheen observed.	No

Monitoring Well Logs



BORING METHOD: Sonic

BOREHOLE DIAMETER: 6.0 (in)

DRILL RIG: Track Sonic

CONTRACTOR: Boart Longyear

LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88

GROUND SURFACE ELEVATION: NA

CASING ELEVATION: NA

DRILLING DATES: 7/19/2011 - 7/19/2011

REMARKS:
No well completed due to presence of potentially mobile NAPL at 15 to 17.5 feet bgs. Moved well location to east.

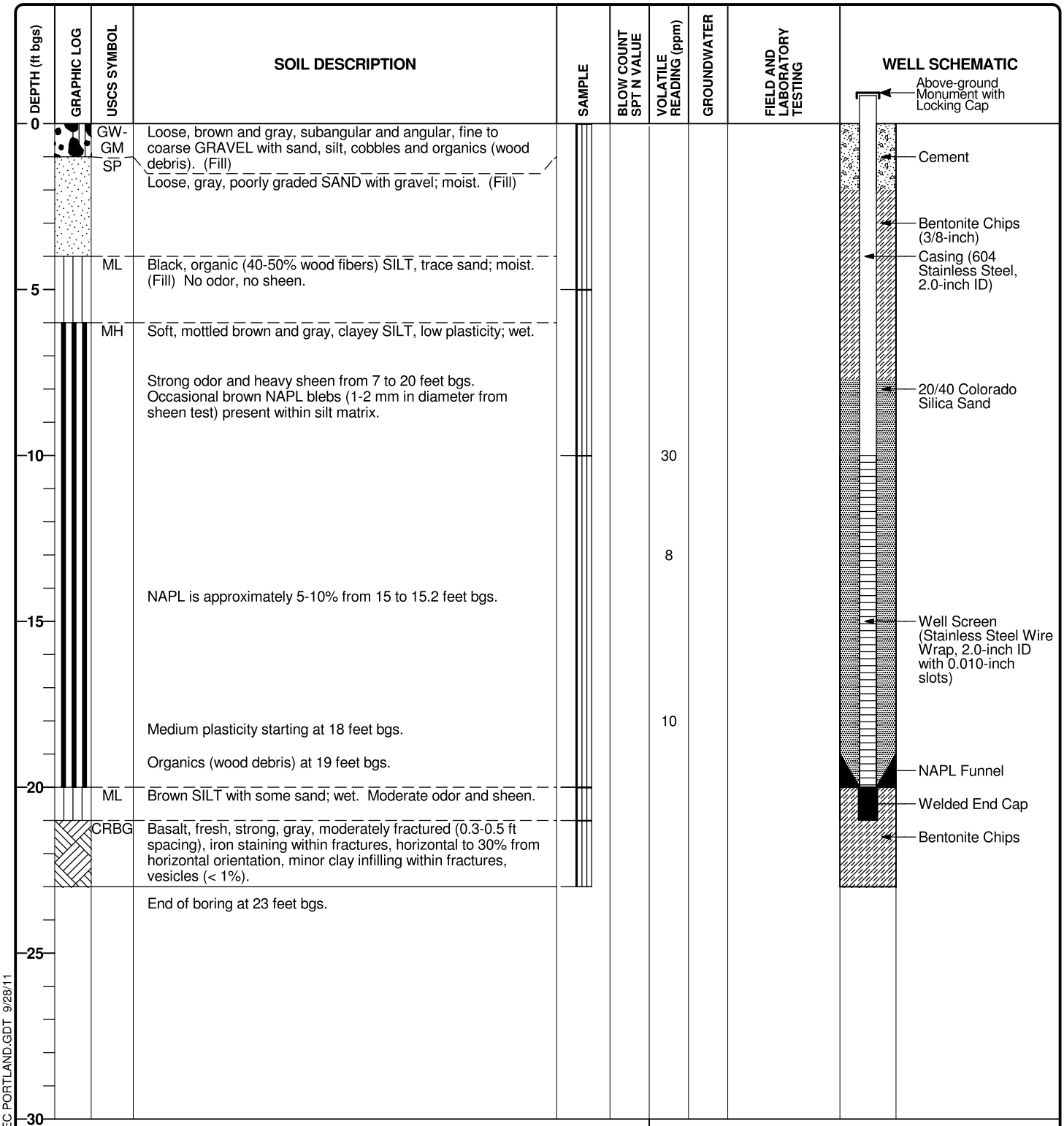
ENVIRONMENTAL BORING (FIELD&LAB TESTING) 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING MW-22 (Abandoned)



BORING METHOD: Sonic
BOREHOLE DIAMETER: 6.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: 23.71 feet
CASING ELEVATION: 26.42 feet
START CARD/TAG ID: 1014256/L99253
DRILLING DATES: 7/21/2011 - 7/21/2011

REMARKS:

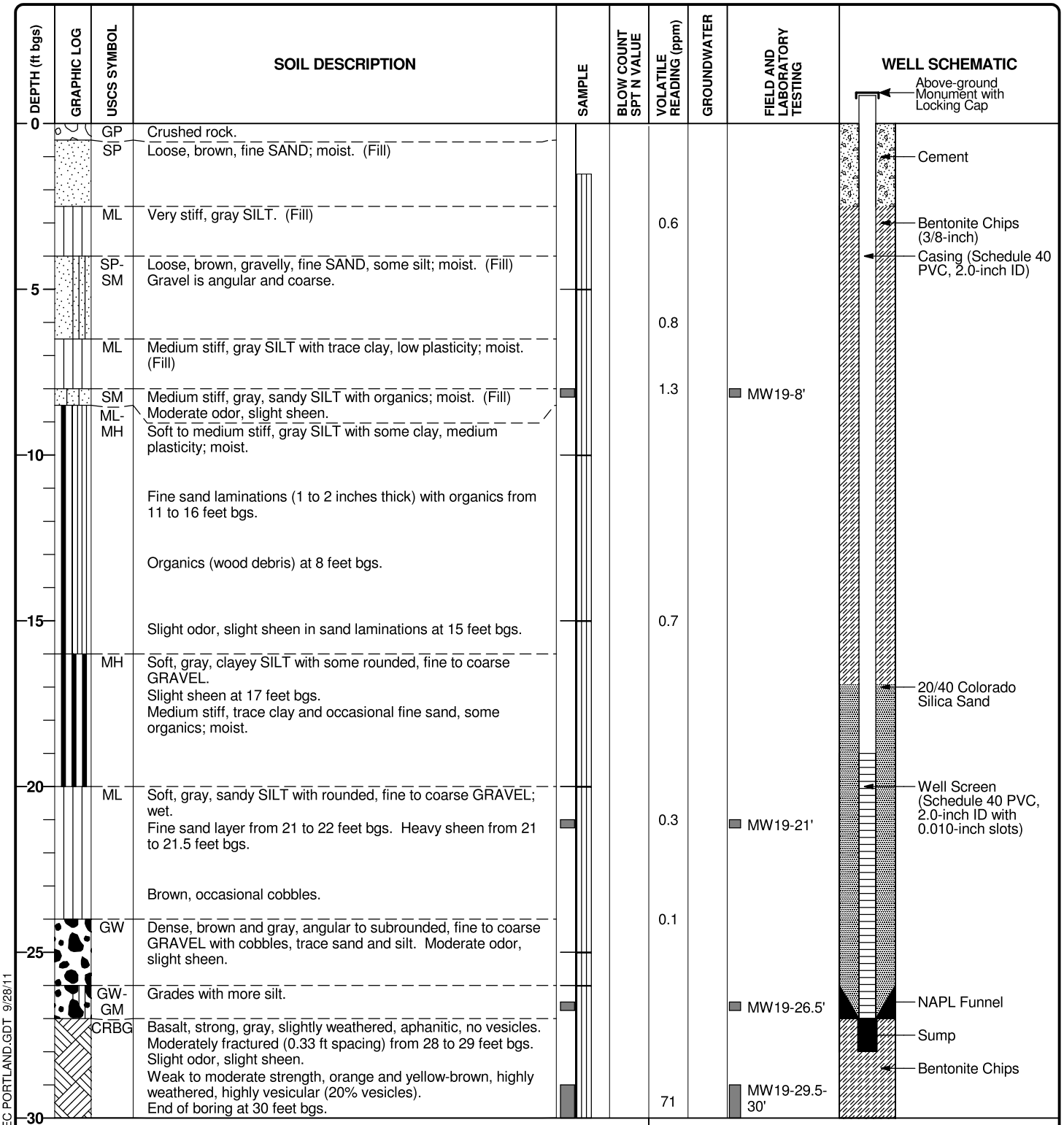
ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

AMEC
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel (503) 639-3400
Fax (503) 620-7892

LOG OF BORING MW-2A



BORING METHOD: Sonic
BOREHOLE DIAMETER: 6.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: 23.67 feet
CASING ELEVATION: 26.97 feet
START CARD/TAG ID: 1014255/L99252
DRILLING DATES: 7/19/2011 - 7/19/2011

REMARKS:

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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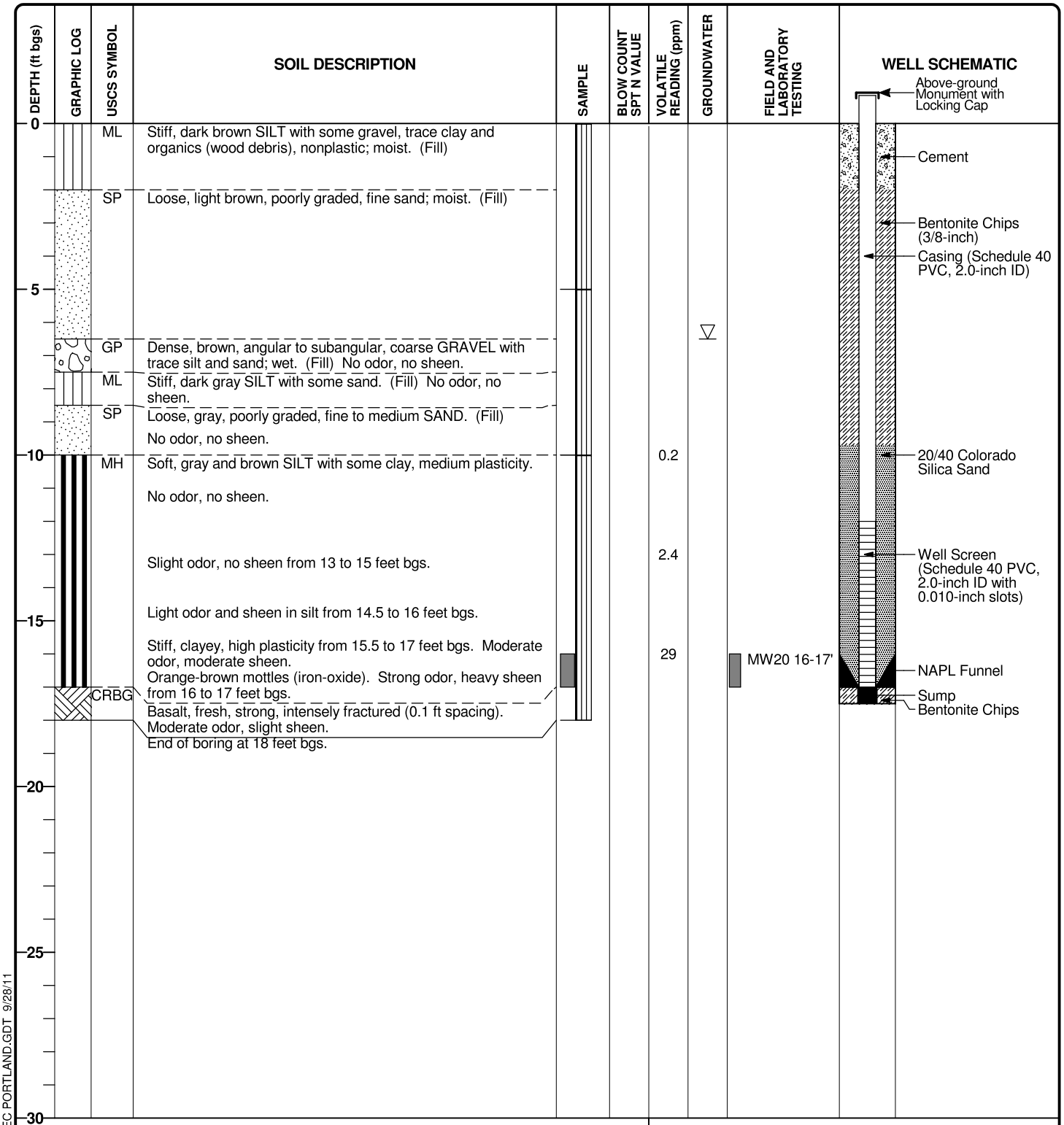
LOG OF BORING MW-19



BORING METHOD: Sonic
BOREHOLE DIAMETER: 6.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: 23.77 feet
CASING ELEVATION: 26.44 feet
START CARD/TAG ID: 1014257/L99254
DRILLING DATES: 7/21/2011 - 7/21/2011

REMARKS:

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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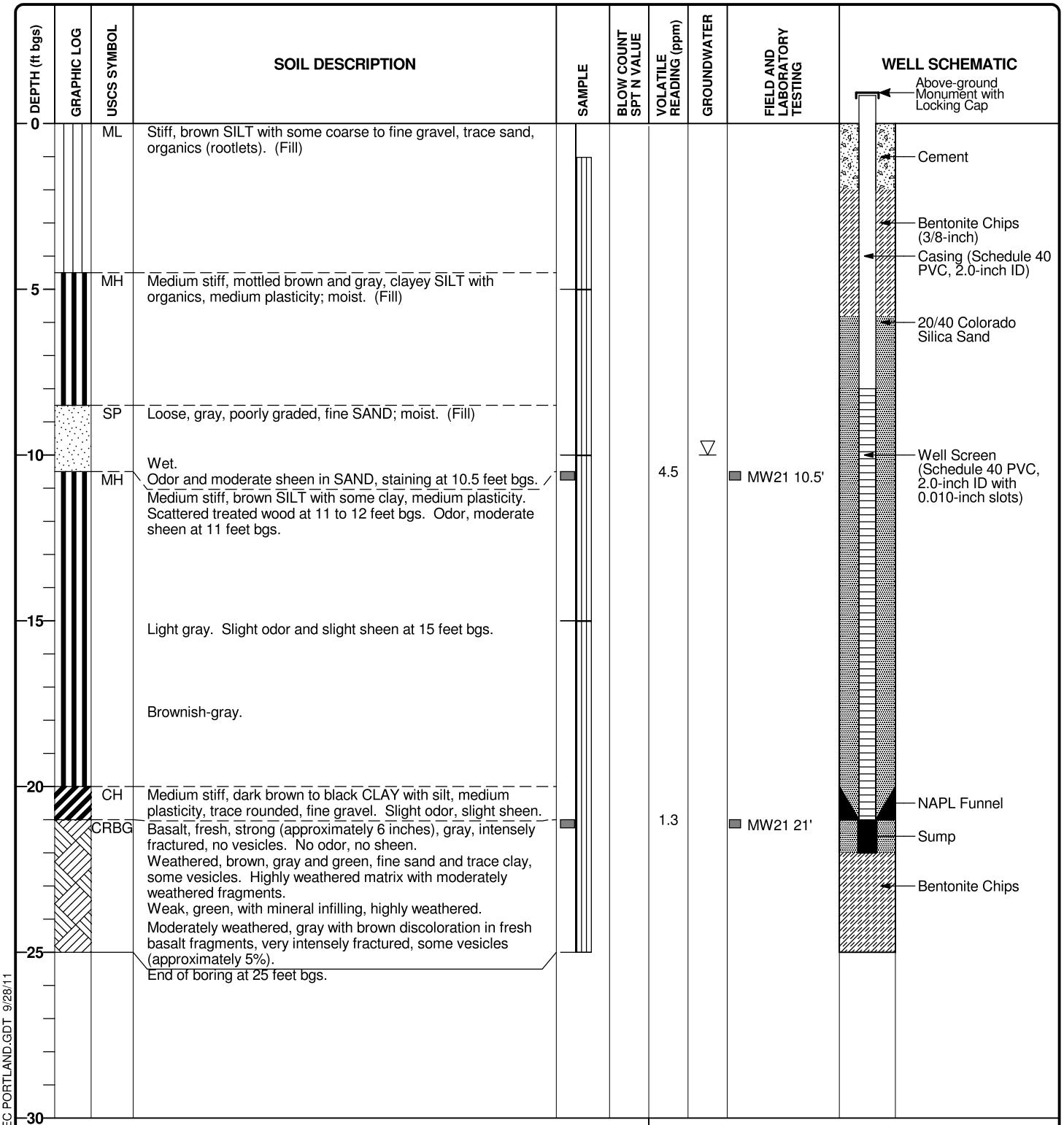
LOG OF BORING MW-20



BORING METHOD: Sonic
BOREHOLE DIAMETER: 6.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: 22.36 feet
CASING ELEVATION: 25.78 feet
START CARD/TAG ID: 1014254/L99251
DRILLING DATES: 7/21/2011 - 7/21/2011

REMARKS:

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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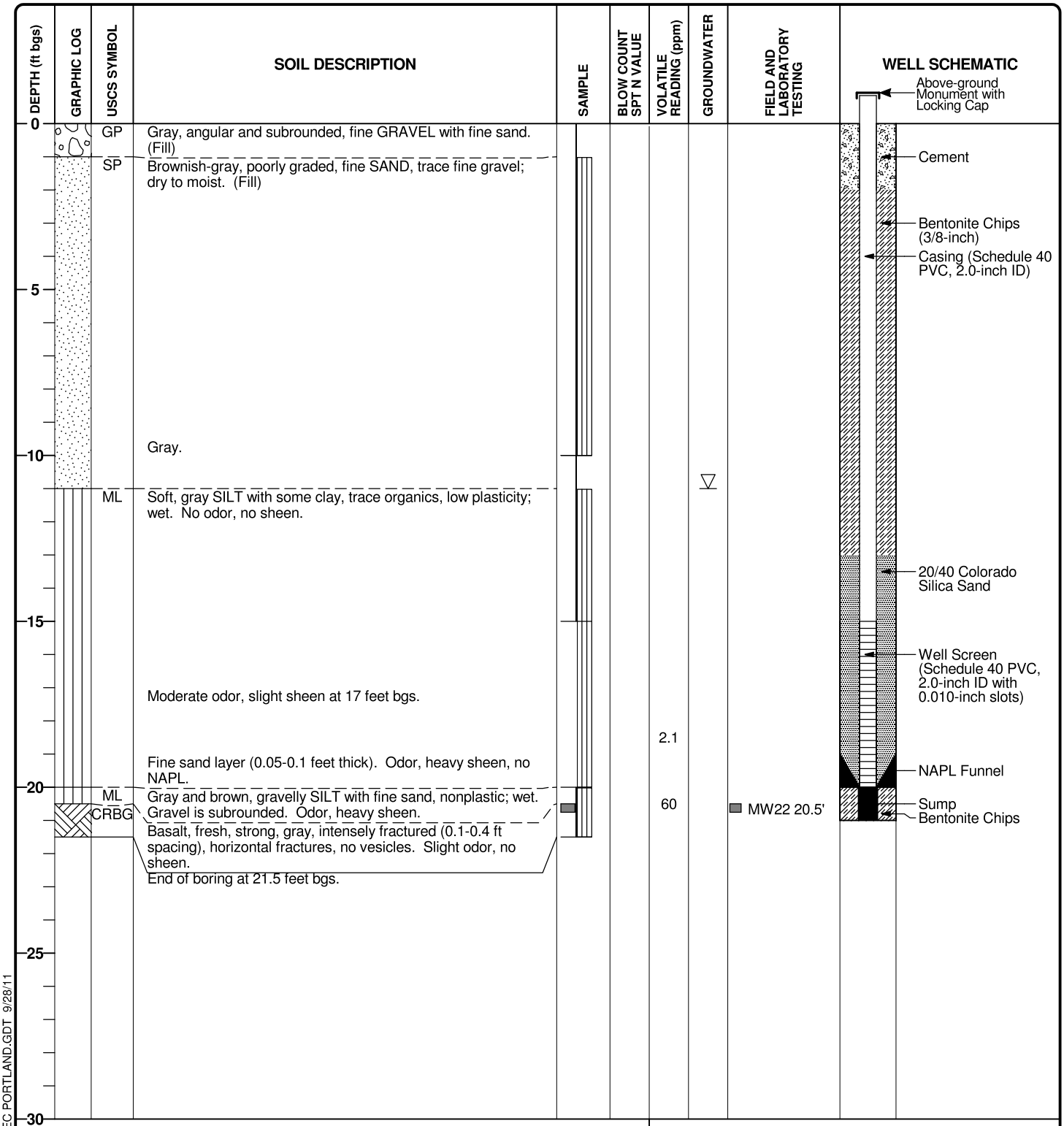
LOG OF BORING MW-21



BORING METHOD: Sonic
BOREHOLE DIAMETER: 6.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: 25.66 feet
CASING ELEVATION: 28.10 feet
START CARD/TAG ID: 1014258/L99255
DRILLING DATES: 7/22/2011 - 7/22/2011

REMARKS:

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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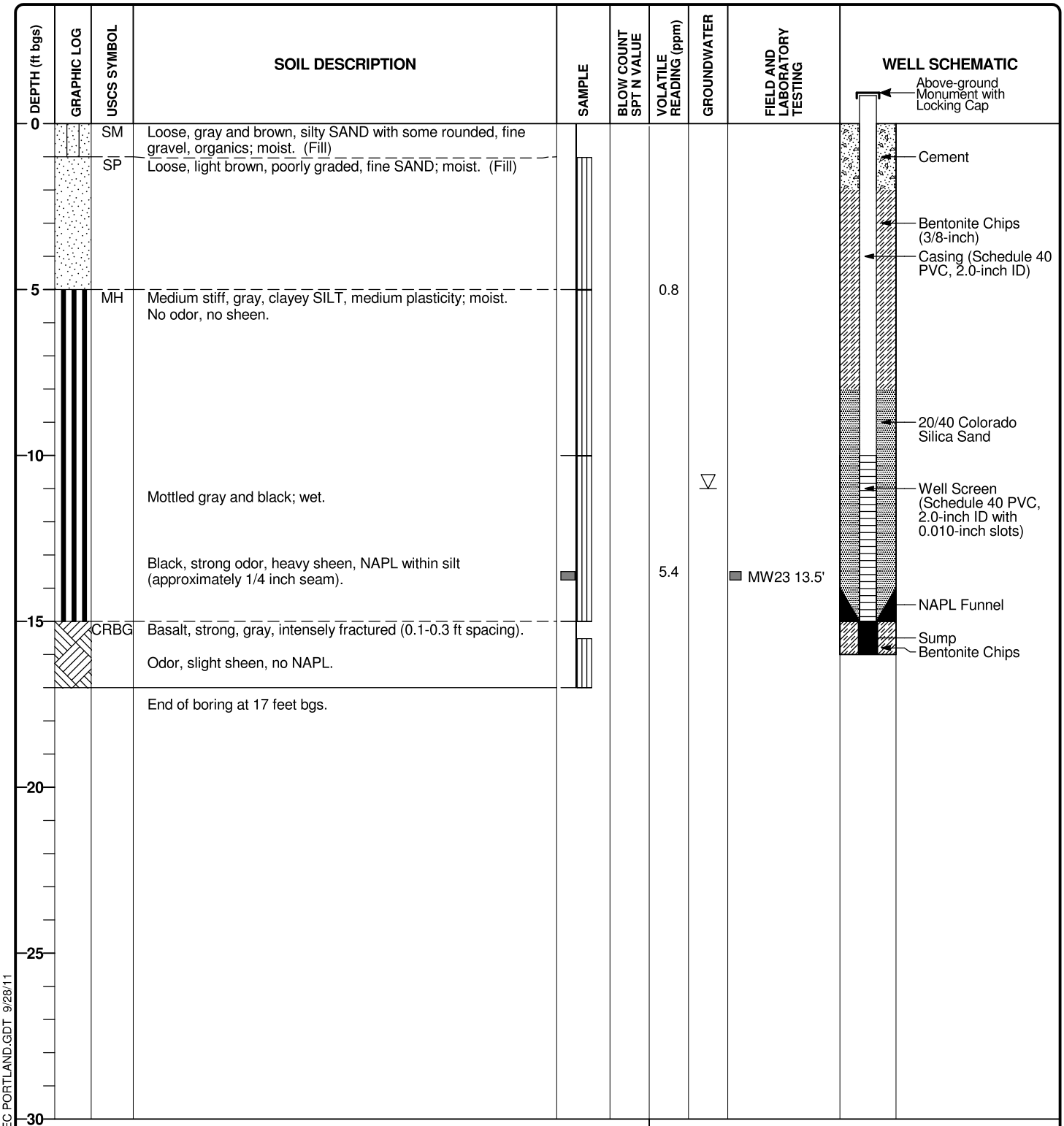
LOG OF BORING MW-22



BORING METHOD: Sonic
BOREHOLE DIAMETER: 6.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: 24.54 feet
CASING ELEVATION: 26.91 feet
START CARD/TAG ID: 1014258/L99255
DRILLING DATES: 7/19/2011 - 7/19/2011

REMARKS:

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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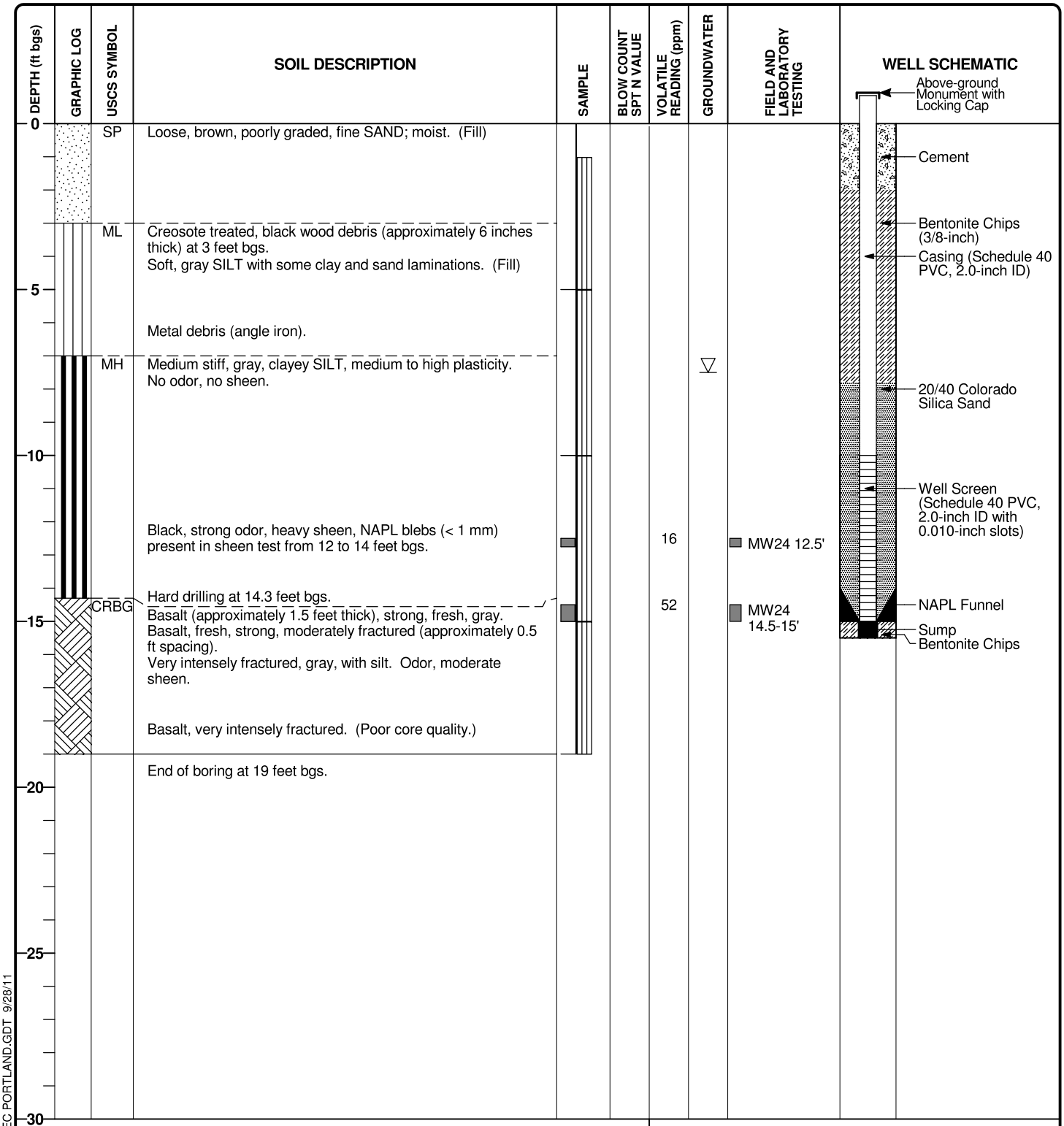
LOG OF BORING MW-23



BORING METHOD: Sonic
BOREHOLE DIAMETER: 6.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: 22.38 feet
CASING ELEVATION: 25.25 feet
START CARD/TAG ID: 1014260/L99257
DRILLING DATES: 7/19/2011 - 7/19/2011

REMARKS:

Port of St. Helens

9-61M-112202.05

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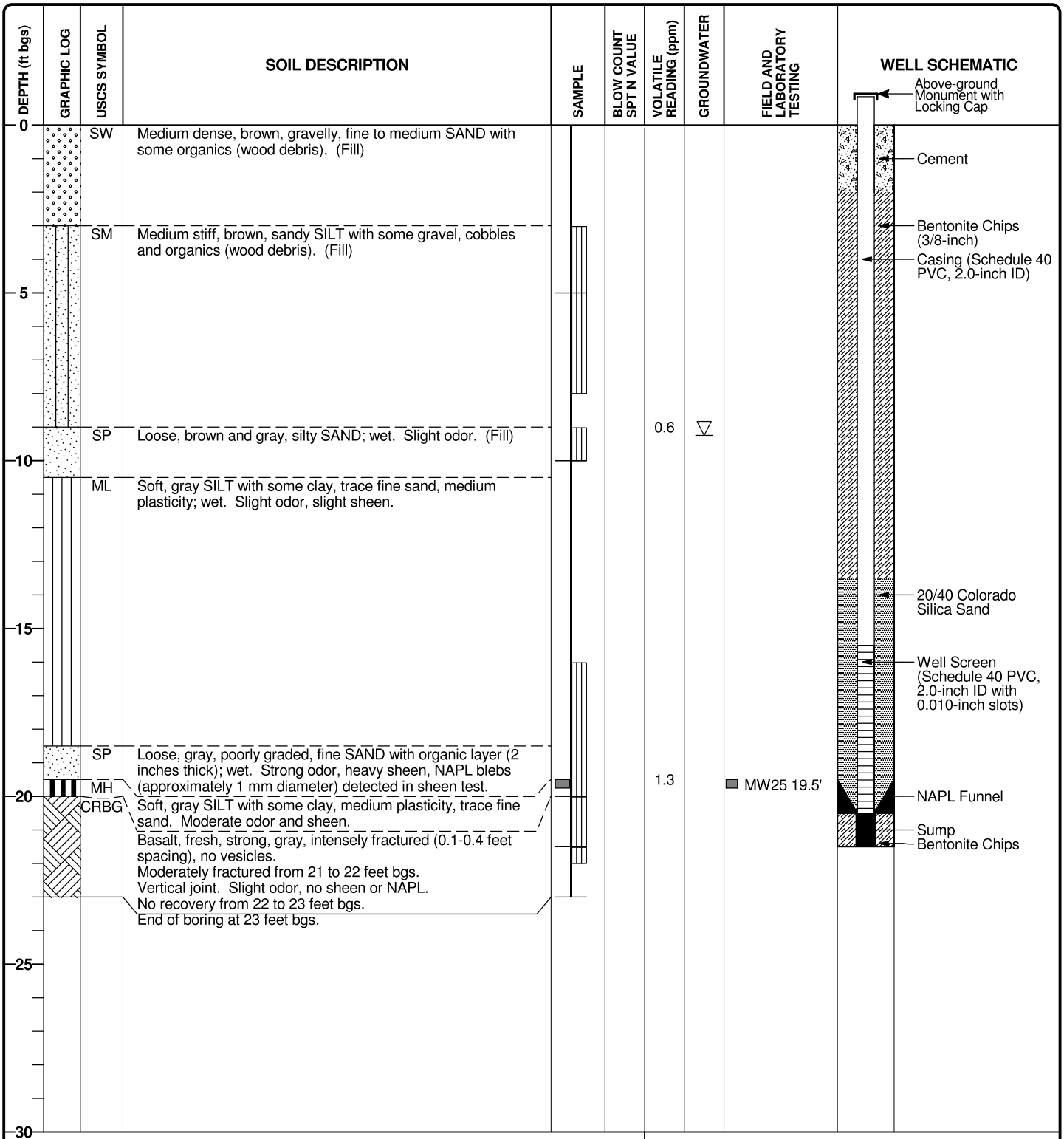
LOG OF BORING MW-24

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11



BORING METHOD: Sonic
BOREHOLE DIAMETER: 6.0 (in)
DRILL RIG: Track Sonic
CONTRACTOR: Boart Longyear
LOGGED BY: J. Fassio/G. Taylor

ELEVATION REFERENCE: NAVD88
GROUND SURFACE ELEVATION: 18.09 feet
CASING ELEVATION: 20.99 feet
START CARD/TAG ID: 1014261/L99258
DRILLING DATES: 7/22/2011 - 7/22/2011

REMARKS:

ENVR+WELL BORING 9-61M-112202.05.GPJ AMEC PORTLAND.GDT 9/28/11

Port of St. Helens

9-61M-112202.05

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LOG OF BORING MW-25

2012 Field Forms

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801182.61
Easting : 7613920.95

STATION ID : PWS-01

DATE : 7/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Sun, warm ~80°F

START TIME : 1000
WATER DEPTH : 10.5 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 9 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-30	2	SP-SM	Brown, silt with trace sand, organic debris.		
_2						PWS-01_1-4	1140
_3	0.1	-109	5-10	SM	Gray, silt with some sand, trace clay, scattered organics (wood debris)		
_4							
_5					From 5" to 12", red worms and minor vegetative debris. (Leaf litter, grass and sticks).	PWS-01_4-7	1140
_6	0.3	NA	10-15	ML	Gray silt with trace organics (rootlets)		
_7							
_8					Brown oxidized circular zones which are associated with red worm burrows.		
_9	NA	NA	15-20	SP	Gray, poorly graded fine to medium sand with trace of silt and clay, some organics (vegetative debris). Faint creosote odor.	PWS-01_8-9	1140
_10					TD = 9"		
_11							
_12							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-01_8-9
Samples to be Archived : PWS-01_1-4, PWS-01_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

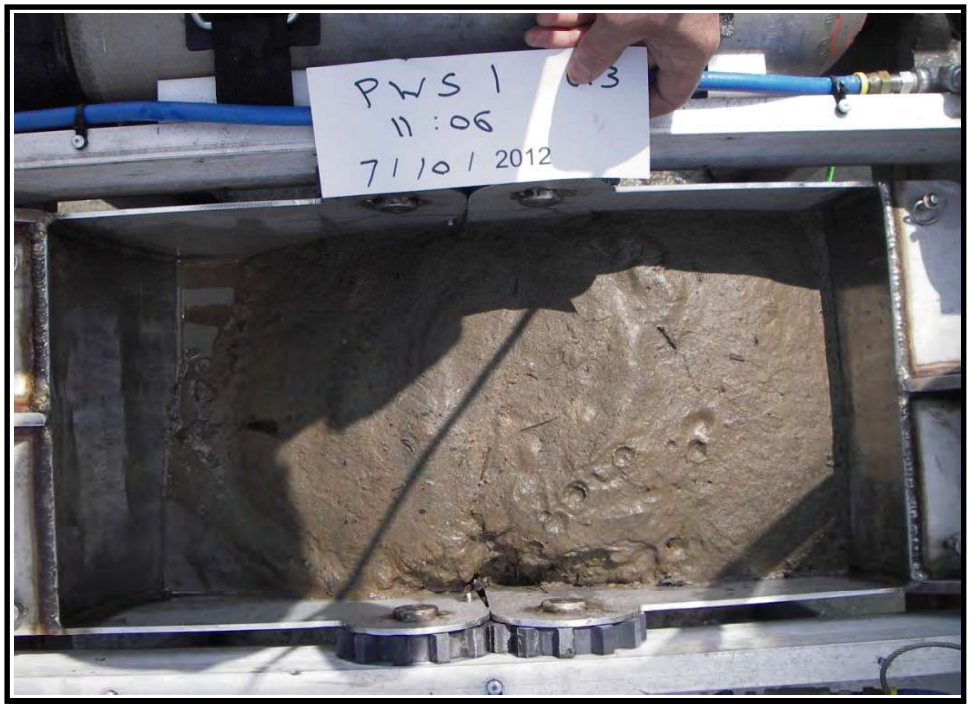
PID CALIBRATION (Date/Time) : 7/10/2012 / 0800
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/10/2012 / 0810
ORP CALIBRATION STANDARD : Zobell 238 @15°C

ADDITIONAL COMMENTS:

ORP reading not collected from 4-7" or from 8-9" because sand content was too high to maintain moisture.

SIGNATURE: Graeme B. Taylor

PWS-01 Station Wood debris and other refuse caught in sampler during first attempt.



PWS-01 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801012.24
Easting : 7613808.49

STATION ID : PWS-02

DATE : 7/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Sun, warm ~80°F

START TIME : 1530
WATER DEPTH : 16.5 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 10 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1	0.1	-110	1	ML	Brown silt with trace clay and sand		
_2						PWS-02_1-4	1620
_3		-160	30-40	ML	Brown silt with some sand, trace clay, abundant organics (wood debris)		
_4							
_5						PWS-02_4-7	1620
_6	0.9	-475	30-40	ML	Silt with some sand, trace clay, abundant organics (wood debris), creosote odor, moderate sheen. NAPL		
_7							
_8							
_9						PWS-02_8-10	1620
_10	6	-540	30	ML	Silt with some sand, trace clay, abundant organics (wood debris); creosote odor, moderate sheen. NAPL		
_11							
_12							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-02_1-4, PWS-02_8-10
Samples to be Archived : PWS-02_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	12 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/10/2012 / 0800
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/10/2012 / 0810
ORP CALIBRATION STANDARD : Zobell 238 @15°C

ADDITIONAL COMMENTS:

During first attempt a 2.5 foot long 2 by 6 treated board was caught in the teeth of the power grab. A sheen on the water surface was observed and a heavy cresote odor was noted. The wood and sediment was returned to the water. During the second attempt the recovery was 80% and some metal debris was present in the sampler. NAPL and a sheen was observed on the water surface and a creosote odor was noted.

SIGNATURE: Graeme B. Taylor

PWS-02 Station Surface sediment showing sheen on sediment.

PWS-02 Station Treated lumber retrieved in sampler during the first attempt.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800938.24
Easting : 7613655.78

STATION ID : PWS-03

DATE : 7/12/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sun, warm ~70°F

START TIME : 1000
WATER DEPTH : 10.7 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-154	1	ML	Brown silt and trace organics (fine wood debris and charcoal) Gray at 1 inch.		
_2						PWS-03_1-4	1005
_3	0.5	-181	10-20	ML	Silt with some organics (wood debris). Worms present. Slight sheen releasing from wood debris. No creosote odor detected.		
_4							
_5						PWS-03_4-7	1005
_6	0.03	-245	30-40	ML	Sandy silt with some organics (fine wood debris), slight sheen and cresote odor from wood debris.		
_7							
_8							
_9						PWS-03_8-11	1005
_10	0.03	-279	25-30	SM	Silty fine sand with some organics (wood fibers)		
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-03_8-11
Samples to be Archived : PWS-03_1-4, PWS-03_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/12/2012 / 0800
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/12/2012 / 0810
ORP CALIBRATION STANDARD : Zobell 236.6 @15°C

ADDITIONAL COMMENTS:

Surface appeared silty with some lumber in video. Adjusted station location.

SIGNATURE: Graeme B. Taylor

PWS-03 Station Surface sediment.

PWS-03 Station Surface sediment overhead view.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800868.95
Easting : 7613554.77

STATION ID : PWS-04

DATE : 7/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge, R. Beach
WEATHER : Sun, warm ~80°F

START TIME : 1340
WATER DEPTH : 9 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		+100		ML	Brown, silt with trace of sand and clay, oxidized		
_2					Circular brown oxidized zones associated with abandoned burrows from worms are present from 1 to 7 inches covering approximately 10% of the surface area.	PWS-04_1-4	1400
_3	0.4	-105	2	SP-SM	Sand with trace silt, clay, and organics (wood debris)		
_4							
_5						PWS-04_4-7	1005
_6	0.3	-140	8-10	SP-SM	Sand with trace silt, clay and organics		
_7							
_8					At 8 inches, ~5% of surface area has circular brown oxidized zones indicative of biological activity.		
_9	0.4	-170		SP-SM	Sand with trace silt and clay	PWS-04_8-11	1005
_10							
_11							
_12					TD = 12 inches		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-04_8-11
Samples to be Archived : PWS-04_1-4, PWS-04_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

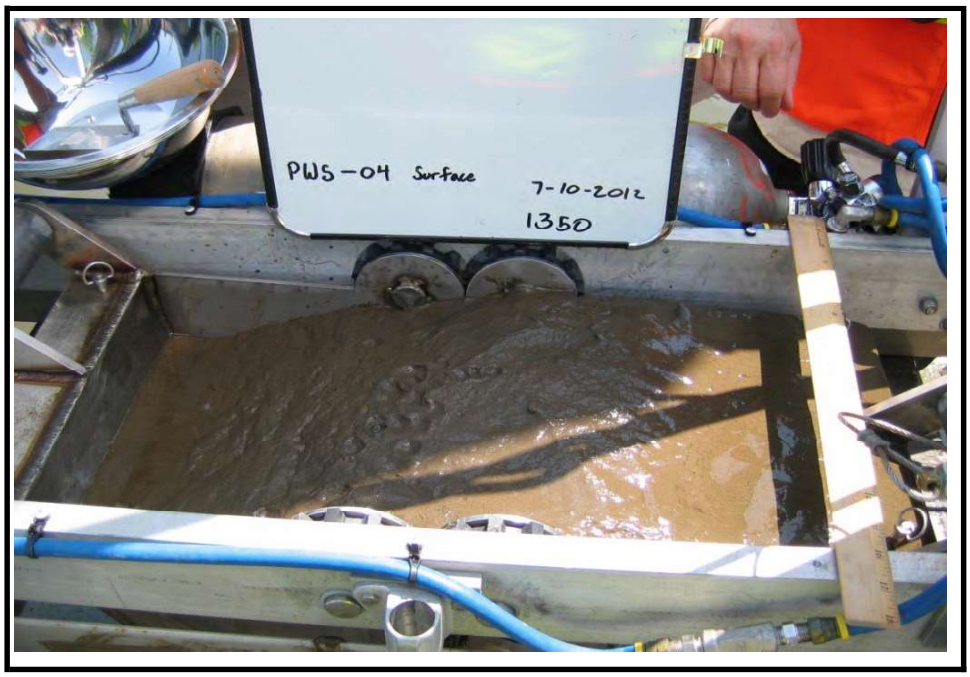
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/10/2012 / 0800
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/10/2012 / 0810
ORP CALIBRATION STANDARD : Zobell 238 @15°C

ADDITIONAL COMMENTS: First attempt had poor recovery. Second attempt contained a sloped sample with ~105% recovery on half of the sample and ~80% recovery on the other half. When processing sample, maintained the same slope. Worms were present in the center of brown oxidzed layers indicating evidence of biological activity within the sediment profile.

SIGNATURE: Graeme B. Taylor



PWS-04 Station Surface sediment.

PWS-04 Circular oxidized zones at about 1-inch in depth.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800818.82
Easting : 7613530.27

STATION ID : PWS-05

DATE : 7/12/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sun, warm ~75°F

START TIME : 1050
WATER DEPTH : 13.3 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-40	>1	ML	Brown silt, very slight isolated sheen on sediment surface.		
_2					Slight sheen at ~1-inch below surface.	PWS-05_1-4	1100
_3	0.5	-180	20	ML	Gray, silt with some clay and organics (wood debris), 1/2 inch layer of wood debris.		
_4							
_5						PWS-05_4-7	1100
_6	0.3	-151	10	ML	Silt with trace fine sand, clay and organics (wood debris), organic odor.		
_7							
_8					Buried red brick		
_9						PWS-05_8-11	1100
_10	0.3	-132	25	ML	Sandy silt with some organics (wood debris)		
_11					Large pieces of wood and fine wood debris		
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-05_8-11
Samples to be Archived : PWS-05_1-4, PWS-05_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/12/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/12/21012
ORP CALIBRATION STANDARD : Zobell 236.5 @15°C

ADDITIONAL COMMENTS:

Surface appeared to be silty with possible wood debris in video.

SIGNATURE: Graeme B. Taylor

PWS-05 Station Surface sediment.

PWS-05 Sandy silt at 8 inches.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800707.54
Easting : 7613395.18

STATION ID : PWS-06

DATE : 7/12/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Sun, warm ~75°F

START TIME : 1230
WATER DEPTH : 17.5 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-52	2	ML	Brown silt, trace organics (fine charcoal and wood debris on surface).		
_2						PWS-06_1-4	1310
_3	0.5	-161	5	SM	Gray silty fine sand with trace clay and organics (wood debris)		
_4							
_5						PWS-06_4-7	1310
_6	0.7	-94	30 - 40	ML	Gray silt with trace fine sand and clay; some organics (large wood pieces); organic odor.		
_7							
_8							
_9	0.3	-122	50	SM	Gray silty fine sand with trace clay; organics (wood debris)	PWS-06_8-11	1310
_10					Wood debris consists of wood chips, bark, and other wood debris.		
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-06_8-11
Samples to be Archived : PWS-06_1-4, PWS-06_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	8 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/12/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/12/21012
ORP CALIBRATION STANDARD : Zobell 236.5 @15°C

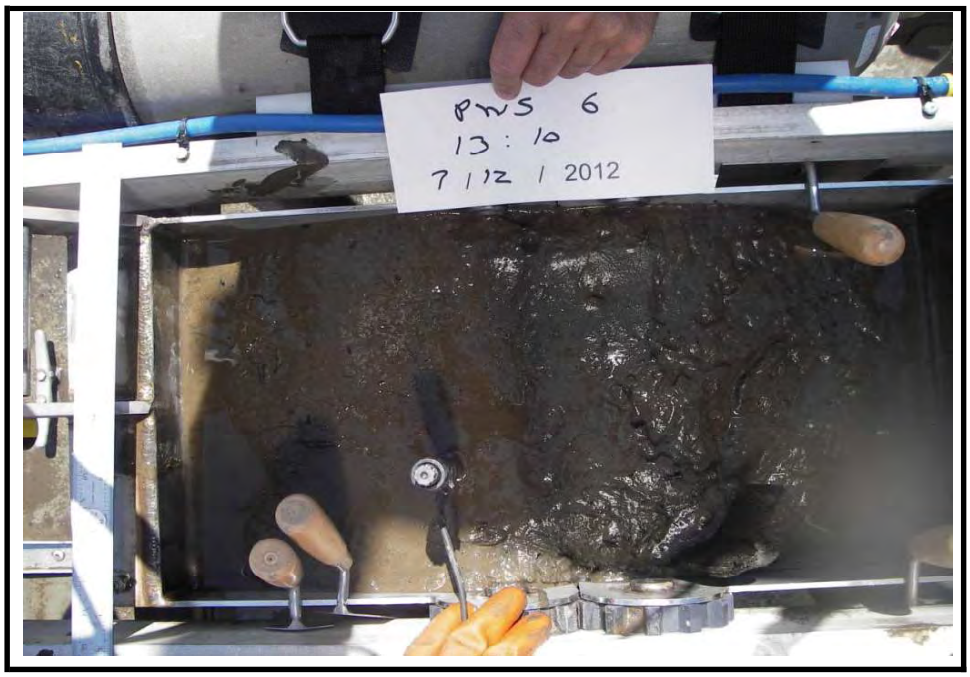
ADDITIONAL COMMENTS:

1st attempt: 10-inches recovery but sample contained large piece of wood caught in teeth of power grab.

2nd attempt: 12-inches of recovery in center and 6-inches on sampler sides. Maintained these proportions when processing the sample.

50% wood debris from 6 to 12 inches.

SIGNATURE: Graeme B. Taylor



PWS-06 Station Surface sediment.

PWS-06 Station Wood debris caught in sampler during 1st attempt.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800839.42
Easting : 7613310.21

STATION ID : PWS-07

DATE : 7/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Overcast, cool ~65°F

START TIME : 8:17
WATER DEPTH : 5.5 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-40	<2 char	SM	Brown silty sand (oxidized); clam ~2 cm in diameter.		
_2				SM-SP	Gray sand with some silt, trace clay, anoxic	PWS-07_1-4	830
_3	0.1	-160	<1		Slight sheen (~2 mm in diameter) observed in two isolated locations associated with wood debris.		
_4					Pockets of sand increasing with depth.		
_5					Wood debris increasing with depth.	PWS-07_4-7	830
_6	0.2	-270	1-3		Slight sheen (~2 mm in diameter) observed in isolated locations associated with wood debris. Vegetative debris also present.		
_7					Water content in sediment decreasing with depth.		
_8					Increased wood debris and vegetative debris with depth. No sheen or evidence of impact.		
_9	0.2	-300	5-8		Clay layer ~2" thick; medium plasticity	PWS-07_8-11	830
_10				SM-SP	Dry, peaty material ~ 1-1/2" diameter. Gray sand with silt		
_11							
_12					TD = 12"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-07_8-11
Samples to be Archived : PWS-07_1-4, PWS-07_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/10/2012 / 0800
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/10/2012 / 0810
ORP CALIBRATION STANDARD : Zobell 238 @15°C

ADDITIONAL COMMENTS: Used method of filling voa vial with ~5mL of water and mixing with sediment to determine the silt, sand, clay content. This method was used for the remainder of the project.

SIGNATURE: Graeme B. Taylor

PWS-07 Station Sediment conditions from 4 to 7 inches below surface.

PWS-07 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800732.48
Easting : 7613259.44

STATION ID : PWS-08

DATE : 7/12/2012

START TIME : 1410

SAMPLING METHOD : Powered Grab

WATER DEPTH : 8.7' 1st attempt; 9.0' 2nd attempt; 9.7' 3rd attempt

PERSONNEL : G. Taylor

TARGET PENETRATION DEPTH : 12 inches

WEATHER : Sun, warm ~80°F

ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface		-82	2	ML	Brown silt with trace fine sand and organics (wood debris)		
_1							
_2					Patches of sand		
_3	0.3	-151	<1	ML	Gray silt with trace sand and clay and little or no wood debris	PWS-08_1-4	1440
_4							
_5							
_6	0.5	NA	1	ML	Gray silt with trace sand and clay. Rootlets and worms at 4 to 7 inches. Sheen ~2 mm in diameter.	PWS-08_4-7	1440
_7							
_8							
_9	0.3	-155	5	ML	Gray silt with trace of sand, clay and organics (wood chips and other wood debris). Slight sheen released from wood chips. Slight creosote odor.		
_10						PWS-08_8-11	1440
_11							
_12							

Photograph of sample taken? No

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-08_8-11
Samples to be Archived : PWS-08_1-4, PWS-08_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/12/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/12/21012
ORP CALIBRATION STANDARD : Zobell 236.5 @15°C

ADDITIONAL COMMENTS:

1st attempt: In the video, the original sample location appeared to be directly above a piling. Tree rings and metal cable were oberved. Moved station ~10 feet downriver.

2nd attempt: Poor penetration into sediment.

3rd attempt: Collected full sample.

SIGNATURE: Graeme B. Taylor

Intentionally Blank

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800669.68
Easting : 7613131.93

STATION ID : PWS-09

DATE : 7/12/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sun, 75°F

START TIME : 1540
WATER DEPTH : 10.1 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 14 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-141	1	ML	Brown silt		
_2						PWS-09_1-4	1545
_3	0.1	-181	1	ML	Gray silt with trace fine sand and organics (rootlets), worms		
_4							
_5						PWS-09_4-7	1545
_6	0.1	-160	2	ML	Gray silt with trace fine sand and organics		
_7							
_8							
_9	0.1	-152	2	ML	Gray silt with trace of fine sand and organics (wood chips and rootlets), organic odor.	PWS-09_8-11	1545
_10							
_11							
_12					TD = 14 inches		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-09_8-11
Samples to be Archived : PWS-09_1-4, PWS-09_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

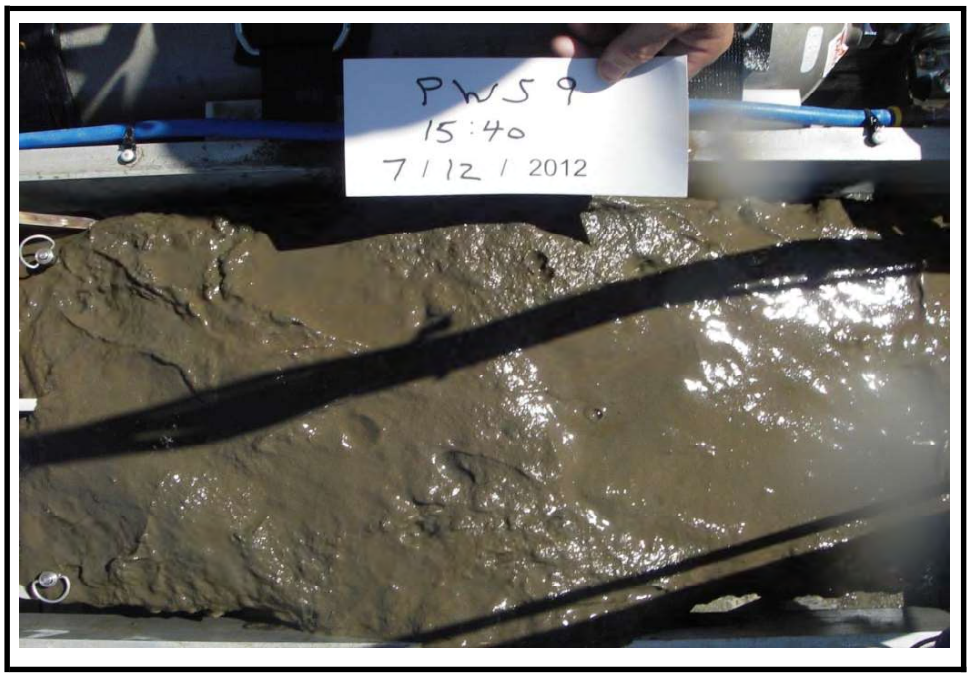
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/12/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/12/21012
ORP CALIBRATION STANDARD : Zobell 236.5 @15°C

ADDITIONAL COMMENTS:

Silty clear flat bottom with no visible debris. Full sample recovery. Sediment profile consistent from surface to total depth.

SIGNATURE: Graeme B. Taylor



PWS-09 Station Surface sediment.

PWS-09 Silt sediment at 4 inches.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800786.21
Easting : 7613119.37

STATION ID : PWS-10

DATE : 7/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge, R. Beach
WEATHER : Sunny, Warm

START TIME : 1000
WATER DEPTH : 6.6 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-83		ML	Silt with trace clay and sand		
_2		-180				PWS-10_1-4	1030
_3	0.3		5		Trace organics (wood fragments)		
_4							
_5						PWS-10_4-7	1030
_6	0.5	NA	15	ML	Medium gray silt with trace clay and fine sand; some organics (rootlets, grass); red worms		
_7							
_8							
_9	0.3	-256	30 - 35	OL	Gray, organic (wood debris) silt with some sand, trace clay, black sand	PWS-10_8-11	1030
_10					Faint creosote odor.		
_11							
_12					TD = 11 inches		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-10_8-11
Samples to be Archived : PWS-10_1-4, PWS-10_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/11/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/11/2012 at 740
ORP CALIBRATION STANDARD : Zobell 235 @17°C

ADDITIONAL COMMENTS:

SIGNATURE: Graeme B. Taylor

PWS-10 Station Surface sediment.

PWS-10 Station Location and retrieval of sample.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800840.96
Easting : 7612996.8

STATION ID : PWS-11

DATE : 7/9/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Sun, warm ~80°F

START TIME : 11:34
WATER DEPTH : 6.7 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1			5	ML	Some algae present on sediment surface. ~5% black charred material on surface. Brown silt.		
_2					At 1 inch below the surface color changes from brown to gray indicating the top of the anoxic zone. Clam shell from 1-2 inches.	PWS-11_1-4	1155
_3	0.0	-156	<1	ML	Gray to black silt trace organics (wood debris).		
_4							
_5						PWS-11_4-7	1155
_6	0.0	-201	<1	ML	Gray to black, silt, trace organics consisting of rootlets and wood debris (lumbered)		
_7					Water content of sediment decreases with depth.		
_8							
_9	0.0	-220	5			PWS-11_8-11	1155
_10				ML	Dark gray, silt with trace clay and some fine sand, trace organics (wood debris [lumber and wood chips]); slight creosote odor; rootlets; clam shell; organic odor.		
_11							
_12					TD = 12"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-11_8-11
Samples to be Archived : PWS-11_1-4, PWS-11_4-7

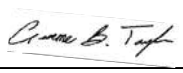
SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

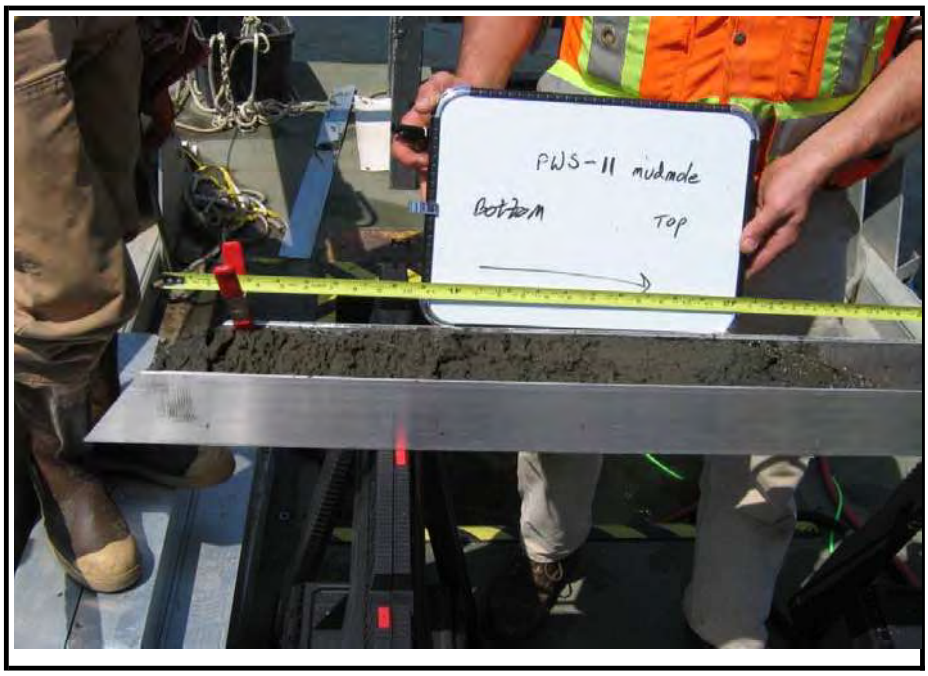
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/9/2012 / 1000
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/9/2012 1150
ORP CALIBRATION STANDARD : Zobell 220 @28.5°C

ADDITIONAL COMMENTS: In video, water became turbid when sampler swept across the bottom of the cove. A 3/4-inch gap between the jaws of the sampler when sample retrieved, in which a minimal amount of water and sediment escaped. A Mudmole™ boring was completed adjacent to the powered grab sample collection to confirm that recovery and sediment were similar with both technologies. The Mudmole™ method yielded similar sediment recovery and contained a similar sediment type although the material appeared to be more disturbed. The powered grab technology was used for the rest of the project. Sediment was originally collected on 7/9/2012 and submitted to the lab on rushed analysis. It was determined that the sediment did not yield enough pore water for the requested analysis. Additional sediment volume was collected on 7/13/2012 at 1510. The additional volume was collected ~7.68 feet from the original station.

SIGNATURE: 



PWS-11 Station Collocated Mudmole™ boring.

PWS-11 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800751.73
Easting : 7612938.18

STATION ID : PWS-12

DATE : 7/12/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sunny, approximately 80°F

START TIME : 1647
WATER DEPTH : 7.4 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 14 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-10	<1	ML	Brown silt, algae		
_2						PWS-12_1-4	1650
_3	0.3	-157	0	ML	Gray silt		
_4							
_5						PWS-12_4-7	1650
_6		-134	0	ML	Gray silt with trace sand		
_7							
_8							
_9		-123	0	ML	Gray, silt.	PWS-12_8-11	1650
_10							
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-12_8-11, PWS-12_8-11DUP
Samples to be Archived : PWS-12_1-4, PWS-12_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : Duplicate

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	14 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

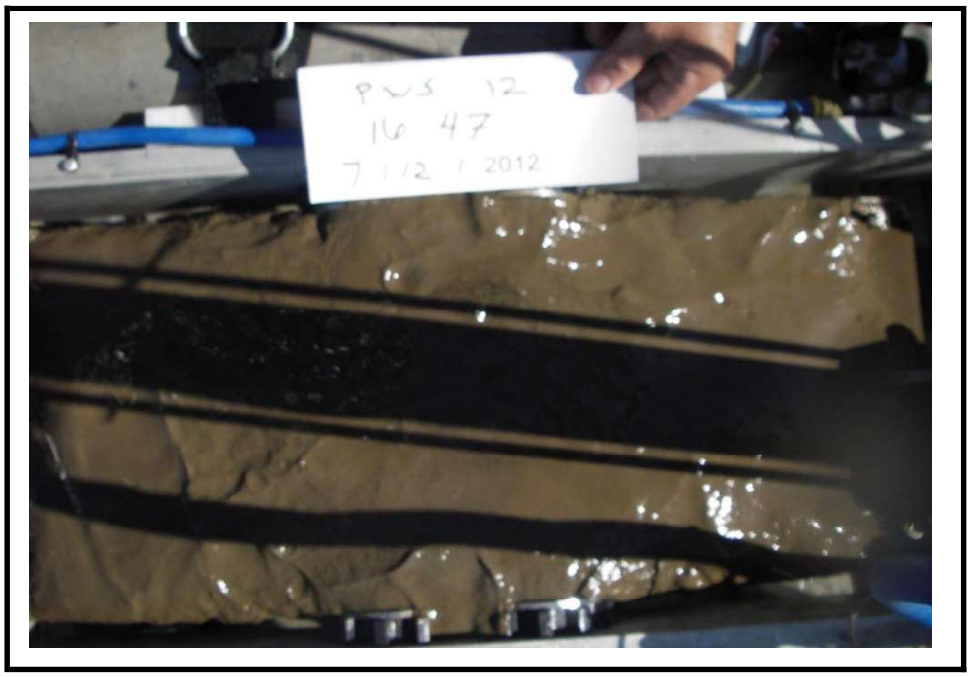
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/12/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/12/2012
ORP CALIBRATION STANDARD : Zobell 236.6 @15°C

ADDITIONAL COMMENTS:

Flat bottom (silty), some algae and grass at surface. 10 sample containers collected from target interval for duplicate.

SIGNATURE: Graeme B. Taylor



PWS-12 Station Surface sediment.

PWS-12 Station Location.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800476.40
Easting : 7612972.44

STATION ID : PWS-13

DATE : 7/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Sun, hot ~85°F

START TIME : 1300
WATER DEPTH 13 feet
TARGET PENETRATION 12 inches
ACTUAL PENETRATION 13 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-160 @ 20°C	5-10	ML	Brown silt with trace clay and organics.		
_2						PWS-13_1-4	1330
_3	1.0	-160 @ 20°C	20-30	ML	Gray, silt with trace clay, sand, some organics (vegetative mat of leaf litter, sticks, grass and other organic material)		
_4					From 3-4" below sediment surface slight sheen released from vegetation; No creosote odor.		
_5					At 4" sheen no longer observed.	PWS-13_4-7	1330
_6	0.7	-159 @ 20°C	40-50	OL	Gray organic silt with trace clay and fine sand Vegetative mat makes up ~50% of collected material from 4" to TD.		
_7							
_8							
_9	0.0		40-50	OL	Gray organic silt with trace clay and fine sand.	PWS-13_8-11	1330
_10							
_11							
_12					TD = 13"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Samples for Analysis : PWS-13_1-4, PWS-13_8-11
Sample to be Archived : PWS-13_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				
EPH / VPH (PWS-13_1-4 only)				

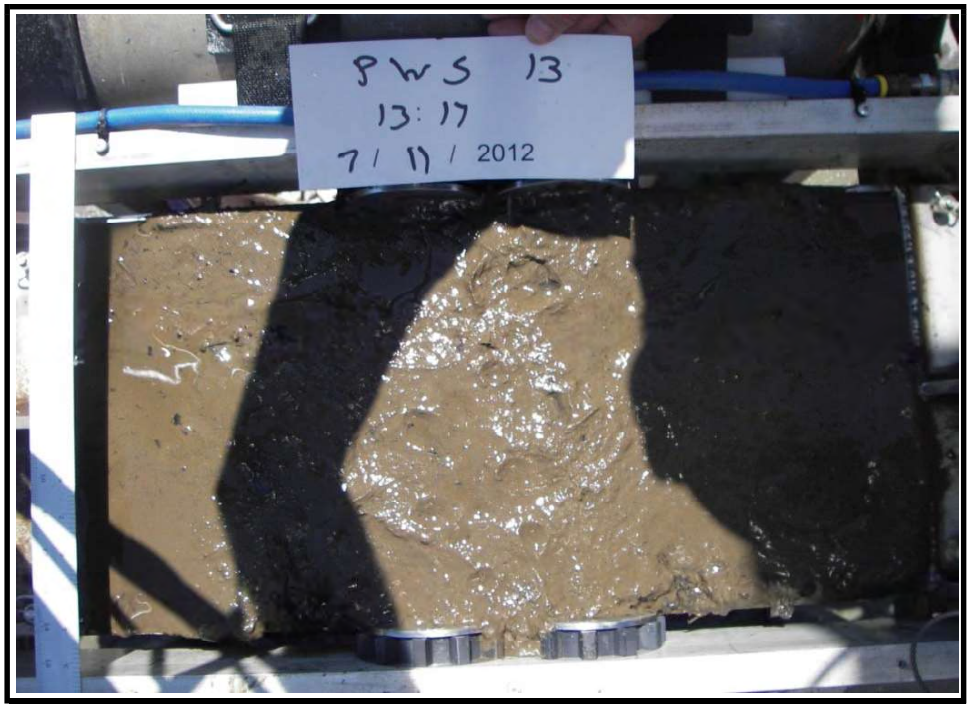
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/11/2012 / 0700
PID CALIBRATION STANDARD : 103 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/11/2012 / 0740
ORP CALIBRATION STANDARD : Zobell 235 @17°C

ADDITIONAL COMMENTS: In video, observed woody debris at the surface. Silty surface easily disturbed by sampler which caused large cloud soon after deployment. First attempt to collect sample failed due to equipment malfunction. Repositioned boat and collected sample. 2nd attempt video timestamp: 1317. Vegetative matter is thought to be associated with depositional material from Milton Creek. A similar vegetative layer was observed in stations PWS-22, PWS-23 and PWS-24. Submitted surface interval and target interval for laboratory analysis.

SIGNATURE:

PWS-13 Station Sheen at ~3-4" below sediment surface.



PWS-13 Station Surface sediment

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801050.53
Easting : 7613922.75

STATION ID : PWS-15

DATE : 7/12/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge, G. Maxwell
WEATHER : Sunny, Warm, ~65°F

START TIME : 820
WATER DEPTH : 19.4 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		+69	0	ML	Brown silt, circular brown (oxidized) worm burrows.		
_2						PWS-15_1-4	900
_3	0.1	-68	2	SP	Sand with trace fine gravel and organics (leaf litter and other debris). Increased density of circular brown worm burrows.		
_4							
_5						PWS-15_4-7	900
_6	0.5	-163	20	SP-SM	Gravelly coarse sand with trace silt, some organics (sticks and wood debris)		
_7					Silt lens		
_8			5		@7" feet clay		
_9	0.3	-111				PWS-15_8-11	900
_10			20	CL	Clay with some silt and trace fine sand, some organics (wood debris is fine shredded material).		
_11							
_12					TD = 12 inches		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-15_8-11
Samples to be Archived : PWS-15_1-4, PWS-15_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/12/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/12/2012
ORP CALIBRATION STANDARD : Zobell 236.6 @15°C

ADDITIONAL COMMENTS:

Attempted 6 grabs. Refusal, poor penetration or poor recovery from each attempt because of logs, metal debris and wood debris. Moved attempts away from the transfer table. Sixth grab contained full recovery.

SIGNATURE: Graeme B. Taylor

PWS-15 Station Surface sediment.

PWS-15 Surface Sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800824.12
Easting : 7612856.08

STATION ID : PWS-16

DATE : 7/9/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Sun, warm ~80°F

START TIME : 15:25
WATER DEPTH : 6.6 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-100	<2	ML	Brown silt with trace sand and organics (black charred material on surface). Some algae present on sediment surface.		
_2					At 1 inch below the surface color changes from brown to gray. Some fine wood debris (shredded).	PWS-16_1-4	1545
_3	0.0	-185	<1	ML	Gray to black, soft silt with trace sand.		
_4							
_5						PWS-16_4-7	1545
_6	0.0	-190	2-3	ML	Gray to black sandy silt; trace organics (wood debris and plant matter [limbs and leaf litter]).		
_7							
_8							
_9	0.0	-371	<1			PWS-16_8-11	1545
_10				SM	Dark gray silty sand, trace clay; organic odor.		
_11							
_12					TD = 12"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-16_8-11
Samples to be Archived : PWS-16_1-4, PWS-16_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

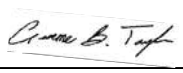
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/9/2012 / 1000
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/9/2012 1500
ORP CALIBRATION STANDARD : Zobell 208 @39.4°C

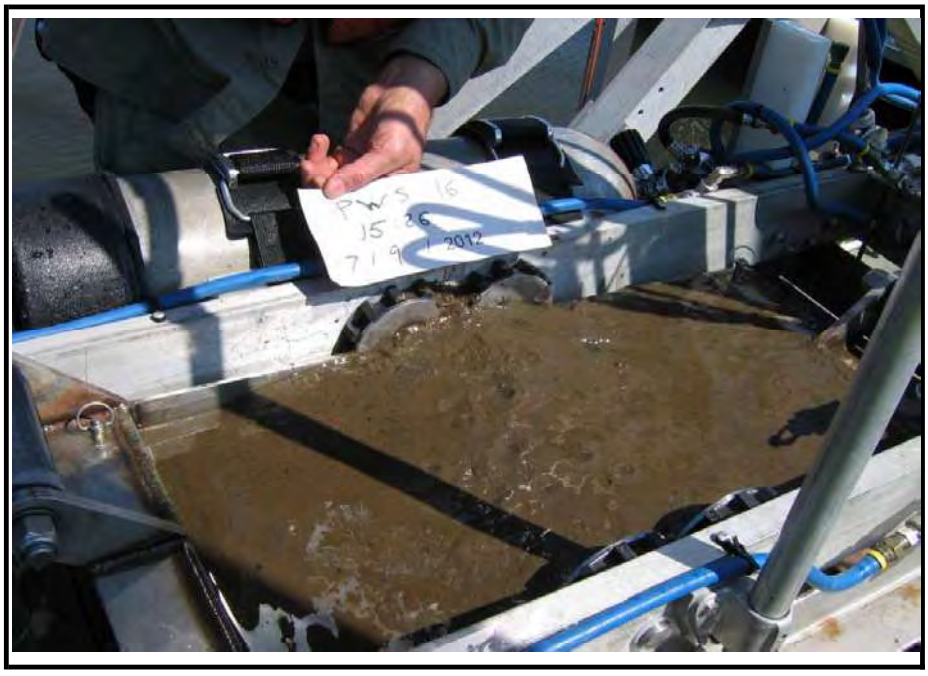
ADDITIONAL COMMENTS: In video, a sandy bottom was visible. Sediment was originally collected on 7/9/2012 and submitted to the lab on rushed analysis.

It was determined that the sediment did not yield enough pore water for the requested analysis. Additional sediment volume was collected on 7/13/2012 at 1535.

The additional volume was collected ~5 feet from the original station.

SIGNATURE: 

PWS-16 Station Location.



PWS-16 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 798867.16
Easting : 7611007.01

STATION ID : PWS-18

DATE : 7/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge, R. Beach
WEATHER : Sunny, Warm, ~80°F

START TIME : 1650
WATER DEPTH : 8.2 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-2@ 23°C	70	OL	Brown organic silt with trace clay, abundant wood chips, some large burnt wood char.		
_2						PWS-18_1-4	1700
_3	0.5	-55@22°C		ML	Brown silt with trace clay, 98% silt		
_4					At 4 inches, sheen released from wood chips		
_5						PWS-18_4-7	1700
_6		-31@21°C	70	OL	Brown organic silt with trace clay, wood debris		
_7							
_8							
_9						PWS-18_8-11	1700
_10	0		50	ML	Gray sandy silt trace clay, abundant wood debris		
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-18_8-11
Samples to be Archived : PWS-18_1-4, PWS-18_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/11/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/11/2012
ORP CALIBRATION STANDARD : Zobell 235 @17°C

ADDITIONAL COMMENTS: Sample collected 100% recovery in the center and ~80% recovery on the edges of the sampler. The profile was maintained when processing the sample. Algae on surface, worm burrow in surface sediment. Wood chips and sticks made up the majority of the material collected from ~1 inch to the total depth collected. Station PWS-18 is a background sample located ~0.5 miles southwest from the site up Scappoose Bay.

SIGNATURE: Graeme B. Taylor

PWS-18 Station Surface sediment.

PWS-18 Wood debris from ~4 inches below surface.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 798209.01
Easting : 7610598.4

STATION ID : PWS-19

DATE : 7/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge, R. Beach
WEATHER : Sunny, Warm

START TIME : 1450
WATER DEPTH : 9.4 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 13 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		+5@ 23°C	<1	ML	Brown silt with trace clay		
_2						PWS-19_1-4	1450
_3	0.3	-31@20.8°C	1	ML	Gray silt with trace clay		
_4							
_5						PWS-19_4-7	1450
_6	0.5	-147@21°C	1	ML	Gray silt with trace clay		
_7							
_8							
_9		-150@20°C	1	ML	Gray silt with trace clay	PWS-19_8-11	1450
_10							
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-19_8-11
Samples to be Archived : PWS-19_1-4, PWS-19_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

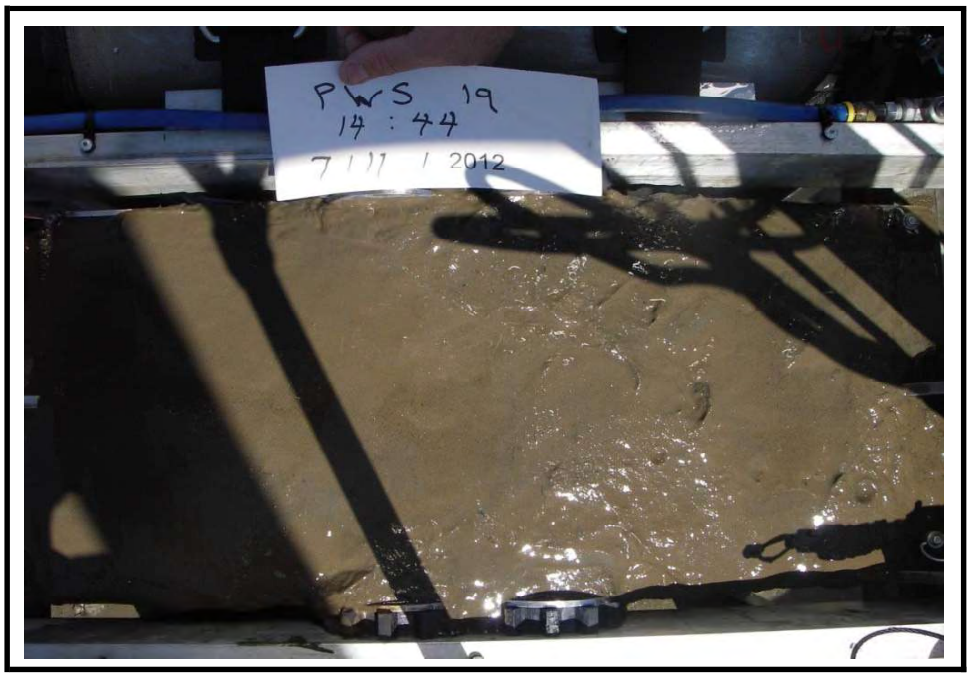
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/11/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/11/2012
ORP CALIBRATION STANDARD : Zobell 235 @17°C

ADDITIONAL COMMENTS: Station PWS-19 is a background sample located approximately 0.7 miles to the southwest of the site up Scappoose Bay.

SIGNATURE: Graeme B. Taylor



PWS-19 Station Surface sediment.

PWS-19 Sediment at approximately 3 inches depth.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800208.60
Easting : 7612473.38

STATION ID : PWS-20

DATE : 7/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge, R. Beach
WEATHER : Sunny, Warm, ~75°F

START TIME : 1115
WATER DEPTH : 8.9 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 13 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-13@ 21.5°C	1	ML	Brown silt with trace sand, clay and organics (wood fragments)		
_2						PWS-20_1-4	
_3	0.1	-129@19.9°C		ML	Gray silt with trace sand and clay. Aquatic creature at 2.5 inches		
_4							
_5						PWS-20_4-7	
_6	0.9	-167@20°C	1	SM	Gray silty sand with trace clay. Empty clam shell (3-inches in diameter) at 5.5 inches in depth		
_7							
_8						PWS-20_8-11	
_9	0.5	-119@19.4°C	1	SM	Gray silty sand, sand increasing with depth, water content decreasing with depth		
_10							
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-20_8-11, PWS-20_8-11DUP
Samples to be Archived : PWS-20_1-4, PWS-20_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : Duplicate

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	10 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

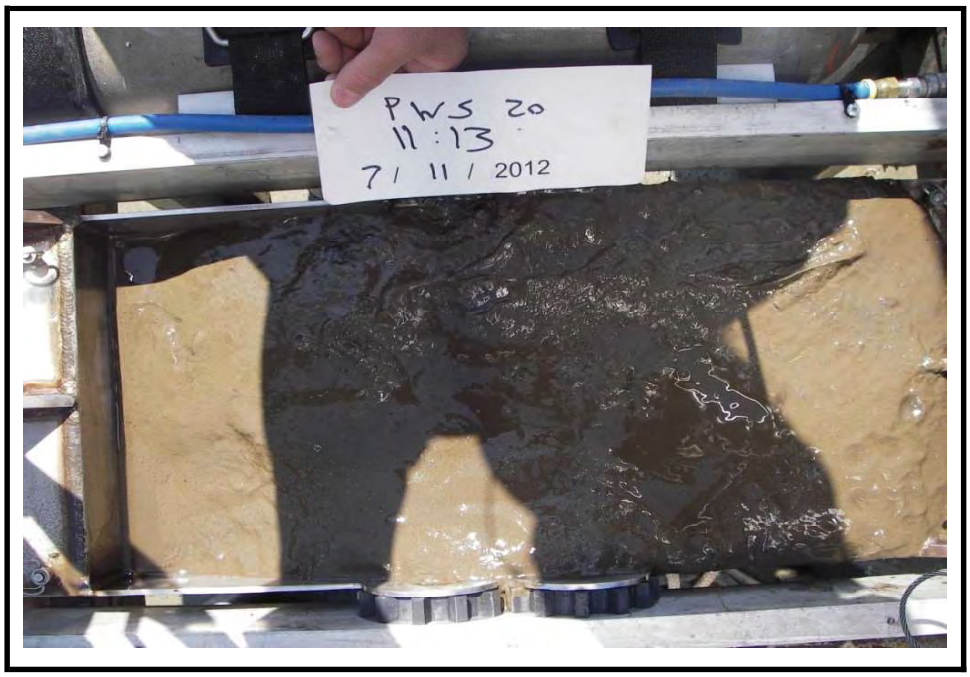
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/11/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/11/2012
ORP CALIBRATION STANDARD : Zobell 235 @17°C

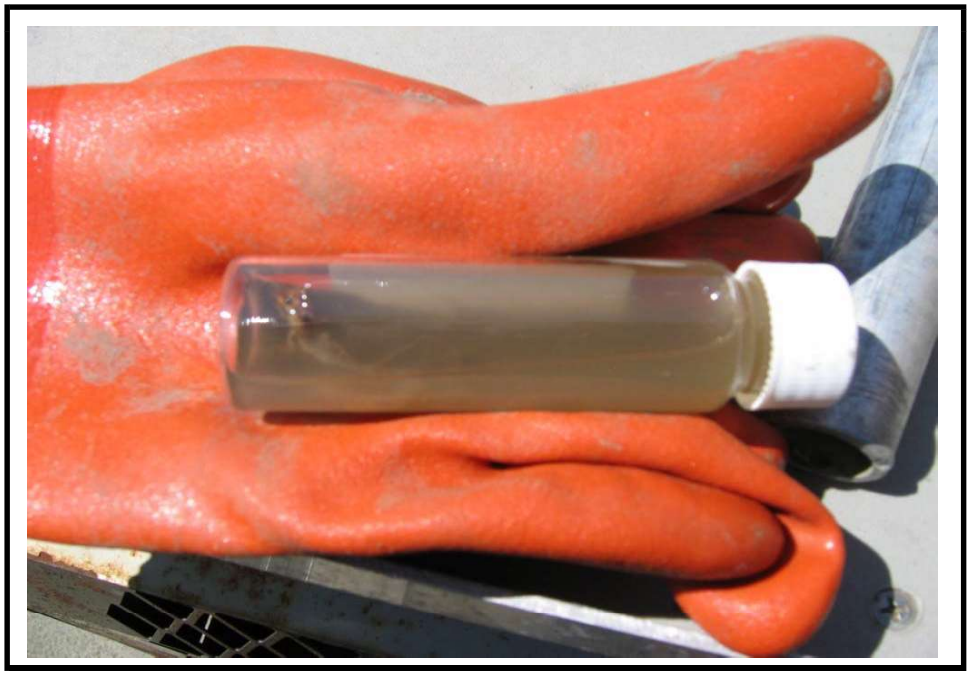
ADDITIONAL COMMENTS: Station is located adjacent to Armstrong World Industries site to the southwest from the Port of St Helens site up Scappoose Bay.

An extra 3 soil jars were collected from the primary target interval for duplicate sampling.

SIGNATURE: Graeme B. Taylor



PWS-20 Station Surface sediment.



PWS-20 Aquatic creature found in sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800589.34
Easting : 7614228.73

STATION ID : PWS-21

DATE : 7/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge, R. Beach

WEATHER : Sunny, Warm

START TIME : 800
WATER DEPTH : 13.3 feet
TARGET PENETRATION DEPTH : 12 inches

ACTUAL PENETRATION DEPTH : 10 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		+260@ 19°C		SM	Brown, silty fine sand with trace of clay and debris (wood debris and small metal fragments); Very soft.		
_2	0.3	+282@14°C	<1			PWS-21_1-4	840
_3				CL	@ 3 inches gray, silty clay, soft.		
_4							
_5						PWS-21_4-7	840
_6	0.7	+4.3@19°C		CL	Gray silty clay with trace sand, increasing stiffness and decreasing availabile porewater with depth.		
_7							
_8						PWS-21_8-10	840
_9	0.3	-69.5@18°C		CL	Gray silty clay, very tight and very little availabile pore water.		
_10							
_11					TD = 10 inches		
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-21_8-10
Samples to be Archived : PWS-21_1-4, PWS-21_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/11/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/11/2012
ORP CALIBRATION STANDARD : Zobell 235 @17°C

ADDITIONAL COMMENTS:

Video indicates higher velocity flow than other stations. Sediment load is visibly mobile in the video. Station is a background station within Multnomah Channel approximately 0.2 miles southeast from the Port of St Helens site. Surface sediment appears to contain sand and gravel with some algae. At ~3 inches below the surface the material becomes a gray clay which bocmes tighter with depth and contains very little pore water.

SIGNATURE: Graeme B. Taylor

PWS-21 Station Surface sediment.

PWS-21 Silty clay at 8 inches in depth.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800530.44
Easting : 7613053.14

STATION ID : PWS-22

DATE : 7/12/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sunny, approximately 65°F

START TIME : 1812
WATER DEPTH : 12.5 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-51	1-2	ML	Brown silt with trace organics (debris on surface includes charcoal, leaf litter, wood debris).		
_2					Slight sheen approximately 2 mm in diameter released from organic matter (vegetative matter) at 1.5 inches.	PWS-22_1-4	1820
_3	0.1	-123					
_4			25-35	SM	@4-6 inches, brown silty sand		
_5						PWS-22_4-7	1820
_6	0.2	-112	25-35	CL	Gray silty clay with trace sand with some organics (vegetative matter).		
_7			10		Decreasing organics (vegetative matter)		
_8							
_9						PWS-22_8-11	1820
_10	0.1	-104	20	SM	Gray silty sandy with some organics (decomposed vegatative matter, wood debris), organics increasing with depth, no sheen.		
_11							
_12					TD = 12 inches		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-22_8-11
Samples to be Archived : PWS-22_1-4, PWS-22_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/12/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/12/2012
ORP CALIBRATION STANDARD : Zobell 236.6 @15°C

ADDITIONAL COMMENTS:

Silty bottom, small debris evident in surface sediment. Vegetative matter from ~2 inches to the total depth of the collected sample consists of grass and leaf litter, sticks and other organics. The vegetative matter believed to be from Milton Creek is similar to observations made at stations PWS-13, PWS-23, and PWS-24.

SIGNATURE: Graeme B. Taylor

PWS-22 Station Surface sediment.

PWS-22 Isolated sheen in surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800442.23
Easting : 7612865.30

STATION ID : PWS-23

DATE : 7/13/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Cloudy, approximately 60°F

START TIME : 800
WATER DEPTH : 9.5 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 13 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-91	3-5	ML	Brown silt with trace sand and organics (vegetative matter), small sheen observed on surface, approximately 2 mm in diameter.		
_2						PWS-23_1-4	825
_3	0.3	-116	20-30	ML	Brown silt with trace sand. Increased organics (leaf litter, grass, sticks in vegetative matt). Worms in sediment.		
_4					@ 4 inches depth live clam 3 inches in diameter.		
_5			40-50		Slight sheen observed. approximately 2 mm in diameter.	PWS-23_4-7	825
_6	0.4	-128			Shredded vegetative matter		
_7				ML	Silt with some sand		
_8					Increased organics (wood debris)		
_9	0.4	-107	60-70	OL	Material is predominately vegetative matter with some gray silt.	PWS-23_8-11	825
_10							
_11							
_12					TD = 13 inches		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-23_8-11
Samples to be Archived : PWS-23_1-4, PWS-23_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/13/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/13/2012
ORP CALIBRATION STANDARD : Zobell 239 @13.5°C

ADDITIONAL COMMENTS:

Surface appears to be silty with some algae or vegetative matter on surface.

Station has charateristics of vegetative matting from Milton Creek as oberved in PWS-13, PWS-22, and PWS-24.

SIGNATURE: Graeme B. Taylor

PWS-23 Station Surface sediment.

PWS-23 Organic matter at approximately 8 inches below surface.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800436.42
Easting : 7613010.68

STATION ID : PWS-24

DATE : 7/13/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Cloudy, approximately 60°F

START TIME : 935
WATER DEPTH : 16.2 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-7.7	4-5	ML	Brown silt with trace sand and organics at 1 inch depth (sticks, leaf litter and vegetative matter).		
_2						PWS-24_1-4	940
_3	0.4	-99	20	ML	Gray silt with trace sand, some organics		
_4					At 4 inches, slight sheen ~2 mm diameter. Sheen observed, no creosote odor. Reduced organics 4 to 7 inches.		
_5						PWS-24_4-7	940
_6		-130	15	ML	Gray silt with some sand and organics (vegetative matter with leaf litter and sticks).		
_7							
_8							
_9	0.3	-101	50	ML	Gray silt with some sand.	PWS-24_8-11	940
_10							
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-24_8-11
Samples to be Archived : PWS-24_1-4, PWS-24_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/13/2012
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/13/2012
ORP CALIBRATION STANDARD : Zobell 239 @13.5°C

ADDITIONAL COMMENTS:

Surface appears to be silty with some algae or vegetative matter on surface.

Station has charateristics of vegetative matting from Milton Creek as oberved in PWS-13, PWS-22, and PWS-23.

SIGNATURE:

PWS-24 Station Surface sediment.

PWS-24 Sheen and wood debris at 4-inches in depth.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800953.00
Easting : 7613756.79

STATION ID : PWS-25

DATE : 7/13/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Cloudy, cool ~65°F

START TIME : 1052
WATER DEPTH : 18.0 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-104	<1	ML	Brown, silt, trace organic debris. Slight sheen.		
_2						PWS-25_1-4	1100
_3	0.8	-148	3-4	ML	Gray silt and trace organics. Wood debris (bark) at ~2.5 inches. No sheen.		
_4							
_5						PWS-25_4-7	1100
_6	0.5	-127	10-20	ML	Gray silt and trace fine sand and some organic debris.		
_7							
_8							
_9	0.5	-137	20-30	OL	Gray, organic sandy silt. Wood debris (fine to 2" particles of shredded wood and 2-4" wood chips).	PWS-25_8-11	1100
_10							
_11							
_12					TD = 12"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-25_8-11
Samples to be Archived : PWS-25_1-4, PWS-25_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/13/2012 / 0800
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/13/2012 / 0815
ORP CALIBRATION STANDARD : Zobell 239 @13.5°C

ADDITIONAL COMMENTS: Log debris on sediment surface. Moved station approximately 5 feet downriver. Station is approximately 35 feet from the transfer table. Metal debris collected in the jaws of the bottom of the grab. Station was a stepout location from PWS_02 as requested by DEQ.

SIGNATURE: Graeme B. Taylor

PWS-25 Station Surface sediment.

PWS-25 Station Location ~35 feet from dock.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800968.70
Easting : 7613857.97

STATION ID : PWS-26

DATE : 7/13/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Sunny, warm ~80°F

START TIME : 1200
WATER DEPTH : 19 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		+17	<1	ML	Brown silt with trace fine sand.		
_2						PWS-26_1-4	1250
_3	0.4	-147	1	ML	Gray silt with trace fine sand and organics (wood bark).		
_4							
_5						PWS-26_4-7	1250
_6	0.3	-116	5	ML	Gray sandy silt with trace organic debris. Wood debris (shredded).		
_7					@ 7" dead clam ~3 inches in diameter		
_8							
_9		-116	10	ML	Gray sandy silt with trace organic debris (wood) Untreated 1"x2" lumber with no evidence of contamination from wood debris. Red worm.	PWS-26_8-11	1250
_10							
_11							
_12							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-26_8-11
Samples to be Archived : PWS-26_1-4, PWS-26_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location: Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 7/13/2012 / 0800
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/13/2012 / 0815
ORP CALIBRATION STANDARD : Zobell 239 @13.5°C

ADDITIONAL COMMENTS: Wood debris (logs, planks, lumber) was observed on sediment surface in the video. Debris collected in grab sampler in first 5 attempts preventing the sampler from penetrating to the target depth. Sampler collected materials included logs, treated lumber with creosote odor and untreated lumber. As accepted by DEQ, collected material was replaced back in Scappoose Bay. After each failed attempt, the boat was repositioned and another attempt was made GPS datapoints were collected at each attempted location. Sediment collected in all six attempts was a sandy silt similar to the sediment that was collected in the 6th attempt which is described above.

SIGNATURE:

PWS-26 Station Wood debris collected during sampling attempt. Debris included sticks and lumber.

PWS-26 Station Surface sediment from 6th attempt.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800432.45
Easting : 7612641.58

STATION ID : PWS-27

DATE : 7/13/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Sun, warm ~80°F

START TIME : 1400
WATER DEPTH : 7.0 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-37	<1	ML	Brown silt with trace sand and organic debris.		
_2						PWS-27_1-4	1405
_3	0.5	-118	1	ML	Gray silt with trace sand and organic debris.		
_4							
_5					From 5" to 12", red worms and minor organic debris. (Leaf litter, grass and sticks).	PWS-27_4-7	1405
_6	0.5	-114	5	ML	Gray silt and trace organics (rootlets).		
_7							
_8							
_9	0.5	-118	5-10	ML	Gray silt with trace clay.	PWS-27_8-11	1405
_10							
_11							
_12					TD = 12"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-27_8-11
Samples to be Archived : PWS-27_1-4, PWS-27_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

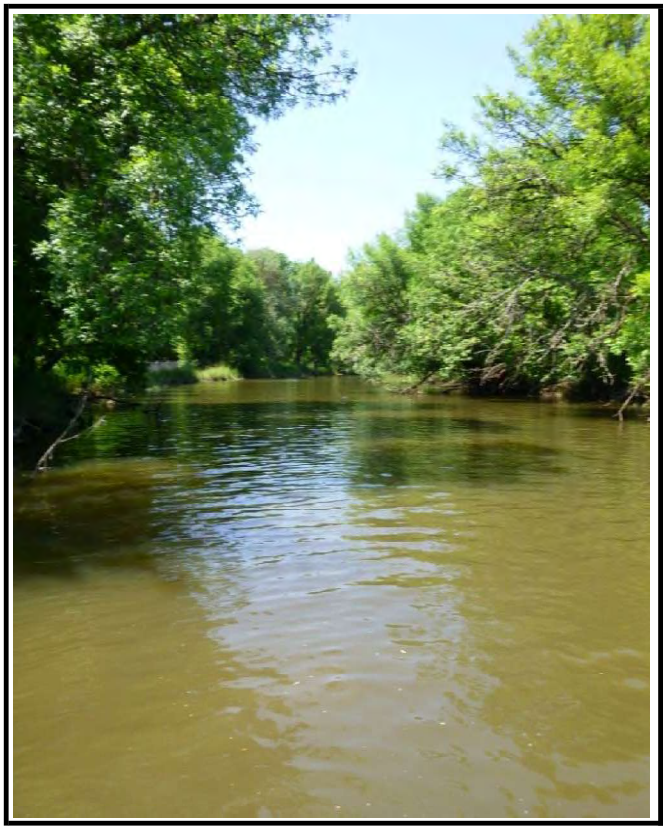
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

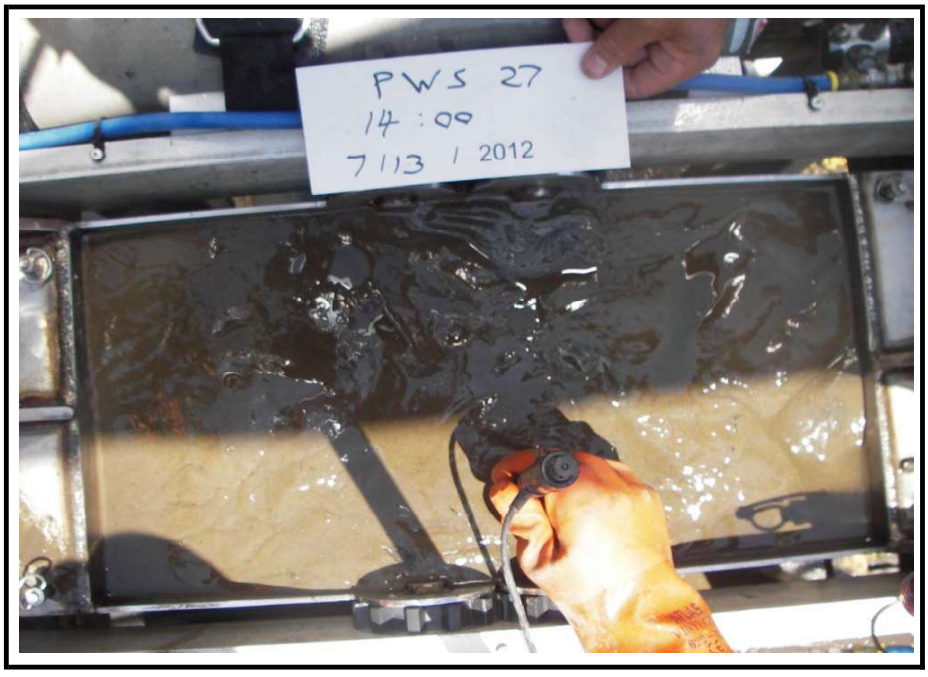
PID CALIBRATION (Date/Time) : 7/13/2012 / 0800
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : 7/13/2012 / 0815
ORP CALIBRATION STANDARD : Zobell 239 @13.5°C

ADDITIONAL COMMENTS: In video, surface appeared free of debris with no indication of vegetation. 'Vegetative mat' (leaf debris, sticks, grass and other vegetation) which was a dominant matrix in 'delta region' stations (PWS-13, PWS-23, PWS-24, and PWS-25), was only evident as a minor unit within the predominant silty sediment column described above. Some clay present at ~ 8 inches.

SIGNATURE: Graeme B. Taylor



PWS-27 Station Location at the mouth of Milton Creek.



PWS-27 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801182.30
Easting : 7613936.19

STATION ID : PWS-01

DATE : 10/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Clear, 65°F

START TIME : 13:28
WATER DEPTH : 6.0 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-60	1	SM	Algae on surface, brown silty sand with trace organics (wood debris), becomes gray at 1 inch.		
_2						PWS-01_1-4	1328
_3							
_4							
_5		-139.5	<1	SP	Gray, fine to medium sand with trace organics (wood debris), oxidized burrows at 5 inches.	PWS-01_4-7	1328
_6							
_7							
_8							
_9		-437.7				PWS-01_8-11	1328
_10							
_11							
_12							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-01_8-10*
Samples to be Archived : PWS-01_1-4, PWS-01_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars 1 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/10/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

** Sample ID was erroneously marked on the Chain of Custody as "PWS-01_8-10"; sample was collected from the 8" to 11" depth interval. (T.Wilson, 2/28/13)*

SIGNATURE:

PWS-01 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801014.56
Easting : 7613823.43

STATION ID : PWS-02

DATE : 10/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Cloudy, 65°F

START TIME : 1000
WATER DEPTH : 10.3 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1			<1	ML	Brown silt with trace fine sand, trace organics (splintered lumber, wood chips, charred wood debris), moderate sheen and creosote odor.		
_2						PWS-02_1-4	1023
_3		-121.7	2-3	ML			
_4					Soft, dark gray silt with trace fine sand with trace debris (wood and metal debris), NAPL present with heavy sheen and creosote odor.		
_5						PWS-02_4-7	1023
_6		-155.3	5				
_7							
_8							
_9		-155.6	1-2	ML	Very soft, gray, silt with some clay, trace organics (fine shredded wood debris), NAPL present with heavy sheen and strong creosote odor.	PWS-02_8-11	1023
_10							
_11							
_12							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-02_1-4, PWS-02_8-11
Samples to be Archived : PWS-02_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars 1 x 16oz	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/11/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

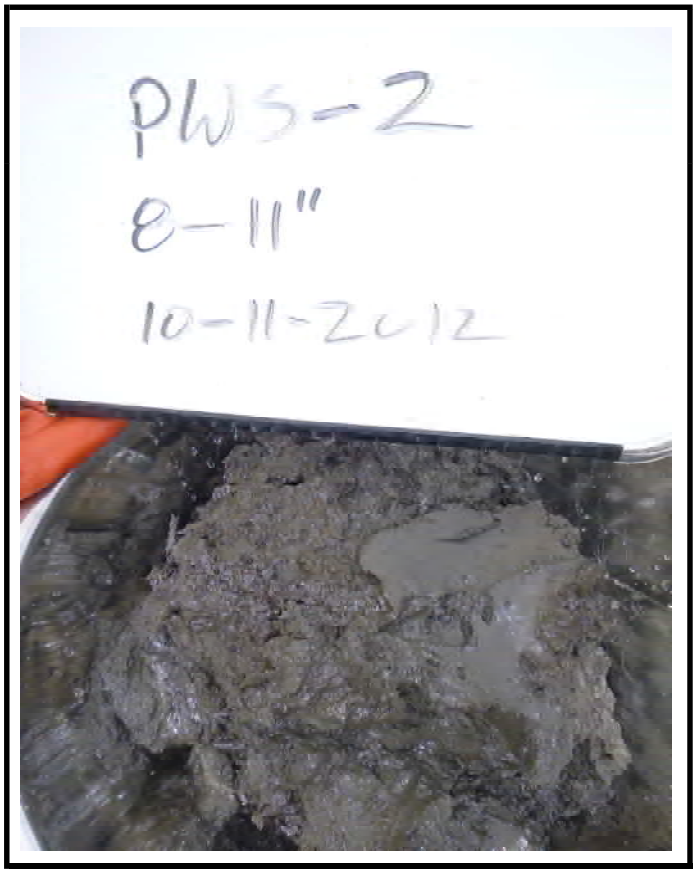
Attempted six grabs with poor penetration in the first five attempts. Grab retrieved treated and untreated lumber, metal debris or inadequate volume.

Full recovery on sixth attempt. Strong creosote odor.

Wood debris encountered from 4 to 7 inches.

SIGNATURE: Graeme B. Taylor

PWS-02 Station Surface sediment showing sheen on sediment.



PWS-02 Wood debris and sheen in 8-to-11 inch sample.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800936.37
Easting : 7613671.82

STATION ID : PWS-03

DATE : 10/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Clear, ~70°F

START TIME : 12:45
WATER DEPTH : 7.0 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-92.8	2-5		Algae covered surface.		
_2		-145.8			Soft, brown silt with trace sand, wood debris.	PWS-03_1-4	1245
_3					Slight sheen at 3 inches, no odor.		
_4							
_5		261	2-3	SP	Some root matter and wood debris .	PWS-03_4-7	1245
_6							
_7					Clam shell at 7 inches.		
_8					Brown silty sand with organic matter.		
_9		189	5			PWS-03_8-11	1245
_10					Slight increase in wood debris.		
_11							
_12							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-03_8-11
Samples to be Archived : PWS-03_1-4, PWS-03_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

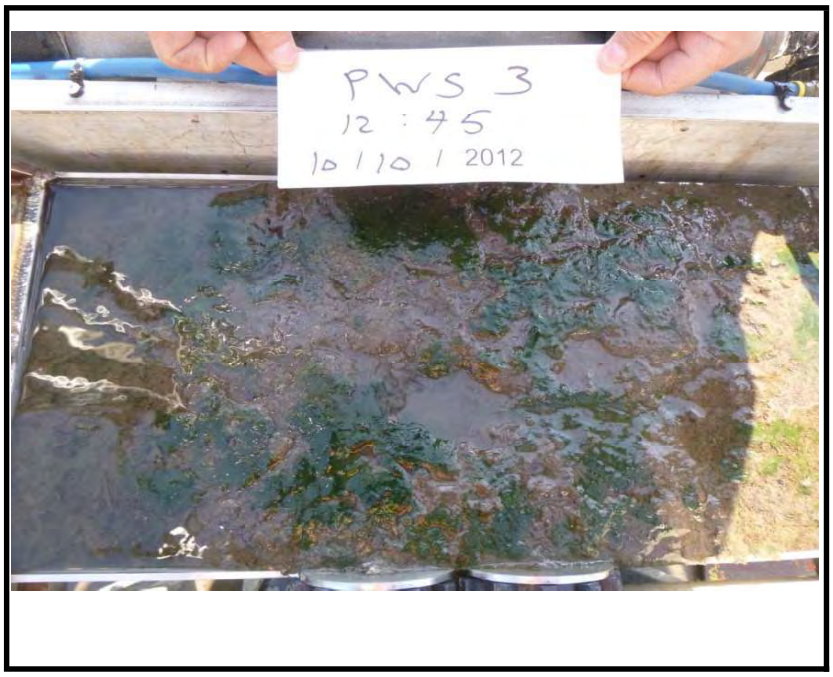
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars 1 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/10/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

SIGNATURE:



PWS-03 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800870.65
Easting : 7613571.44

STATION ID : PWS-04

DATE : 10/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Sun, cool, windy, 65°F

START TIME : 1200
WATER DEPTH : 4.3 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-85	<1	SM	Brown sand with some silt.		
_2		-139.1			Becomes gray.	PWS-04_1-4	1203
_3					Crawfish in sediment at 3.5 inches.		
_4							
_5		-145	~2	SM	Medium dense, brown silty sand with trace debris (plant matter).	PWS-04_4-7	1203
_6					Oxidized burrows.		
_7							
_8							
_9		-160.7				PWS-04_8-11	1203
_10							
_11					TD = 11 inches		
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-04_8-11
Samples to be Archived : PWS-04_1-4, PWS-04_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars 1 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/10/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: First attempt 10-inches recovery, second attempt 11-inches below mud line.

SIGNATURE: Graeme B. Taylor

PWS-04 Station Surface sediment.

PWS-04 Sediment at 4-inches depth.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800818.86
Easting : 7613548.47

STATION ID : PWS-05

DATE : 10/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Cloudy, cool ~60°F

START TIME : 950
WATER DEPTH : 6.7 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-45.5	<1	SM	Very soft, brown, silty sand, algae covering surface.		
_2					Slight sheen at ~1-inch below surface.	PWS-05_1-4	1000
_3		-142.8	<1	SM	Soft, gray, silty sand, slight to moderate sheen.		
_4							
_5						PWS-05_4-7	1000
_6		-150.1	2	SM	Soft gray, silty sand with trace organics (sticks and bark).		
_7							
_8							
_9						PWS-05_8-11	1000
_10		-165.8	5	SM	Medium dense, gray, silty sand with trace organics (bark, sticks, rootlets).		
_11							
_12					TD = 12		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-05_8-11
Samples to be Archived : PWS-05_1-4, PWS-05_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars 1 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

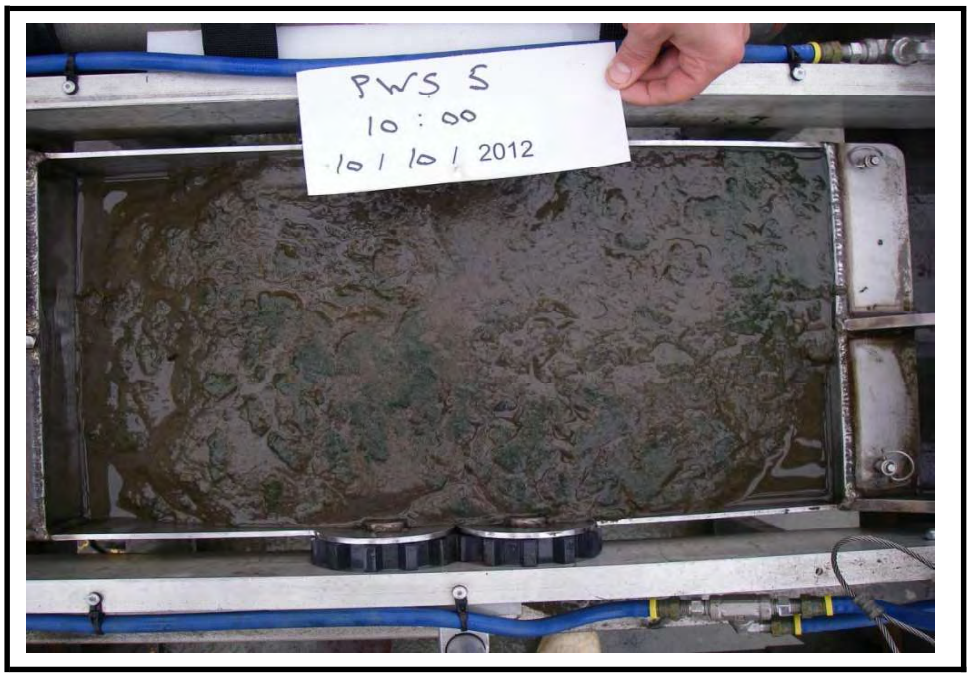
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/10/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

Algae on surface. Slight sheen observed at surface to ~3-inches depth. Slight to moderate sheen at 4-inches.

SIGNATURE: Graeme B. Taylor



PWS-05 Station Surface sediment.

PWS-05 Silt sand at 8 inches.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800709.43
Easting : 7613412.15

STATION ID : PWS-06

DATE : 10/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Cloudy, cool ~60°F

START TIME : 850
WATER DEPTH : 11 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-108	<1	ML	Very soft, brown, silt with some sand, trace organics (wood debris).		
_2						PWS-06_1-4	855
_3		-140.2	2	ML	Soft, gray, silt with some fine sand, trace organics (fine shredded wood debris, sticks, and wood chips).		
_4							
_5						PWS-06_4-7	855
_6		-152	5-10	SP	Medium dense, gray sand with scattered wood debris (wood chips and sticks).		
_7							
_8					Slight isolated sheen approximately 2 mm in diameter released from wood debris.		
_9		-171	30-40	SM	Gray, medium dense, silty sand with abundant organics (fragmented lumber and chips).	PWS-06_8-11	855
_10							
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-06_8-11
Samples to be Archived : PWS-06_1-4, PWS-06_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars 1 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

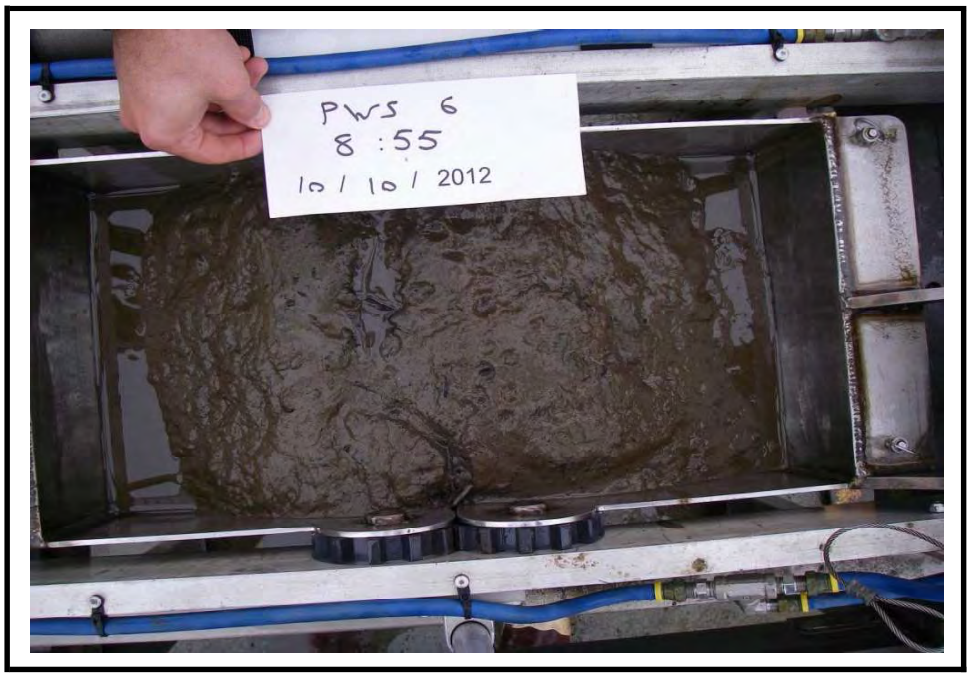
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/10/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

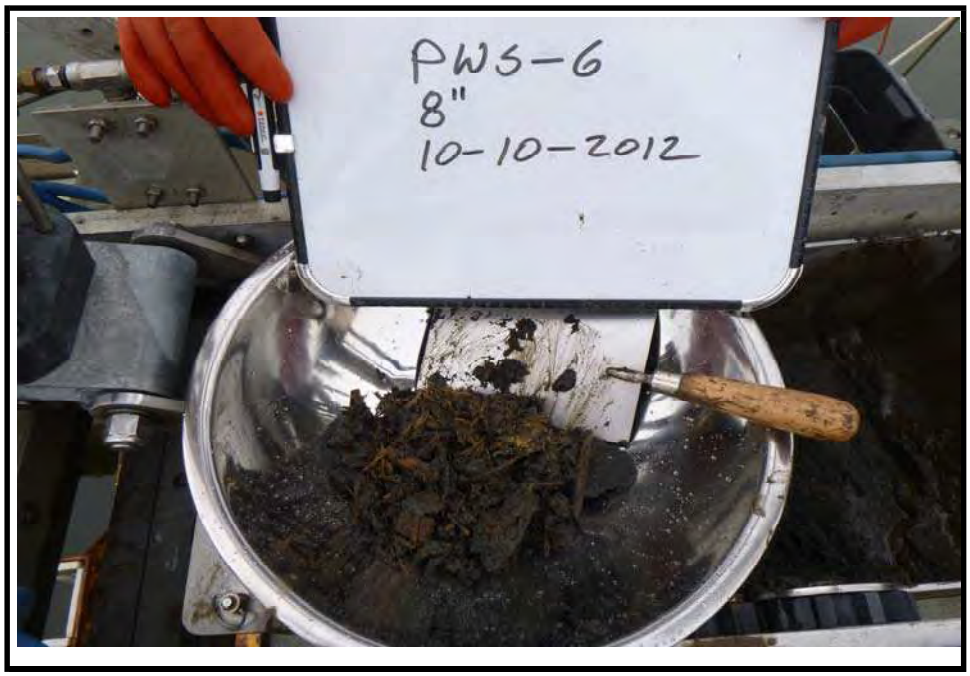
ADDITIONAL COMMENTS:

Sample contained wood debris appearing fresh and consisted of wood chips and splintered wood fibers.

SIGNATURE: Graeme B. Taylor



PWS-06 Station Surface sediment.



PWS-06 Sediment with wood debris at 8-inches in depth.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800841.84
Easting : 7613323.66

STATION ID : PWS-07

DATE : 10/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Clear, ~70°F

START TIME : 13:28
WATER DEPTH : 1.3 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 10 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1			2	ML	Brown sandy silt with trace organics (wood debris and plant matter)		
_2		-204.1				PWS-07_1-4	1328
_3							
_4					Piece of plastic sheeting at 4-inches		
_5		-182.3	5	ML	Gray sandy silt with occasional organics (wood debris)	PWS-07_4-7	1328
_6							
_7							
_8			3	ML	Gray silt with some sand, occasional organics (wood debris). Faint creosote odor.		
_9		-447.2			Pieces of broken glass	PWS-07_8-10	1328
_10					TD = 10"		
_11							
_12							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-07_8-10
Samples to be Archived : PWS-07_1-4, PWS-07_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : PWS-7_8-10-Dup

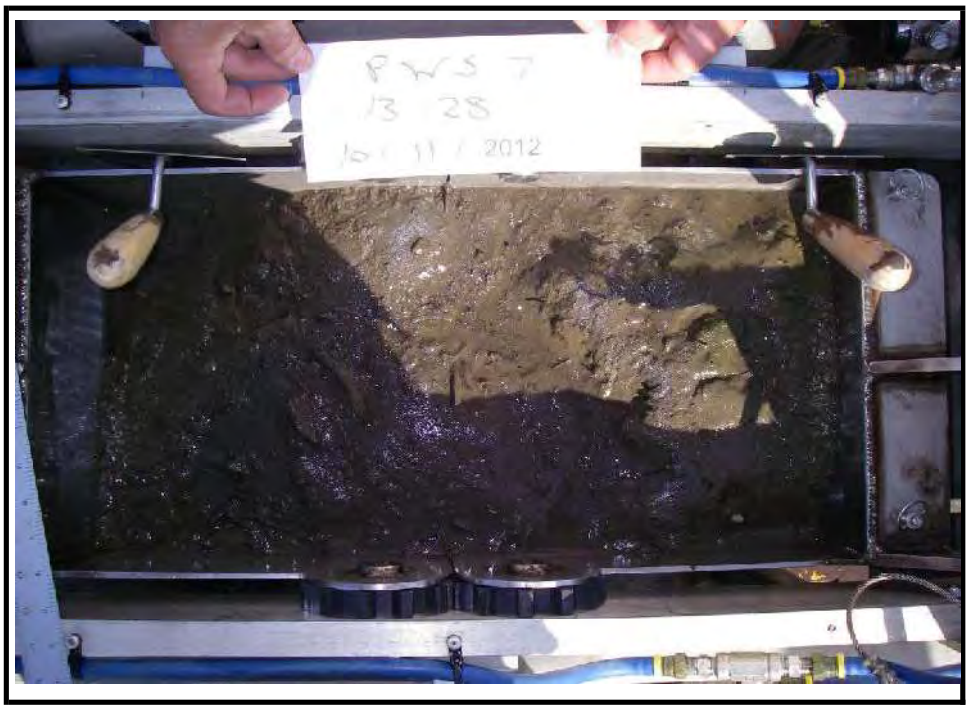
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	8 x 1L soil jars 2 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

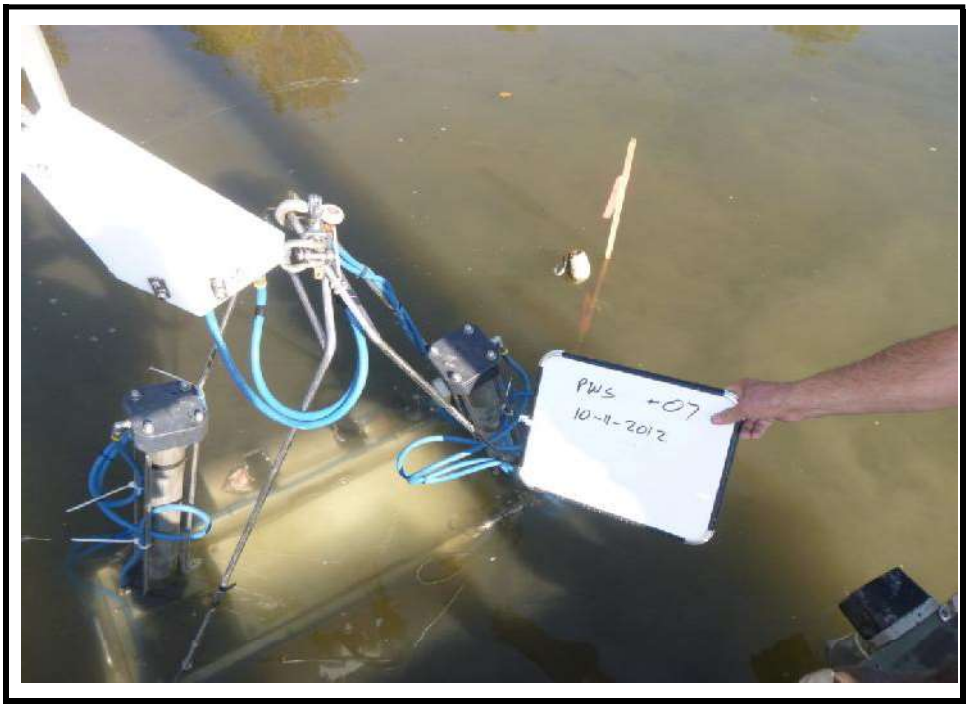
PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/11/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: Duplicate collected (PWS-7_8-10-Dup)

SIGNATURE:



PWS-07 Station Surface sediment.



PWS-07 Station

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800735.51
Easting : 7613274.82

STATION ID : PWS-08

DATE : 10/9/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sun, warm ~75°F

START TIME : 1650
WATER DEPTH : 4.4 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface		-110	<1	ML	Brown, sandy silt with trace organics (charred wood and wood fragments)		
1							
2						PWS-08_1-4	1655
3		-148.5	1	ML	Gray, sandy silt with trace organics (fine shredded wood, wood chips and small sticks)		
4							
5					Eel approximately 6-inches long at 4-inches depth.	PWS-08_4-7	1655
6							
7		-161	1	ML	Medium dense, gray silt with trace organics (wood debris, rootlets, and shredded wood fragments)		
8							
9						PWS-08_8-11	1655
10		-180	5-10	ML	Medium dense, gray silt with trace organics (sticks). Increase in size and volume of wood debris.		
11							
12							

Photograph of sample taken? Yes

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-08_8-11
Samples to be Archived : PWS-08_1-4, PWS-08_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars 1 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/9/2012; 07:30
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

Sloped surface of sediment in grab sample.

SIGNATURE: Graeme B. Taylor

PWS-08 Station Surface sediment.

PWS-08 Surface Sediment

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800673.59
Easting : 7613149.93

STATION ID : PWS-09

DATE : 10/9/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sun, warm, 75°F

START TIME : 1550
WATER DEPTH : 4.8 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-127	1	ML	Very soft, brown silt with trace organics. Algae on surface.		
_2						PWS-09_1-4	1557
_3		-172.5	1	ML	Soft, gray silt, trace organics (fine shredded back and rootlets).		
_4							
_5						PWS-09_4-7	1557
_6		-157.3	1	ML	Soft, gray silt, trace organics.		
_7							
_8							
_9		-163.5	1	ML	Medium dense, gray silt with trace organics.	PWS-09_8-11	1557
_10							
_11							
_12					TD = 12 inches		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-09_8-11
Samples to be Archived : PWS-09_1-4, PWS-09_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

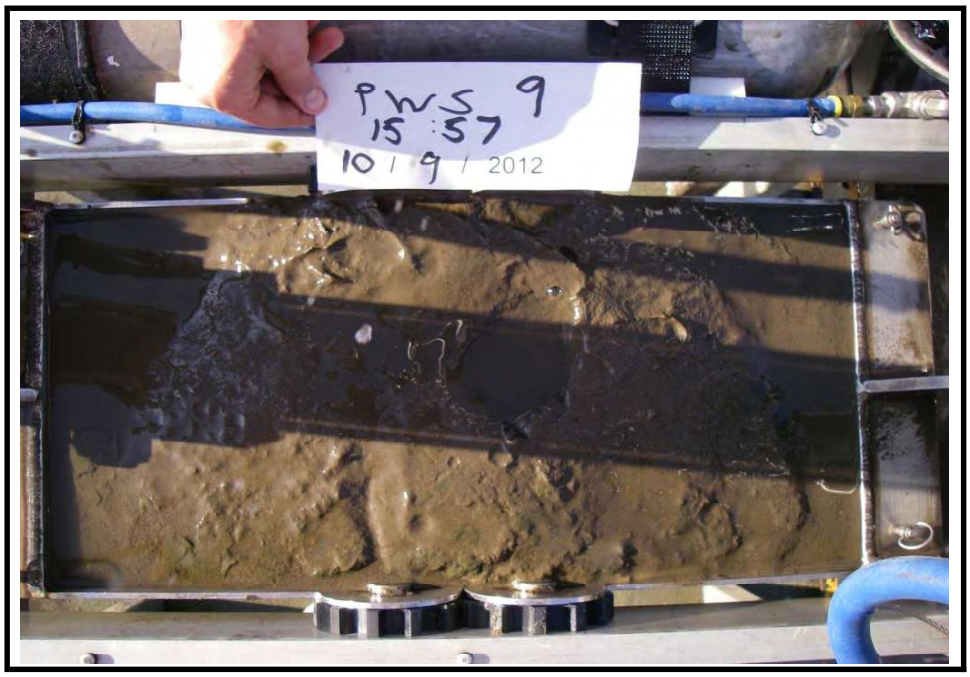
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars 1 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/9/2012; 07:30
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

SIGNATURE: Graeme B. Taylor



PWS-09 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800794.44
Easting : 7613130.29

STATION ID : PWS-10

DATE : 10/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge, R. Beach
WEATHER : Clear, ~70°F

START TIME : 15:32
WATER DEPTH : 1.9 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-112.5	<1	ML	Gray silt with trace sand and organics (sticks)		
_2		-181.2				PWS-10_1-4	1532
_3							
_4							
_5		-211.5	2-3	SM	Gray silty sand with trace organics (sticks, bark, rootlets)	PWS-10_4-7	1532
_6							
_7							
_8							
_9		-210.8	3-4	ML	Medium stiff, gray, silt with trace clay and organics (sticks)	PWS-10_8-11	1532
_10					Faint creosote odor.		
_11							
_12					TD = 12 inches		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-10_8-11
Samples to be Archived : PWS-10_1-4, PWS-10_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

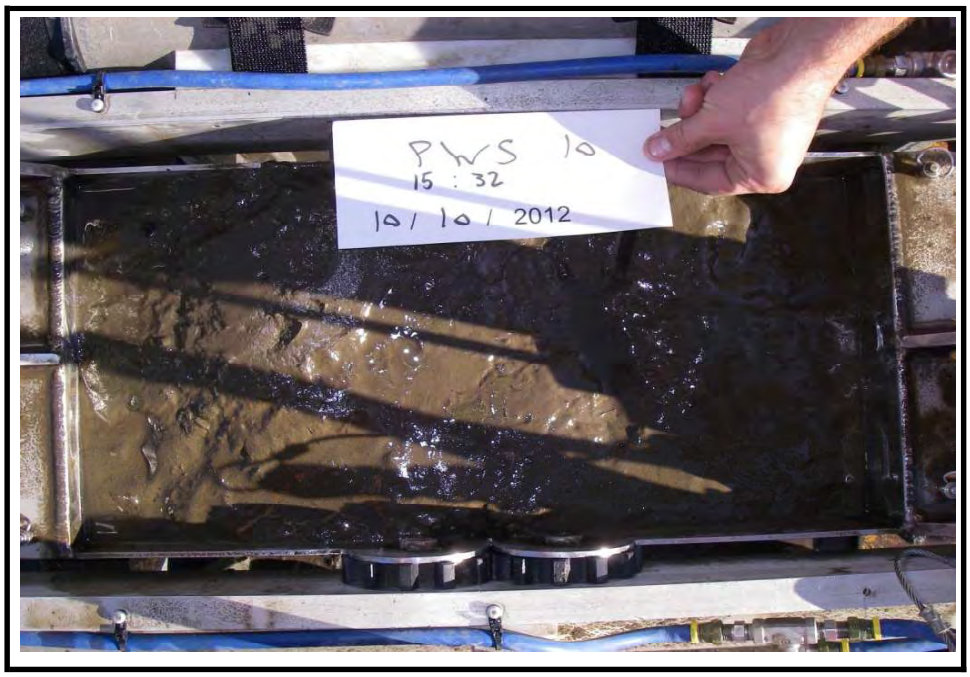
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars 1 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/10/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

SIGNATURE:



PWS-10 Station Surface sediment.

PWS-10 Surface Sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800845.32
Easting : 7613011.06

STATION ID : PWS-11

DATE : 10/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Clear, warm ~70°F

START TIME : 14:52
WATER DEPTH : 1.9 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		**-150**	**<1**	**ML**	Some algae present on sediment surface. Brown silt, becomes gray at 6-inches.		
_2				**ML**	Gray silt with trace sand and organics.	PWS-11_1-4	**1452**
_3		**-174.5**	**<1**				
_4					Stick at 4-inches.		
_5		**-165.5**	**<1**	**ML**	Soft, gray, sandy silt.	PWS-11_4-7	**1452**
_6				**ML**	Medium stiff, gray silt with trace sand and trace organic matter (sticks).		
_7							
_8							
_9		**-174.9**	**<1**	**ML**	Medium stiff, gray silt with trace sand and clay.	PWS-11_8-11	**1452**
_10					Clam shell and piece of bark at 10-inches.		
_11							
_12					TD = 12"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-11_8-11
Samples to be Archived : PWS-11_1-4, PWS-11_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

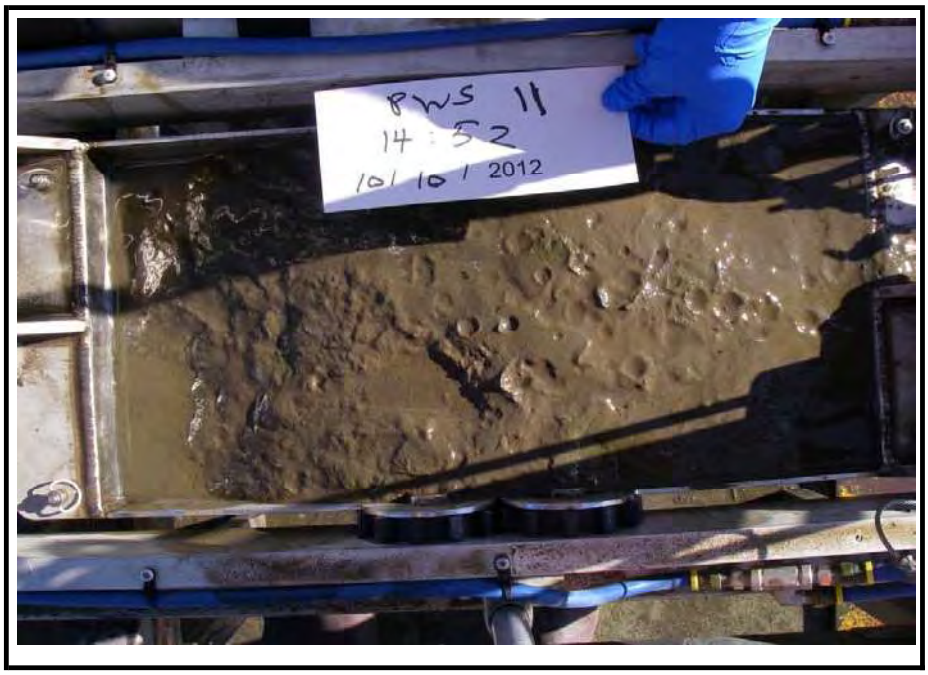
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1L jars 1 X 8oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/10/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

SIGNATURE:



PWS-11 Station Surface Sediment

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800763.33
Easting : 7612953.91

STATION ID : PWS-12

DATE : 10/9/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sunny, approximately 80°F

START TIME : 1330
WATER DEPTH : 2.8 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-80	1	ML	Very soft, brown, silt with trace fine sand. One large stick near surface.		
_2						PWS-12_1-4	1336
_3		-150	0	ML	Soft, gray silt.		
_4							
_5						PWS-12_4-7	1336
_6		-148	0	ML	Soft, gray silt.		
_7							
_8							
_9						PWS-12_8-11	1336
_10		-160	0	ML	Medium stiff, gray silt.		
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-12_8-11, PWS-12_8-11DUP
Samples to be Archived : PWS-12_1-4, PWS-12_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : Duplicate

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1L jars 1 X 8oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/9/2012; 07:30
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

SIGNATURE: Graeme B. Taylor

PWS-12 Station Surface sediment.

PWS-12 Silt with little or no organics at 8 to 11 inches.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800479.66
Easting : 7612989.05

STATION ID : PWS-13

DATE : 10/9/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Overcast, cool ~58°F

START TIME : 900
WATER DEPTH 5.8 feet
TARGET PENETRATION 12 inches
ACTUAL PENETRATION 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		50.4	5	SM	Loose, brown, silty fine sand with trace organics (wood debris).		
_2					Slight isolated 2 mm sheen	PWS-13_1-4	915
_3		47.9	10	SM	Loose, brown, silty fine sand with trace organics (wood debris, sticks, and leaves), slight sheen.		
_4							
_5						PWS-13_4-7	915
_6							
_7			20	ML	Gray sandy silt with abundant organics (wood debris, bark, leaves, and other plant matter), slight isolated sheen.		
_8							
_9					Gray organic silt with trace clay and fine sand.	PWS-13_8-11	915
_10		-123.8	30	OL	Dark gray, organic sandy silt (large sticks, bark, leaves, and other vegetative matter), slight sheen.		
_11							
_12					TD = 12"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Samples for Analysis : PWS-13_1-4, PWS-13_8-11
Sample to be Archived : PWS-13_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

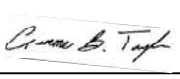
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	7 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				
EPH / VPH (PWS-13_1-4 only)				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/9/2012: 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: Surface was free of large debris. Vegetation indicative of "delta area" deposition.

Slight sheen observed throughout sampling intervals. No creosote odor.

SIGNATURE: 

PWS-13 Station surface sediment.

PWS-13 Organics in sediment at 8 to 11 inches.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801174.90
Easting : 7612676.20

STATION ID : PWS-14

DATE : 10/11/2012
SAMPLING METHOD : Cookie Cutter
PERSONNEL : J. Fassio, R. Roloson
WEATHER : Sunny, Warm, ~65°F

START TIME : 1200
WATER DEPTH : 0 feet
TARGET PENETRATION DEPTH : 11 inches
ACTUAL PENETRATION DEPTH : 8 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1			20	ML	Very soft, gray silt with some sand and abundant organics (plant matter), spotty sheen.		
_2							
_3							
_4							
_5	5.6		5	ML	Soft gray sandy silt with scattered organics (roots, plant matter), spotty sheen. Creosote odor.	PWS-14_4-8	1200
_6							
_7							
_8			0	CL	Stiff, gray-blue clay with some silt, low plasticity.		
_9					TD = 8 inches		
_10							
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-14_4-8
Samples to be Archived :

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

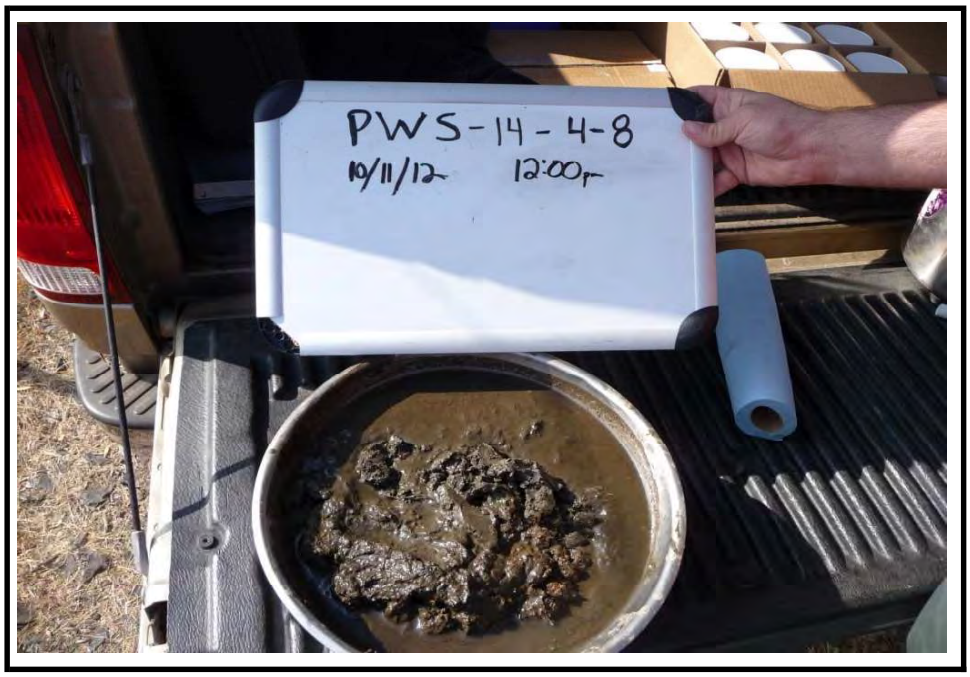
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1 L jars 1 X 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/11/2012; 10:30
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

SIGNATURE: Joe Fassio



PWS-14 Sediment at 4 to 8 inches.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801050.81
Easting : 7613938.23

STATION ID : PWS-15

DATE : 10/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Cloudy, cool ~60°F

START TIME : 755
WATER DEPTH : 13.5 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-101.1	<1	ML	Very soft, brown, sandy silt with trace organics (splintered lumber and charred wood chips).		
_2						PWS-15_1-4	810
_3		-164.5	<1		Becomes gray.		
_4				SW	Loose, gray, fine to coarse sand with trace fine gravel and organics (sticks and wood chips).		
_5						PWS-15_4-7	810
_6		-196.2					
_7							
_8			10-20	ML	Soft, gray silt with fine to coarse sand, trace clay and scattered organics.		
_9		-137.8	5-10			PWS-15_8-11	810
_10							
_11					TD = 11		
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-15_8-11
Samples to be Archived : PWS-15_1-4, PWS-15_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

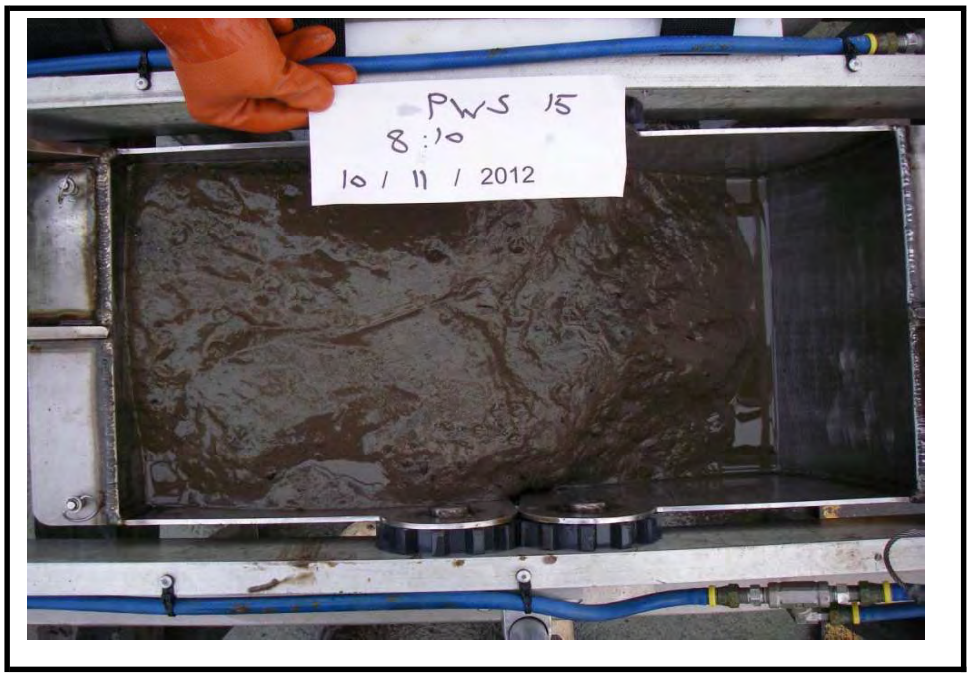
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/11/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: Debris sticking out of grab sample. Sediment collected is slumped likely due to contact with debris.

SIGNATURE: Graeme B. Taylor



PWS-15 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800827.88
Easting : 7612874.993

STATION ID : PWS-16

DATE : 10/9/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sun, warm ~75°F

START TIME : 14:20
WATER DEPTH : 3.2 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-50	1	ML	Very soft, brown, silt with trace sand. Algae on surface.		
_2						PWS-16_1-4	1545
_3		-190	1	ML	Soft, gray silt, with trace organics (wood debris, small sticks, grass).		
_4							
_5						PWS-16_4-7	1545
_6		-160	2	ML	Soft, gray silt with trace organics (wood debris, small sticks, grass, fine shredded fibrous organics and wood and pieces of lumber).		
_7							
_8							
_9		-149.8			Medium stiff, gray silt with some sand and increasing organics with depth.	PWS-16_8-11	1545
_10							
_11							
_12					TD = 12"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-16_8-11
Samples to be Archived : PWS-16_1-4, PWS-16_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1 L jars 1 X 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/9/2012; 07:30
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

SIGNATURE: Graeme B. Taylor

PWS-16 Station Surface Sediment.

PWS-16 Sediment at 8 to 11 inches.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801222.09
Easting : 7612699.982

STATION ID : PWS-17

DATE : 10/10/2012
SAMPLING METHOD : Cookie Cutter/shovel
PERSONNEL : J. Fassio, R. Roloson
WEATHER : Sunny, Warm, ~75°F

START TIME : 1515
WATER DEPTH : 0 feet
TARGET PENETRATION DEPTH : 11 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1			45	SM	Soft, brown, organic sand silt. Organics consist of rootlets and plant matter.		
_2							
_3							
_4							
_5	5.0		5	SM	Soft, gray sandy silt with trace clay and organics (plant matter).		
_6						PWS-17_4-7	1540
_7					Refusal at 7 inches with cookie cutter.		
_8			1-2	CH	Stiff, blue-gray clay with moderate to high plasticity, trace organics (wood chips) and trace angular gravel		
_9							
_10							
_11					TD = 11 inches		
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-17_4-7
Samples to be Archived :

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1 L jars 1 X 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/10/2012; 10:30
PID CALIBRATION STANDARD : 100 ppm, isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS: Used cookie cutter from 0 to 7 inches and shovel from 7 to 11 inches, Did not collect 8 to 11 inch sample for porewater since it consisted of a tight clay which would not yield an adequate porewater sample volume. No odors or sheen noted in sediment at this location.

SIGNATURE: Joe Fassio

PWS-17 Station location.

PWS-17 Sediment collect from 4 to 7 inches

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 798866.61
Easting : 7611022.122

STATION ID : PWS-18

DATE : 10/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Clear, Warm, ~70°F

START TIME : 14:34
WATER DEPTH : 4.3 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 10 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-46.5	40	SM	Brown organic silty sand. Abundant wood debris.		
_2						PWS-18_1-4	1434
_3		-93.5	40-45				
_4					Slight sheen at 4 inches.		
_5		-108.7	40-45			PWS-18_4-7	1434
_6							
_7							
_8							
_9		-107	40-45			PWS-18_8-10	1434
_10					TD = 10		
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-18_8-10
Samples to be Archived : PWS-18_1-4, PWS-18_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

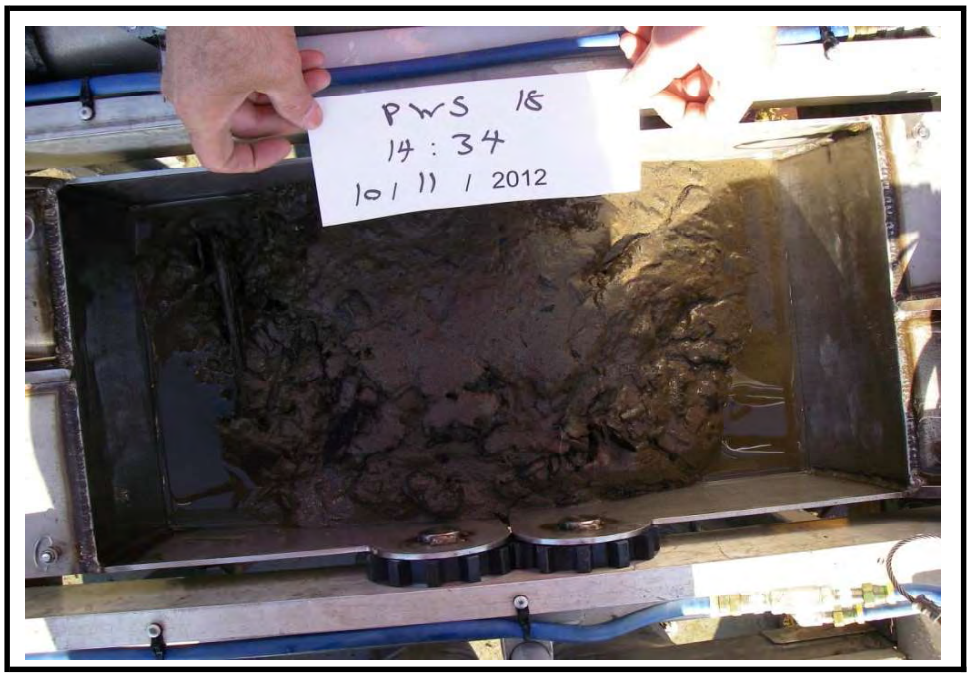
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	9 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/11/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: Large pieces of wood in power grab jaws but good recovery.

SIGNATURE: Graeme B. Taylor



PWS-18 Station Surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 798212.23
Easting : 7610614.32

STATION ID : PWS-19

DATE : 10/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Clear, ~70°F

START TIME : 15:16
WATER DEPTH : 6.7 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-171.8	<1	ML	Brown silt, algae at surface.		
_2				ML	Gray silt with trace sand and organics (fine rootlets).	PWS-19_1-4	1516
_3		-140.7					
_4			<1		Gray silt with trace fine sand and organics (rootlets).		
_5		-155				PWS-19_4-7	1516
_6				ML	Gray silt with trace clay.		
_7							
_8							
_9			2-3	ML	Gray silt with some fine to medium sand and trace organics (wood chips).	PWS-19_8-11	1516
_10							
_11							
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-19_8-11
Samples to be Archived : PWS-19_1-4, PWS-19_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1 L jars 1 X 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/11/2012
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS:

SIGNATURE: J d J Eledge

PWS-19 Station Surface sediment.

PWS-19 Close-up of surface sediment with algae accumulation.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800211.62
Easting : 7612488.85

STATION ID : PWS-20

DATE : 10/9/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sunny, Warm, ~75°F

START TIME : 11:25
WATER DEPTH : 3.4 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-60	1	SM	Brown and gray, silty sand with trace organics (wood debris). Algae at surface.		
_2						PWS-20_1-4	1130
_3		-160	1	ML	Soft, gray sandy silt with trace clay. 3-inch diameter clam.		
_4					Sand content increased with depth.		
_5						PWS-20_4-7	1130
_6		-172	5	SM	Soft, gray, silty fine sand, trace organics.		
_7							
_8					Dead clam.	PWS-20_8-11	1130
_9							
_10		-172	10-20	SM	Medium dense, gray silty fine sand with abundant organics.		
_11							
_12					TD = 12 inches		

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-20_8-11, PWS-20_8-11DUP
Samples to be Archived : PWS-20_1-4, PWS-20_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : Duplicate

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1 L jars 1 X 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/9/2012; 07:30
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: Wire debris caught in power grab jaws.

SIGNATURE: Graeme B. Taylor

PWS-20 Station Surface sediment.

PWS-20 Sediment at 8 to 11 inches.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800936.74
Easting : 7613805.59

STATION ID : PWS-25

DATE : 10/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Clear, ~68°F

START TIME : 12:19
WATER DEPTH : 13.5 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 8 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1			45	ML	Soft, gray-brown sandy silt with abundant organics (large wood debris).		
_2						PWS-25_1-4	1300
_3							
_4			35	SM	Brown silty sand with abundant organics (large wood debris).		
_5						PWS-25_4-8	1300
_6		-47.5	45	ML			
_7							
_8					TD = 8 inches		
_9							
_10							
_11							
_12							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-25_4-8
Samples to be Archived : PWS-25_1-4

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	6 x 1L soil jars 1 x 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/11/2012; 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: 1st attempt poor recovery - wood chips in jaws, 2nd attempt - jaws did not close, 3rd attempt - wood and metal in jaws poor recovery, 4th attempt - metal debris in jaws moved southward 15 ft for 5th attempt, 5th attempt - only 6 inches of recovery, wood in jaws, 6th attempt (moved 20 feet south from original position) poor recovery due to wood debris, 7th attempt (30 feet south from original position) poor recovery, 8th attempt (35 feet south from original position) 8-inches recovery.

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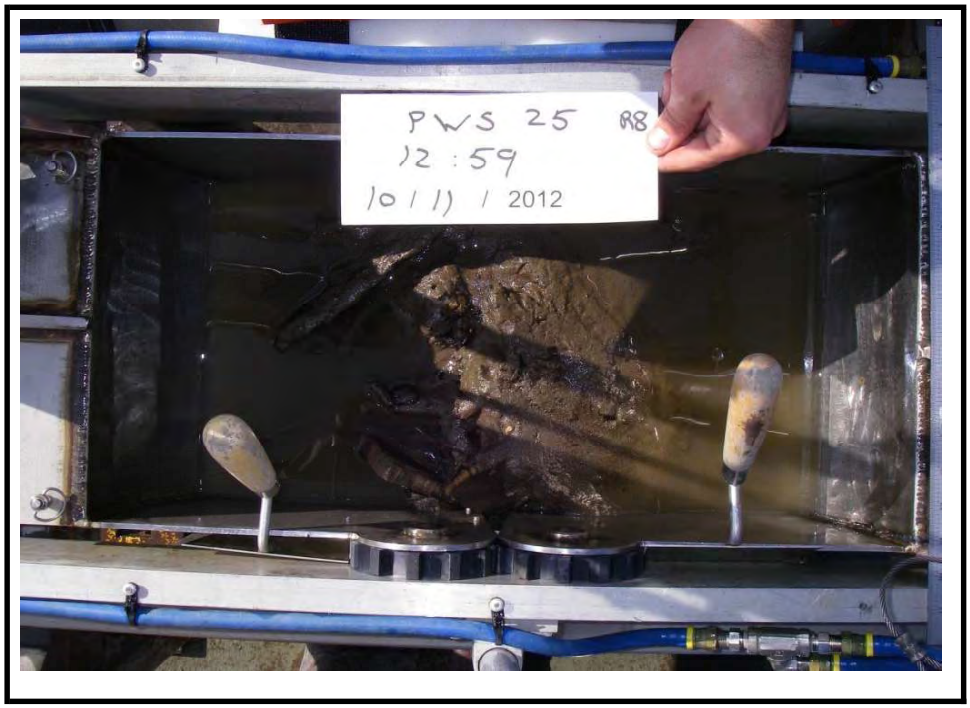

PWS-25 Station Surface sediment.

PWS-25 Abundant wood debris in surface sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800971.43
Easting : 7613874.41

STATION ID : PWS-26

DATE : 10/11/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Cloudy, cool ~60°F

START TIME : 900
WATER DEPTH : 13.5 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-56.4	1	ML	Very soft, brown silt with trace organics (wood chips, charred wood fragments).		
_2						PWS-26_1-4	907
_3		-92.2	2-3	SP	Medium dense, gray medium sand with trace silt and organics (wood debris including sticks and bark).		
_4							
_5						PWS-26_4-7	907
_6		-113.9	5-10	SM	Medium dense, gray silty fine sand with trace wood debris (including sticks, bark, and wood debris). Slight isolated sheen 2 mm in diameter.		
_7							
_8							
_9		-429.4	10-20	SM	Medium dense, dark gray, silty fine sand with abundant organics (wood chips and splintered wood fragments). Organic odor.	PWS-26_8-11	907
_10							
_11							
_12					TD = 12 inches		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-26_8-11, PWS-26_8-11-DUP
Samples to be Archived : PWS-26_1-4, PWS-26_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : Duplicate

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	8 X 1 L jars 1 X 8 oz jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location: Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/11/2012: 08:00
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: Collected sediment is sloped. Wood debris caught in grab sampler jaws.

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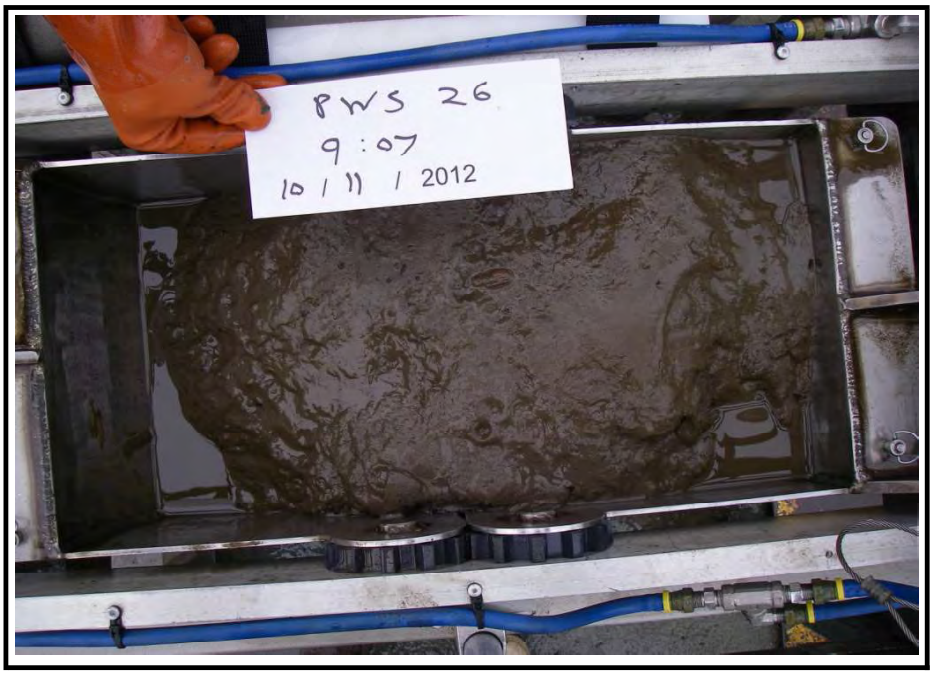


PWS-26 Station Surface Sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800433.75
Easting : 7612657.45

STATION ID : PWS-27

DATE : 10/9/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor
WEATHER : Sun, warm ~70°F

START TIME : 1015
WATER DEPTH : 1.9 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 12 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-78	<1	ML	Soft, dark gray silt with trace organics at surface.		
_2						PWS-27_1-4	1029
_3		-263	<1	ML	Soft, dark gray silt with trace organics (wood debris).		
_4							
_5						PWS-27_4-7	1029
_6		-148	2	ML	Soft, dark gray silt, low plasticity, trace organics (wood chips, sticks).		
_7							
_8							
_9		-153	3-5	ML	Medium stiff, dark gray silt with trace sand and organics (wood chips, sticks, leaves, and grasses).	PWS-27_8-11	1029
_10							
_11							
_12					TD = 12"		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-27_8-11
Samples to be Archived : PWS-27_1-4, PWS-27_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

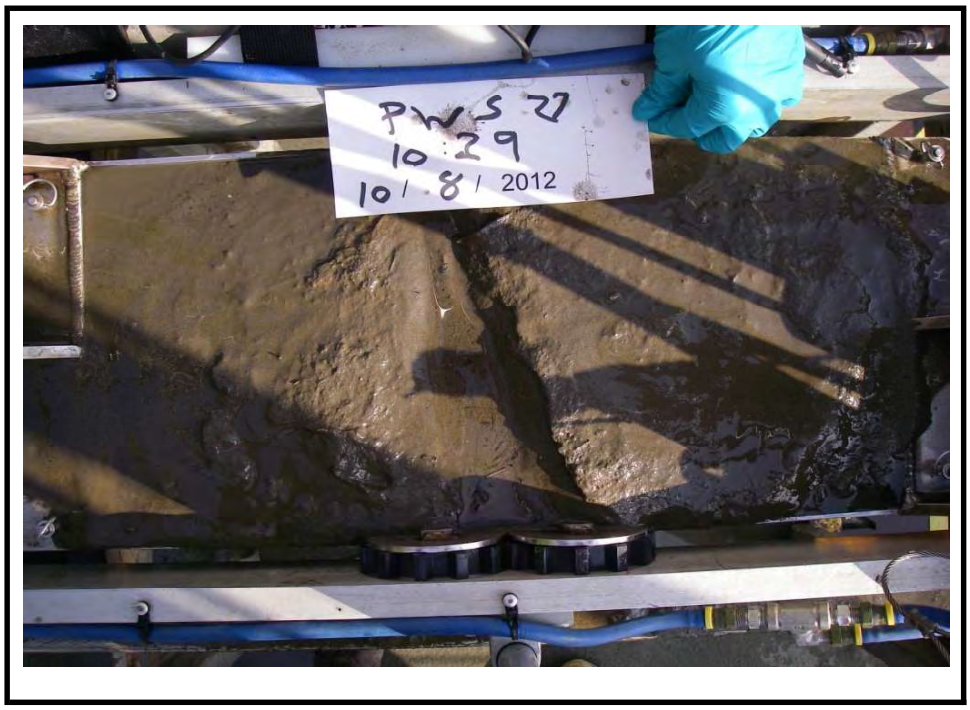
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	8 X 1 L jars 1 X 8 oz jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

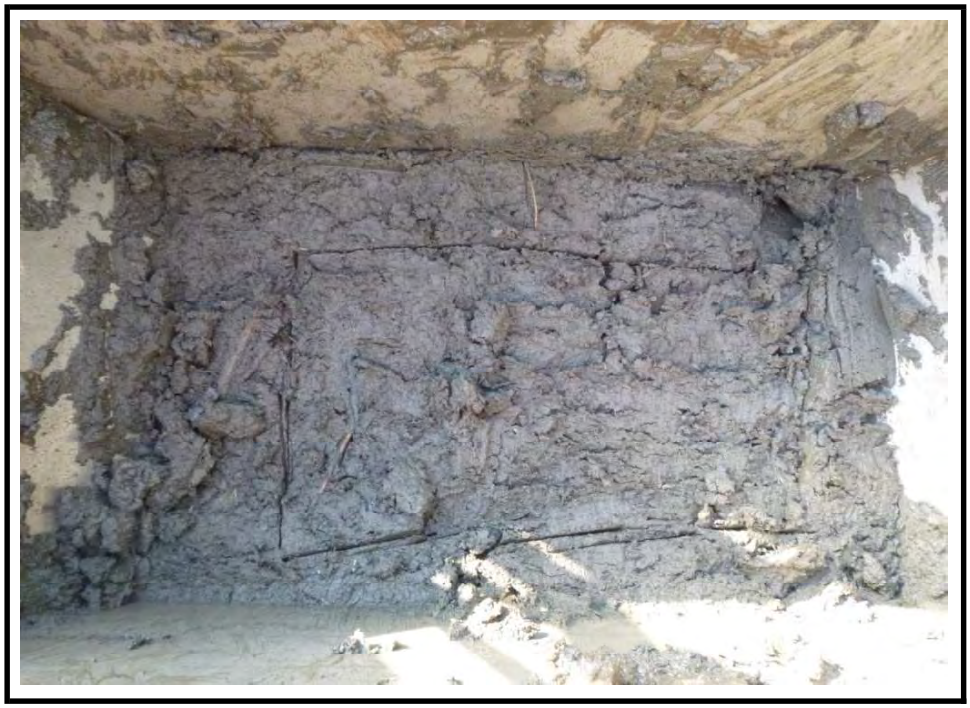
PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 7/13/2012: 08:15
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: Located at mouth of Milton Creek. Silt stiffness increassed with depth. Wood chips and other organic debris present from 4 inches to total depth.

SIGNATURE: Graeme B. Taylor



PWS-27 Station Surface Sediment.



PWS-27 Sediment at 8 inches depth.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801224.71
Easting : 7614077.91

STATION ID : PWS-28

DATE : 10/10/2012
SAMPLING METHOD : Powered Grab
PERSONNEL : G. Taylor, J. Eledge
WEATHER : Clear, cool ~60°F

START TIME : 14:15
WATER DEPTH : 13.8 feet
TARGET PENETRATION DEPTH : 12 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1		-110.3	<1	ML	Brown silt with trace sand. Surface algae.		
_2		-160.5	<1	ML	Soft, brown silt with trace sand.	PWS-28_1-4	907
_3							
_4			1-2	ML	Soft, gray-brown, sandy silt with trace organics (sticks).		
_5		-181.3				PWS-28_4-7	907
_6							
_7					Worms at 7 inches.		
_8							
_9		-187.8	<1	ML	Soft, gray sandy silt with trace organics (sticks).	PWS-28_8-11	907
_10							
_11					TD = 11 inches		
_12							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-28_8-11
Samples to be Archived : PWS-28_1-4, PWS-28_4-7

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

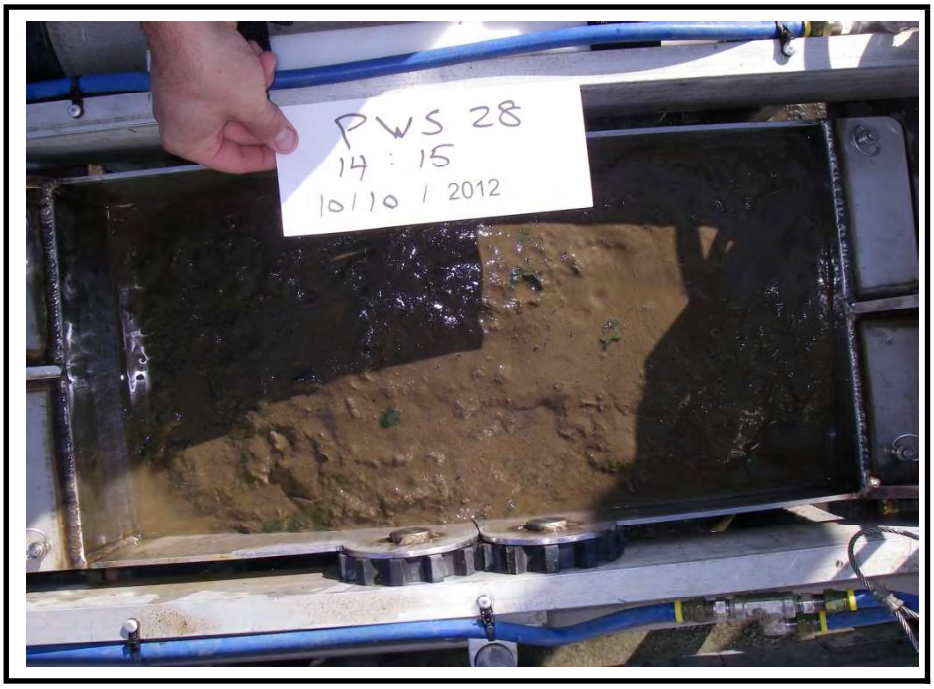
Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	8 X 1 L jars 1 X 8 oz jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location: Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : 10/10/2012
ORP CALIBRATION STANDARD : Zobell solution

ADDITIONAL COMMENTS: New station with no previous July 2012 sample.

SIGNATURE: J. Eledge



PWS-28 Station Surface Sediment.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801080.10
Easting : 7612568.86

STATION ID : PWS-29

DATE : 10/12/2012
SAMPLING METHOD : Shovel
PERSONNEL : J. Fassio, R. Roloson
WEATHER : Rainy, cool, ~55°F

START TIME : 1000
WATER DEPTH : 0 feet
TARGET PENETRATION DEPTH : 11 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1			5	ML	Soft, dark brown silt with trace organics (plant matter).		
_2			0	ML	Stiff, gray, clayey silt with trace coarse rounded gravel, strong creosote odor.		
_3							
_4							
_5							
_6							
_7							
_8				ML	Becomes wet, brown, moderate to strong spotty sheen within macropores in silt, strong creosote odor.		
_9							
_10						PWS-29_8-11	**1030**
_11					TD = 11 inches		
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-29_8-11
Samples to be Archived :

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	5 X 1 L jars 1 X 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

SIGNATURE: Joe Fassio

PWS-29 Station Location adjecent to Milton Creek.

PWS-29 Spotty sheen noted in sample.

POREWATER SEDIMENT SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801037.65
Easting : 7612528.09

STATION ID : PWS-30

DATE : 10/12/2012
SAMPLING METHOD : Shovel
PERSONNEL : J. Fassio, R. Roloson
WEATHER : Rainy, cool, ~55°F

START TIME : 930
WATER DEPTH : 0 feet
TARGET PENETRATION DEPTH : 11 inches
ACTUAL PENETRATION DEPTH : 11 inches

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface _1			1	ML	Soft, brown, silt with some gravel and cobbles.		
_2			1	GM	Dense, brown, cobbles and coarse gravel with some silt and clay, trace sand, wet. No odors or sheen noted.		
_3							
_4							
_5							
_6							
_7							
_8							
_9							
_10			1	GM	Dense, brown, cobbles and coarse gravel with some silt and clay, trace sand, wet. No odors or sheen noted.	PWS-30_8-11	950
_11					TD = 11 inches		
_12							

Photograph of sample taken? Yes **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-30_8-11
Samples to be Archived :

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1 L jars 1 X 8 oz jar	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NA
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS: No sheen or odor noted.

SIGNATURE: Joe Fassio

PWS-30 Station Location adjecent to Milton Creek.

PWS-30 Station sample. No sheen noted in sample.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801182.61
Easting : 7613920.95

STATION ID : LSI-01

DATE : 10/16/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge
WEATHER : Partly cloudy, 55°F

START TIME : 13:00
DEPTH TO WATER IN BORING: 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 4.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface				SP	Loose, gray, fine to metdium sand with trace silt, no creosote odor or sheen (wet).		
_1			5	SM	Medium dense, gray, silty fine sand with trace organics (wood debris),	LSI-01_8-11	1330
	0.5				faint creosote odor, slight sheen (wet).		
_2			50	SP-SM	Some to trace silt, abundant organics (coarse wood debris), no odor, no sheen (wet)		
	0.9				Wood debris layer at 2.5 to 3.0 feet, faint creosote odor, slight sheen		
_3			25		Fine fibrous wood debris		
				SM	Medium dense, gray, silty fine sand with trace organics (wood debris), no odor,		
_4	0.4		10		no sheen (wet).		
					TD = 4.5 feet		
_5							
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : LSI-01_8-11
Samples to be Archived : NA

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/16/2012 10:30
PID CALIBRATION STANDARD : 100 ppm isobuthylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Sample collected at water's edge during low tide.

NM - not measured.

NA - not applicable

SIGNATURE:

LSI-01 Station Location - water in hole is from pore water.

LSI-01 Station Pore water sediment sample

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800821.98
Easting : 7613325.67

STATION ID : LSI-02

DATE : 10/9/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Johnson
WEATHER : Partly cloudy, 55°F

START TIME : 8:25
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			5	ML	Soft, gray sandy silt with some clay, trace organics (wood debris), faint creosote odor		
_1					and slight sheen (wet).	LSI-02_8-11	825
_2			5		Soft, gray silt with some clay and trace fine sand, trace organics (wood debris),		
					faint odor, slight sheen (wet).		
_3			1		Same as above, except no odor, no sheen.		
_4			1		Same as above, except no odor, no sheen.		
_5					TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : LSI-02_8-11
Samples to be Archived : NA

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L soil jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

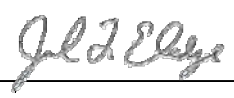
PID CALIBRATION (Date/Time) : not functioning
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Sample collected at water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE: 

LSI-02 Sediment core.

LSI-02 Upper portion of sediment core.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800832.61
Easting : 7613283.65

STATION ID : LSI-03

DATE : 10/8/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, K. Harrington
WEATHER : Clear, 70°F

START TIME : 10:40
DEPTH WATER IN BORING : 0.5 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface	0		2	SM	Loose, gray, silty fine sand, trace organics (vegetative matter - grass), faint creosote odor and slight sheen (wet).		
_1							
			<1	ML	Soft, gray sandy silt, faint odor, slight sheen (wet).		
_2	0				Same as above		
_3					Same as above, except no odor, no sheen.		
_4	0				Some to trace fine sand.		
_5					Trace fine sand, TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : NA

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : None
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

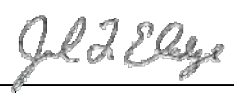
Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/8/2012 10:30
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NM - not measured

NA - not applicable

SIGNATURE: 

LSI-03 Hand auger boring sediments 0 to 2.6 feet in depth.

LSI-03 Hand auger boring sediments 1.3 to 5 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800808.56
Easting : 7613342.59

STATION ID : LSI-04

DATE : 10/9/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Johnston
WEATHER : Partly sunny, 65°F

START TIME : 8:45
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			1	ML	Soft, gray silt with some clay, trace fine sand, low plasticity, trace organics (wood debris), no creosote odor, no sheen (wet).		
_1						LSI-04_8-11	855
_2			1-5		Same as above with scattered organics (wood debris and grass), no odor, no sheet (wet).		
_3			1		Same as above, except little or no sand, no odor, no sheet (wet).		
_4					Same as above		
_5					TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : LSI-04_8-11

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1 L Jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

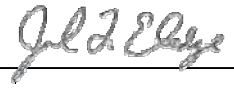
PID CALIBRATION (Date/Time) : Not functioning
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Sample collected at water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE: 

LSI-04 Hand auger boring sediments 0 to 3 feet in depth.

LSI-04 Hand auger boring sediments 2 to 5 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800856.41
Easting : 7613362.16

STATION ID : LSI-05

DATE : 10/8/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge
WEATHER : Clear, 70°F

START TIME : 11:00
WATER DEPTH : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface	1.9		0	SP	Loose, brown fine to medium sand, poorly graded with trace silt, no creosote odor or sheen (wet).		
_1					Gray at 0.5 feet.		
_2	3.2		0		Same as above, except faint organic odor, no sheen at 2 feet.		
_3					Poor sample recovery 3.3 to 5 feet due to heaving sand.		
_4	11		0		Same as above		
_5					TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

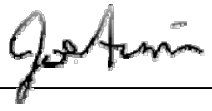
Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/8/2012 10:30
PID CALIBRATION STANDARD : 100 ppm Isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE: 

LSI-05 Hand auger boring sediments 0 to 2.3 feet in depth.

LSI-05 Hand auger boring sediments 2.3 to 5 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800831.28
Easting : 7613361.55

STATION ID : LSI-06

DATE : 10/10/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Johnston
WEATHER : Partly sunny, 65°F

START TIME : 8:00
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface	9.4		50	SM	Gray, loose silty fine to medium sand with abundant organics (wood fibers from 0 to 0.5 feet), no creosote odor or sheen (wet).		
_1			10			LSI-06_8-11	830
			5	ML	Soft, gray, sandy silt with scattered organics (wood fibers), no odor, no sheen (wet).		
_2							
	10.3		1		Trace fine sand and organics (wood fibers), no odor, no sheen (wet).		
_3							
_4							
_5	14.7		5		Medium stiff, increase in organic content (wood fibers), no odor, no sheen (wet).		
					TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : LSI - 06 8-11

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1 L Jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/10/2012 8:00
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE:

LSI-06 Hand auger boring sediments 0 to 2 feet in depth.

LSI-06 Hand auger boring sediments 2 to 5 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800842.87
Easting : 7613410.07

STATION ID : LSI-07

DATE : 10/8/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge
WEATHER : Clear, 75°F

START TIME : 13:45
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 3.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface				SM	Dark gray siltly fine to coarse sand with some organics (fine wood pieces), faint odor and slight sheen (wet).		
_1	108		25-30		Heavy creosote odor and sheen, 1-mm diameter NAPL blebs in wood waste buried 6 to 8 inches below surface.		
_2	60				Gray silty sand, no organics, creosote odor and moderate sheen (wet).		
_3	11.5		0	SP	Loose, gray fine sand, trace silt, no organics, faint odor, slight sheen (wet).		
					TD = 3 feet		
_4							
_5							
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

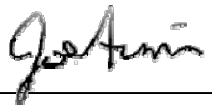
Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/8/2012 10:30
PID CALIBRATION STANDARD : 100 ppm Isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE: 

LSI-07 Hand auger boring sediments 0 to 2.5 feet in depth.

LSI-07 Hand auger boring sediments in upper one foot with sheen and NAPL blebs.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800856.79
Easting : 7613439.71

STATION ID : LSI-07B

DATE : 10/8/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge
WEATHER : Clear, 75°F

START TIME : 14:30
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 3 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface				SP	Brown fine to medium sand with occasional wood debris, faint odor, slight sheen (wet).		
_1							
_2					Dark gray, fine to medium sand with trace silt, occasional wood debris, faint odor, slight sheen (wet).		
_3					Dark gray fine sand with occasional wood fragments, no odor, no sheen (wet).		
					TD = 3 feet		
_4							
_5							
_6							

Photograph of sample taken? No

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

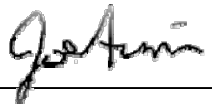
Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NM
PID CALIBRATION STANDARD : NM
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE: 

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LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800815.75
Easting : 7613383.14

STATION ID : LSI-08

DATE : 10/8/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, R. Johnston
WEATHER : Sunny, 70°F

START TIME : 9:15
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			15	ML	Soft, gray, sandy silt with some organics (wood debris), no odor, no sheen (wet).		
_1			50			LSI-08_8-11	830
				SM	Soft, gray, silty fine sand with scattered organics (wood fibers), no odor, slight organic sheen (wet).		
_2							
_3			5	ML	Soft, gray, silt with some clay and trace fine sand, and scattered organics (wood fibers), no odors, no sheen (wet).		
_4			5				
_5				SW	Medium stiff, gray fien to coarse sand with trace silt, increase in organic content (wood fibers), faint odor, slight sheen (wet).		
					TD = 5.0 feet		
_6							

Photograph of sample taken? No

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : LSI-08_8-11

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1 L Jars	Y	Lab Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : Not functioning
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Sample collected at water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE:

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LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800832.52
Easting : 7613384.51

STATION ID : LSI-09

DATE : 10/9/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Johnston
WEATHER : Clear, 70°F

START TIME : 10:00
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			50	SM	Loose, gray, fine sand with some silt, abundant organics (coarse wood chips), creosote odor and sheen within upper 1 foot (wet).		
_1						LSI-09_8-11	1015
			5	SM	Loose gray, silty fine sand, scattered organics (fine wood fibers), faint odor, slight sheen (wet).		
_2							
_3					Same		
					Faint odor, moderate discontinuous sheen within scattered wood debris at 3.5 feet.		
_4			5				
				ML	Soft, gray, sandy silt, no odor, no sheen (wet).		
_5							
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : LSI-09_8-11
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1L	Y	Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : Not functioning
PID CALIBRATION STANDARD : NM
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE:

LSI-09 Hand auger boring sediments 0 to 3 feet in depth.

LSI-09 Hand auger boring sediments 3 to 5 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800863.58
Easting : 7613457.16

STATION ID : LSI-10

DATE : 10/8/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, K. Harrington
WEATHER : Clear, 70°F

START TIME : 14:45
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 3.8 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface				SP	Loose, brown, fine to medium sand with occasional wood fragments, moist, no odor, no sheen (wet).		
_1					Color change to gray.		
					Trace coarse sand.		
_2				SP	Loose, fine to medium sand with trace silt and occasional wood fragments, no odor, no sheen (wet).		
_3					Silty sand layer 2 - 3-inches thick at 3.5 feet, no odor, no sheen (wet).		
					TD = 3.8 feet (poor sample recovery)		
_4							
_5							
_6							

Photograph of sample taken? No

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/8/2012 10:30
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

PID not used.

NM - not measured

NA - not applicable

SIGNATURE:

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LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800831.48
Easting : 7613441.71

STATION ID : LSI-11

DATE : 10/10/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Roloson
WEATHER : Clear, 60°F

START TIME : 14:45
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 2.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			10	SP	Loose, gray, fine to medium sand with trace silt, scattered organics (wood fibers), creosote odor and sheen within upper 1 foot (wet).		
_1	2.5					LSI-11_8-11	1025
					Predominantly fine sand, little or no silt, trace organics (wood fibers) at 1.5 feet, faint odor, slight sheen (wet).		
_2	7.5		2		Refusal at 2 feet due to heaving sands.		
_3							
_4							
_5							
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : LSI-11_8-11
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1L jars	Y	Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/10/2012 8:00
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Sample collected near water's edge during low tide.

NM - not measured

SIGNATURE:

LSI-11 Hand auger boring sediments 0 to 1.5 feet in depth.

LSI-11 Hand auger boring sediments 0 to 2 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800897.34
Easting : 7613493.74

STATION ID : LSI-12

DATE : 10/8/2012
SAMPLING METHOD : Hand Auger, shovel
PERSONNEL : J. Fassio, K. Harrington
WEATHER : Clear, 70°F

START TIME : 15:30
DEPTH TO WATER IN BORING : 2.5 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface				SP	Loose, brown, fine to medium sand with wood fragments, no odor, no sheen (moist).		
_1					Color change to gray.		
			10	SP	Medium dense, gray fine to medium sand with trace silt and abundant wood fragments, no odor, no sheen (moist).		
_2			10				
			5	SP-SM	Medium dense, gray fine to medium sand with some silt and trace wood fragments, no odor, no sheen (wet).		
_3			1	SM	Medium dense, gray silty fine sand with occasional wood fragments, no odor, no sheen (wet).		
					Faint odor, moderate discontinuous sheen in scattered wood debris at 3.5 feet.		
_4	5.7			SP-SM	Gray, fine to medium sand with silt and occasional wood fragments. Faint odor, slight sheen (wet).		
_5	5				Trace coarse sand, faint odor, slight sheen (wet).		
					TD = 5.0 feet		
_6							

Photograph of sample taken? No

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/8/2012 10:30
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE:

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LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800844.20
Easting : 7613466.29

STATION ID : LSI-13

DATE : 10/10/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Roloson
WEATHER : Clear, 60°F

START TIME : 10:30
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			0	SP	Loose brown, fine sand, faint odor, slight sheen (wet).		
_1					Color change to gray.		
_2	4.7		1		Same		
			5		Some fibrous organics (plant matter) 2.5 to 5 feet, faint odor, slight sheen (wet).		
_3							
_4	4.1				Trace silt 3.5 to 4 feet.		
					Wood debris at 4.5 to 5 feet, faint odor, slight sheen, (wet).		
_5			10		TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/10/2012 8:00
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Core collected at water's edge during low tide.

NM - not measured

NA - not applicable.

SIGNATURE:

LSI-13 Hand auger boring sediments 0 to 2.0 feet in depth.

LSI-13 Hand auger boring sediments 2 to 5 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800858.54
Easting : 7613491.80

STATION ID : LSI-14

DATE : 10/11/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Roloson
WEATHER : Overcast, 60°F

START TIME : 8:35
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			30	SP	Loose, brown, fine to medium sand with abundant organics (fine wood chips and fibers), creosote odor and sheen (wet).		
_1	1.8						
			10		Trace silt, gray, faint odor, slight sheen (wet).		
_2							
				SM	Loose, gray, silty fine sand, scattered organics (wood chips), faint odor, slight sheen (wet).		
_3	3.6						
_4			20		Some silt, no odor, no sheen (wet).		
_5	4.5		10		TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/11/2012 8:00
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Boring collected at water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE:

LSI-14 Sheen at surface at boring location.

LSI-14 Hand auger boring sediments 0 to 5 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800867.52
Easting : 7613515.20

STATION ID : LSI-15

DATE : 10/11/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge
WEATHER : Overcast, 60°F

START TIME : 8:05
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 2.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			10	SP	Loose, gray, fine to medium sand with scattered fine wood fibers, creosote odor and sheen (wet).		
_1							
	3.6						
_2			30	SM	Loose, gray, fine sand with some silt, and abundant organics (fine wood debris), cresote odor and sheen (wet).		
					TD = 2 feet		
_3							
_4							
_5							
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/11/2012 8:00
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

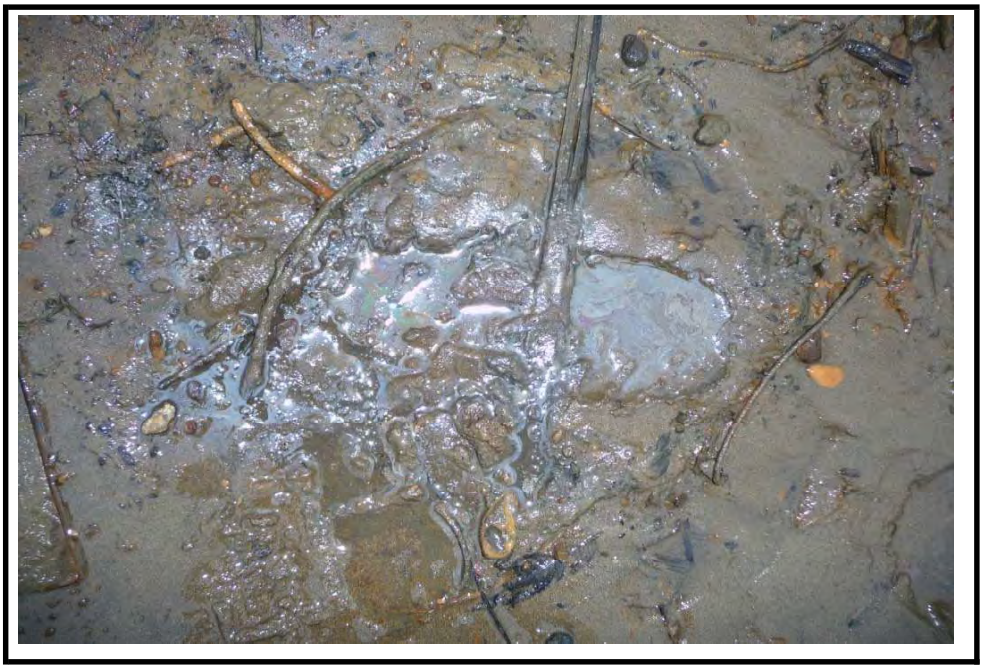
Heavy sheen at surface prior to starting boring.

Boring completed at water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE:



LSI-15 Sheen at surface at boring location.

LSI-15 Hand auger boring sediments 0 to 2 feet in depth. Note heavy sheen.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800875.64
Easting : 7613536.38

STATION ID : LSI-16

DATE : 10/10/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Roloson
WEATHER : Overcast, 60°F

START TIME : 8:30
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			2	SP	Loose, gray, fine sand, trace silt and organics (wood fibers), faint odor, no sheen (wet).		
_1	15						
			0				
_2					Faint odor, slight sheen, 2 to 3 feet (wet).		
	19.4		10	SM	Loose, gray silty fine sand, scattered organics.		
_3				ML	Soft, gray sandy silt, scattered organics, creosote odor and sheen, (wet).		
_4			50		Wood debris layer 4 to 4.5, creosote odor and sheen (wet).		
			5	SP	Loose, gray, fine sand, scattered organics (wood fibers), creosote odor ande sheen (wet).		
_5					TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/10/2012 8:00
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Boring completed at water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE:

LSI-16 Sediment core from 0 to 2 feet.

LSI-16 Hand auger boring sediments 2 to 5 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800913.60
Easting : 7613528.82

STATION ID : LSI-17

DATE : 10/8/2012
SAMPLING METHOD : Hand Auger, shovel
PERSONNEL : J. Fassio, J. Eledge
WEATHER : Clear, 70°F

START TIME : 8:30
DEPTH TO WATER IN BORING : 2.0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface				SP	Loose, brown-gray, fine to medium sand, no odor, no sheen (moist).		
_1							
_2					Becomes saturated at 2 feet.		
_3				SM	Becomes gray with some silt and wood fragments.		
	134				Increase in wood fragments, creosote odor and sheen (wet).		
_4							
	119			SM	Gray fine sand with some silt, creosote odor and sheen (wet).		
_5				ML	Gray sandy silt, faint odor, slight sheen (wet).		
					TD = 5.0 feet		
_6							

Photograph of sample taken? No

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/8/2012 10:30
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE:

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LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800898.93
Easting : 7613569.37

STATION ID : LSI-18

DATE : 10/10/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Roloson
WEATHER : Clear, 65°F

START TIME : 9:30
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			<1	SP	Loose, gray, fine to medium sand, little or no silt, trace organics, no odor, no sheen (wet).		
_1	8.9					LSI-18_8-11	1000
_2	8.8				Same		
_3	8						
			5	SM	Loose, gray, silty fine to medium sand, scattered organics (small wood fibers and chips), no odor, slight sheen (wet).		
_4	7.1				Silt layer about 3-inches thick at 4 feet, faint odor, slight sheen (wet).		
_5	15.4						
					TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : LSI-18_8-11

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 X 1L jars	Y	Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/10/2012 8:00
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Boring completed near water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE:

LSI-18 Sediment core from 0 to 2 feet and 3 to 4 feet.

LSI-18 Hand auger boring sediments 1 to 3 feet and 4 to 5 feet in depth.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800931.43
Easting : 7613571.77

STATION ID : LSI-19

DATE : 10/9/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Johnston
WEATHER : Clear, 75°F

START TIME : 13:30
DEPTH TO WATER IN BORING : 2.0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			0	SP	Loose, brown, fine sand with trace silt, no odor, no sheen (moist).		
_1					Color change to gray at 6-inches, no odor, no sheen (moist).		
			1				
_2					Becomes wet		
_3			1				
_4							
			1		2-inch thick silt layer at 4.5 feet, trace coarse sand 4.5 to 5 feet, no odor, no sheen (wet).		
_5							
					TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

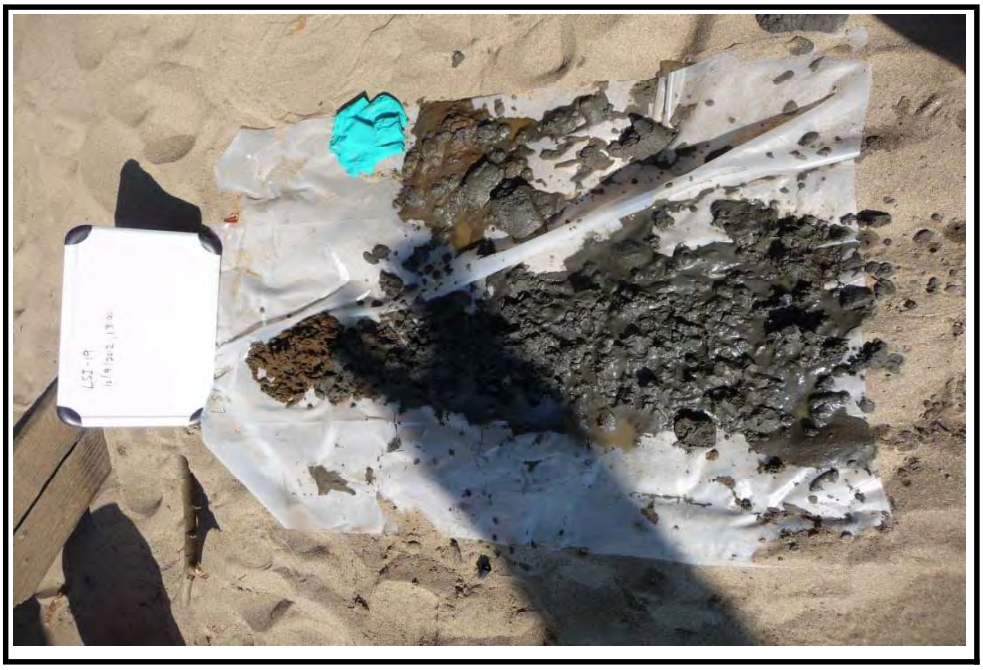
PID CALIBRATION (Date/Time) : Not functioning
PID CALIBRATION STANDARD : NM
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE:



LSI-19 Sediment core from 0 to 5 feet.

LSI-19 Hand auger boring 0 to 5 feet (close-up).

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800908.79
Easting : 7613585.72

STATION ID : LSI-20

DATE : 10/10/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge
WEATHER : Cloudy, 60°F

START TIME : 9:30
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			15	SP	Loose, brown, fine sand with trace silt, abundant organics (plant fibers), no odor, no sheen (wet).		
_1	8.8		5		Scattered organics (small wood chips), no odor, no sheen (wet).	LSI-20_8-11	930
_2	21.6						
_3	6.6				Same with faint odor, slight sheen at 3 feet (wet).		
_4	5						
			20	SP-SM	Loose, brown, fine sand with silt, abundant organics, faint odor, slight sheen (wet).		
_5	5				Decomposed wood at 5 feet, faint odor, slight sheen, (wet).		
					TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : LSI-20_8-11
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 - 1L jars	Y	Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/10/2012 8:00
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Boring completed at water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE:

LSI-20 Sediment core from 0 to 2 feet.

LSI-20 Hand auger boring 1 to 4 feet.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800934.52
Easting : 7613607.41

STATION ID : LSI-21

DATE : 10/11/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Rolson
WEATHER : Cloudy, 60°F

START TIME : 8:45
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 5.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			40	SM	Loose, gray, silty fine to medium sand, abundant organics (wood chips), creosote odor and sheen, metal cable at surface (wet).		
_1	4.6					LSI-21_8-11	920
_2			20		Same, except faint odor, slight sheen (wet)		
_3	7.3		70		Wood debris layer at 2.5 to 3 feet, faint odor, slight sheen (wet).		
_4			20	SM-SP	Grades with less silt, faint odor, slight sheen at 4 to 5 feet (wet).		
_5	7.3						
					TD = 5.0 feet		
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : LSI-21_8-11

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 - 1L jars	Y	Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Archive Samples for potential future analyses				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : 10/11/2012 8:00
PID CALIBRATION STANDARD : 100 ppm isobutylene
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE:

LSI-21 Sediment core from 1 to 2 feet and 4 to 5 feet.

LSI-21 Hand auger boring 2 to 4 feet.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 800971.24
Easting : 7613630.89

STATION ID : LSI-22

DATE : 10/9/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Fassio, J. Eledge, R. Johnston
WEATHER : Partly sunny, 65°F

START TIME : 14:15
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 6.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			10	SP	Loose, brown, fine to medium sand with metal and wood debris, creosote odor and sheen (wet).		
_1			10	SM	Loose, gray, fine to medium sand with some silt, faint odor, slight sheen (wet).		
			30	ML	Soft, dark gray, sandy silt, creosote odor and sheen, 1-mm diameter NAPL blebs within abundant fibrous wood debris (wet).		
_2			20				
_3			5	ML	Medium stiff, gray silt with trace fine sand, scattered wood debris, faint odor, slight sheen (wet).		
				SM	Medium dense, gray silty fine to medium sand with scattered wood fibers, creosote odor and sheen (wet).		
_4			10				
_5			10-15	SM-SP	Gray, medium dense, fine to medium sand with some silt, creosote odor and sheen (wet).		
_6					TD = 6.0 feet		

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : Not functioning
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

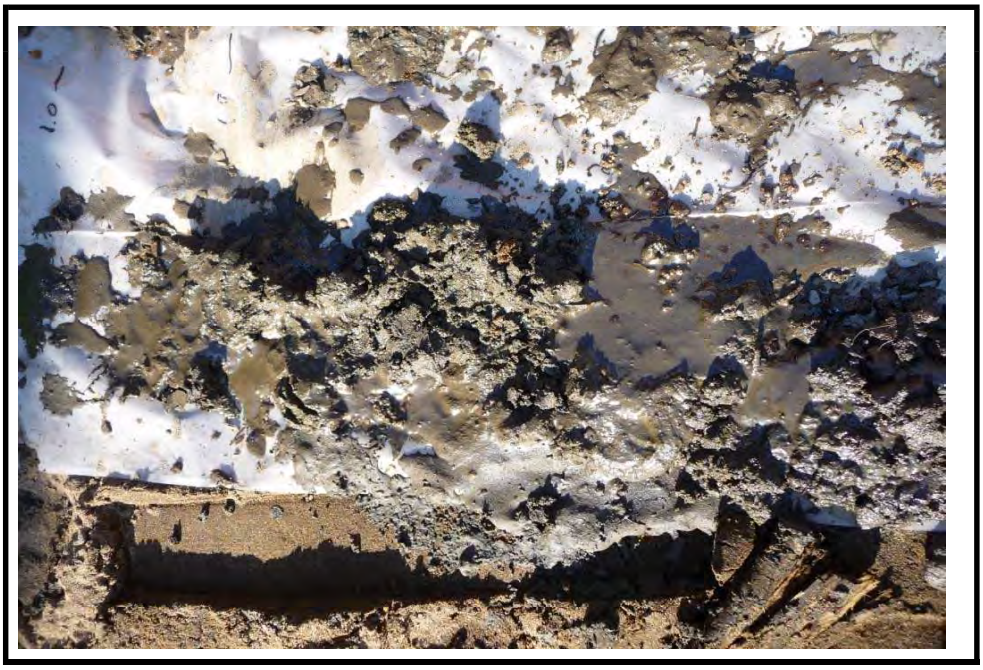
ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE:

LSI-22 Sediment core from 0 to 6 feet.



LSI-22 Sediment core from 5 to 6 feet.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801015.48
Easting : 7613602.50

STATION ID : LSI-23

DATE : 10/9/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Eledge, R. Johnston
WEATHER : Clear, 75°F

START TIME : 14:35
DEPTH TO WATER IN BORING : NA
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 3.2 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface			5		Medium dense, brown, fine to medium sand with some silt and trace organic matter (grass), no odor, no sheen (moist).		
_1					Same		
_2			10		Brown sandy silt with occasional organics, no odor, no sheen (moist).		
_3			45		Wood debris layer (natural wood), no odor, no sheen (moist).		
					End of boring = 3.2 feet (refusal)		
_4							
_5							
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

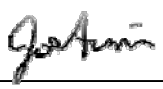
Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : Not functioning
PID CALIBRATION STANDARD : NA
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

NA - not applicable

NM - not measured

SIGNATURE: 

LSI-23 Sediment core from 0 to 3.2 feet.

LSI-23 Sediment core from 2 to 3.2 feet.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801247.10
Easting : 7613964.60

STATION ID : LSI-24

DATE : 10/12/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Eledge, G. Taylor
WEATHER : Rainy, 60°F

START TIME : 9:30
DEPTH TO WATER IN BORING : 0.5 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 3.0 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface				SP	Loose, brown, medium sand to 6-inches depth, no odor, no sheen (moist).		
_1			0	SC	Loose, gray sand with clay to 8-inches, some wood debris, faint odor, slight (moist to wet).	LSI-24_8-11	
_2			<1		Same		
_3			0	CL	Gray clay, no odor, no sheen (wet).		
					End of boring = 3.0 feet		
_4							
_5							
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : LSI-24_8-11
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L jars	Y	Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

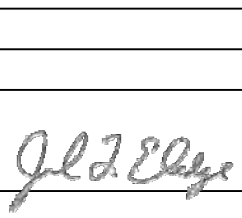
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

PID CALIBRATION (Date/Time) : NM
PID CALIBRATION STANDARD : NM
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS: Boring location is downriver from transfer table at the estimated high tide mark.

NA - not applicable

NM - not measured

SIGNATURE: 

LSI-24 Sediment core from 0 to 3 feet.

LSI-24 Sediment core from 2 to 3 feet.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801233.31
Easting : 7613972.14

STATION ID : LSI-25

DATE : 10/12/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Eledge, G. Taylor
WEATHER : Rainy, 60°F

START TIME : 10:30
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 1.5 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface				SP	Gray-brown, fine to medium sand with wood debris, creosote odor and sheen (wet).		
_1							
				SM	Gray-brown, silty sand with wood debris, creosote odor and sheen (wet).		
_2					End of boring = 1.5 feet (refusal on wood debris)		
_3							
_4							
_5							
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : None

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : NA
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363				
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : NA
Analytical Laboratory : NA
Waste Disposal Location : Onsite IDW Storage Area

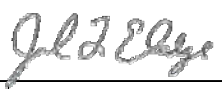
PID CALIBRATION (Date/Time) : NM
PID CALIBRATION STANDARD : NM
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Boring completed at water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE: 

LSI-25 Sediment core location.

LSI-25 Sediment core from 0 to 1.5 feet.

LIMITED SEDIMENT SAMPLING (LSI) INVESTIGATION SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 961M112202.07**

Datum : OR State Plane North Feet, NAD 83
Northing : 801252.42
Easting : 7614022.27

STATION ID : LSI-26

DATE : 10/12/2012
SAMPLING METHOD : Hand Auger
PERSONNEL : J. Eledge, G. Taylor
WEATHER : Rainy, 60°F

START TIME : 11:00
DEPTH TO WATER IN BORING : 0 feet
TARGET PENETRATION DEPTH : 5.0 feet
ACTUAL PENETRATION DEPTH : 1.5 feet

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (feet)	PID (ppm)	ORP (mV)	Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
Surface				SP	Gray-brown, fine to medium sand with trace silt, no odor, no sheen (wet).		
_1				SP	Gray fine sand with trace silt, no odor, no sheen (wet).	LSI-26_8-11	1120
_2					End of boring = 1.5 feet (refusal on rip rap/rock)		
_3							
_4							
_5							
_6							

Photograph of sample taken? YES **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : None
Samples to be Archived : LSI-26_8-11

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : None

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Porewater by ASTM D7363	None	4 x 1L jars	Y	Courier
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : Onsite IDW Storage Area

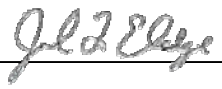
PID CALIBRATION (Date/Time) : NM
PID CALIBRATION STANDARD : NM
ORP METER CALIBRATION (Date/Time) : NM
ORP CALIBRATION STANDARD : NM

ADDITIONAL COMMENTS:

Boring completed at water's edge during low tide.

NA - not applicable

NM - not measured

SIGNATURE: 

LSI-26 Sediment core from 0 to 1.5 feet.

LSI-26 Sediment core from 0 to 1.5 feet (close-up).

2017 Field Forms

Cascadia
Associates, LLC

9615 SW Macadam Ave, Suite 255 | Portland, Oregon 97219 | Office (503) 906.6577 | Fax (503) 906.6567

DAILY FIELD REPORT

Job No.	0034-001-002
W/O No.	
Date of Work:	6/13/2017

Project Name and Address	Client/Owner: Port of St. Helens	Page 1 of 1
	Project Manager: Kurt Harrington	Weather Showers (50s)

Description of Work: Ground water Discharge/Sheen Test Pilot Study

Field Staff: Joel Muttecheck, Ian Maguire, Kurt Harrington

Report: Arrive onsite. Mutt w/ Solmar Hydro onsite w/ boat in Cove. Begin to load and setup equipment

930 Kurt onsite. Proceed to channel side of islands to test equipment

1000 Madi & Herring (DEQ) onsite. Return to Shore. Proceed to first location GWPS-1. Setup. location is inside cove area, close to shore. Very little flow achieved, trace sheen. Screen clogged w/ fine sediment

1110 MOB to location GWPS-2. Limit Flow observed. Similar temps btwn purged & surface water.

1130 FET onsite w/ YSI

1200 Pickup YSI, proceed to 3rd location, ~~off from Stilling well~~ inside Cove. GWPS-3. Place Temp probe in sampler initially. Sampler clogged.

1330 Setup at GWPS-3. Very low flow achieved w/ Sampler. Approx. 3°C temp difference observed btwn when temp probe installed in ~~tubing~~ tooling & when placed in weighted bracket and placed ~1' above mud surface.

1530 Return to Shore.

Site Status:

Drum Inventory:

Sr. Tech Hours: prep: job: travel:	Total Mileage
Sr. Tech Hours: prep: job: travel:	Truck Car

Report By: Copy Given To:

Cascadia
Associates, LLC

6915 SW Macadam Ave, Suite 250 | Portland, Oregon 97219 | Office (503) 906.6577 | Fax (503) 906.6567

Job No. 0034-001-002
Report By: I. Maguire
Date of Work: 6/14/2017

DAILY FIELD REPORT

Project Name and Address	Client/Owner: Port of St. Helens	Page 1 of 2
	Project Manager: Kurt Harrington	Weather: overcast. 60's

Description of Work: Pilot Study

Field Staff: Joel M/Ian M.

Report: Arrive onsite at 915, Matt w/ Salmar onsite. Begin to load boat
940 MOB to location GWPS-5 in Cove, Setup. Place Screen Sleeve on Sampler as recommended by Mark Henry (Manufacturer).
- Screen & Sleeve clogged after approx. 0.5h. Remove Sleeve, clean Screen in water, re-install, Clogged.
- Install porous air stone. Air stone clogged w/ fine Sediment
1100 MOB to GWPS-6. Screen Sleeve clogged quickly, removed and re-installed. Low-Flow achieved.
1215 MOB to GWPS-7, adjacent to Stilling well. Set up. Unable to get consistent flow from Sampler, w/ or w/o Sleeve. tried air stone → No Flow, Clogged.
1315 MOB to GWPS-8 → No Flow achieved.
1410 MOB to GWPS-9. Low Flow (consistent) observed, uncertain if Pore water or Surface water breakthrough. advanced Sampler ~12" Clogged. Unable achieve flow. Pull Sampler.

Site Status:

Drum Inventory:

Time of Arrival On-Site:	Total Mileage
Time of Departure from Site:	Truck Car

Attachments:

Cascadia
Associates, LLC

6915 SW Macadam Ave, Suite 250 | Portland, Oregon 97219 | Office (503) 906.6577 | Fax (503) 906.6567

Job No. 0034-001-002
Report By: I. Magaire
Date of Work: 6/14/2017

DAILY FIELD REPORT

Project Name and Address

Client/Owner: Port of St. Helens

Page 2 of 2

Project Manager: Kurt Harrington

Weather: overcast 60's

Description of Work: Pilot Study

Field Staff: Joel M & Ian M.

Report:

~~MOB~~

1500 MOB to location GWPS-10, adjacent to former dock-table pilings, close to shore.
Low flow (consistent) achieved. Similar to location GWPS-9. Slight temp difference (~1°C) observed when temp probe installed in sampler and placed ~1' above mudline. Flow cell temp (purged water) similar to the temperature probe placed ~1' above mudline & YSI Probe placed ~7' ~~below~~ below water surface.

1400 ~~1430~~ Download transducer data Stilling well
MOB to shore, unload, download MW-25 ~~SPL~~ transducer data

1430 Cascadia offsite. Secure gates

Site Status:

Drum Inventory:

Time of Arrival On-Site:

Total Mileage

Time of Departure from Site:

Truck Car

Attachments:

Pore Water Monitoring Sheet

Location ID: GWPS-1

Date: 6/13/2017 Time: 1015

Water Depth: 8.9'

Target/Actual Sediment Penetration: 8 to 12"

Purge Method: Peristaltic Pump.

Static Head Test: NM

Project: Port of St. Helens

Sampler: Joel M./Ian M.

Sediment Thickness:

Soft Sed Depth: 8.9'

Stiff Sed Depth 9.2'

Thickness 0.3

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
		NO Flow		achieved		

Notes: No Sheen observed from sediment poling

No flow achieved from pore water.

Pore Water Monitoring Sheet

Location ID: ~~2~~ GWPS-2

Date: 6/13/2017 Time: 1110

Water Depth: 11.3

Target/Actual Sediment Penetration: 10"

Purge Method: Peristaltic Pump

Static Head Test: NM

Project: Port of St. Helens

Sampler: Joel M. / Ian. Maguire

Sediment Thickness:

11.3' Top of mudline

11.7 Bottom of mud line

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
1138	0.2	16.6		493	6.7	
1142	0.2	16.8		491	6.4	~~Pro temp~~ Henry probe: 17.6°C
1145	0.2	17.0		492	6.8	17.7°C
1148	0.2	17.1		497	6.2	17.7°C
Surface	water	(1' off	mudline)			
1155		17.0		125	7.0	~~Temp~~ Henry probe: 17.7°C
1157		17.3		105	7.0	17.7°C
1158		17.4		98	7.1	17.7°C

Notes:

- NO Screen w/ disc or point
- Parameters measured w/ Stick probe
- limit flow achieved, Sampler Screens Clogging

Photo 1 (top) GWPS-2 Screenshot	June 2017 Pilot Study
	Port of St. Helens
	St. Helens, Oregon
Photo 2 (bottom) GWPS-2 Screenshot	0034-001-002
	Cascadia Associates, LLC

Pore Water Monitoring Sheet

GWPS-3

Location ID: ~~3~~ inside cove by island

Project: Port of St. Helens

Date: 6/13/2017 Time: 1210

Sampler: Joel M/Ian M.

Water Depth: 9.6' /10.2 to bottom

Sediment Thickness: ~~10.2~~ 0.6'

Target/Actual Sediment Penetration: 8" initial depth

Purge Method: Peristaltic

Static Head Test: NM - No flow

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
Initial	Temp (sensor in rod)					
	1237	13.2				
	1299	13.2				
	1241	13.2				
1300		16.41	1.40	270 0.27	6.65	Henry Probe 16.9
	Loss of flow. Trouble		Quit, Call Mark			Henry.
	Pull tubing	down	tubing			

Notes:

No Sheen w/ disc or Point

Difficulty w/ Sampler, Remove & Clean Screen, Push deeper, Change fitting to install tubing down rod

Screen clogged w/ fine silt sediment

Call M. Henry → Suggested using Sleeve screen, tubing down rod, etc.

Photo 1 (top) GWPS-3 Screenshot	June 2017 Pilot Study
	Port of St. Helens
	St. Helens, Oregon
Photo 2 (bottom) GWPS-3 Screenshot	0034-001-002
	Cascadia Associates, LLC

Pore Water Monitoring Sheet

Location ID: ~~4~~ GWPS-4

Project: Port of St. Helens

Date: 6/13/2017 Time: 1330

Sampler: Joel M / Ian M

Water Depth: 15.7 / 15.9

Sediment Thickness: 0.2

Target/Actual Sediment Penetration: 8-12"

Purge Method: Peristaltic Pump

Static Head Test: NM

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
Initial	Pore water Sample temp:					
2:07		16.0				
2:10		14.4				
~~2:12~~ 2:11		14.4				
Porewater Discharge monitor						~~Henry Probe~~ in River
2:26						17.9°C (after ~10 min)
2:30	FC filling	18.20	NM*	~~0.481~~ 481	6.31	17.9°C
2:33	FC filling	18.20	1.89*	~~0.504~~ 504	6.31	17.9°C
2:36	FC filling	18.22	1.56	505	6.33	17.9°C
FLOW 2:47	0.14	18.13	1.51	610	6.33	17.9°C
2:50	0.16	17.65	1.69	656	6.33	18.0°C
2:54		17.08	1.73	693	6.35	18.1°C
Surface	water Parameters,			Probe 1 used		15:01
1504	—	17.73	7.90	74	7.20	
1506	—	17.73	7.60	75	7.19	

Notes:

No Sheen

Slow pumping from porewater

* flow cell not full, reading not accurate

attempted static head test. Unable to get a full water column to perform head test, air bubbles rising in tubing

Photo 1 (top) GWPS-4 Screenshot	June 2017 Pilot Study Port of St. Helens St. Helens, Oregon
Photo 2 (bottom) GWPS-4 Screenshot	0034-001-002 Cascadia Associates, LLC

Pore Water Monitoring Sheet

Location ID: GWPS-5

Project: Port of St. Helens

Date: 6/14/17 Time: 940

Sampler: Joel M/Ian M

Water Depth:

Sediment Thickness: 0.6'

Target/Actual Sediment Penetration: 12"

Purge Method: 8.4'/Push to 9.0'

Static Head Test:

NM

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
1000		14.6				Probe in sampler
1003		14.4				"
1006		14.3				" ; Remove temp probe, place in River
Setup	Pump	begin pumping		1020		
1031						River Probe: 16.8°C
1039						16.1°C
1044	Flowcell	only 1/2 full, switch to airstone				16.8°C
1052	airstone	clogged				16.8°C

Notes:

8.4' (Depth to Mudline)

9.0' (push through past mudline)

No Stream observed

Place Sleeve on Sampler before installing. No Flow. Reverse to clean screen No flow Remove flow, ~~on~~ Sampler Clogged attempt to use air stone. Purged approx 100 mL before Stone Clogged.

Photo 1 (top) GWPS-5 Screenshot	June 2017 Pilot Study Port of St. Helens St. Helens, Oregon
Photo 2 (bottom) GWPS-5 Screenshot	0034-001-002 Cascadia Associates, LLC

Pore Water Monitoring Sheet

Location ID: GWPS-6

Project: Port of St. Helens

Date: 6/14/2017 Time: 1100

Sampler: Joel M/Ian M

Water Depth: 10.1 / Push to 10.5

Sediment Thickness: 0.4'

Target/Actual Sediment Penetration: 8"

Purge Method: Peristaltic Pump

Static Head Test: 2" below River surface

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
1110						T-Probe in Sampler: 15.1°C
1113						14.8°C
1116						14.8°C
1120	Hook up tubing,	begin Pumping				T-Probe in River: 16.7°C
1127	no flow, tight Sediment (fine silt) around Screen,					Remove Screen 16.7°C
1135	~~1~~ 0.12 ~~2~~	18.44	0.60	412	6.67	16.7°C
1138		17.25	0.89	457	6.69	16.7°C
1141		17.11	0.70	425	6.73	16.7°C
1144		16.94	0.67	405	6.74	16.7°C
1147		~~17.00~~ 17.10	0.54	395	6.74	16.7°C
1150		17.72	0.52	373	6.76	16.7°C
1154		17.15	6.86	82	7.18	16.6
1202		16.98	8.89	75	7.19	16.7°C
1205		17.06	9.16	75	7.23	16.7°C
1211		16.34	8.33	74	7.39	16.7°C

all Samples 4 above Manifold

1st in River - 5 min

Notes:

No sheen observed

Low flow achieved w/ Sampler

Photo 1 (top) GWPS-6 Screenshot	June 2017 Pilot Study Port of St. Helens St. Helens, Oregon
Photo 2 (bottom) GWPS-6 Screenshot	0034-001-002 Cascadia Associates, LLC

Pore Water Monitoring Sheet

Location ID: GWPS-7

Project: Port of St. Helens

Date: 6/14/2017 Time: 1215

Sampler: Joel M/Ian M.

Water Depth: 8.8, Mudline: 9.1

Sediment Thickness: 0.3'

Target/Actual Sediment Penetration: 8"

Purge Method: Peristaltic Pump

Static Head Test: NM

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
Temp Probe in tubing					@	Initial: 15.8 @ 1215 5 minutes: 15.7 1220
1251						Temp Probe in River 16.7°C
1305						16.7°C

Notes:

Sunday Conditions. No Sheen. Hook up pump w/ tubing down tooling. Sleeve on. pump ~10 min w/o sock, Screen Clogged, Recover, clean screen and put ~~on sock~~ Sleeve on. Screen Clogged → Remove Sleeve. Reinstalled after cleaning. Tried air stone. Initially worked better than Simple. Became clogged before flowcell full. Air stone stuck in sediment, pulled off tubing

Photo 1 (top) GWPS-7 Screenshot	June 2017 Pilot Study Port of St. Helens St. Helens, Oregon
Photo 2 (bottom) GWPS-7 Screenshot	0034-001-002 Cascadia Associates, LLC

Pore Water Monitoring Sheet

Location ID: GWPS-8
Date: 6/14/2017 Time: 1315
Water Depth: 11.8' 12.2 to bottom Mudline
Target/Actual Sediment Penetration: 10"
Purge Method: Peristaltic Pump
Static Head Test: NM

Project: Port of St. Helens
Sampler: Joel M / Ian M
Sediment Thickness: 0.4'

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
Temp Probe in tooling:						Initial: 18.1 After 5 min: 18.7 @1335
1355						Temp probe in River: 16.7C
Surface Water Parameters						
1400		16.32	8.42	74	7.31	16.7C
1405		17.21	7.95	74	7.28	16.8C
~~1410~~						

Notes: No Sheen observed
Video: Setup Sampler w/ out Screen Sock → Sampler Clogged no flow.
Install screen sleeve → ~~Sock~~ Sleeve Clogged, less than 100mL purged. Remove Sampler → Install 1" air stone
Air Stone clogged → No flow

Photo 1 (top) GWPS-8 Screenshot	June 2017 Pilot Study Port of St. Helens St. Helens, Oregon
Photo 2 (bottom) GWPS-8 Screenshot	0034-001-002 Cascadia Associates, LLC

Pore Water Monitoring Sheet

Location ID: GWPS-9

Date: 6/14/17 Time: 1410

Water Depth: 10.8' Push to 11.1'

Target/Actual Sediment Penetration: 10"

Purge Method: ~~10 ft~~ Peristaltic Pump

Static Head Test: NM

Project: Port of St. Helens

Sampler: Joel M / Ian M.

Sediment Thickness: 0.3'

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
Temp Probe in toolstr						Initial 14:21 : 15.8°C after 5 min (1426) 15.3°C
1432	0.14	17.20	4.56	618	6.33	Temp Probe: 17.1
1435		17.16	1.45	643	6.32	17.3
1438		17.14	1.30	656	6.32	17.4
1441		17.13	2.10	667	6.32	17.0
	lowered Probe ~12 inches					
Sampler clogged, pull Sampler						
Place Parameter Probe in surface water						
1449		17.15	7.40	74	7.26	17.4
1454		16.89	8.00	74	7.20	17.2

Notes:

No Sheen; F.t Sampler w/ screen ~~Stick~~ Sleeve Install into sediment. Water ran tooling under pressure

Photo 1 (top) GWPS-9 Screenshot	June 2017 Pilot Study Port of St. Helens St. Helens, Oregon
Photo 2 (bottom) GWPS-9 Screenshot	0034-001-002 Cascadia Associates, LLC

Pore Water Monitoring Sheet

Location ID: GWPS-10
Project: Port of St. Helens
Date:
Time: ~~1458~~ 1500
Sampler: Joel M / Ian M
Water Depth: 8.5' / Push to 8.6
Sediment Thickness: 0.1'
Target/Actual Sediment Penetration: 8"
Purge Method: Peristaltic Pump
Static Head Test: NM

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	Notes:
Temp Probe in tooling:					1508 – 1513 –	Initial: 17.8°C after 5 min: 16.9°C
					1515	16.7°C
Purging Pore water w/ Sampler						
1521	0.18	17.72	4.01	412	6.32	Probe in surface water: 18.0°C
1524		17.68	1.27	431	6.36	17.9°C
1527		17.70	0.93	436	6.37	17.6°C
1530		17.70	1.31	439	6.38	18.0°C
1533		17.75	1.50	456	6.37	ORP -119.8 18.1°C
1536		17.82	1.53	457	6.38	-121.1 17.8°C
lower ~~flowcell~~ probes into surface water						
	observe slight odor on multiparameter probes					
1540		17.29	7.75	74	7.27	-66.5 17.9°C
1547		17.24	7.50	75	7.19	-26.5 18.1°C
1552		17.19	7.10	75	7.2	-4.0 17.8°C
~~No Sheen~~ see below						

Notes:

Sediment feels Sandy when Poling
Video ✓, Poling ✓, install Screen sock
Good flow, continuous

Sheen Test: Poling w/ Spike end at rod. Slight Sheen observed at surface. Stick test → Coalesced after disturbance
Jar Test → Couldn't observe Sheen.

Photo 1 (top) GWPS-10 Screenshot	June 2017 Pilot Study Port of St. Helens St. Helens, Oregon
Photo 2 (bottom) GWPS-10 Screenshot	0034-001-002 Cascadia Associates, LLC

Pore Water Monitoring Sheet

Location ID: MW-25

Date: 6/15/2017 Time: 1030

Water Depth: 6.52 btc

Target/Actual Sediment Penetration: NA

Purge Method: Peristaltic

Static Head Test: NA

Project: Port of St. Helens

Sampler: Ian M / Kurt H.

Sediment Thickness: — NA

Time:	Purge Rate (LPM):	Temp. °C:	DO (mg/L):	Cond (µs/cm):	pH:	ORP	Notes: DTW
1156	0.18 ~~7.69~~	13.35	5.36	822	6.60	-109.5	7.64
1159		13.26	3.40	817	6.68	-122.9	8.06
1202		13.24	2.85	813	6.70	-125.5	8.52
1205		13.25	2.60	810	6.73	-129.0	9.05

Notes:

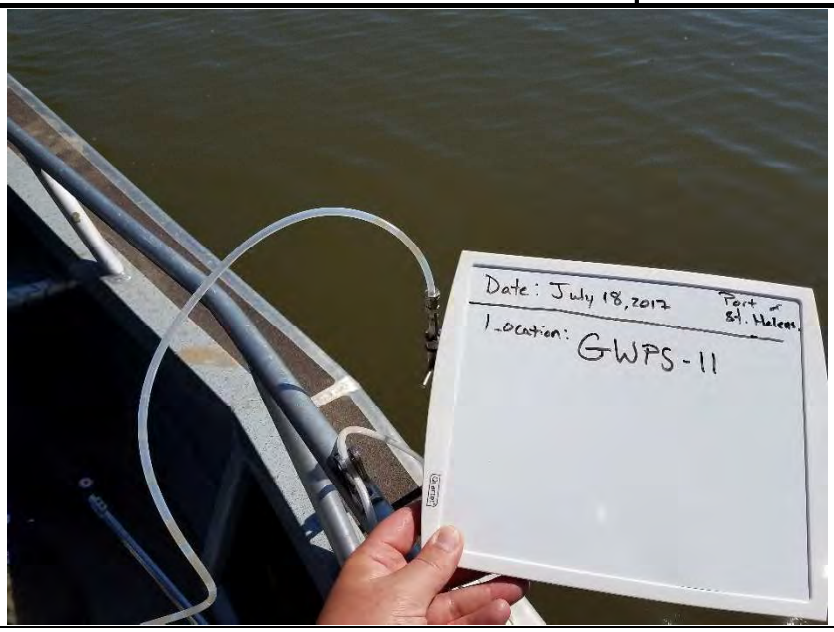
1070 open well Remove leave transducer in well

DTW: 6.52 BTC

: 6.95' BTC @ pumping

12/12 - Place Transducer in well & close up

Location ID: GWS-11	Date: 7/18/2017



Location Notes: Slight sheen observed when poling, re-coalesced when disturbed. Creosote odor observed. Wood debris observed.

Pore-space water temperature (°F): 61.9
Surface water temperature (°F): 71.8

Depth to top of mudline: 3.1 feet
Depth to bottom of mudline: 3.4 feet
Mudline Thickness: 0.3 feet

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0034-001-002

Cascadia Associates, LLC

Location ID: GWS-12	Date: 7/18/2017

Location Notes: Moderate sheen observed when poling, re-coalesced when disturbed. Wood debris observed.

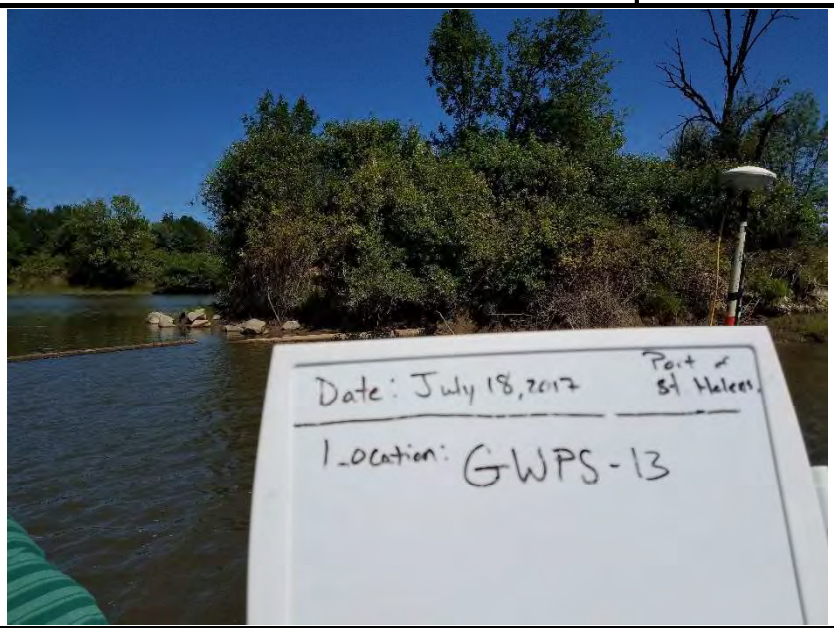
Pore-space water temperature (°F): 64.6
Surface water temperature (°F): 72.9

Depth to top of mudline: 3.2 feet
Depth to bottom of mudline: 3.3 feet
Mudline Thickness: 0.1 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-13	Date: 7/18/2017



Location Notes: Moderate sheen observed when poling, re-coalesced when disturbed. No odor. Some wood debris observed.

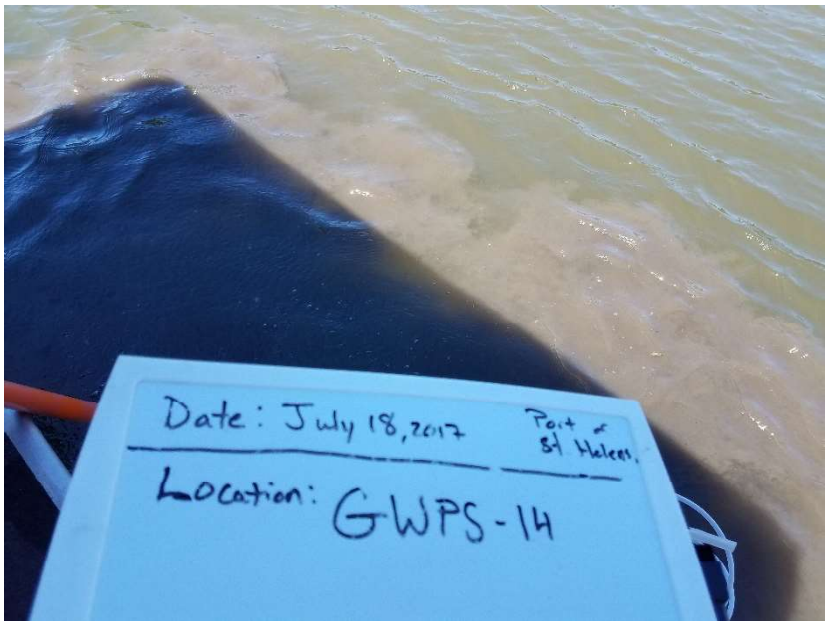
Pore-space water temperature (°F): 64.4
Surface water temperature (°F): 73.0

Depth to top of mudline: 4.6 feet
Depth to bottom of mudline: 4.8 feet
Mudline Thickness: 0.2 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-14	Date: 7/18/2017



Location Notes: No Sheen. Very slight biogenic sheen (stringy sheen, less than 2-inches observed, did not recoalesce).

Pore-space water temperature (°F): 64.9
Surface water temperature (°F): 72.9

Depth to top of mudline: 4.9 feet
Depth to bottom of mudline: 5.3 feet
Mudline Thickness: 0.4 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-15	Date: 7/18/2017

Location Notes: Slight sheen observed when poling, did not re-coalesce when disturbed and seemed to be biogenic. Wood debris observed.

Pore-space water temperature (°F): 64.0
Surface water temperature (°F): 72.9

Depth to top of mudline: 4.2 feet
Depth to bottom of mudline: 4.3 feet
Mudline Thickness: 0.1 feet

Offshore Data Gap Investigation
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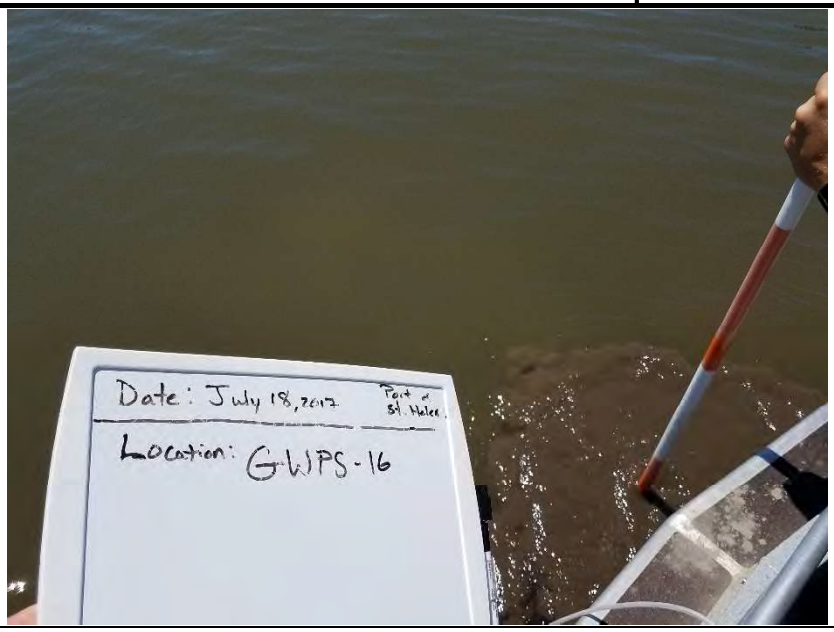
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-16	Date: 7/18/2017



Location Notes: Slight to moderate biogenic sheen observed when poling. Did not re-coalesce when disturbed. Pore-space water temperature (°F): 63.9 Surface water temperature (°F): 72.5 Depth to top of mudline: 4.2 feet Depth to bottom of mudline: 4.9 feet Mudline Thickness: 0.7 feet	Offshore Data Gap Investigation Port of St. Helens St. Helens, Oregon 0034-001-002 Cascadia Associates, LLC

Location ID: GWS-17	Date: 7/18/2017

No Picture Taken

Location Notes: Biogenic sheen observed, no creosote sheen from poling.

Pore-space water temperature (°F): 63.7
Surface water temperature (°F): 72.1

Depth to top of mudline: 3.7 feet
Depth to bottom of mudline: 4.2 feet
Mudline Thickness: 0.5 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-18	Date: 7/18/2017

No Picture Taken

Location Notes: No sheen from poling observed

Pore-space water temperature (°F): 66.0
Surface water temperature (°F): 73.6

Depth to top of mudline: 2.6 feet
Depth to bottom of mudline: 2.6 feet
Mudline Thickness: 0.0 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-19	Date: 7/18/2017

No Picture Taken

Location Notes: No sheen observed from poling.

Pore-space water temperature (°F): 66.2
Surface water temperature (°F): 73.8

Depth to top of mudline: 2.3 feet
Depth to bottom of mudline: 2.3 feet
Mudline Thickness: 0.0 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-20	Date: 7/18/2017

Location Notes: Heavy creosote-related sheen observed from poling at multiple locations

Pore-space water temperature (°F): 65.1
Surface water temperature (°F): 70.9

Depth to top of mudline: 10.0 feet
Depth to bottom of mudline: 11.0 feet
Mudline Thickness: 1.0 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-21	Date: 7/18/2017

No Picture Taken

Location Notes: Moderate creosote-related sheen observed from poling at multiple locations/widespread. Recoalesce after being disturbed.

Pore-space water temperature (°F): 65.1
Surface water temperature (°F): 70.9

Depth to top of mudline: 10.0 feet
Depth to bottom of mudline: 11.0 feet
Mudline Thickness: 1.0 feet

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St. Helens, Oregon
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Cascadia Associates, LLC

Location ID: GWS-22	Date: 7/18/2017

No Picture Taken

Location Notes: No sheen observed from poling at multiple locations.

Pore-space water temperature (°F): 70.5
Surface water temperature (°F): 72.5

Depth to top of mudline: 13.5 feet
Depth to bottom of mudline: 13.7 feet
Mudline Thickness: 0.2 feet

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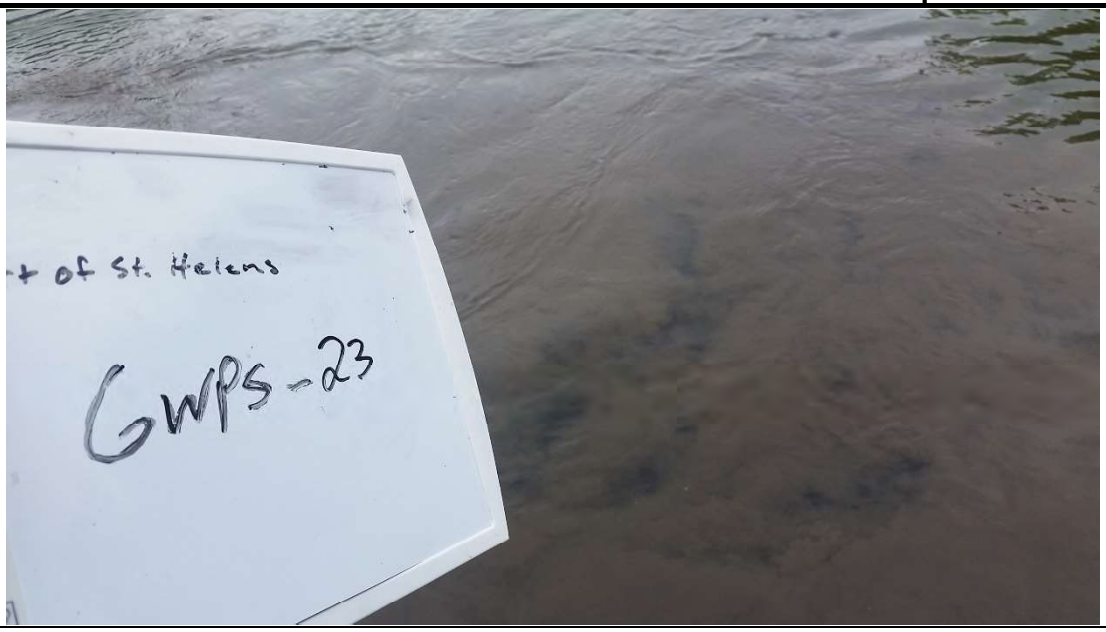
Location ID: GWS-23	Date: 7/18/2017



Location Notes: No sheen observed from poling at multiple locations.

Pore-space water temperature (°F): 63.9
Surface water temperature (°F): 71.6

Depth to top of mudline: 2.4 feet
Depth to bottom of mudline: 2.8 feet
Mudline Thickness: 0.4 feet

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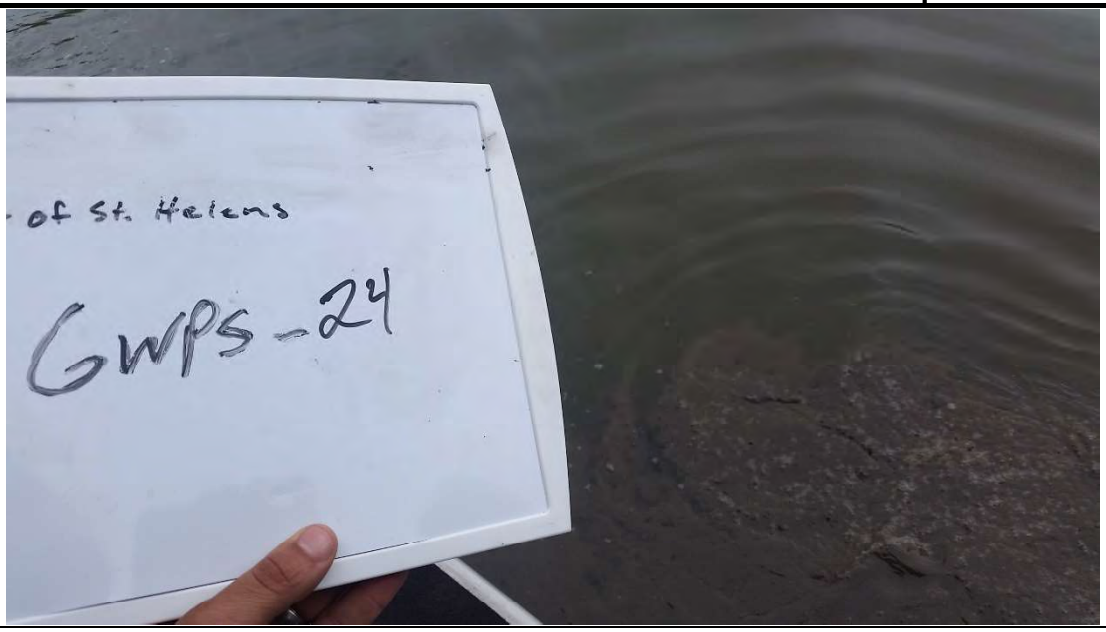
Cascadia Associates, LLC

Location ID: GWS-24	Date: 7/18/2017



Location Notes: No sheen observed from poling at multiple locations.

Pore-space water temperature (°F): 64.0
Surface water temperature (°F): 71.8

Depth to top of mudline: 1.4 feet
Depth to bottom of mudline: 1.9 feet
Mudline Thickness: 0.5 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-25	Date: 7/18/2017

No Picture Taken

Location Notes: No sheen observed from poling at multiple locations.

Pore-space water temperature (°F): 61.0
Surface water temperature (°F): 71.8

Depth to top of mudline: 3.2 feet
Depth to bottom of mudline: 3.7 feet
Mudline Thickness: 0.5 feet

Offshore Data Gap Investigation
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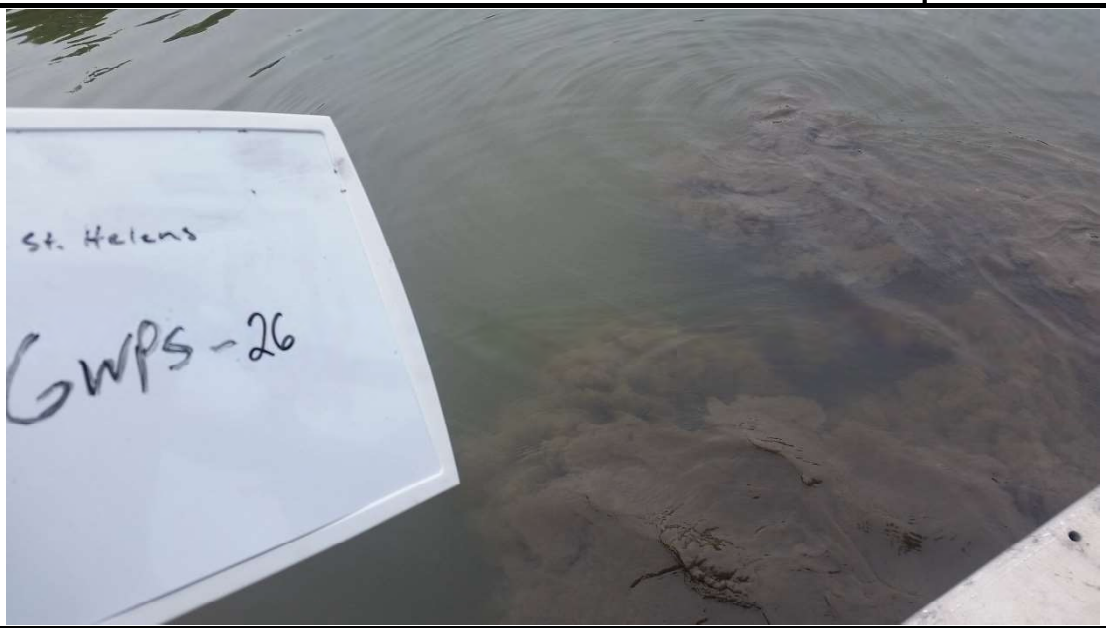
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-26	Date: 7/18/2017



Location Notes: No sheen observed from poling at multiple locations.

Pore-space water temperature (°F): 63.7
Surface water temperature (°F): 72.9

Depth to top of mudline: 1.1 feet
Depth to bottom of mudline: 1.5 feet
Mudline Thickness: 0.4 feet

Offshore Data Gap Investigation
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St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-27	Date: 7/18/2017

Location Notes: No sheen observed from poling at multiple locations.

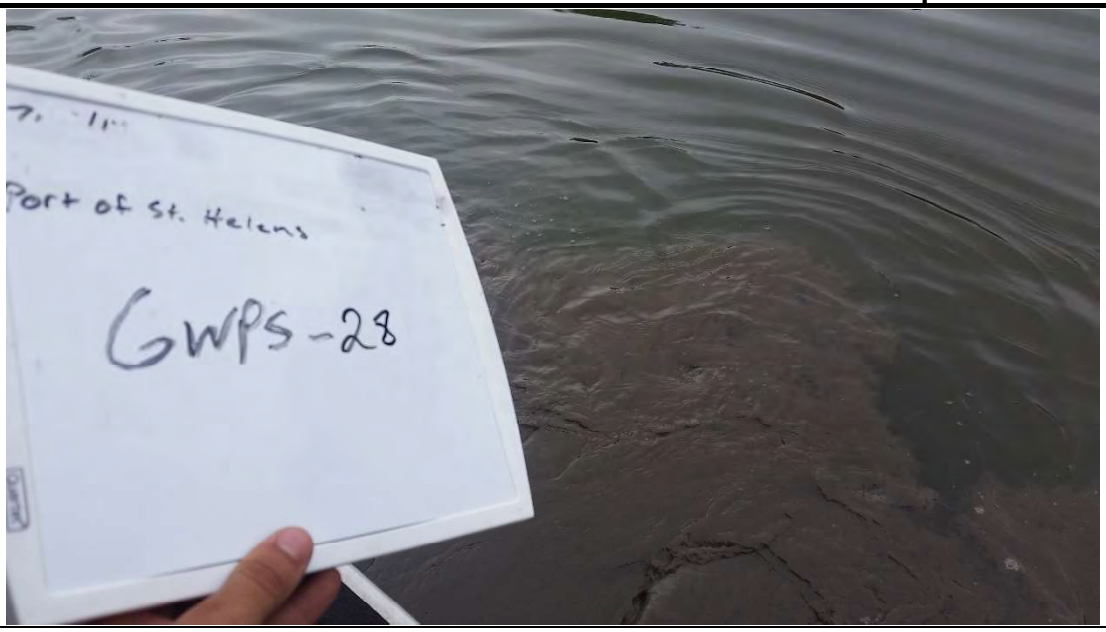
Pore-space water temperature (°F): 60.0
Surface water temperature (°F): 72.0

Depth to top of mudline: 2.1 feet
Depth to bottom of mudline: 2.5 feet
Mudline Thickness: 0.4 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-28	Date: 7/18/2017



Location Notes: No sheen observed from poling at multiple locations.

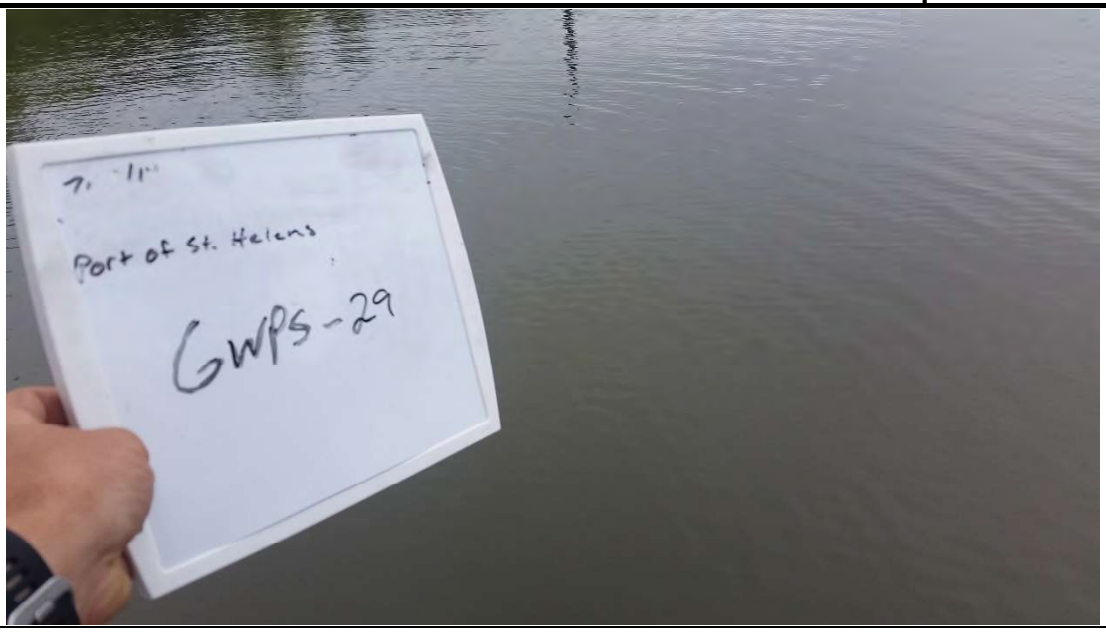
Pore-space water temperature (°F): 63.5
Surface water temperature (°F): 74.3

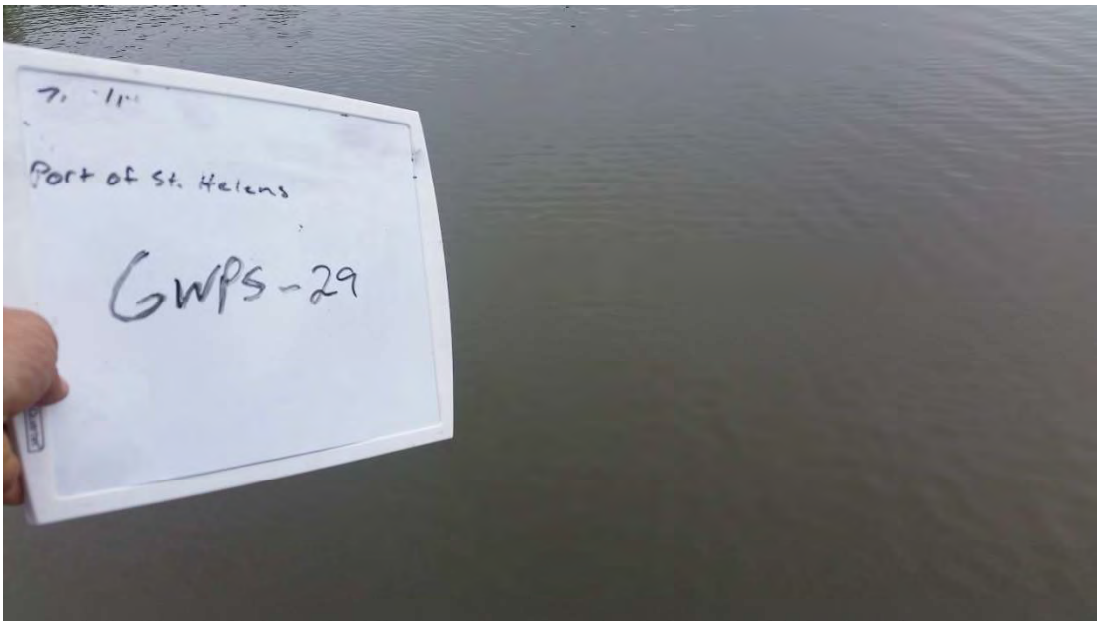
Depth to top of mudline: 1.4 feet
Depth to bottom of mudline: 2.0 feet
Mudline Thickness: 0.6 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-29	Date: 7/18/2017





Location Notes: No sheen observed from poling at multiple locations.

Pore-space water temperature (°F): 63.5
Surface water temperature (°F): 72.3

Depth to top of mudline: 2.3 feet
Depth to bottom of mudline: 3.3 feet
Mudline Thickness: 1.0 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
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Cascadia Associates, LLC

Location ID: GWS-30	Date: 7/19/2017

No Picture Taken

Location Notes: No sheen observed from poling at multiple locations.

Pore-space water temperature (°F): 61.9
Surface water temperature (°F): 71.8

Depth to top of mudline: 5.3 feet
Depth to bottom of mudline: 6.0 feet
Mudline Thickness: 0.7 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-31	Date: 7/19/2017

No picture taken

Location Notes: No sheen observed from poling at multiple locations.

Pore-space water temperature (°F): 60.6
Surface water temperature (°F): 70.9

Depth to top of mudline: 19.7 feet
Depth to bottom of mudline: 20.0 feet
Mudline Thickness: 0.3 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-32	Date: 7/19/2017

No Picture Taken

Location Notes: No sheen observed from poling at multiple locations.

Pore-space water temperature (°F): 66.6
Surface water temperature (°F): 72.5

Depth to top of mudline: 11.2 feet
Depth to bottom of mudline: 11.3 feet
Mudline Thickness: 0.1 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-33	Date: 7/19/2017

Location Notes: No sheen observed from poling at multiple locations. Location sandier than others.

Pore-space water temperature (°F): 69.3
Surface water temperature (°F): 72.9

Depth to top of mudline: 5.0 feet
Depth to bottom of mudline: 5.1 feet
Mudline Thickness: 0.1 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-34	Date: 7/19/2017

Location Notes: Heavy creosote-related sheen observed during poling. Sheen isolated to 7' off piles. No sheen observed towards channel.

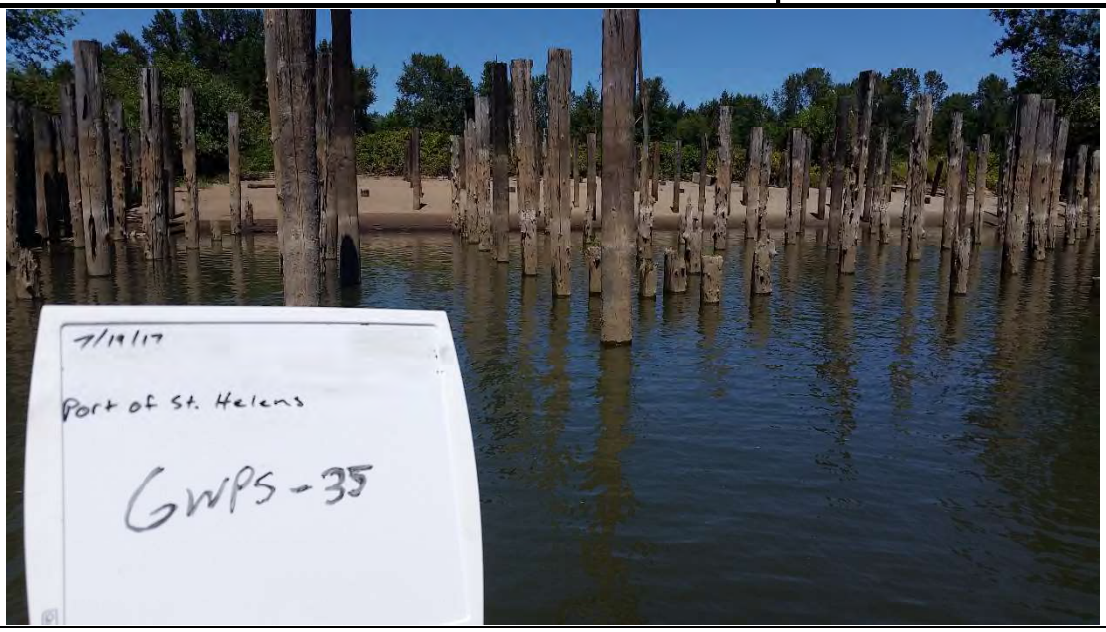
Pore-space water temperature (°F): 69.2
Surface water temperature (°F): 73.0

Depth to top of mudline: 8.7 feet
Depth to bottom of mudline: 9.0 feet
Mudline Thickness: 0.3 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-35	Date: 7/19/2017



Location Notes: No sheen observed from poling at multiple locations. Approximately 8, off piles. Wood debris present.

Pore-space water temperature (°F): 64.2
Surface water temperature (°F): 73.2

Depth to top of mudline: 7.8 feet
Depth to bottom of mudline: 8.0 feet
Mudline Thickness: 0.2 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
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Cascadia Associates, LLC

Location ID: GWS-36	Date: 7/19/2017

Location Notes: Moderate creosote-related sheen observed at some poling locations, not all. Approximately 4' off piles. Wood debris

Pore-space water temperature (°F): 63.0
Surface water temperature (°F): 72.7

Depth to top of mudline: 4.8 feet
Depth to bottom of mudline: 5.0 feet
Mudline Thickness: 0.2 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-37	Date: 7/19/2017

Location Notes: Intermittent slight to moderate creosote-related sheen located 0 to 7' off piles. Wood debris present.

Pore-space water temperature (°F): 64.7
Surface water temperature (°F): 73.6

Depth to top of mudline: 3.5 feet
Depth to bottom of mudline: 3.8 feet
Mudline Thickness: 0.3 feet

Offshore Data Gap Investigation
Port of St. Helens
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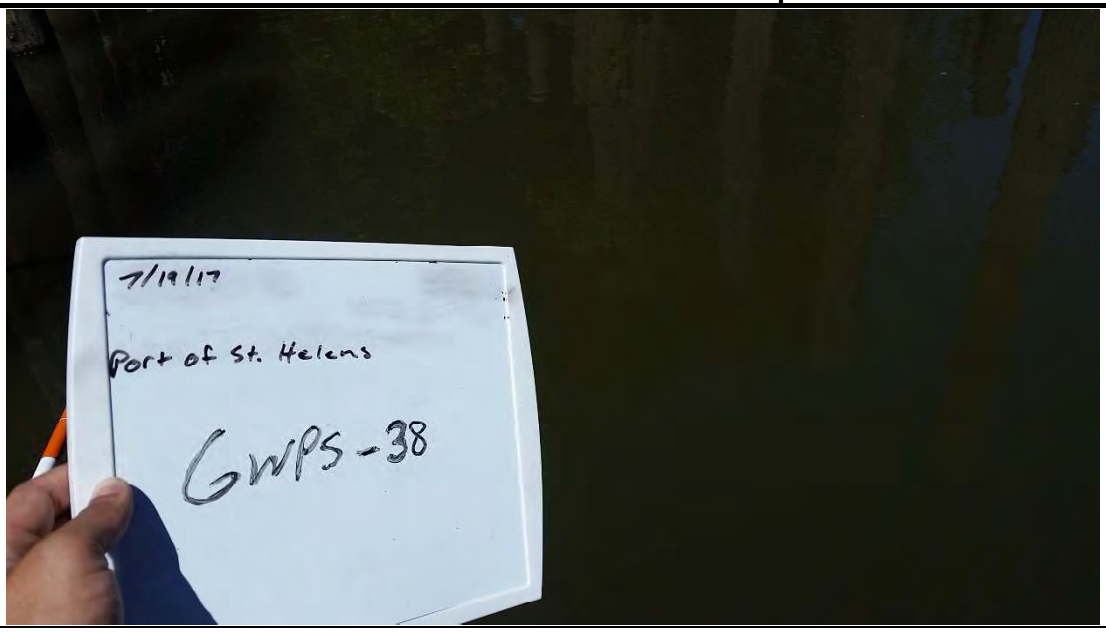
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-38	Date: 7/19/2017



Location Notes: Slight biogenic sheen observed at locations 0 to 4' off piles. Wood debris present.

Pore-space water temperature (°F): 66.6
Surface water temperature (°F): 73.0

Depth to top of mudline: 3.1 feet
Depth to bottom of mudline: 3.2 feet
Mudline Thickness: 0.1 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-39	Date: 7/19/2017

Location Notes: Heavy sheen observed at all poling locations. Wood debris present.

Pore-space water temperature (°F): 63.5
Surface water temperature (°F): 74.5

Depth to top of mudline: 3.0 feet
Depth to bottom of mudline: 3.2 feet
Mudline Thickness: 0.2 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-40	Date: 7/19/2017

Location Notes: No sheen observed from multiple poling locations. Trace wood debris present.

Pore-space water temperature (°F): 72.0
Surface water temperature (°F): 75.1

Depth to top of mudline: 10.0 feet
Depth to bottom of mudline: 10.5 feet
Mudline Thickness: 0.5 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-41	Date: 7/19/2017

Location Notes: No sheen observed from multiple poling locations. No wood debris present.

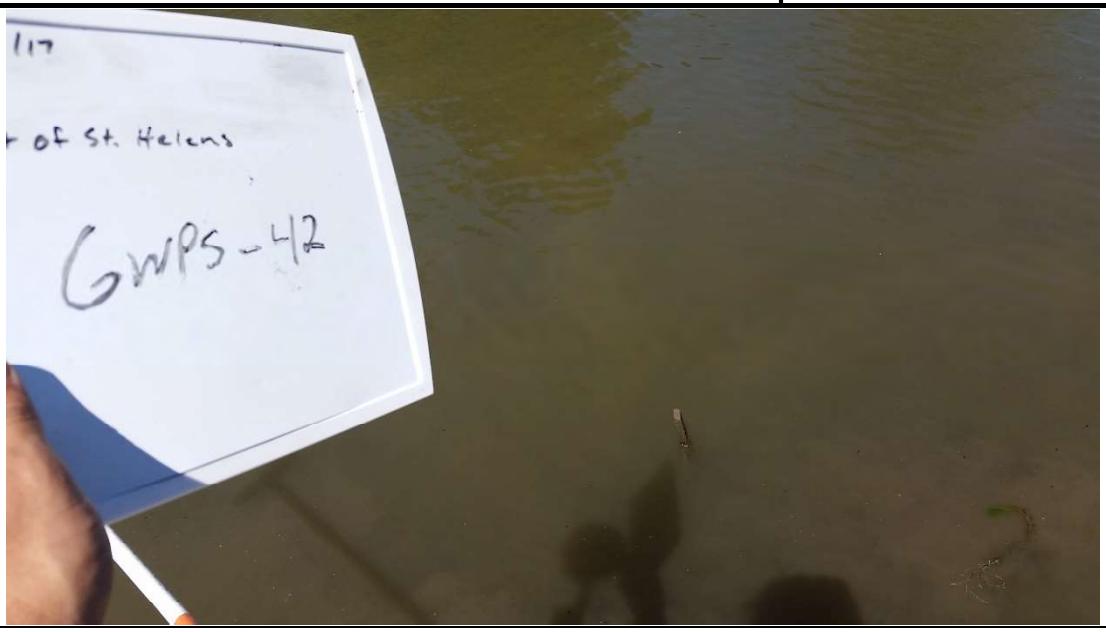
Pore-space water temperature (°F): 71.7
Surface water temperature (°F): 75.0

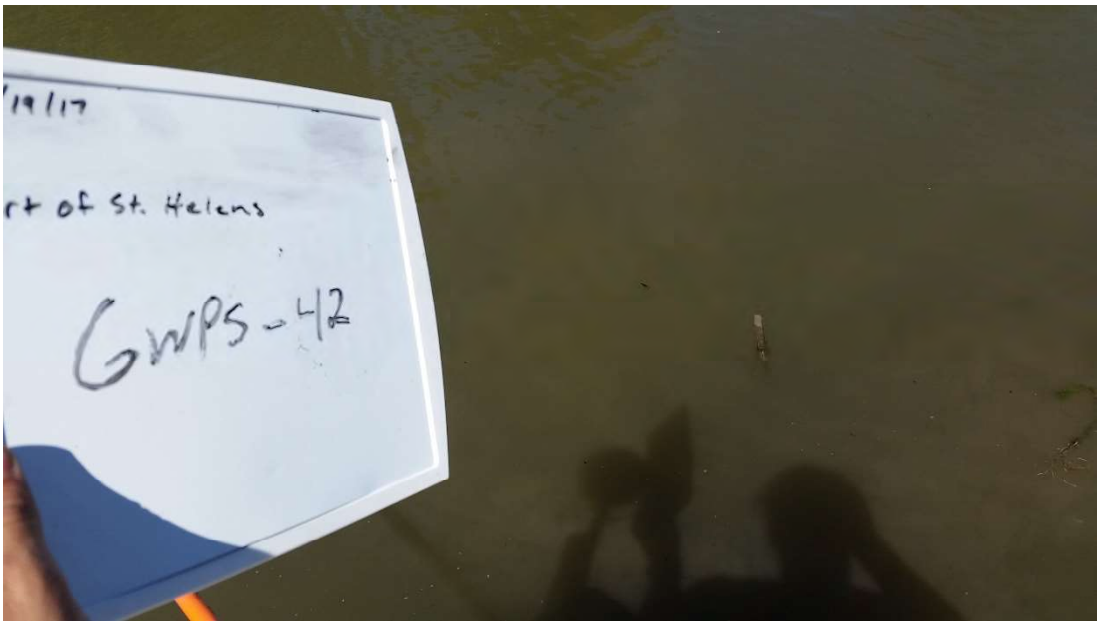
Depth to top of mudline: 10.8 feet
Depth to bottom of mudline: 11.0 feet
Mudline Thickness: 0.2 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-42	Date: 7/18/2017





Location Notes: No sheen observed from multiple poling locations. No wood debris present.

Pore-space water temperature (°F): 64.6
Surface water temperature (°F): 75.4

Depth to top of mudline: 2.5 feet
Depth to bottom of mudline: 3.0 feet
Mudline Thickness: 0.5 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-43	Date: 7/19/2017

Location Notes: No sheen observed from multiple poling locations. No wood debris present.

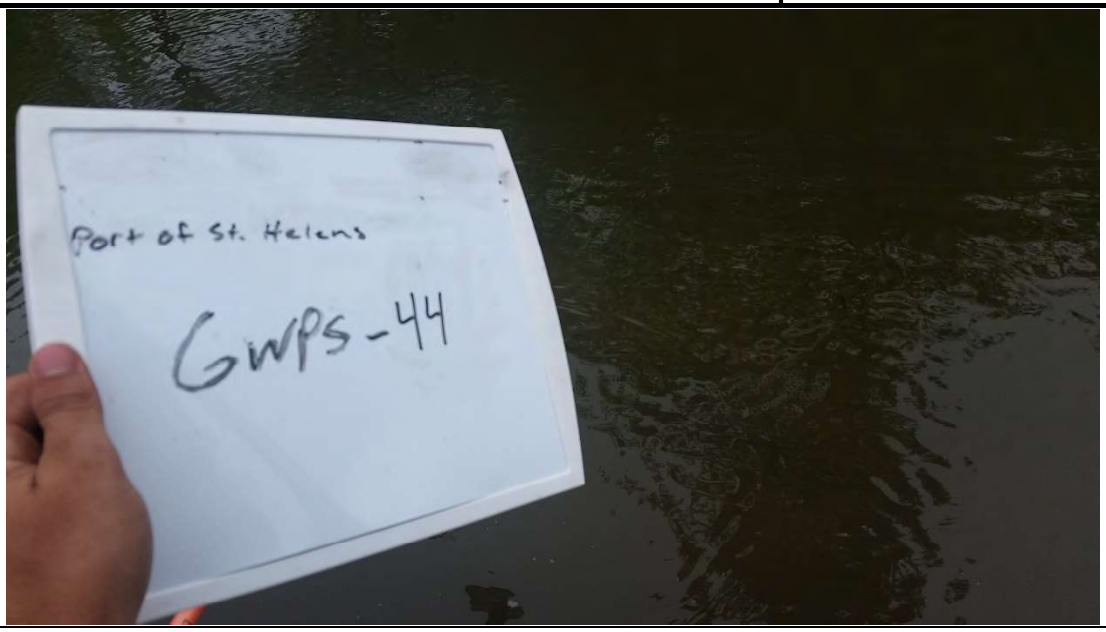
Pore-space water temperature (°F): 61.0
Surface water temperature (°F): 74.5

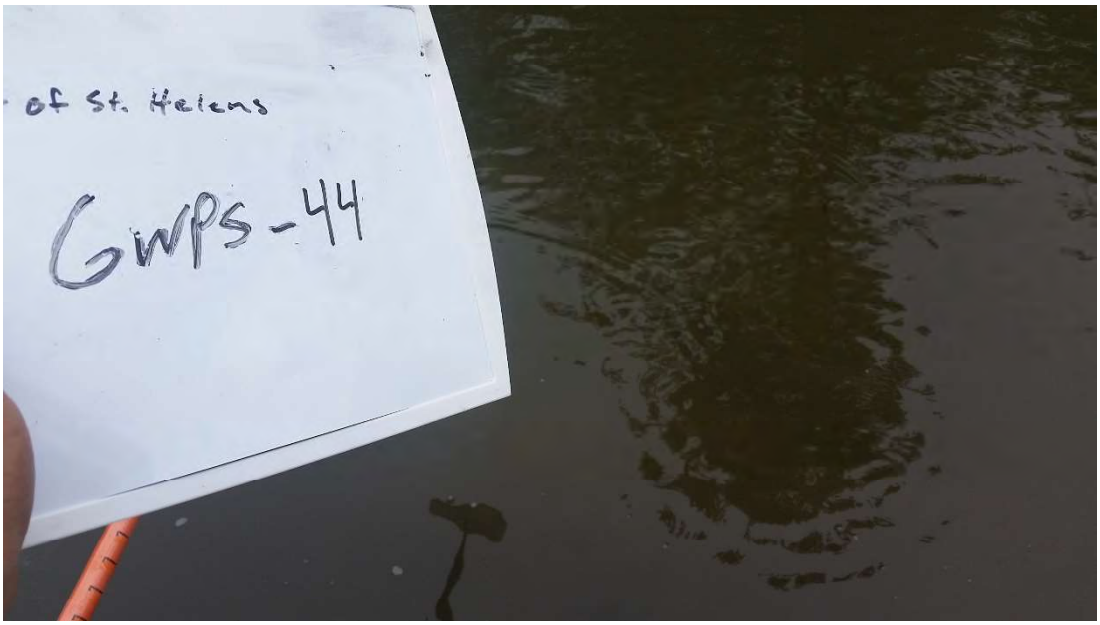
Depth to top of mudline: 2.1 feet
Depth to bottom of mudline: 2.8 feet
Mudline Thickness: 0.7 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-44	Date: 7/20/2017





Location Notes: No sheen observed from multiple poling locations. No wood debris present.

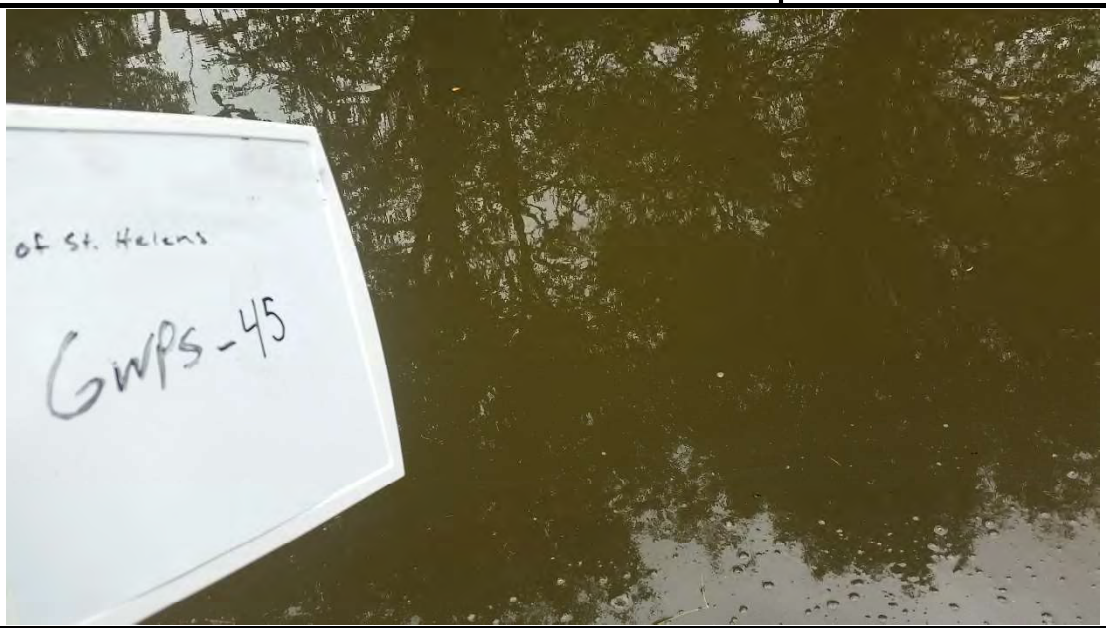
Pore-space water temperature (°F): 64.0
Surface water temperature (°F): 68.0

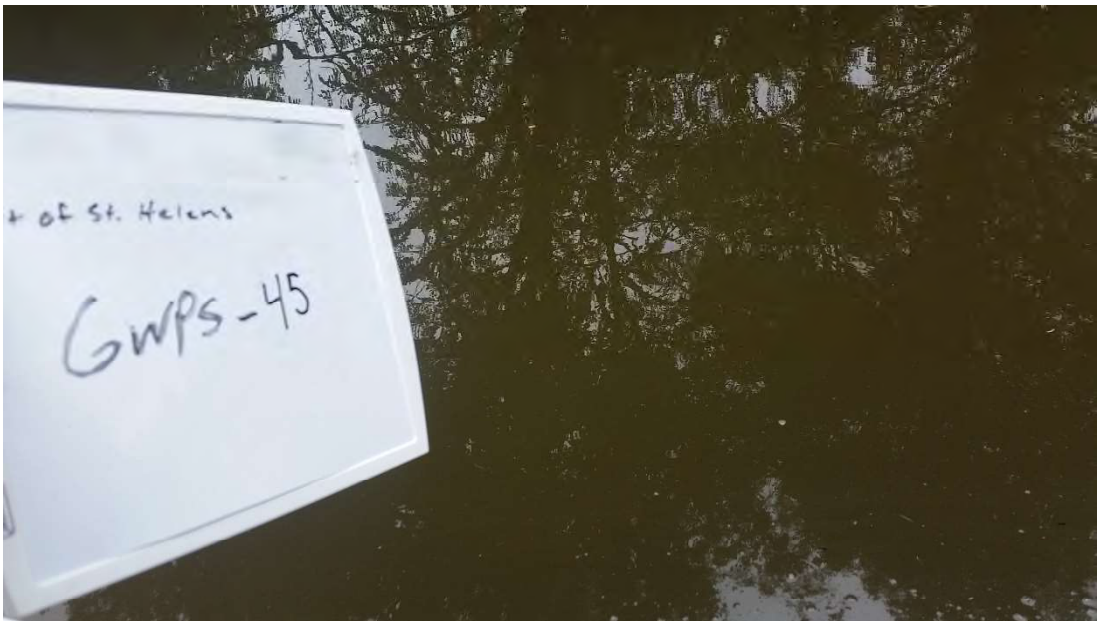
Depth to top of mudline: 5.4 feet
Depth to bottom of mudline: 5.8 feet
Mudline Thickness: 0.4

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-45	Date: 7/20/2017





Location Notes: Slight biogenic sheen observed. Trace wood debris present.

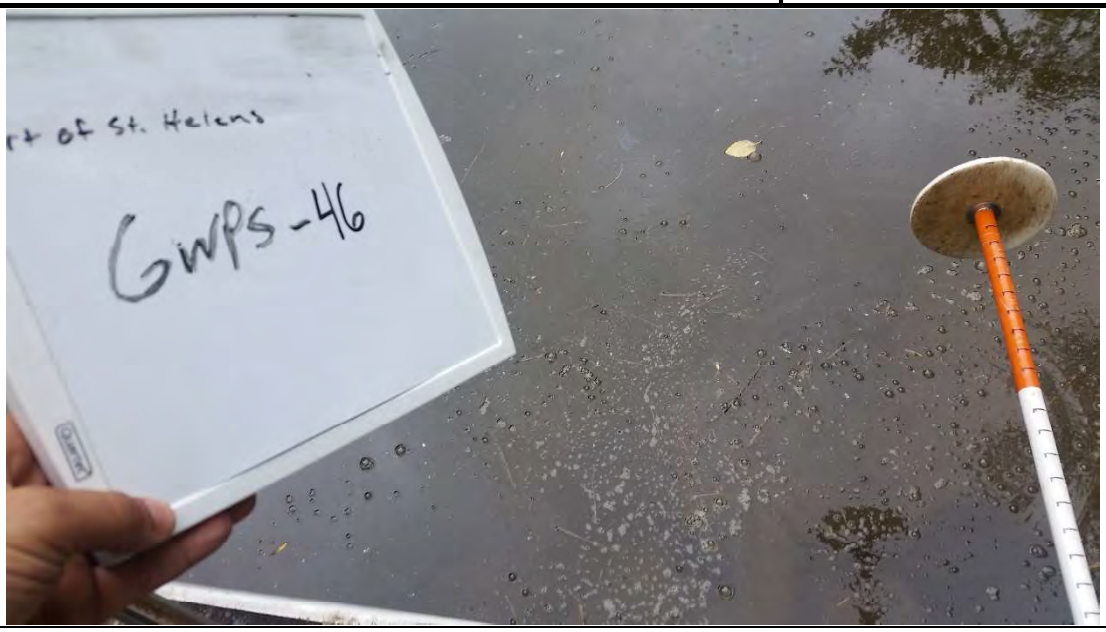
Pore-space water temperature (°F): 61.9
Surface water temperature (°F): 67.1

Depth to top of mudline: 4.2 feet
Depth to bottom of mudline: 4.4 feet
Mudline Thickness: 0.2 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-46	Date: 7/20/2017



Location Notes: Slight biogenic sheen observed. Trace wood debris present.

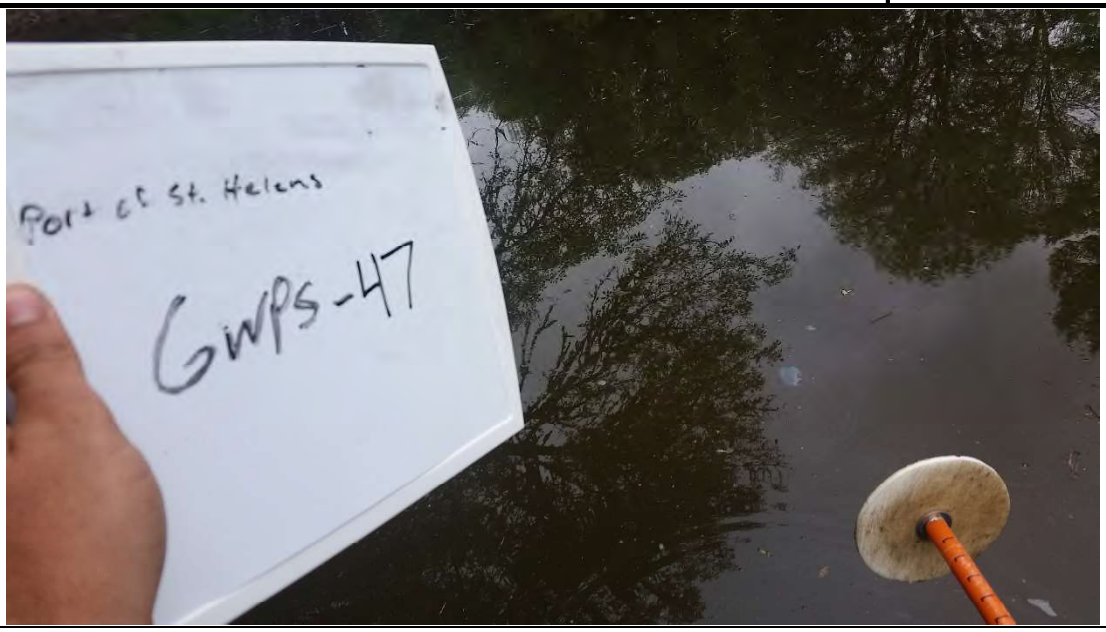
Pore-space water temperature (°F): 58.0
Surface water temperature (°F): 66.7

Depth to top of mudline: 3.3 feet
Depth to bottom of mudline: 3.8 feet
Mudline Thickness: 0.5 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-47	Date: 7/20/2017



Location Notes: Slight biogenic sheen observed. Trace wood debris and organics present.

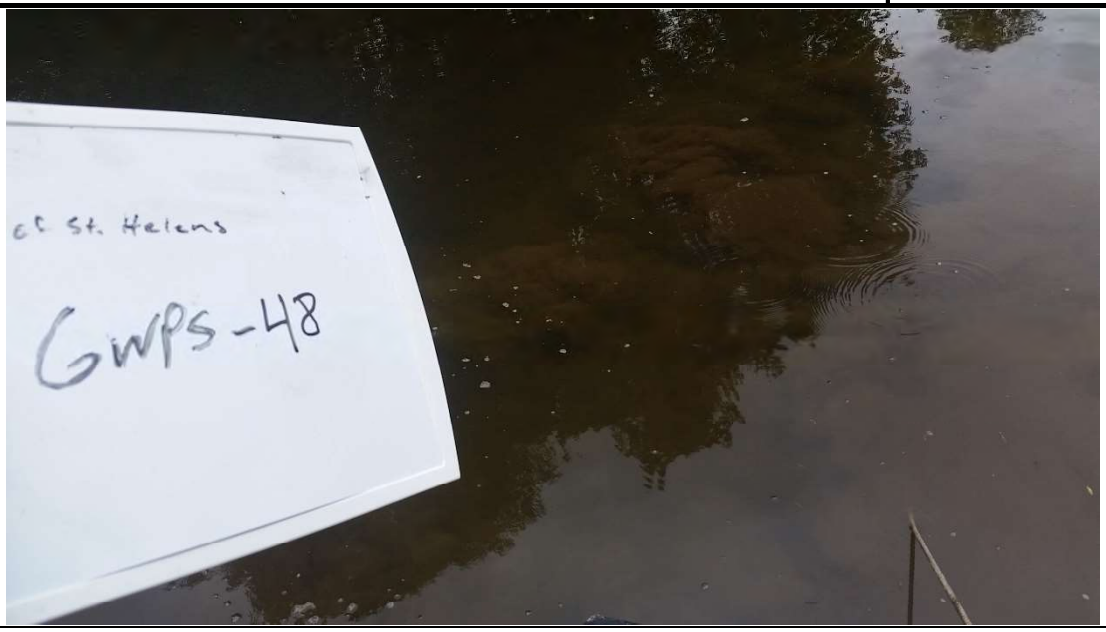
Pore-space water temperature (°F): 60.3
Surface water temperature (°F): 66.4

Depth to top of mudline: 2.7 feet
Depth to bottom of mudline: 3.0 feet
Mudline Thickness: 0.3 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-48	Date: 7/20/2017



Location Notes: Slight biogenic sheen observed. Trace wood debris and organics present.

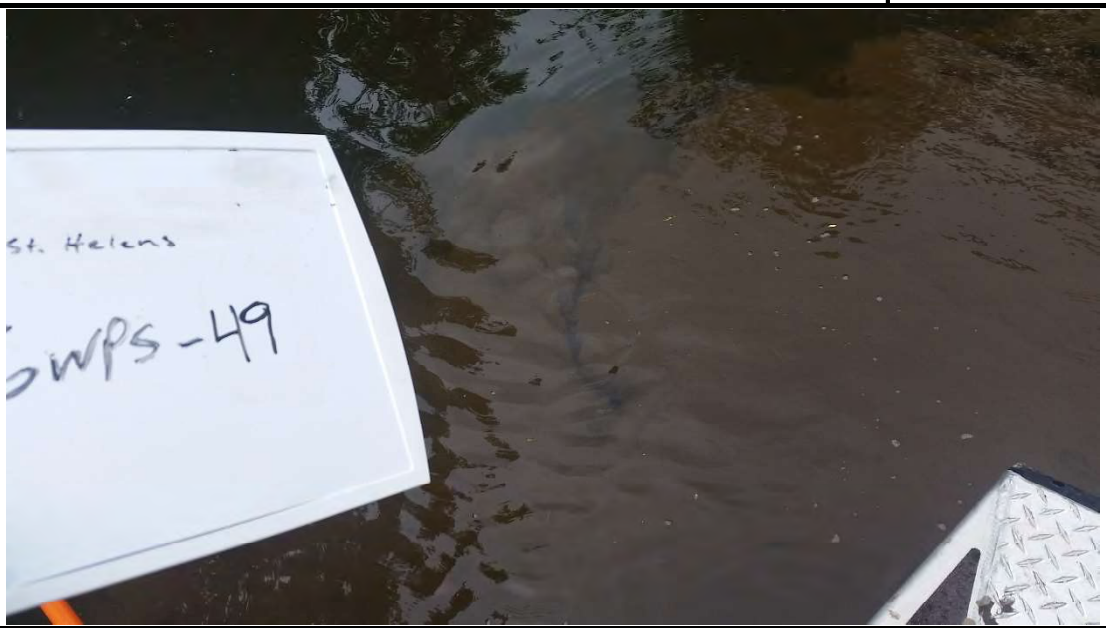
Pore-space water temperature (°F): 65.2
Surface water temperature (°F): 66.0

Depth to top of mudline: 2.5 feet
Depth to bottom of mudline: 3.0 feet
Mudline Thickness: 0.5 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-49	Date: 7/20/2017



Location Notes: Biogenic sheen observed. Trace wood debris and organics present.

Pore-space water temperature (°F): 65.7
Surface water temperature (°F): 66.0

Depth to top of mudline: 2.5 feet
Depth to bottom of mudline: 3.0 feet
Mudline Thickness: 0.5 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-50	Date: 7/20/2017

Location Notes: Slight sheen to moderate sheen observed at poling some locations. Wood debris present.

Pore-space water temperature (°F): 65.1
Surface water temperature (°F): 66.0

Depth to top of mudline: 1.8 feet
Depth to bottom of mudline: 2.0 feet
Mudline Thickness: 0.2 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-51	Date: 7/20/2017

Location Notes: No sheen observed at poling locations. Rock substrate observed. Trace wood debris present.

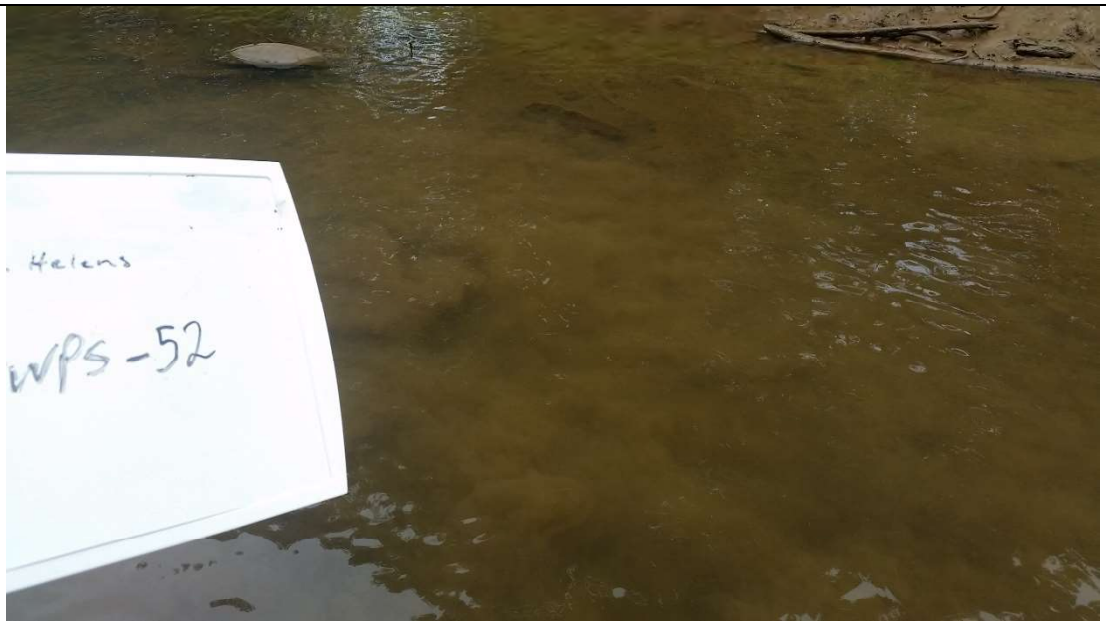
Pore-space water temperature (°F): 65.0
Surface water temperature (°F): 66.4

Depth to top of mudline: 1.8 feet
Depth to bottom of mudline: 2.0 feet
Mudline Thickness: 0.2 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-52	Date: 7/20/2017



Location Notes: No sheen observed at poling locations. Rock substrate observed. Trace wood debris and organics present.

Pore-space water temperature (°F): 65.2
Surface water temperature (°F): 66.0

Depth to top of mudline: 1.8 feet
Depth to bottom of mudline: 2.0 feet
Mudline Thickness: 0.2 feet

Offshore Data Gap Investigation
Port of St. Helens
St. Helens, Oregon
0034-001-002

Cascadia Associates, LLC

Location ID: GWS-53	Date: 7/20/2017

Location Notes: Surface water sheen observed, not generated by poling sediment. Pore-space water temperature (°F): 65.0 Surface water temperature (°F): 66.0 Depth to top of mudline: 1.5 feet Depth to bottom of mudline: 1.8 feet Mudline Thickness: 0.3 feet	Offshore Data Gap Investigation Port of St. Helens St. Helens, Oregon 0034-001-002 Cascadia Associates, LLC

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 1

DATE : 9/6/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 0930
DEPTH OF WATER AT BORING LOCATION: 3.5'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			15 - 20%	CL/ML	Clayey Silt with trace organics, light gray, stiff to medium stiff, slight odor, trace wood debris present, slight biogenic sheen present.	PWS-090617-1	0930

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090617-1
Samples to be Archived : --

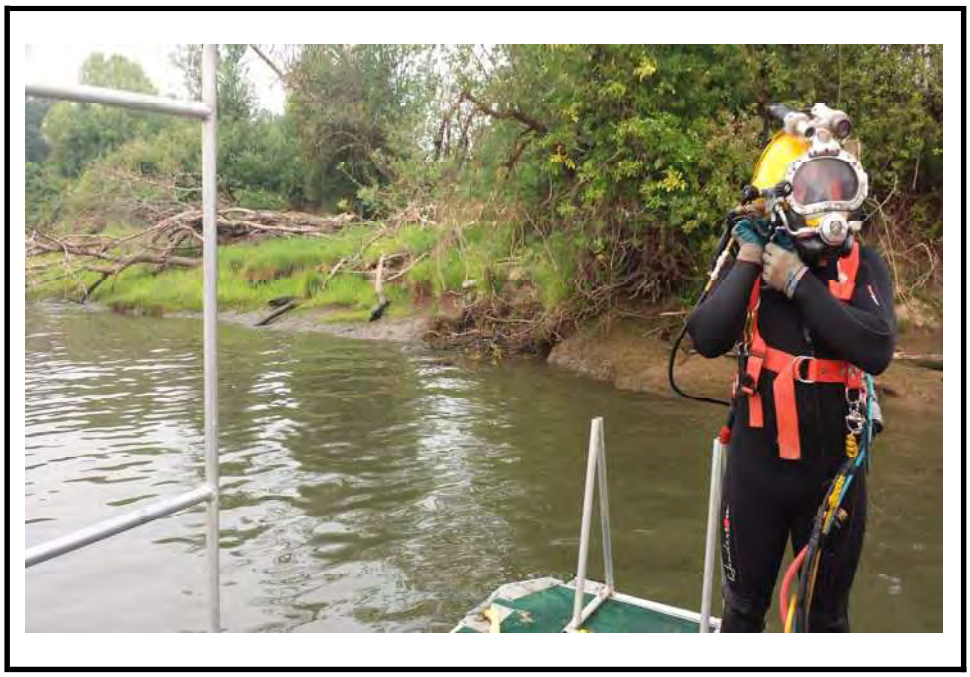
SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location .
- No surface water cage sampler placed at location.



Station 1 Location

Station 1 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 2

DATE : 9/6/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 0900
DEPTH OF WATER AT BORING LOCATION: 3.5'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 16"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			0 - 5%	ML/SP	Silt with organics and fine sand, light gray, very soft, slight biogenic sheen and odor.	PWS-090617-2	0900
12 - 16"			0 - 5%	ML/SP	Silt with organics and fine sand, light gray, very soft, slight biogenic sheen and odor.		

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090617-2
Samples to be Archived : --

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- Surface water cage sampler placed at location.

Station 1 Location

Station 1 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 3

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1400
DEPTH OF WATER AT BORING LOCATION: 5.7'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			0 - 5%	ML/SP	Silt with trace wood debris and poorly graded, fine sand.	PWS-090617-3	1400

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090617-3
Samples to be Archived : --

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- Surface water cage sampler placed at location.

Station 3 Location

Station 3 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 4

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1530
DEPTH OF WATER AT BORING LOCATION: 6.0'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			10%	ML/SP	Silt with trace wood debris and fine sand, light gray, very soft, slight sheen	PWS-9517-4	1530
12-16"			10%	ML/SP	Silt with trace wood debris and fine sand, light gray, very soft, slight sheen		

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-9517-4
Samples to be Archived : --

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- Surface water cage sampler placed at location.

Station 4 Location

Station 4 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 5

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1600
DEPTH OF WATER AT BORING LOCATION: 2.0'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			5%	CL/ML	Clay with silt and trace organics, gray, stiff to hard	PWS-9517-5	1600

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-9517-5
Samples to be Archived : --

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- No surface water cage sampler placed at location.

Station 5 Location

Station 5 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 6

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1330
DEPTH OF WATER AT BORING LOCATION: --
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			10%	ML	Silt, dark brown, soft, wood debris present from 0-6"	PWS-090517-6	1400

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090517-6
Samples to be Archived : --

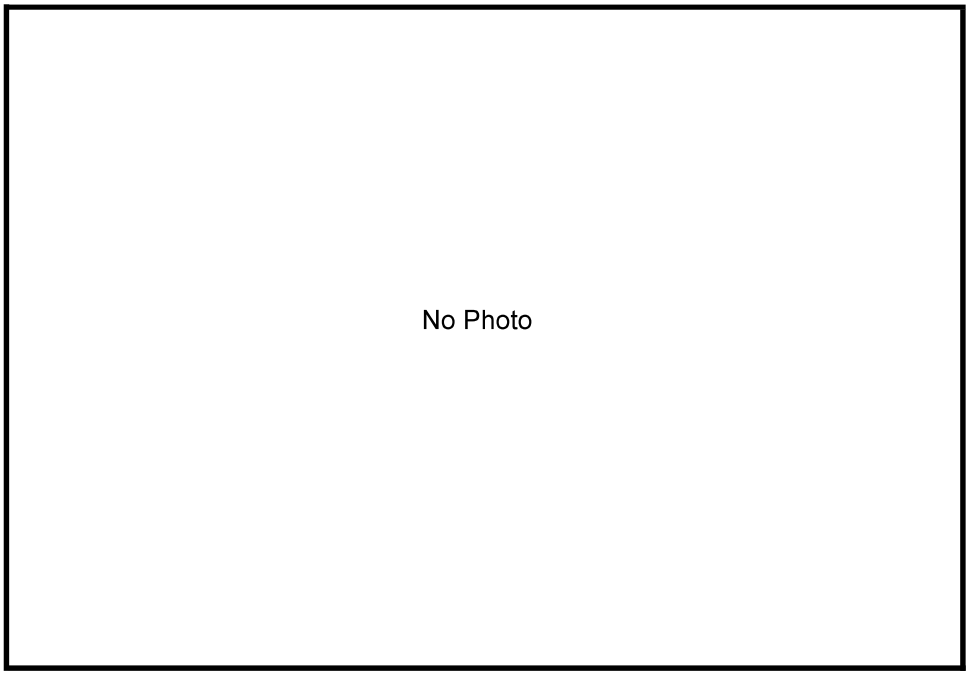
SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

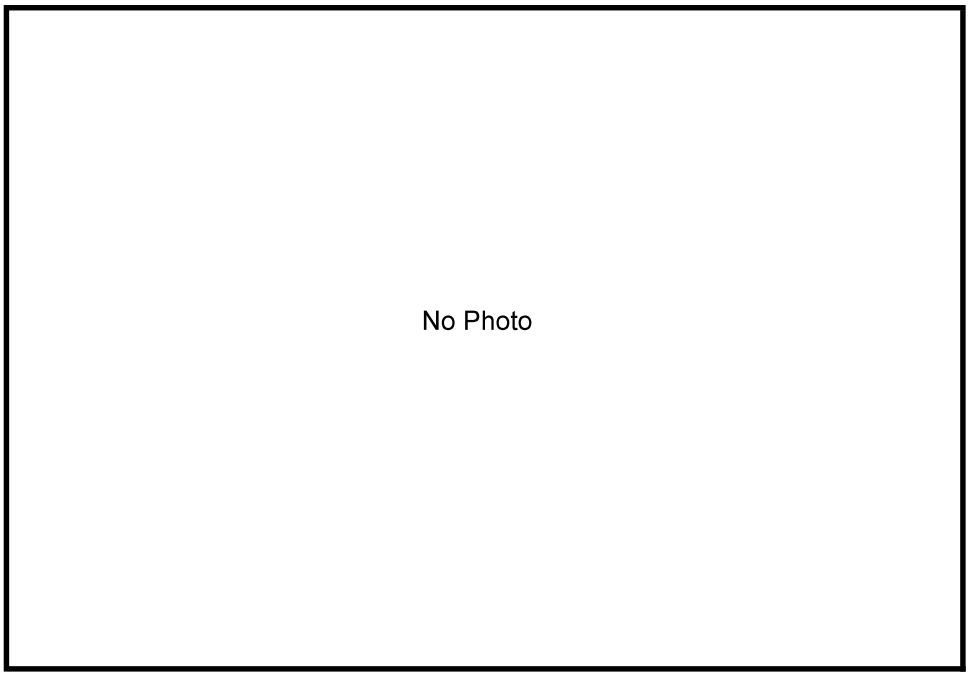
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- No surface water cage sampler placed at location.



Station 6 Location



Station 6 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 7

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1150
DEPTH OF WATER AT BORING LOCATION: --
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-8"			5%	ML	Silt with trace sand, dark brown, soft	PWS-090517-7	1200
8-12"			< 5%	SP	Fine sand with trace silt, medium dense, dark brown		

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090517-7
Samples to be Archived : --

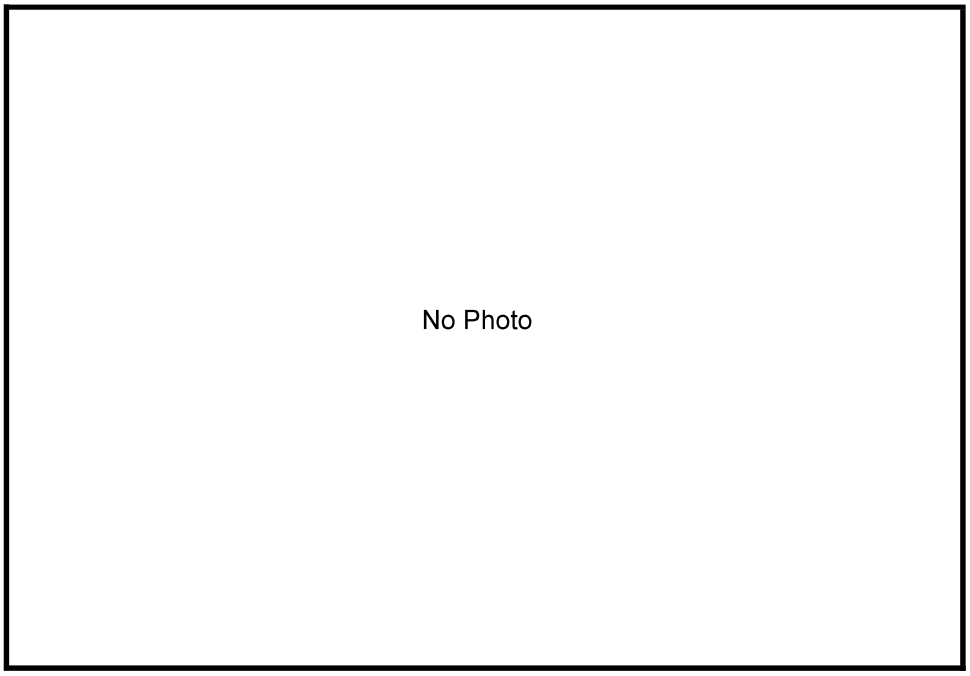
SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

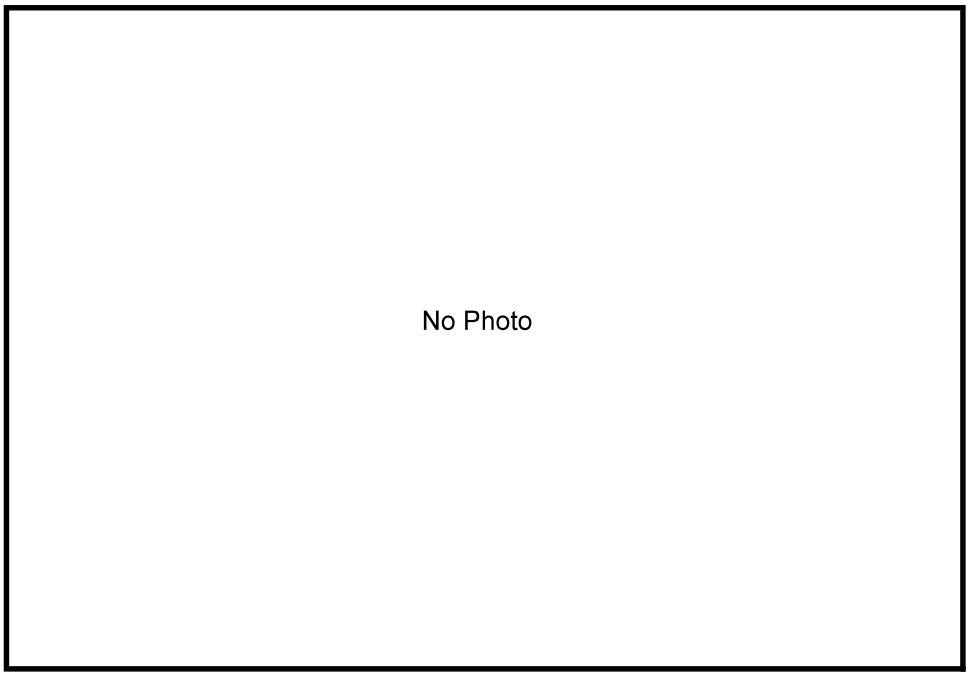
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- No surface water cage sampler placed at location.



Station 7 Location



Station 7 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 8

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1130
DEPTH OF WATER AT BORING LOCATION: 12"
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			< 5%	ML	Silt with fine sand and trace organics, dark brown, soft	PWS-090517-8	1130

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090517-8
Samples to be Archived : --

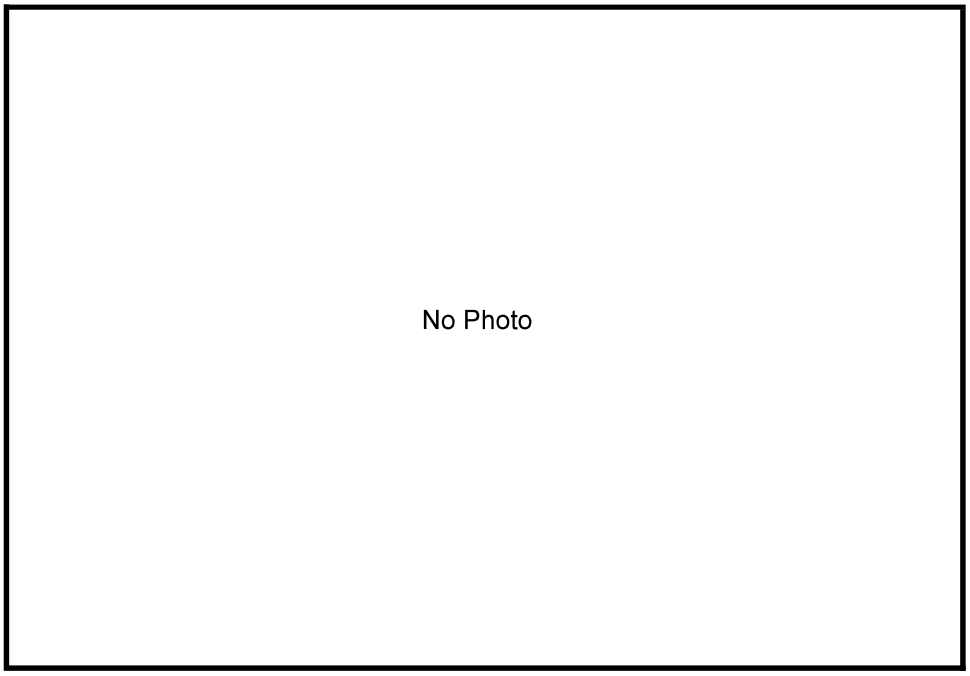
SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

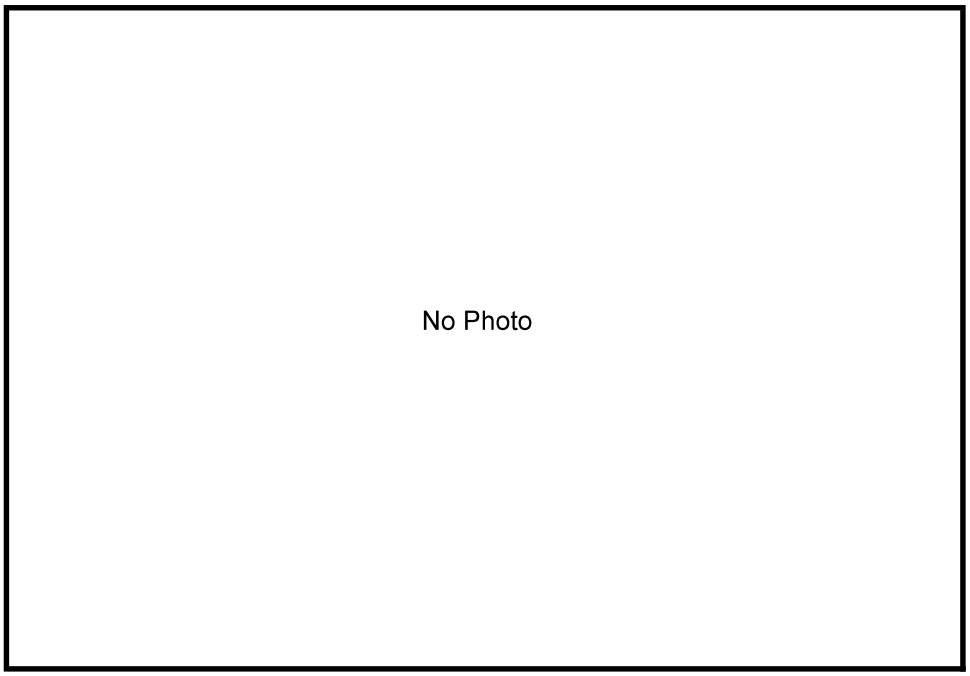
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- No surface water cage sampler placed at location.



Station 8 Location



Station 8 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 9

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1400
DEPTH OF WATER AT BORING LOCATION: 12"
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-3"			5%	ML	Silt with fine sand, dark brown, soft	PWS-090517-09	1415
3-12"			5%	ML	Becomes dense		

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090517-09
Samples to be Archived : --

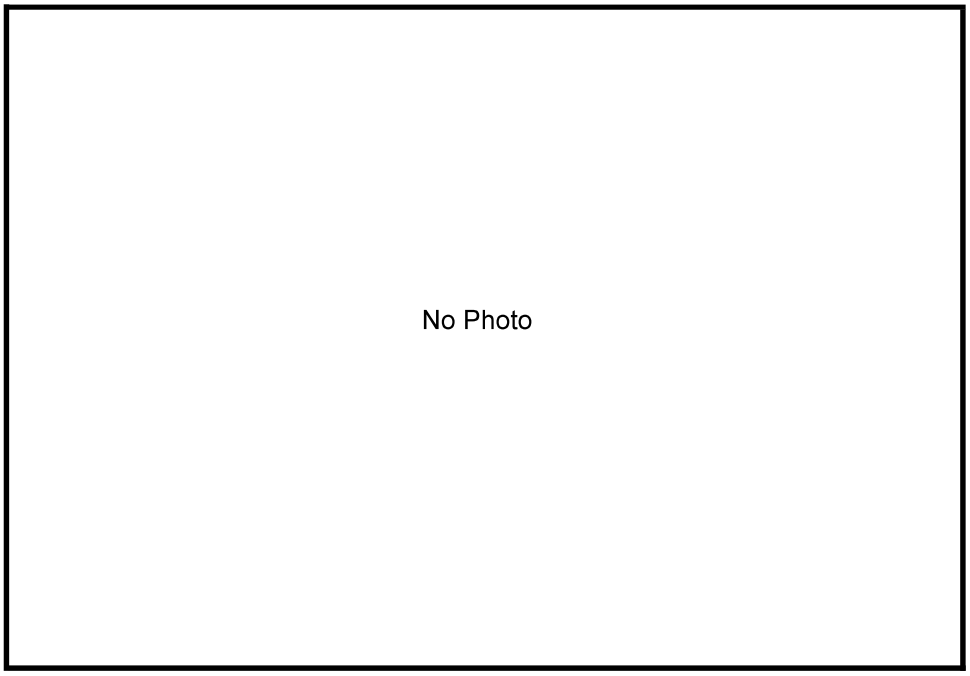
SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

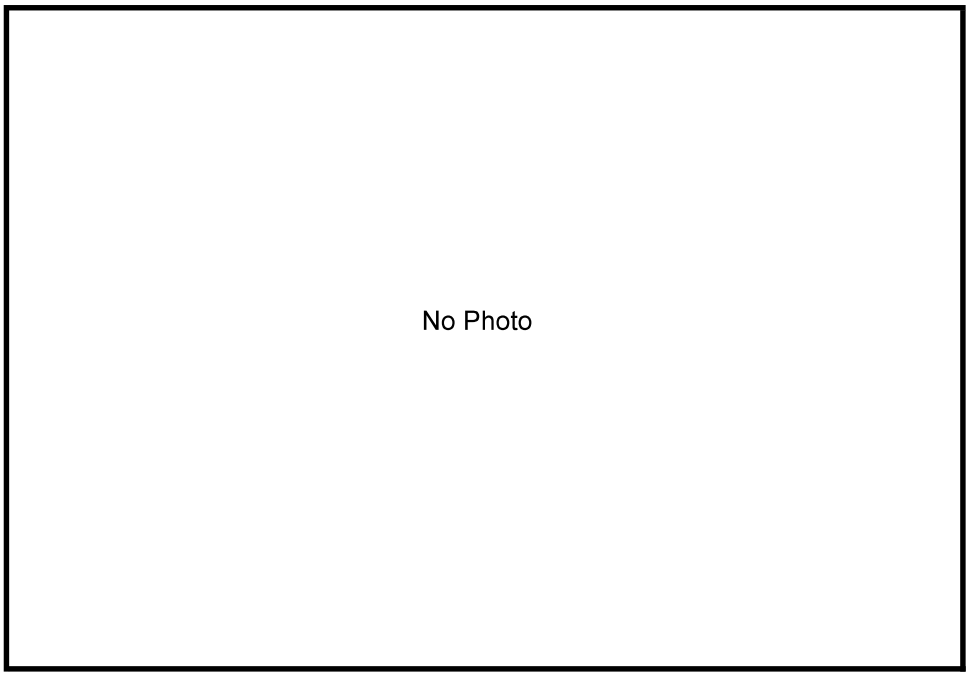
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- Surface water cage sampler placed at location.



Station 9 Location



Station 9 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 10

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1040
DEPTH OF WATER AT BORING LOCATION: 5'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			5%	ML	Silt with trace organics, light gray, slight sheen present	PWS-9517-10	1120

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090517-10
Samples to be Archived : --

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : PWS-9517-10D

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- Surface water cage sampler placed at location.

Station 10 Location

Station 10 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 11

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1245
DEPTH OF WATER AT BORING LOCATION: 2'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 30"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-6"			5%	ML	Silt with trace fine sand, dark brown, soft	PWS-9517-11	1300
6-12"			< 5%	ML/SP	Fine Sand with trace silt (80% sand, 20% silt), dark brown, soft		

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090517-11
Samples to be Archived : --

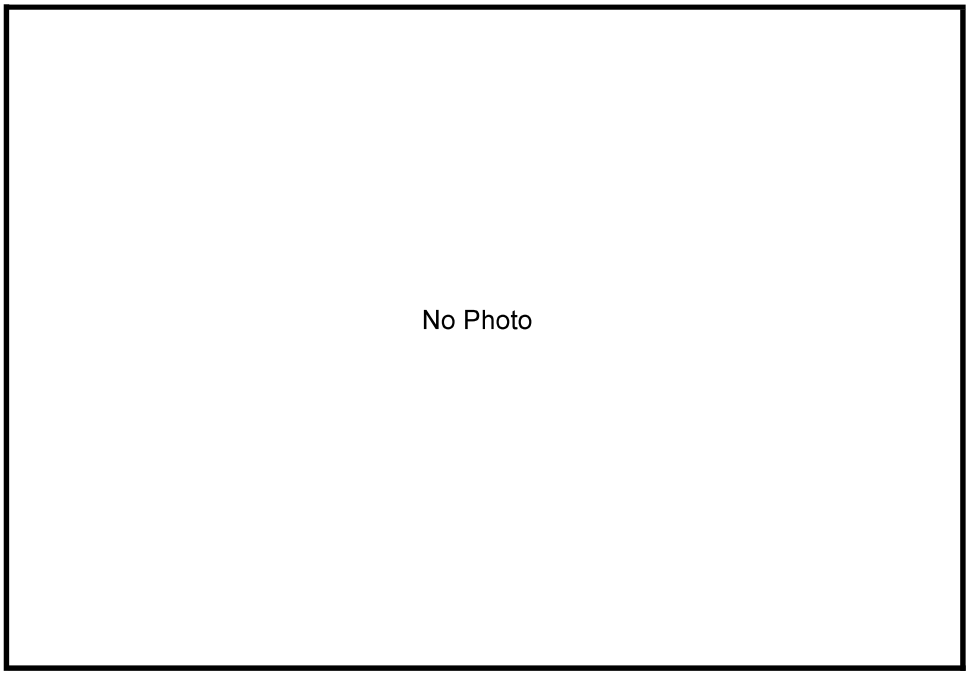
SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

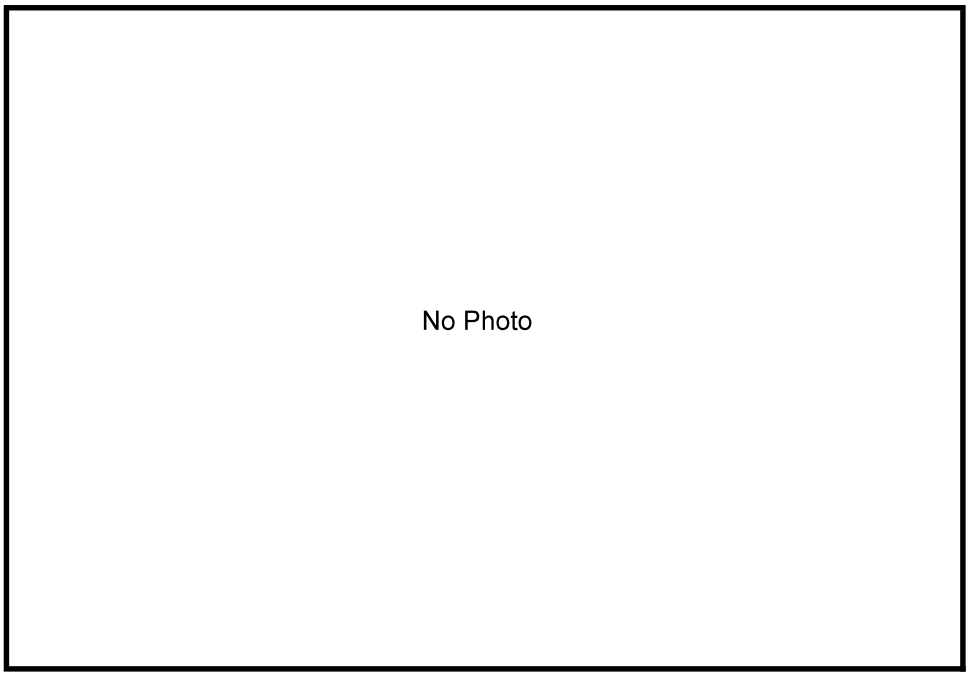
Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- No surface water cage sampler placed at location.



Station 11 Location



Station 11 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 12

DATE : 9/6/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1120
DEPTH OF WATER AT BORING LOCATION: 5'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			10%	ML/SP	Poorly graded, coarse-grain sand with silt and aproximately 10% wood debris/organics soft from 0-6", becomes stiff from 6-12".	PWS-090617-12	1140

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090517-12
Samples to be Archived : --

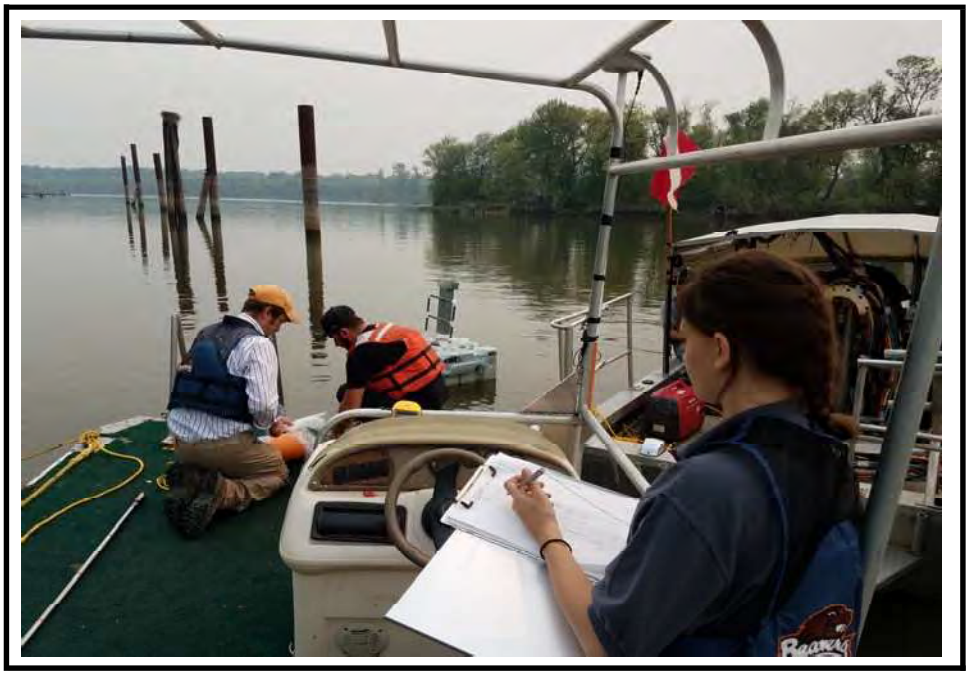
SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- Surface water cage sampler placed at location.



Station 12 Location

Station 12 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 13

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1040
DEPTH OF WATER AT BORING LOCATION: 7'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			5%	ML/SP	Silt with fine sand and trace organics, very soft, light gray.	PWS-9517-13	1100

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090517-13
Samples to be Archived : --

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- Surface water cage sampler placed at location.

Station 13 Location

Station 13 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 14

DATE : 9/5/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1150
DEPTH OF WATER AT BORING LOCATION: 9.75'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 16"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-16"			10%	ML/SP	Silt with wood debris and poorly graded sand, lt gray, medium stiff	PWS-9517-14	1200

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-9517-14
Samples to be Archived : --

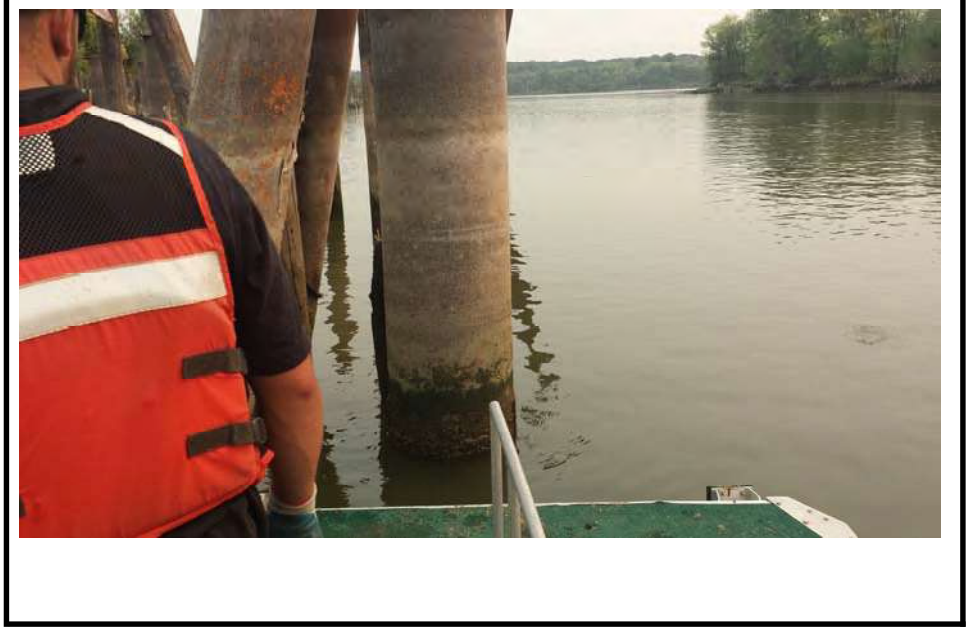
SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
34 PAHs in Bulk Sediment by EPA 8270-SIM				
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- Surface water cage sampler placed at location.



Station 14 Location

Station 14 Bulk sediment sample

SEDIMENT AND POREWATER SAMPLING FORM **Port of St Helens, Former Pope & Talbot - Project 0034-001-003-01**

Datum : OR State Plane North Feet, NAD 83
GPS Point Collected : Yes

STATION ID : 15

DATE : 9/6/2017
SAMPLING METHOD : Macro Core Sleeve
PERSONNEL : OSU/Cascade Dive/Cascadia Associates
WEATHER :

START TIME : 1000
DEPTH OF WATER AT BORING LOCATION: 9'
TARGET PENETRATION DEPTH : 0 - 30"
ACTUAL PENETRATION DEPTH : 0 - 12"

OBSERVATIONS/ FIELD MEASUREMENTS

Depth (inches)			Debris (%)	USCS Symbol	Visual sample description	Sample ID	Sample Time
0-12"			10%	ML/SP	Silt with poorly graded fine sand and trace organics, light brown to light gray, soft from 0-4" then medium stiff from 4-12".	PWS-090617-15	1200

Photograph of sample taken? **Yes** **See Reverse Side for Station Photographs**

SAMPLE COLLECTION

Primary Sample for Analysis : PWS-090617-15
Samples to be Archived : --

SAMPLE TYPE (IE: GRAB, SPLIT, ETC.) : Grab
QA/QC SAMPLES COLLECTED : --

Parameters	Preservation	Sample Containers	Iced (Y/N)	Transportation
34 PAHs in Bulk Sediment by EPA 8270-SIM	None	3 X 40-ml voas 2 X 4 oz jar 1 X 8 oz jar	Yes	--
Total Organic Carbon (TOC) by EPA 9060				
Black Carbon by Gustafsson 2001 Method				
Washington VPH				

Decon Procedures Followed : Yes
Chain of Custody Completed : Yes
Analytical Laboratory : APEX
Waste Disposal Location : NA

ADDITIONAL COMMENTS:

- In-situ sediment sampler placed at location.
- Passive Diffusion Bag sampler placed at location.
- No surface water cage sampler placed at location.

Station 15 Location

Station 15 Bulk sediment sample

APPENDIX D

CHEMICAL ANALYTICAL PROGRAM

ANALYTICAL PROGRAM

As part of the Supplemental Remedial Investigation (RI), Wood (formerly Amec Foster Wheeler) and Cascadia Associates, LLC (Cascadia) working on behalf of the Port of Columbia County (formerly Port of St. Helens; "the Port") investigated chemical concentrations in groundwater, creosote non-aqueous phase liquid (NAPL), soil, and bulk sediment samples collected at the former Pope & Talbot wood-treating property, located at 1550 Railroad Avenue in St. Helens, Oregon (Site). In addition, freely dissolved chemical concentrations of parent and alkyl polycyclic aromatics in sediment porewater were obtained in 2012 using commercially available polydimethylsiloxane (PDMS)-coated fused silica fibers as part of an *ex-situ* solid-phase microextraction (SPME) process defined in ASTM International (ASTM) Method D7363-13a. In 2017, freely dissolved chemical concentrations in sediment porewater and surface water were obtained using commercially available low-density polyethylene (LDPE) passive sampling media deployed for 20 days at the Site. This appendix summarizes analytical methodologies applied to samples collected during the Supplemental RI between 2010 and 2017. Collected samples were either submitted to Apex Laboratories, LLC (Apex Labs), located in Tigard, Oregon, or were prepared and analyzed by the Food Safety and Environmental Stewardship (FSES) program at Oregon State University (OSU). Chemical analysis of Site media and/or passive sampling media included one or more of the following:

- Gasoline-range hydrocarbons by Northwest Total Petroleum Hydrocarbons (NWTPH)-Gx;
- Diesel- and oil-range hydrocarbons by NWTPH-Dx;
- Metals by United States Environmental Protection Agency (EPA) Method 6020;
- Volatile organic compounds (VOCs) by EPA Method 8260;
- Volatile petroleum hydrocarbons (VPH) by the Northwest Method for the Determination of VPH Fractions (NW-VPH) and extractable petroleum hydrocarbons (EPH) by the Northwest Method for the Determination of EPH Fractions (NW-EPH);
- 18 to 63 individual polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270D, FSES standard operating procedure (SOP) 418.00 (Determination of Parent and Alky Substituted PAHs by Gas Chromatography-Tandem Mass Spectrometry), and Standard Operating Procedure (SOP) 407.01 (Calculation of Freely Dissolved Water Concentrations of Organic Compounds Derived from PE PSDs);
- 18 parent PAH and 16 groups of prominent C_1 to C_4 alkyl PAH derivatives (so-called 34 PAHs) by modified EPA Method 8270D, ASTM Method D7363-13a, and/or FSES SOP 427.00 (Determination of Forensic Alkyl PAHs using GC-MS/MS) and SOP 407.01; and
- Total organic carbon (TOC) or dissolved organic carbon (DOC) by Standard Method (SM) 5310B.

Apex Labs subcontracted selected samples to Analytical Resources, Inc. (ARI), located in Tukwila, Washington, where they were analyzed for VPH and EPH. Apex Labs subcontracted chemical analysis of the sediment samples for Carbon Black (% Soot) using publications by Accardi-Dey and Gshwend, 2003; and Gustafsson (et al.), 2004 to Alpha Analytical, Inc. (Alpha) in Mansfield, Maine.

In addition to the 34 and 63 PAHs analysis, FSES calculated freely dissolved concentrations (Cfree) of oxygenated polycyclic aromatic hydrocarbons (OPAHs) from the LDPE media using SOPs 414.00 and 407.01. Also, FSES measured hopanes and cholestanes on the LDPE media (instrument concentrations) using SOP 416.01 (Determination of Hopane and Cholestane Compounds by SIM GC/MS).

Project analytical methodologies for the analytes are summarized in the following sections.

PETROLEUM HYDROCARBONS

Groundwater, NAPL, and bulk sediment were analyzed for petroleum hydrocarbons using NWTPH-Gx, NWTPH-Dx, VPH, and/or EPH using Northwest and Washington Department of Ecology (Ecology) methodologies where volatile aliphatic and aromatic hydrocarbons are collectively quantified within the following equivalent carbon ranges by gas chromatography (GC) using a photo ionization detector (PID) and flame ionization detector (FID) in series:

- Volatile aliphatics - C_5 through C_6, $C_{>6}$ through C_8, $C_{>8}$ through C_{10}, and $C_{>10}$ through C_{12} ranges; and
- Volatile aromatics - C_8 through C_{10}, $C_{>10}$ through C_{12}, and $C_{>12}$ through C_{13} ranges.

EPH using Ecology methodology includes extractable aliphatic and aromatic hydrocarbons were collectively quantified within the following ranges by GC using an FID:

- C_8 through C_{10}, $C_{>10}$ through C_{12}, $C_{>12}$ through C_{16}, $C_{>16}$ through C_{21}, and $C_{>21}$ through C_{34} ranges;

Many of the NWTPH-Gx and Dx results were N-qualified during validation as being presumptively identified because the sample chromatograms did not match the standard chromatograms or the chromatograms were made up of individual peaks instead of petroleum-like unresolved complex mixtures.

None of the volatile aliphatic and aromatic hydrocarbons quantified by the Ecology VPH method were detected in the Phase 3 sediment samples (all 15 Phase 3 sampling locations). High molecular weight aliphatics and aromatics ($C_{>16}$-C_{21} and $C_{>21}$-C_{34}) were detected in all ten of the 2017 surface sediment samples submitted for the Ecology EPH analysis. It is important to note that the laboratory's EPH reporting limits are 6 to 10 times lower than VPH method reporting limits for comparable TPH fractions. Bulk samples collected on September 6, 2017 (i.e., PWS-090617-1, -2, -12, -13, -15) were not analyzed for EPH because Apex Labs failed to list it on its ARI work order. Cascadia was not aware of the situation nor given an opportunity to review the laboratory work orders until Apex Labs started issuing draft reports in December 2017.

The Phase 3 sampling included a separate *in-situ* passive diffusive bag (PDB) sampler[1] for assessing freely dissolved concentrations of VPH using the above-referenced Ecology method and benzene, toluene, ethylbenzene, total xylenes, and naphthalene (BTEX+N) by EPA 8260C using multiple-ion monitoring (MIM). Specifically, MIM techniques were used to search for aliphatic hydrocarbons between $C_{>10}$-C_{12} below VPH detection limit (50 micrograms per liter [µg/L]). According to Apex Labs, the PDB water samples were free of interference and the absence of select VOCs (BTEX and naphthalene) suggests that VPH fractions are not present at significant freely dissolved concentrations in the sediment porewater at the 2017 sampling locations. There were no analytical difficulties associated with the petroleum hydrocarbons analyses of these samples.

METALS

Groundwater and select sediment samples were analyzed for metals using EPA Method 6020. There were no analytical difficulties associated with the metals analyses.

VOLATILE ORGANIC COMPOUNDS

Groundwater and select sediment samples were analyzed for VOCs using EPA Method 8260B. There were no analytical difficulties associated with the VOC analyses of these samples.

POLYCYCLIC AROMATIC HYDROCARBONS

Soil, sediment, and NAPL samples were analyzed for PAHs, with or without PAH homologs, using EPA Method 8270D. Background concentrations of target and non-target analytes often interfered with surrogate and matrix spike recoveries.

The 2012 porewater and groundwater samples were analyzed for PAHs and/or PAH homologs using ASTM Method D7363-13a. Porewater was separated from bulk sediment samples at the laboratory by decanting overlying water, pressing the sediment through screens, and then centrifuging the screened sediments. Hence, the 2012 porewater is referred to herein as "*ex-situ*" data (i.e., derived in a laboratory). Multiple aliquots of water obtained from the same sediment sample were then combined and centrifuged again to separate any remaining sediment. The combined water was then transferred to a clean container and flocculated to remove remaining solids. The flocculation was repeated once more before a subsample was taken, spiked with internal standards, and extracted using SPME.

[1] As requested by DEQ, the Phase 3 investigation of sediment porewater also included deployment of PDB samplers in separate adjacent sediment probes (passive samplers) to accumulate dissolved TPH in a controlled manner. Measurements of dissolved TPH concentrations in sediment porewater were extracted from ASTM Type 1 Deionizer water inside the PDBs. PDBs consist of low density polyethylene bags filled with relatively de-oxygenated distilled water. When placed in water or sediment containing water, dissolved phase organic compounds diffuse through the wall of the bag in response to the concentration gradient between the porewater in the sediment and the distilled water in the bag.

The ASTM method does not include PAHs with more than four rings because water solubility is generally inversely proportional to molecular weight and the number of rings. The heavier PAHs are essentially non-water soluble and cannot be present in the dissolved phase in porewater. At the Port's request, however, the laboratory included heavier PAHs, including benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, benzo(e)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and pyrene. When these heavier PAHs were added to spiked samples, recoveries were poor due to their high molecular weights and low water solubilities, verifying that these PAHs cannot be present in porewater in the dissolved phase.

As required in the ASTM method, alkyl homolog results were reported based on response factors calculated from individual parent PAHs due to the lack of commercially available alkyl homolog reference standards. Alkyl homologs were considered to be detected when the analyte-specific pattern was present in the sample chromatogram and the signal-to-noise ratio for the peak met method-specified criteria. If analyte-specific patterns were not present in the sample chromatograms, the homologs were reported as being not detected at an estimated detection limit, which was calculated from the signal-to-noise ratio at the expected retention time range of the target homolog.

The 2017 porewater and surface water samples were collected using passive samplers[2] (i.e., sampling equipment equipped with LDPE passive sampling media) to assess the freely dissolved concentrations of PAHs and PAH homologs in sediment porewater and surface water. The passive samplers prepared and provided by FSES consisted of LDPE sheets impregnated with performance reference compounds (PRCs) that were then left in the sediment and/or overlying water for approximately 21 days and allowed to approach equilibrium. Upon sample retrieval, the passive samplers were processed and extracted as per FSES SOP 406.02 between October 17 and 26, 2017. Chemical analysis of surface water and sediment porewater LDPE PSDs was completed by the OSU FSES Program as described in the following SOPs.

- SOP 407.01 – Calculation of Freely Dissolved Water Concentrations (C_{free}) of Organic Compounds Derived from PE PSDs;
- SOP 418.00 – Determination of Parent and Alkyl Substituted PAHs (a total of 63 PAHs) using Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS);
- SOP 414.00 – Determination of OPAHs (a total of 22 analytes) using GC/MS;

[2] The term "passive sampler" is used in this report to refer to the sampling hardware (either sediment probes or surface water cages) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU SOPs to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These *in-situ* passive samplers are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in sediment porewater or surface water.

- SOP 416.10 – Determination of Hopane and Cholestane Compounds (a total of 11 analytes) by SIM GC/MS; and
- SOP 427.00 – Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS. The primary standard for this method was NIST SRM 1991 Mix Coal Tar/Petroleum Extract in Methylene Chloride.

Problems occurred during the preparation of one of the triplicate surface water samples (rep 2), as well as the deeper sediment porewater sample, at Phase 3 sampling location #10; subsequently the analytical results for these Phase 3 samples have been omitted from the FSES Final Report. According to FSES, the remaining field samples were analyzed for all methods with quality assurance/quality control (QA/QC) that met applicable data quality objectives (DQOs). As requested by DEQ, a sample of the certified reference material NIST SRM 2779 Gulf of Mexico Crude Oil was analyzed for alkyl PAHs by FSES and was included in its Final Report along with measures of instrument precision.

TOTAL AND DISSOLVED ORGANIC CARBON

Porewater and sediment samples were analyzed for DOC and TOC, respectively, using SM 5310B. Porewater samples were prepared for DOC analysis using the same screening and centrifuging technique used to prepare porewater samples for PAH analysis, but the samples did not undergo flocculation prior to DOC analyses.

DATA VALIDATION

The data from these samples were reviewed at a level equivalent to an EPA Stage 2A validation and verification, as defined in the EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA, 2009). The validation included review and validation of the laboratories' analytical reports to assess the following quality control parameters:

- Data completeness;
- Compliance with method-specified maximum holding times;
- The absence of laboratory or field contamination, as proven by the analysis of laboratory, equipment, and/or trip blanks;
- Analytical accuracy, as determined from laboratory control sample, matrix spike, and/or surrogate spike recoveries; and
- Sampling and/or analytical precision, as determined by the analysis of laboratory and field duplicates.

The validation did not include review or validation of the raw analytical data, with the exception of reviewing the chromatograms from the diesel- and oil-range organics analyses and comparing the sample chromatograms against the standard chromatograms.

In an effort to further evaluate and validate FSES porewater alkylated PAH data, we performed the following activities/tasks:

- Review FSES current freely dissolved PAH concentration calculation approach.
- Request additional information from FSES to confirm the specific calculation approach used by FSES for the alkylated PAHs.
  - Specifically, obtained complete sample information for deep porewater sample 1 (FSES project sample ID A170725) which included instrument concentrations, freely dissolved calculated concentrations, initial and final PRC concentrations, deployment time, deployment temperature, and which PRC(s) were used to calculate freely dissolved concentrations.
- Build an Excel calculator to match the approach used by FSES to calculate freely dissolved porewater concentrations of alkylated PAHs for the Port project.
- Calculate porewater concentrations for deep porewater sample 1 (FSES sample ID A170725).
  - Specifically, calculated freely dissolved porewater concentrations of naphthalene, C3-naphthalenes, and C4-naphthalenes for this sample. All calculated concentrations were within 10% of concentrations reported by FSES. Concentrations calculated as part of this validation exercise were consistently 8-9% lower than concentrations reported by FSES.
- Calculate toxic (TU) values using calculated porewater concentrations. Compared TU values using porewater concentrations calculated as part of this validation exercise to TU values using porewater concentrations reported by FSES. TU contributions calculated as part of this exercise were 8 to 9% lower than TU values calculated with porewater concentrations reported by OSU.

Copies of the spreadsheet output used to confirm OSU's FSES freely dissolved concentrations and the corresponding equations/partitioning coefficients are included in the Phase 3 Offshore Data Gap Investigation data quality review report provided in Appendix D.

In summary, we did not reject any data from these samples and the data may be considered 100% usable. We applied the following qualifiers during validation:

- J or UJ – 22% of the data from field samples were J or UJ qualified as being estimated values. We applied these qualifiers because of missed analytical hold times, high or low calibration verification recoveries, low laboratory control sample recoveries, high or low matrix spike recoveries, matrix interference, the lack of analyte-specific reference standards, and/or field duplicate imprecision.
- N or NJ – 1.8% of the data from field samples were N or NJ qualified as being presumptively identified because the sample chromatograms did not match the standard chromatograms.

- U – Less than 0.1% of the data were U qualified as being not detected because of target analyte detections in the associated blanks.

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DATA QUALITY REVIEW

Port of St. Helens

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Table 1: Samples Submitted to Apex Laboratories and Analytical Resources Incorporated

Table 2: Field Duplicate Detections

Table 3: Qualifiers Added During Data Quality Review

ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
AMEC	AMEC Environment & Infrastructure, Inc.
Apex	Apex Laboratories, LLC
ARI	Analytical Resources, Inc.
COC	chain of custody
DRO	diesel-range organics
Ecology	Washington Department of Ecology
EPA	United States Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
GRO	gasoline-range organics
ID	identification
LCS	laboratory control sample
mg/kg	milligrams per kilogram
MS	matrix spike
MSD	matrix spike duplicate
ORO	oil-range organics
PAH	polycyclic aromatic hydrocarbon
QC	quality control
RL	reporting limit
RPD	relative percent difference
TOC	total organic carbon

TPH	total petroleum hydrocarbons
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbons

DATA QUALITY REVIEW
Port of St. Helens

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) collected 143 sediment samples (including 4 field duplicates), 40 water samples (including 3 field duplicates, 3 trip blanks, and 5 rinsate blanks), and one product sample from the Port of St. Helens between September 7, 2010 and October 7, 2011. The samples were submitted to Apex Laboratories, LLC (Apex) in Tigard, Oregon, where they were assigned to sample delivery groups A10I079, A10I112, A11G167, A11G169, A11G186, A11G202, A11G219, A11G244, A11G294, A11H101, A11H114, and A11J131. Apex analyzed the samples for total petroleum hydrocarbons (TPH) by Washington Department of Ecology (Ecology) Methods NWTPH-Gx and/or NWTPH-Dx, metals by United States Environmental Protection Agency (EPA) Method 6020A, volatile organic compounds (VOCs) by EPA Method 8260B, polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270D, and/or total organic carbon (TOC) by Standard Methods 5310B. Apex subcontracted selected samples to Analytical Resources, Inc. (ARI) in Tukwilla, Washington for volatile petroleum hydrocarbons (VPH) by the Ecology Method for the Determination of VPH Fractions and extractable petroleum hydrocarbons (EPH) by the Ecology Method for Determination of EPH Fractions.

A list of all samples by sample location, Apex sample identification (ID), ARI Sample ID, matrix, and sample collection date is presented in Table 1.

2.0 DATA QUALITY REVIEW METHODOLOGY

Quality review of these data followed the National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008) and Inorganic Superfund Data Review (EPA, 2010). The EPA guidelines were written specifically for the Contract Laboratory Program, and have been modified for the purposes of this data quality review where they differ from method-specific quality control (QC) requirements. This data quality review consisted of assessment of summary reports, and does not include review or validation of the raw analytical data.

It is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but reported values may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCSs) are aliquots of analyte-free water or clean solid matrix that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked water or solid matrix is then processed through the same extraction, concentration, cleanup, and/or analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 MATRIX SPIKE RECOVERIES

Matrix spikes (MSs) and MS duplicates (MSDs) are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.4 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free water or clean solid matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

Trip blanks are vials of analyte free water that accompany sample bottles shipped to the field and back to the laboratory with field samples. The collection of a trip blank assesses contamination attributed to shipping and handling procedures, as well as contamination from containers. Target analytes should not be found in trip blanks.

Rinsate blanks are prepared by passing analyte-free water through or over sample collection equipment and collecting the water in sample containers. Rinsate blanks are analyzed for the analytical suite required for the project. Rinsate blanks are used to monitor for possible sample contamination during the sample collection process and serve as a check on the effectiveness of field decontamination procedures.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA QUALITY REVIEW

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

5.1 SAMPLE RECEIPT AT APEX

Samples were received at Apex intact, in good condition, and with proper chain of custody (COC) documentation. Apex only lists sample receipt temperature on the laboratory report when samples are received outside the EPA-recommended limit. Sample receipt temperatures were not listed on this report.

5.2 SAMPLE RECEIPT AT ARI

Samples were received at ARI intact, in good condition, with proper COC documentation, and at temperatures less than the EPA-recommended maximum of six degrees Celsius.

6.0 TOTAL PETROLEUM HYDROCARBONS

TPH data from this event may be considered usable with the qualifications specified in Sections 6.1 through 6.7.

6.1 HOLDING TIMES

All samples were extracted and analyzed within the 14-day method-recommended maximum holding time for preserved water samples and soil samples, except as described below.

Sample SB14-6-7 was sampled on July 15, 2011, but was not analyzed for VPH until September 5, 2011. The sample was frozen between sampling and analysis, but the maximum hold time for VOCs is 14 days for frozen samples. AMEC J qualified the detected C10-C12 aromatics result and UJ qualified the nondetected VPH results from this sample because of the missed hold time.

6.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with the TPH analysis of these samples, except as described below.

C8-C10 aliphatics were detected at a concentration of 3,400 micrograms per kilogram (µg/kg) in the laboratory blank associated with the EPH analysis of sample SB14-6-7. AMEC U qualified the

C8-C10 aliphatic result from this sample because the concentration detected in the sample was less than five times the concentration detected in the blank.

6.3 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within the laboratory-specified 70% to 130% limits.

6.4 SURROGATE RECOVERIES

Surrogate recoveries were within laboratory-specified limits, except as described below.

Apex was unable to recover the surrogate compound o-terphenyl from sample MW-3A (9/8/2010). The sample was analyzed at a 1:100 dilution that reduced the surrogate concentration below the analytical detection limit. In AMEC's professional opinion, data usability is not adversely affected.

6.5 MATRIX SPIKE RECOVERIES

AMEC used ARI's advisory control limits to evaluate MS and MSD recoveries. It should be noted that ARI did not report MS recoveries when analytes were not recovered or exhibited negative recoveries due to high analyte concentrations in the native unspiked sample.

- ARI performed a MS on sample SB14-6-7 for EPH. C_{10}-C_{12} aliphatics recovery was low at 10.3% in the MS, C_{12}-C_{16} aliphatics recoveries were low at -196% in the MS and -83% in the MSD, C_{16}-C_{21} aliphatics recoveries were low at -101% in the MS and -31% in the MSD, C_{10}-C_{12} aromatics recovery was low at 14.7% in the MS, C_{12}-C_{16} aromatics recoveries were low at -269% in the MS and -70% in the MSD, C_{16}-C_{21} aromatics recoveries were low at -466% in the MS and -169% in the MSD, and C_{21}-C_{34} aromatics recoveries were low at -266% in the MS and -86% in the MSD. Specific limitations are summarized below.
  - The background C_{12}-C_{16} aliphatics (347,000 µg/kg), C_{16}-C_{21} aliphatics (229,000 µg/kg), C_{12}-C_{16} aromatics (360,000 µg/kg), C_{16}-C_{21} aromatics (1,190,000 µg/kg), and C_{21}-C_{34} aromatics (881,000 µg/kg) concentrations in the unspiked sample were more than four times the spike concentrations. It is not possible to fully evaluate data usability for these analytes based on MS recoveries.
  - AMEC J qualified the detected C_{10}-C_{12} aliphatics and C_{10}-C_{12} aromatics results from this sample because of possibly low analytical bias.
- ARI performed a MS on sample SSED-MC-1 for EPH. C_{12}-C_{16} aliphatics recoveries were high at 131% in the MS and 130% in the MSD, C_{12}-C_{16} aromatics recoveries were high at 131% in the MS and 270% in the MSD, C_{16}-C_{21} aromatics recovery was high at 767% in the MSD, and C_{21}-C_{34} aromatics recovery was low at 40% in the MS. In all cases the background concentration in the unspiked native sample was more than four

times the spike concentration. It is not possible to fully evaluate data usability for these analytes based on MS recoveries.

6.6 LABORATORY DUPLICATES

Apex performed duplicate analyses of samples MC03-7.1, MW-18 (9/7/2010), SB03-11, SB12-9, and SB23-0-0.3. Target analytes were not detected in these duplicate pairs.

Apex performed duplicate analyses of samples MW25-19.5 and SB16-10. The results of the duplicate analyses indicate acceptable analytical precision with relative percent differences (RPDs) less than the laboratory's maximum limit of 30%.

Apex performed a duplicate analysis of sample SB11-0-0.3. Target analytes were not detected in the primary analysis, however oil-range organics (ORO) was detected at a concentration greater than the reporting limit (RL) in the duplicate analysis. AMEC UJ qualified the nondetected ORO result from sample SB11-0-0.3 because of analytical imprecision.

Apex performed a duplicate analysis of sample SB14-6-7. There was 37% RPD between the ORO results, and AMEC J qualified the ORO result from this sample because of analytical imprecision.

Apex performed a duplicate analysis of sample SB24-0-0.3. There was 34% RPD between the diesel-range organics (DRO) results and 33% RPD between the ORO results. AMEC J qualified the DRO result from this sample because of the analytical imprecision. The difference between the detected ORO results was less than the applicable RL and data usability is not adversely affected.

Apex performed a duplicate analysis of sample SSED-9. Target analytes were not detected in the primary analysis, however DRO was detected at a concentration greater than the RL in the duplicate analysis. AMEC UJ qualified the nondetected DRO result from sample SSED-9 because of the analytical imprecision.

6.7 DATA REPORTING AND ANALYTICAL PROCEDURES

According to Apex's notes, the gasoline-range organics (GRO) detection from samples MW-1-BTM, MW-1-MID, MW-3A (9/8/2010), MW-3B (9/8/2010), MW-6A (9/8/2010), and MW19-29.5-30 consisted primarily of individual peaks, and a fuel pattern was not detected. AMEC N qualified the GRO results from these samples as being presumptively identified.

According to Apex's notes, the chromatograms for the DRO detections in groundwater samples MW-1, MW-1-BTM, MW-1-Mid, MW-2A, MW-3A (9/8/2010 and 8/9/2011), MW-3B (9/8/2010),

MW-6A (9/8/2010 and 8/9/2011), MW-9 (9/7/2010 and 8/8/2011), MW-10 (9/7/2010 and 8/8/2011), MW-19, MW-20, MW-21, MW-22, MW-23, MW-24, MW-25; and soil and sediment samples MC2A-12, MC2A-12 DUP, MW19-21, MW19-29.5-30, MW20-16-17,MW20-16-17 DUP, MW21-21, MW22-20.5, MW23-13.5, MW24-14.5-15, MW25-19.5, SB01-5, SB03-7, SB04-3, SB05-4, SB06-5, SB05-8, SB08-4.5, SB08-8, SB09-5, SB10-2, SB10-8, SB11-4, SB11-15.5, SB11-24, SB12-3.9, SB13-2.5, SB14-0-0.3, SB14-6-7, SB15-4, SB15-8.5, SB16-5-6, SB16-10, SB17-5-6, SB18-0-0.3, SB18-4, SB18-18, SB20-6-7, SB21-6-7, SB22-7.5-8, SB24-0-0.3, SB26-4-4.5, SB28-0-0.3, SB28-2, SSED-2, SSED-6, SSED-7, SSED-MC-1, and SSED-MC-4 do not match the standard used for quantification. AMEC N qualified these DRO results as being presumptively identified.

According to Apex's notes, the DRO results from samples SB05-0-0.3, SB15-0-0.3, SB17-0-0.3, SB25-1.5, SB27-0-0.3, and SSED-5 are primarily from ORO eluting in the DRO retention time range. AMEC N qualified these DRO results as being presumptively identified.

According to Apex's notes, the chromatograms for the ORO detections in samples MC2A-12, MC2A-12 DUP, MW-3A (9/8/2010), MW20-16-17, MW20-16-17 DUP, MW22-20.5, SB03-7, SB04-3, SB05-4, SB08B-0-0.3, SB09-5, SB10-2, SB10-8, SB11-4, SB11-15.5, SB11-24, SB14-0-0.3, SB14-6-7, SB15-8.5, SB16-5-6, SB16-10, SB18-0-0.3, SB18-4, SB22-7.5-8, SB26-4-4.5, SB28-0-0.3, SB28-2, SSED-2, SSED-6, SSED-7, SSED-MC-1, and SSED-MC-4 do not match the standard used for quantification. AMEC N qualified these ORO results as being presumptively identified.

According to Apex's notes, the ORO detections in samples MW19-29.5-30 and MW24-14.5-15 are primarily from DRO eluting in the ORO retention time range. AMEC N qualified these ORO results as being presumptively identified.

According to ARI's documentation, C21-C34 aromatics recoveries were low in the calibration verification standards associated with the analysis of sample SB14-6-7. AMEC J qualified the C21-C34 aromatics result from this sample because of possibly low analytical bias.

Sample SB10-3 and SB11-4 were analyzed twice for VPH, once on July 18 and a second time on July 19. According to ARI's notes, the continuing calibrations associated with the July 19 analyses had high and low recoveries, while the continuing calibrations associated with the July 18 analyses just had high n-dodecane recovery. The results from the July 18 VPH analyses of samples SB10-3 and SB11-4 should be reported and the detected n-dodecane result from sample SB10-3 J qualified because of possibly high analytical bias. n-Dodecane was not detected in sample SB11-14 and data usability is not adversely affected by the possible high analytical bias.

7.0 METALS BY EPA METHOD 6020

Metal data from this event may be considered fully usable without qualification.

7.1 HOLDING TIMES

All samples were analyzed within the 180-day technical holding time.

7.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

7.3 RINSATE BLANKS

Target analytes were not detected in the rinsate blanks collected on July 20, 2011.

7.4 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within the laboratory-specified 80% to 120% limits.

7.5 MATRIX SPIKE RECOVERIES

Apex performed MSs on samples MW-3A (8/9/2011), MW-4A (9/7/2010), MW-10 (8/8/2011), and SSED-8. Recoveries were within laboratory-specified limits.

Apex performed a MS on sample SB17-0-0.3, but was not able to recover the iron spike. The background iron concentration in the unspiked native sample, at 29,800 milligrams per kilogram (mg/kg) was more than eight times the spike concentration of 3,710 mg/kg. It is not possible to fully evaluate data usability for this analyte based on the MS recovery.

7.6 LABORATORY DUPLICATES

Apex performed duplicate analyses of samples MW-10 (8/8/2011) and SB17-0-0.3. RPDs between duplicate results were less than the laboratory-specified maximum of 20%.

8.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

VOC data from this event may be considered usable with the limitations and exceptions described in Sections 8.1 through 8.7.

8.1 HOLDING TIMES

All samples were analyzed within the technical holding time of 14 days from sample collection.

8.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

8.3 TRIP BLANK

Target analytes were not detected in the trip blank associated with these samples.

8.4 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within the laboratory-specified 65% to 135% limits, with the following exceptions.

- Bromomethane and hexachlorobutadiene recoveries were outside the laboratory's limits at 47% and 139%, respectively, in the LCS associated with the analysis of samples SB10-3, SB11-4, SB17-0-0.3, and SB18-0-0.3. Specific limitations are summarized below.
  - AMEC UJ qualified the nondetected bromomethane result from these samples because of possibly low analytical bias.
  - Hexachlorobutadiene was not detected in the associated samples. Data usability is not adversely affected by the possibly high analytical bias.
- Bromomethane (151%), chlorobenzene (306%), and trichlorofluoromethane (342%) recoveries were high in the LCS associated with the analysis of sample SB14-6-7. These analytes were not detected in the associated sample. Data usability is not adversely affected by the possibly high analytical bias.
- Bromomethane (145%), chloroethane (195%), and trichlorofluoromethane (345%) recoveries were high in the LCS associated with the analysis of the trip blank collected on July 20, 2011. These analytes were not detected in the associated sample. Data usability is not adversely affected by the possibly high analytical bias.

- Chloroethane and trichlorofluoromethane recoveries were high at 200% and 199%, respectively, in the LCS associated with the analysis of samples SSED-5 and SSED-MC-1. Chloroethane and trichlorofluoromethane were not detected in the associated samples. Data usability is not adversely affected by the possibly high analytical bias.
- m,p-Xylene and o-xylene recoveries were high at 131% and 137%, respectively, in the LCS associated with the analysis of the trip blank collected on September 7, 2010. These analytes were not detected in the associated sample and data usability is not adversely affected by the possibly high analytical bias.

8.5 SURROGATE STANDARD RECOVERIES

All surrogates recoveries associated with the VOC analyses were within laboratory-specified limits.

8.6 MATRIX SPIKES

Apex performed a MS on sample MW-9 (9/7/2010). The MS was analyzed outside the method-specified 12-hour analytical window; however, analyte recoveries were acceptable. In AMEC's professional opinion, data usability is not adversely affected.

8.7 LABORATORY DUPLICATES

Apex performed a duplicate analysis of sample MW-18 (9/7/2010). Target analytes were not detected in the primary sample or laboratory duplicate.

Apex performed a duplicate analysis of sample SB14-6-7. Naphthalene was detected at a concentration of 2,990 µg/kg in the primary analysis and at a concentration of 5,120 µg/kg in the duplicate. The RPD between these two results was high at 52%. AMEC J qualified the naphthalene result from this sample because of analytical imprecision.

Apex performed a duplicate analysis of sample SSED-5. RPDs for all detected analytes were less than the laboratory's maximum of 30%, or the differences between detected analyte concentrations were less than the applicable RL.

9.0 POLYCYCLIC AROMATIC HYDROCARBONS BY EPA METHOD 8270D

PAH data from this event may be considered usable with the limitations and exceptions described in Sections 9.1 through 9.8.

9.1 HOLDING TIMES

All samples were extracted within the method-specified 7-day maximum holding time for preserved water samples or 14-day maximum holding time for solid samples. All sample extracts were analyzed within the 40-day maximum holding time from extraction until analysis.

9.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples except as described below.

- Naphthalene was detected at a concentration of 6.90 µg/kg in the laboratory blank associated with the analysis of samples SB02-0-0.3, SB04-3, SB05-0-0.3, SB06-5, SB08-0-0.3, SB08-4.5, SB09-0-0.3, SB10-0-0.3, SB10-2, SB11-0-0.3, SB14-0-0.3, SB14-6-7, SB15-0-0.3, SB15-4, SB15-8.5, SB16-5-6, SB16-10, SB17-5-6, SB18-4, SB18-18, SB20-0-0.3, SB20-6-7, SB21-6-7, SB25-1.5, SB26-4-4.5, and SB28-0-0.3. The naphthalene concentrations in the associated samples were more than five times the concentration detected in the blank, corrected for dilutions, and data usability is not adversely affected.
- Acenaphthylene was detected at a concentration of 11.0 µg/kg in the laboratory blank associated with the analysis of sample SB28-2. The acenaphthylene concentration in the associated sample, was more than five times the concentration detected in the blank, corrected for dilution, and data usability is not adversely affected.
- Acenaphthene and naphthalene were detected at concentrations of 0.0289 micrograms per liter (µg/L) and 0.826 µg/L, respectively, in the laboratory blank associated with the analysis of the clamshell rinsate and rinsate blank collected on July 20, 2011. The rinsate was the only sample associated with this blank. In AMEC's professional opinion, overall data usability is not adversely affected.

9.3 RINSATE BLANKS

Fluoranthene (0.0572 µg/L), naphthalene (1.32 µg/L), phenanthrene (0.0551 µg/L), and pyrene (0.0386 µg/L) were detected in the rinsate blank collected on September 8, 2010. The concentrations detected in the associated field samples were more than five times the concentrations detected in the blank, and data usability is not adversely affected.

Fluoranthene (0.0379 µg/L), naphthalene (0.0866 µg/L), and phenanthrene (0.0735 µg/L) were detected in the rinsate blank collected on July 15, 2011. The concentrations detected in the aqueous blank were orders of magnitude lower than reporting limits for the associated soil samples, and data usability is not adversely affected.

Benzo(a)anthracene (0.0680 µg/L), benzo(b)fluoranthene (0.0461 µg/L), chrysene (0.0673 µg/L), fluoranthene (0.111 µg/L), and pyrene (0.0818 µg/L) were detected in the clamshell rinsate collected on July 20, 2011. The concentrations detected in the aqueous blank were orders of magnitude lower than reporting limits for the associated soil samples, and data usability is not adversely affected.

Acenaphthene (0.546 µg/L), anthracene (1.90 µg/L), benzo(a)anthracene (0.523 µg/L), benzo(a)pyrene (0.0916 µg/L), benzo(b)fluoranthene (0.185 µg/L), benzo(k)fluoranthene (0.0748 µg/L), chrysene (0.440 µg/L), chrysene (0.440 µg/L), fluoranthene (6.85 µg/L), fluorene (3.45 µg/L), naphthalene (0.102 µg/L), and pyrene (4.08 µg/L) were detected in the rinsate blank collected on July 20, 2011. The concentrations detected in the aqueous blank were orders of magnitude lower than reporting limits for the associated soil samples, and data usability is not adversely affected.

9.4 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's limits.

9.5 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits, except as described below.

- Recoveries of all surrogate compounds were high in the analysis of sample MW-3A (9/8/2010). The sample was analyzed at 1:500 and 1:5,000 dilutions due to high target analyte concentrations, causing the surrogate concentrations to be reduced below the analytical calibration range. In AMEC's professional opinion, data usability is not adversely affected.
- Recovery of the surrogate compound 4-bromofluorobenzene was high at 122% in the trip blank collected on September 8, 2010. AMEC does not routinely qualify data from trip blanks and overall data usability is not adversely affected.
- Recoveries of the surrogate compound 2-fluorobiphenyl were low in the analysis of samples MW-3B (8/9/2011) (31%), MW-4B (8/8/2011)(40%), MW-6A (8/9/2011)(30%), MW-9 (9/7/2010) (43%), MW-19 (31%), MW-20 (26%), MW-21 (31%), and MW-25 (22%). AMEC J qualified the detected results and UJ qualified the nondetected results from these samples because of possibly low analytical bias.
- Recovery of the surrogate compound p-terphenyl-d_{14} was high at 196% in the 1:500 dilution of sample MW-2A. The dilution reduced the surrogate concentration below the analytical calibration range. Data usability is not adversely affected.

- Recoveries of the surrogate compound p-terphenyl-d_{14} were high in samples MW20-16-17 DUP and MW22-20.5 at 132% and 146%, respectively. AMEC J qualified the detected results from these samples because of possibly high analytical bias.

- Recoveries of the surrogate compounds 2-fluorobiphenyl and p-terphenyl-d_{14} were high at 195% and 374%, respectively, in sample SB04-3. This sample was analyzed at a 1:10 dilution due to high target analyte concentrations and the surrogate concentrations were reduced below the analytical calibration range. In AMEC's professional opinion, data usability is not adversely affected.

- Recoveries of the surrogate compounds 2-fluorobiphenyl and p-terphenyl-d_{14} were high at 122% and 251%, respectively, in sample MW-3A (8/9/2011). This sample was analyzed at a 1:20 dilution due to high target analyte concentrations, causing the surrogate concentration to be reduced below the analytical calibration range. In AMEC's professional opinion, data usability is not adversely affected.

- Recoveries of the surrogate compounds 2-fluorobiphenyl and p-terphenyl-d_{14} were high in samples MC2A-12 (143%/281%), MC2A-12 DUP (126%/267%), MW20-16-17 (148%/270%), SB08-4.5 (121%/207%), and SB14-6-7 (138%/208%). These samples were analyzed at 1:5 dilutions due to high target analyte concentrations, causing the surrogate concentration to be reduced below the analytical calibration range. In AMEC's professional opinion, data usability is not adversely affected.

- Recoveries of the surrogate compound p-terphenyl-d_{14} were high in samples SB10-0-0.3 (175%), SB14-0-0.3 (123%), and SB25-1.5 (122%). These samples were analyzed at 1:5 dilutions due to high target analyte concentrations, causing the surrogate concentration to be reduced below the analytical calibration range. In AMEC's professional opinion, data usability is not adversely affected.

- Recovery of the surrogate compound p-terphenyl-d_{14} was high at 207% in sample SB10-2. This sample was analyzed at a 1:20 dilution due to high target analyte concentrations, causing the surrogate concentration to be reduced below the analytical calibration range. In AMEC's professional opinion, data usability is not adversely affected.

- Recoveries of the surrogate compounds nitrobenzene-d_5 and p-terphenyl-d_{14} were outside the laboratory's limits in samples MW25-19.5 (247%/481%) and SB26-4-4.5 (29%/140%). These samples were analyzed at 1:10 dilutions due to high target analyte concentrations, causing the surrogate concentration to be reduced below the analytical calibration range. In AMEC's professional opinion, data usability is not adversely affected.

- Recovery of the surrogate compound p-terphenyl-d_{14} was high at 233% in sample SB28-2. This sample was analyzed at a 1:10 dilution due to high target analyte concentrations, causing the surrogate concentration to be reduced below the analytical calibration range. In AMEC's professional opinion, data usability is not adversely affected.

9.6 MATRIX SPIKE RECOVERIES

Apex performed a MS on sample SB14-6-7. Acenaphthene (129%), anthracene (30%), benzo(a)anthracene (-17%), benzo(a)pyrene (45%), benzo(b)fluoranthene (-9%), chrysene (6%), fluoranthene (166%), fluorene (-248%), indeno(1,2,3-cd)pyrene (38%), and phenanthrene (-433%) recoveries were outside the laboratory's limits. Specific limitations are summarized below.

- The acenaphthene (104,000 µg/kg), anthracene (58,000), benzo(a)anthracene (24,600 µg/kg), chrysene (27,800 µg/kg), fluoranthene (147,000), fluorene (102,000 µg/kg), and phenanthrene (273,000 µg/kg) concentrations detected in the unspiked native sample were more than four times the spike concentration of 4,850 µg/kg. Data usability is not adversely affected by these high or low MS recoveries.
- AMEC J qualified the detected benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene results from sample SB14-6-7 because of possibly low analytical bias.

Apex performed a MS on sample SB28-2. Acenaphthene (35%), chrysene (128%), fluoranthene (160%), naphthalene (-96%), and pyrene (152%) recoveries were outside the laboratory's limits. Specific limitations are summarized below.

- The fluoranthene (49,200 µg/kg), naphthalene (20,400 µg/kg), and pyrene (30,700 µg/kg) concentration detected in the unspiked native sample were more than four times the spike concentration of 3,360 µg/kg. Data usability is not adversely affected by these high or low MS recoveries.
- AMEC J qualified the detected acenaphthene result from this sample because of possibly low analytical bias.
- AMEC J qualified the detected chrysene result from this sample because of possibly high analytical bias.

Apex performed a MS on sample MW25-19.5. Acenaphthene (975%), anthracene (552%), benzo(a)anthracene (24%), benzo(a)pyrene (-19%), benzo(b)fluoranthene (-92%), chrysene (0.8%), fluoranthene (1,110%), fluorene (914%), indeno(1,2,3-cd)pyrene (27%), naphthalene (619%), phenanthrene (2,520%), and pyrene (723%) recoveries were outside the laboratory's limits. Specific limitations are summarized below.

- Acenaphthene (41,500 µg/kg), anthracene (33,400 µg/kg), benzo(a)anthracene (16,400 µg/kg), benzo(a)pyrene (7,4250 µg/kg), benzo(b)fluoranthene (11,900 µg/kg), chrysene (20,500 µg/kg), fluoranthene (85,800 µg/kg), fluorene (41,600 µg/kg), naphthalene (11,300 µg/kg), phenanthrene (135,000 µg/kg), and pyrene (59,400 µg/kg) concentrations in the native unspiked sample were more than four times the spike

concentration of 1,320 µg/kg. Data usability is not adversely affected by these high or low MS recoveries.

- AMEC J qualified the detected indeno(1,2,3-cd)pyrene result from this sample because of possibly low analytical bias.
- AMEC J qualified the detected fluorene and naphthalene results from this sample because of high variability in the analytical results.

9.7 LABORATORY DUPLICATES

Apex performed duplicate analyses of samples MC03-0-0.3 and SB28-2. RPDs between the field duplicate pairs were less than the laboratory's 30% maximum limit, or the difference between analyte concentrations was less than the applicable RL.

Apex performed a duplicate analysis of sample MW21-21. AMEC J qualified the detected acenaphthylene (difference greater than [>] RL) and naphthalene (127% RPD) results from this sample because of analytical imprecision.

Apex performed duplicate analysis of sample SB04-0-0.3. AMEC J qualified the detected acenaphthene (difference > RL), anthracene (difference > RL), fluoranthene (58% RPD), phenanthrene (difference > RL), and pyrene (45% RPD) results from this sample because of analytical imprecision.

Apex performed duplicate analysis of sample SB08A-0-0.3. AMEC J qualified the detected acenaphthene (difference > RL), benzo(a)pyrene (difference > RL), benzo(b+k)fluoranthene(s) (difference > RL), benzo(g,h,i)perylene (difference > RL), fluorene (difference > RL), indeno(1,2,3-cd)pyrene (difference > RL), and phenanthrene (78% RPD) results from this sample because of analytical imprecision.

Apex performed two duplicate analyses of sample MW24-14.5-15. In the first duplicate analysis, RPDs between the primary and duplicate benzo(g,h,i)perylene and chrysene results were high at 33% and 42%, respectively. AMEC J qualified these results because of analytical imprecision. In the second duplicate, RPDs were high for acenaphthene (35%), fluoranthene (33%), fluorene (32%), naphthalene (33%), and phenanthrene (35%). AMEC J qualified these results because of analytical imprecision.

9.8 DATA REPORTING AND ANALYTICAL PROCEDURES

According to Apex's notes, benzo(b)fluoranthene and benzo(k)fluoranthene coelute. When neither analyte was detected, Apex reported the results separately. When only one of the compounds was

detected, but the concentration was less than the combined reporting limit for benzo(b)fluoranthene and benzo(k)fluoranthene, Apex reported the nondetected result as benzo(b+k)fluoranthene(s). When either (or both) analyte(s) were detected at concentrations above the combined reporting limit, the detected result was reported as benzo(b+k)fluoranthene(s).

According to Apex's notes, it was not possible to accurately quantify the naphthalene result from sample MW-10 (9/7/2010) due to matrix interference. AMEC J qualified this result as an estimated value.

According to Apex's notes, it was not possible to accurately quantify the indeno(1,2,3-cds)pyrene result from sample SB21-0-0.3 due to matrix interference. AMEC J qualified this result as an estimated value.

All alkylated PAH homologs should be considered estimated values because reference standards are not available for all of them. The concentrations were calculated using the most similar available reference. AMEC J qualified the detected and UJ qualified the nondetected results for these analytes because of lack of analyte-specific QC samples.

10.0 TOTAL ORGANIC CARBON BY STANDARD METHODS 5310B

TOC data from this event may be considered usable with the limitations and exceptions described in Sections 10.1 through 10.5.

10.1 HOLDING TIMES

All samples were analyzed within the 28-day technical holding time.

10.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

10.3 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within the laboratory-established 90% to 110% limits for unqualified data.

10.4 LABORATORY DUPLICATES

Apex performed duplicate analyses of samples SB02-0-0.3 and SB08A-0-0.3. The results exhibited acceptable analytical precision with less than 20% RPD between duplicate results.

Apex performed a duplicate analysis of sample SSED-2. TOC was detected in the primary analysis at a concentration of 24,000 mg/kg and in the duplicate analysis at a concentration of 31,000 mg/kg, with a RPD of 25%, exceeding the laboratory-established 20% maximum. AMEC J qualified the detected TOC result from sample SSED-2 because of analytical imprecision, possibly attributable to an inhomogeneous sample matrix.

10.5 DATA REPORTING AND ANALYTICAL PROCEDURE

Samples SSED-5, SSED-6, SSED-7, and SSED-MC-1 contained multiple phases: a sand/dirt mix, wood fibers, and/or solidified product. Apex was able to obtain sufficient mass of the sand/dirt fraction to perform TOC analysis, but the wood fiber and/or solidified product compromised a much smaller fraction of the overall sample. Apex analyzed the wood fiber and/or solidified product portion(s) of the samples, but these fractions had TOC content higher than the analytical instrument's maximum range and there was insufficient sample remaining to reanalyze these fractions. Apex reported estimated values for the wood fiber and/or solidified product portions of these samples, which would represent the minimum amount of TOC present in each fraction. These estimated TOC concentrations were not provided in the laboratory's electronic data deliverable.

11.0 FIELD DUPLICATES

Field duplicates were collected at MC2A-12, MW-18 (8/8/2011), MW20-16-17, MW-23, and SB06-13.5. Analytes detected in the field duplicate pairs are summarized in Table 2. RPD values between primary and duplicate results were less than 50% for soil samples, RPDs were less than 30% for aqueous samples, or the differences between analyte concentrations were less than the applicable RL, except as described below.

AMEC J qualified the detected naphthalene results from samples MC2A-12and MC2A-12 Dup because of analytical imprecision.

AMEC J qualified the detected benzo(a)pyrene, benzo(b+k)fluoranthene, and naphthalene results from samples MW-23 and MW-23 DUP because of analytical imprecision.

AMEC J qualified all PAH results from samples MW20-16-17 and MW20-16-17 DUP because of analytical imprecision.

12.0 SUMMARY

AMEC reviewed a total of 3,441 data records during this data quality review. No data were rejected and 100% of the data should be considered fully usable with the addition of the qualifiers summarized below and in Table 3.

- AMEC J or UJ qualified 573 results (17%) as being estimated values because of:
  - Missed analytical hold time (Section 6.1),
  - High or low MS recoveries (Sections 6.5 and 9.6),
  - Laboratory duplicate imprecision (Sections 6.6, 8.7, 9.7, and 10.4),
  - High or low calibration verification standard recoveries (Section 6.7),
  - Low LCS recoveries (Section 8.4),
  - High or low surrogate recoveries (Section 9.5),
  - Matrix interference (Section 9.8),
  - The lack of analyte-specific reference standards (Section 9.8), and
  - Field duplicate imprecision (Section 11.0).
- AMEC N qualified 117 results (3.4%) as being presumptively identified because the sample spectra did not match the standard spectra. (Section 6.7)
- AMEC U qualified one result (0.03%) as being not detected because the analyte concentration detected in the sample was less than five times the concentration detected in the associated laboratory blank. (Section 6.2)

REFERENCES

APHA, 2005. Standard Methods for Examination of Water and Wastewater. 21st Edition.

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EPA, 2007a. Method 6020A, Inductively Coupled Plasma-Mass Spectrometry, Revision 1, February 2007.

EPA, 2007c. Method 8270D, Semivolatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), Revision 4, February 2007.

EPA, 1996b. Method 8260B, Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), Revision 2, December 1996.

LIMITATIONS

This report was prepared exclusively for Port of St. Helens by AMEC Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data quality review is intended to be used by Port of St. Helens for the Port of St. Helens Site only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

TABLES

Table 1
Field Samples Submitted to Apex Laboratories and Analytical Resources Incorporated
Port of Saint Helens

Sample ID	Apex Sample ID	ARI Sample ID	Matrix	Collection Date	Notes
MW-18	A10I079-01	-	Water	9/7/2010	
MW-9	A10I079-02	-	Water	9/7/2010	
MW-5	A10I079-03	-	Water	9/7/2010	
MW-4B	A10I079-04	-	Water	9/7/2010	
MW-4A	A10I079-05	-	Water	9/7/2010	
MW-4A-ED	A10I079-06	-	Water	9/7/2010	Field duplicate
TB-20100907	A10I079-07	-	Water	9/7/2010	Trip blank
EB-20120907	A10I079-08	-	Water	9/7/2010	Rinsate blank
MW-10	A10I079-09	-	Water	9/7/2010	
MW-1-Mid	A10I112-01	-	Water	9/8/2010	
MW-1-BTM	A10I112-02	-	Water	9/8/2010	
MW-6A	A10I112-03	-	Water	9/8/2010	
MW-3A	A10I112-04	-	Water	9/8/2010	
MW-3B	A10I112-05	-	Water	9/8/2010	
EB-20120908	A10I112-06	-	Water	9/8/2010	Rinsate blank
TB-20100908	A10I112-07	-	Water	9/8/2010	Trip blank
MW-3A-DNAPL	A10I112-08	-	Liquid	9/8/2010	NAPL
SB07-0-0.3	A11G167-01	-	Sediment	7/13/2011	
SB07-12.8	A11G167-02	-	Sediment	7/13/2011	
SB07-7.0	A11G167-03	-	Sediment	7/13/2011	On hold
SB08-0-0.3	A11G167-04	-	Sediment	7/13/2011	
SB08-4.5	A11G167-05	-	Sediment	7/13/2011	
SB08-8	A11G167-06	-	Sediment	7/13/2011	
SB10-0-0.3	A11G167-07	-	Sediment	7/13/2011	
SB10-2	A11G167-08	-	Sediment	7/13/2011	
SB10-3	A11G167-09	TE93A	Sediment	7/13/2011	
SB10-8	A11G167-10	-	Sediment	7/13/2011	
SB08A-0-0.3	A11G167-11	-	Sediment	7/13/2011	
SB08B-0-0.3	A11G167-12	-	Sediment	7/13/2011	
SB08C-0-0.3	A11G167-13	-	Sediment	7/13/2011	
SB11-0-0.3	A11G167-14	-	Sediment	7/13/2011	
MCO3-0-0.3	A11G169-01	-	Sediment	7/12/2011	
MC03-1.8	A11G169-02	-	Sediment	7/12/2011	On hold
MCO3-7.1	A11G169-03	-	Sediment	7/12/2011	
MCO3-12.8	A11G169-04	-	Sediment	7/12/2011	
MCO4-0-0.3	A11G169-05	-	Sediment	7/12/2011	
MCO4-3.3	A11G169-06	-	Sediment	7/12/2011	
MCO4-9.5	A11G169-07	-	Sediment	7/12/2011	

Table 1
Field Samples Submitted to Apex Laboratories and Analytical Resources Incorporated
Port of Saint Helens

Sample ID	Apex Sample ID	ARI Sample ID	Matrix	Collection Date	Notes
SB11-4	A11G186-01	TE42B	Sediment	7/13/2011	
SB11-15.5	A11G186-02	-	Sediment	7/13/2011	
SB11-24	A11G186-03	-	Sediment	7/13/2011	
SB05-0-0.3	A11G186-04	-	Sediment	7/14/2011	
SB05-4	A11G186-05	-	Sediment	7/14/2011	
SB05-8	A11G186-06	-	Sediment	7/14/2011	
SB05-9	A11G186-07	-	Sediment	7/14/2011	On hold
SB03_0-0.3	A11G186-08	-	Sediment	7/14/2011	
SB03-7	A11G186-09	-	Sediment	7/14/2011	
SB03-11	A11G186-10	-	Sediment	7/14/2011	
SB01-0-0.3	A11G186-11	-	Sediment	7/14/2011	
SB01-5	A11G186-12	-	Sediment	7/14/2011	
SB01-13.8	A11G186-13	-	Sediment	7/14/2011	On hold
SB02-0.0.3	A11G186-14	-	Sediment	7/14/2011	
SB02-12.5	A11G186-15	-	Sediment	7/14/2011	
SB02-18	A11G186-16	-	Sediment	7/14/2011	On hold
SB03-11 DUP	A11G186-17	-	Sediment	7/14/2011	Field duplicate
SB04-0-0.3	A11G186-18	-	Sediment	7/14/2011	
SB04-3	A11G186-19	-	Sediment	7/14/2011	
SB04-16	A11G186-20	-	Sediment	7/14/2011	On hold
SB06-0-0.3	A11G186-21	-	Sediment	7/14/2011	
SB06-5	A11G186-22	-	Sediment	7/14/2011	
SB06-13.5	A11G186-23	-	Sediment	7/14/2011	
SB06-13.5 DUP	A11G186-24	-	Sediment	7/14/2011	Field duplicate
SB09-0-0.3	A11G186-25	-	Sediment	7/14/2011	
SB09-5	A11G186-26	-	Sediment	7/14/2011	
SB09-11	A11G186-27	-	Sediment	7/14/2011	On hold
SB12-0-0.3	A11G186-28	-	Sediment	7/14/2011	
SB12-3.9	A11G186-29	-	Sediment	7/14/2011	
SB12-9	A11G186-30	-	Sediment	7/14/2011	
SB13-0-0.03	A11G202-01	-	Sediment	7/14/2011	
SB13-2.5	A11G202-02	-	Sediment	7/14/2011	
SB13-4.4	A11G202-03	-	Sediment	7/14/2011	
Rinsate-71411	A11G202-04	-	Water	7/14/2011	Rinsate blank
SB19-0-0.3	A11G202-05	-	Sediment	7/15/2011	
SB19-1.0	A11G202-06	-	Sediment	7/15/2011	
SB19-10	A11G202-07	-	Sediment	7/15/2011	
SB18-0-0.3	A11G202-08	-	Sediment	7/15/2011	
SB18-4	A11G202-09	-	Sediment	7/15/2011	
SB18-18	A11G202-10	-	Sediment	7/15/2011	
SB17-0-0.3	A11G202-11	-	Sediment	7/15/2011	
SB17-5-6	A11G202-12	-	Sediment	7/15/2011	
SB17-22-23	A11G202-13	-	Sediment	7/15/2011	On hold
SB16-0-0.3	A11G202-14	-	Sediment	7/15/2011	
SB16-10	A11G202-15	-	Sediment	7/15/2011	
SB16-5-6	A11G202-16	-	Sediment	7/15/2011	
SB20-0-0.3	A11G202-17	-	Sediment	7/15/2011	
SB20-6-7	A11G202-18	-	Sediment	7/15/2011	
SB20-22.5-23.5	A11G202-19	-	Sediment	7/15/2011	On hold
SB21-0-0.3	A11G202-20	-	Sediment	7/15/2011	
SB021-20.5-21	A11G202-21	-	Sediment	7/15/2011	
SB021-6-7	A11G202-22	-	Sediment	7/15/2011	On hold
SB15-0-0.3	A11G202-23	-	Sediment	7/15/2011	
SB15-4	A11G202-24	-	Sediment	7/15/2011	
SB15-8.5	A11G202-25	-	Sediment	7/15/2011	

Table 1
Field Samples Submitted to Apex Laboratories and Analytical Resources Incorporated
Port of Saint Helens

Sample ID	Apex Sample ID	ARI Sample ID	Matrix	Collection Date	Notes
SB22-0-0.3	A11G219-01	-	Sediment	7/15/2011	On hold
SB22-4-4.5	A11G219-02	-	Sediment	7/15/2011	On hold
SB22-7.5-8	A11G219-03	-	Sediment	7/15/2011	
SB23-0-0.3	A11G219-04	-	Sediment	7/15/2011	
SB23-2.5-3	A11G219-05	-	Sediment	7/15/2011	On hold
SB23-7.5-8	A11G219-06	-	Sediment	7/15/2011	On hold
SB24-0-0.3	A11G219-07	-	Sediment	7/16/2011	
SB24-5-5.5	A11G219-08	-	Sediment	7/16/2011	On hold
SB24-11-11.5	A11G219-09	-	Sediment	7/16/2011	On hold
SB25-0-0.3	A11G219-10	-	Sediment	7/16/2011	On hold
SB25-6.5-7	A11G219-11	-	Sediment	7/16/2011	
SB25-1.5	A11G219-12	-	Sediment	7/16/2011	
SB26-0.3	A11G219-13	-	Sediment	7/16/2011	
SB26-7-7.5	A11G219-14	-	Sediment	7/16/2011	On hold
SB26-4-4.5	A11G219-15	-	Sediment	7/16/2011	
SB27-0-0.3	A11G219-16	-	Sediment	7/16/2011	
SB27-7.5-8	A11G219-17	-	Sediment	7/16/2011	On hold
SB27-4.5-5	A11G219-18	-	Sediment	7/16/2011	On hold
SB28-0-0.3	A11G219-19	-	Sediment	7/16/2011	
SB28-6.5-7	A11G219-20	-	Sediment	7/16/2011	On hold
SB28-2	A11G219-21	-	Sediment	7/16/2011	
SB29-5.6	A11G219-22	-	Sediment	7/16/2011	
SB29-10.5-11	A11G219-23	-	Sediment	7/16/2011	On hold
SB30-0-0.3	A11G219-24	-	Sediment	7/16/2011	On hold
SB30-8-9	A11G219-25	-	Sediment	7/16/2011	On hold
SB30-16.5-18	A11G219-26	-	Sediment	7/16/2011	On hold
SB31-0-0.3	A11G219-27	-	Sediment	7/16/2011	On hold
SB31-0-0.3 Dup	A11G219-28	-	Sediment	7/16/2011	On hold
SB31-2.5-3	A11G219-29	-	Sediment	7/16/2011	On hold
SB31-2.5-3 DUP	A11G219-30	-	Sediment	7/16/2011	On hold
SB14-0-0.3	A11G219-31	-	Sediment	7/15/2011	
SB14-6-7	A11G219-32	TJ82A	Sediment	7/15/2011	
SB14-10-11	A11G219-33	-	Sediment	7/15/2011	On hold
MW19-8	A11G244-01	-	Sediment	7/19/2011	On hold
MW19-21	A11G244-02	-	Sediment	7/19/2011	
MW19-26.5	A11G244-03	-	Sediment	7/19/2011	On hold
MW19-29.5-30	A11G244-04	-	Sediment	7/19/2011	
MW23-13.5	A11G244-05	-	Sediment	7/19/2011	
MW24-12.5	A11G244-06	-	Sediment	7/19/2011	On hold
MW24-14.5-15	A11G244-07	-	Sediment	7/19/2011	

Table 1
Field Samples Submitted to Apex Laboratories and Analytical Resources Incorporated
Port of Saint Helens

Sample ID	Apex Sample ID	ARI Sample ID	Matrix	Collection Date	Notes
Rinsate-Clamshell	A11G294-01	-	Water	7/20/2011	Rinsate blank
TB	A11G294-02	-	Water	7/20/2011	Trip blank
Rinsate-72011	A11G294-03	-	Water	7/20/2011	Rinsate blank
MC2A-12	A11G294-04	-	Sediment	7/20/2011	
MC2A-12 DUP	A11G294-05	-	Sediment	7/20/2011	Field duplicate
MC1A-2	A11G294-06	-	Sediment	7/20/2011	On hold
MC1A-4	A11G294-07	-	Sediment	7/20/2011	On hold
MC1A-10.5	A11G294-08	-	Sediment	7/20/2011	On hold
MC1A-10.5 DUP	A11G294-09	-	Sediment	7/20/2011	On hold
MC2A-6.5	A11G294-10	-	Sediment	7/20/2011	On hold
MC1-9	A11G294-11	-	Sediment	7/20/2011	On hold
MC1-19.5	A11G294-12	-	Sediment	7/21/2011	
MW21-10.5	A11G294-13	-	Sediment	7/21/2011	On hold
MW21-21	A11G294-14	-	Sediment	7/21/2011	
MW20-16-17	A11G294-15	-	Sediment	7/21/2011	
MW20-16-17 DUP	A11G294-16	-	Sediment	7/21/2011	Field duplicate
MW22-20.5	A11G294-17	-	Sediment	7/22/2011	
MW25-19.5	A11G294-18	-	Sediment	7/22/2011	
MW-9	A11H101-01	-	Water	8/8/2011	
MW-18	A11H101-02	-	Water	8/8/2011	
MW-18 DUP	A11H101-03	-	Water	8/8/2011	Field duplicate
MW-10	A11H101-04	-	Water	8/8/2011	
MW-4A	A11H101-05	-	Water	8/8/2011	
MW-4B	A11H101-06	-	Water	8/8/2011	
MW-20	A11H101-07	-	Water	8/8/2011	
MW-19	A11H101-08	-	Water	8/8/2011	
MW-5	A11H101-09	-	Water	8/8/2011	
MW-23	A11H114-01	-	Water	8/9/2011	
MW-23 DUP	A11H114-02	-	Water	8/9/2011	Field duplicate
MW-24	A11H114-03	-	Water	8/9/2011	
MW-21	A11H114-04	-	Water	8/9/2011	
MW-1	A11H114-05	-	Water	8/9/2011	
MW-25	A11H114-06	-	Water	8/9/2011	
MW-6A	A11H114-07	-	Water	8/9/2011	
MW-2A	A11H114-08	-	Water	8/9/2011	
MW-22	A11H114-09	-	Water	8/9/2011	
MW-3B	A11H114-10	-	Water	8/9/2011	
MW-3A	A11H114-11	-	Water	8/9/2011	
SSED-1	A11J131-01	-	Sediment	10/6/2011	On hold
SSED-2	A11J131-02	-	Sediment	10/6/2011	
SSED-3	A11J131-03	-	Sediment	10/6/2011	On hold
SSED-4	A11J131-04	-	Sediment	10/6/2011	On hold
SSED-5	A11J131-05	TR63A	Sediment	10/6/2011	
SSED-6	A11J131-06	-	Sediment	10/6/2011	
SSED-MC-1	A11J131-07	TR63B	Sediment	10/6/2011	
SSED-MC-2	A11J131-08	-	Sediment	10/7/2011	On hold
SSED-MC-3	A11J131-09	-	Sediment	10/7/2011	
SSED-MC-4	A11J131-10	-	Sediment	10/7/2011	
SSED-7	A11J131-11	-	Sediment	10/7/2011	
SSED-8	A11J131-12	-	Sediment	10/7/2011	
SSED-9	A11J131-13	-	Sediment	10/7/2011	

Note:
NAPL = non-aqueous phase liquid

Table 2
Field Duplicate Detections
Port of Saint Helens

Analyte	Reporting Limits	Primary Concentration	Duplicate Concentration	RPD	Notes
Sample MC2A-12					
Diesel-range organics	25.0 mg/kg	**196**	**191**	2.6%	
Oil-range organics	50.0 mg/kg	**68.2**	**75.4**	10%	
Acenaphthene	62.2 µg/kg	**6,940**	**4370**	45%	
Acenaphthylene	62.2 µg/kg	**162**	**124**	27%	
Anthracene	62.2 µg/kg	**3,290**	**2220**	39%	
Benzo(a)anthracene	62.2 µg/kg	**1,370**	**981**	33%	
Benzo(a)pyrene	62.2 µg/kg	**462**	**370**	22%	
Benzo(b+k)fluoranthenes	124 µg/kg	**1,070**	**850**	23%	
Benzo(g,h,i)perylene	62.2 µg/kg	**167**	**144**	15%	
Chrysene	62.2 µg/kg	**1,350**	**982**	32%	
Fluoranthene	62.2 µg/kg	**9,540**	**6,570**	37%	
Fluorene	62.2 µg/kg	**6,940**	**4,660**	39%	
Indeno(1,2,3-cd)pyrene	62.2 µg/kg	**216**	**185**	15%	
Naphthalene	62.2 µg/kg	**3,530**	**2,020**	54%	J-FD
Phenanthrene	62.2 µg/kg	**20,900**	**14,500**	36%	
Pyrene	62.2 µg/kg	**5,710**	**3,990**	35%	
Sample MW-18					
Acenaphthene	0.0377 µg/L	**0.0617**	0.0374 U	NC	J/UJ-FD
Anthracene	0.0377 µg/L	**0.196**	**0.209**	6.4%	
Arsenic	2.00 µg/L	**6.18**	**6.67**	7.6%	
Sample MW20-16-17					
Diesel-range organics	30.3 mg/kg	**1,800**	**2,600**	36%	
Oil-range organics	60.6 mg/kg	**149**	**231**	43%	
Acenaphthene	7,300 µg/kg	**74,600**	**22,400**	108%	J-FD
Acenaphthylene	27.7 µg/kg	**1,320**	**568**	80%	J-FD
Anthracene	27.7 µg/kg	**25,700**	**8,590**	100%	J-FD
Benzo(a)anthracene	27.7 µg/kg	**6,450**	**2,650**	84%	J-FD
Benzo(a)pyrene	27.7 µg/kg	**1,200**	**497**	83%	J-FD
Benzo(b+k)fluoranthenes	55.4 µg/kg	**2,970**	**1,230**	83%	J-FD
Benzo(g,h,i)perylene	27.7 µg/kg	**219**	**91.4**	82%	J-FD
Chrysene	27.7 µg/kg	**5,810**	**2,370**	84%	J-FD
Dibenz(a,h)anthracene	27.7 µg/kg	**123**	**54.1**	78%	J-FD
Fluoranthene	7,300 µg/kg	**74,200**	**23,100**	105%	J-FD
Fluorene	7,300 µg/kg	**88,300**	**26,600**	107%	J-FD
Indeno(1,2,3-cd)pyrene	27.7 µg/kg	**306**	**132**	79%	J-FD
Naphthalene	7,300 µg/kg	**322,000**	**109,000**	99%	J-FD
Phenanthrene	7,300 µg/kg	**216,000**	**65,700**	107%	J-FD
Pyrene	7,300 µg/kg	**39,400**	**12,300**	105%	J-FD
Sample MW-23					
Acenaphthene	3.74 µg/L	**81.3**	**83.5**	2.7%	
Acenaphthylene	0.0374 µg/L	**0.470**	**0.483**	2.7%	
Anthracene	0.0374 µg/L	**9.70**	**9.54**	1.7%	
Benzo(a)anthracene	0.0374 µg/L	**0.618**	**0.734**	17%	
Benzo(a)pyrene	0.0374 µg/L	**0.0917**	**0.130**	35%	
Benzo(b+k)fluoranthenes	0.0748 µg/L	**0.179**	**0.261**	37%	
Chrysene	0.0374 µg/L	**0.457**	**0.538**	16%	
Fluoranthene	3.74 µg/L	**15.7**	**15.6**	0.64%	
Fluorene	3.74 µg/L	**57.0**	**57.5**	0.87%	
Naphthalene	0.0374 µg/L	**0.894**	**2.25**	86%	J-FD
Phenanthrene	3.74 µg/L	**89.3**	**87.2**	2.4%	
Pyrene	0.0374 µg/L	**9.26**	**9.48**	2.3%	
Arsenic	2.00 µg/L	**9.18**	**9.58**	4.3%	
Zinc	2.00 µg/L	**80.8**	**64.9**	22%	

Table 2
Field Duplicate Detections
Port of Saint Helens

Notes:
Bold = the analyte was detected at the stated concentration
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
mg/kg = milligrams per kilogram
RPD = relative percent diference

Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Reason Code:
FD = Field duplicate results indicate sampling or analytical imprecision.

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
MW-1-BTM	9/8/2010	NWTPH-DX	Diesel Range Organics	**5.45** mg/L	N SB
		NWTPH-GX	Gasoline Range Organics	**3.87** mg/L	N SB
MW-1-MID	9/8/2010	NWTPH-DX	Diesel Range Organics	**4.08** mg/L	N SB
		NWTPH-GX	Gasoline Range Organics	**3.64** mg/L	N SB
MW-3A	9/8/2010	NWTPH-DX	Diesel Range Organics	**374** mg/L	N SB
			Oil Range Organics	**103** mg/L	N SB
		NWTPH-GX	Gasoline Range Organics	**28.5** mg/L	N SB
MW-3B	9/8/2010	NWTPH-DX	Diesel Range Organics	**1.72** mg/L	N SB
		NWTPH-GX	Gasoline Range Organics	**0.789** mg/L	N SB
MW-6A	9/8/2010	NWTPH-DX	Diesel Range Organics	**4.11** mg/L	N SB
		NWTPH-GX	Gasoline Range Organics	**4.79** mg/L	N SB
MW-9	9/7/2010	8270C-SIM	Acenaphthene	**56.4** µg/L	J LS
			Acenaphthylene	0.374 µg/L	UJ LS
			Anthracene	**4.01** µg/L	J LS
			Benzo(a)anthracene	0.374 µg/L	UJ LS
			Benzo(a)pyrene	0.374 µg/L	UJ LS
			Benzo(b)fluoranthene	0.374 µg/L	UJ LS
			Benzo(g,h,i)perylene	0.374 µg/L	UJ LS
			Benzo(k)fluoranthene	0.374 µg/L	UJ LS
			Chrysene	0.374 µg/L	UJ LS
			Dibenz(a,h)anthracene	0.374 µg/L	UJ LS
			Fluoranthene	**6.64** µg/L	J LS
			Fluorene	**29.4** µg/L	J LS
			Indeno(1,2,3-cd)pyrene	0.374 µg/L	UJ LS
			Naphthalene	**40.7** µg/L	J LS
			Phenanthrene	**18.0** µg/L	J LS
			Pyrene	**2.87** µg/L	J LS
		NWTPH-DX	Diesel Range Organics	**2.25** mg/L	N SB
MW-10	9/7/2010	8270C-SIM	Naphthalene	**0.0773** µg/L	J MI
		NWTPH-DX	Diesel Range Organics	**0.288** mg/L	N SB
MC2A-12	7/20/2011	8270D-SIM	Naphthalene	**3,530** µg/kg	J FD
		NWTPH-DX	Diesel Range Organics	**196** mg/kg	N SB
			Oil Range Organics	**68.2** mg/kg	N SB
MC2A-12 DUP	7/20/2011	8270D-SIM	Naphthalene	**2,020** µg/kg	J FD
		NWTPH-DX	Diesel Range Organics	**191** mg/kg	N SB
			Oil Range Organics	**75.4** mg/kg	N SB
MCO3-0-0.3	7/12/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	137 µg/kg	UJ NQ
			C-2 Benzo(a)anthracenes/Chrysenes	137 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	137 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	273 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	137 µg/kg	UJ NQ
			C-1 Fluorenes	137 µg/kg	UJ NQ
			C-2 Fluorenes	137 µg/kg	UJ NQ
			C-3 Fluorenes	137 µg/kg	UJ NQ
			C-1 Naphthalenes	137 µg/kg	UJ NQ
			C-2 Naphthalenes	137 µg/kg	UJ NQ
			C-3 Naphthalenes	137 µg/kg	UJ NQ
			C-4 Naphthalenes	137 µg/kg	UJ NQ
			C-1 Phenanthrenes/Anthracenes	137 µg/kg	UJ NQ
			C-2 Phenanthrenes/Anthracenes	137 µg/kg	UJ NQ
			C-3 Phenanthrenes/Anthracenes	137 µg/kg	UJ NQ
			C-4 Phenanthrenes/Anthracenes	273 µg/kg	UJ NQ
MW-1	8/9/2011	NWTPH-DX	Diesel Range Organics	**4.48** mg/L	N SB
MW-2A	8/9/2011	NWTPH-DX	Diesel Range Organics	**26.1** mg/L	N SB
MW-3A	8/9/2011	NWTPH-DX	Diesel Range Organics	**57.1** mg/L	N SB

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
MW-3B	8/9/2011	8270D-SIM	Acenaphthene	**0.247** µg/L	J LS
			Acenaphthylene	0.0377 µg/L	UJ LS
			Anthracene	**0.422** µg/L	J LS
			Benzo(a)anthracene	**0.111** µg/L	J LS
			Benzo(a)pyrene	**0.0473** µg/L	J LS
			Benzo(g,h,i)perylene	0.0377 µg/L	UJ LS
			Benzo(b+k)fluoranthenes	**0.0819** µg/L	J LS
			Chrysene	**0.0900** µg/L	J LS
			Dibenz(a,h)anthracene	0.0377 µg/L	UJ LS
			Fluoranthene	**0.422** µg/L	J LS
			Fluorene	**0.178** µg/L	J LS
			Indeno(1,2,3-cd)pyrene	0.0377 µg/L	UJ LS
			Naphthalene	**6.83** µg/L	J LS
			Phenanthrene	**0.436** µg/L	J LS
			Pyrene	**0.268** µg/L	J LS
MW-4B	8/8/2011	8270D-SIM	Acenaphthene	**0.230** µg/L	J LS
			Acenaphthylene	0.0374 µg/L	UJ LS
			Anthracene	**0.160** µg/L	J LS
			Benzo(a)anthracene	**0.0454** µg/L	J LS
			Benzo(a)pyrene	0.0374 µg/L	UJ LS
			Benzo(b)fluoranthene	0.0374 µg/L	UJ LS
			Benzo(g,h,i)perylene	0.0374 µg/L	UJ LS
			Benzo(k)fluoranthene	0.0374 µg/L	UJ LS
			Chrysene	0.0374 µg/L	UJ LS
			Dibenz(a,h)anthracene	0.0374 µg/L	UJ LS
			Fluoranthene	**0.317** µg/L	J LS
			Fluorene	**0.145** µg/L	J LS
			Indeno(1,2,3-cd)pyrene	0.0374 µg/L	UJ LS
			Naphthalene	**0.301** µg/L	J LS
			Phenanthrene	**0.195** µg/L	J LS
			Pyrene	**0.182** µg/L	J LS
MW-6A	8/9/2011	8270D-SIM	Acenaphthene	**114** µg/L	J LS
			Acenaphthylene	**1.05** µg/L	J LS
			Anthracene	**6.71** µg/L	J LS
			Benzo(a)anthracene	**0.115** µg/L	J LS
			Benzo(a)pyrene	0.0400 µg/L	UJ LS
			Benzo(b)fluoranthene	0.0400 µg/L	UJ LS
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ LS
			Benzo(k)fluoranthene	0.0400 µg/L	UJ LS
			Chrysene	**0.116** µg/L	J LS
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ LS
			Fluoranthene	**4.92** µg/L	J LS
			Fluorene	**69.8** µg/L	J LS
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ LS
			Naphthalene	**194** µg/L	J LS
			Phenanthrene	**62.3** µg/L	J LS
			Pyrene	**2.65** µg/L	J LS
		NWTPH-DX	Diesel Range Organics	**4.28** mg/L	N SB
MW-9	8/8/2011	NWTPH-DX	Diesel Range Organics	**1.52** mg/L	N SB
MW-10	8/8/2011	NWTPH-DX	Diesel Range Organics	**0.730** mg/L	N SB

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
MW-19	8/8/2011	8270D-SIM	Acenaphthene	**128** µg/L	J LS
			Acenaphthylene	**2.95** µg/L	J LS
			Anthracene	**8.51** µg/L	J LS
			Benzo(a)anthracene	**2.07** µg/L	J LS
			Benzo(a)Pyrene	**0.447** µg/L	J LS
			Benzo(b+k)fluoranthenes	**1.00** µg/L	J LS
			Benzo(g,h,i)perylene	**0.0906** µg/L	J LS
			Chrysene	**1.69** µg/L	J LS
			Dibenz(a,h)anthracene	0.0408 µg/L	UJ LS
			Fluoranthene	**16.0** µg/L	J LS
			Fluorene	**83.1** µg/L	J LS
			Indeno(1,2,3-cd)pyrene	**0.119** µg/L	J LS
			Naphthalene	**4,710** µg/L	J LS
			Phenanthrene	**102** µg/L	J LS
			Pyrene	**7.58** µg/L	J LS
		NWTPH-DX	Diesel Range Organics	**12.5** mg/L	N SB
MW19-21	7/19/2011	NWTPH-DX	Diesel Range Organics	**145** mg/kg	N SB
MW19-29.5-30	7/19/2011	NWTPH-DX	Diesel Range Organics	**813** mg/kg	N SB
			Oil Range Organics	**67.0** mg/kg	N SB
		NWTPH-GX	Gasoline Range Organics	**1,290** mg/kg	N SB
MW-20	8/8/2011	8270D-SIM	Acenaphthene	**24.8** µg/L	J LS
			Acenaphthylene	**0.403** µg/L	J LS
			Anthracene	**3.10** µg/L	J LS
			Benzo(a)anthracene	**0.125** µg/L	J LS
			Benzo(a)pyrene	0.0421 µg/L	UJ LS
			Benzo(g,h,i)perylene	0.0421 µg/L	UJ LS
			Benzo(b+k)fluoranthenes	0.0842 µg/L	UJ LS
			Chrysene	**0.124** µg/L	J LS
			Dibenz(a,h)anthracene	0.0421 µg/L	UJ LS
			Fluoranthene	**2.54** µg/L	J LS
			Fluorene	**19.2** µg/L	J LS
			Indeno(1,2,3-cd)pyrene	0.0421 µg/L	UJ LS
			Naphthalene	**7.84** µg/L	J LS
			Phenanthrene	**24.7** µg/L	J LS
			Pyrene	**1.25** µg/L	J LS
		NWTPH-DX	Diesel Range Organics	**0.870** mg/L	N SB
MW20-16-17	7/21/2011	8270D-SIM	Acenaphthene	**74,600** µg/kg	J HS, FD
			Acenaphthylene	**1,320** µg/kg	J HS, FD
			Anthracene	**25,700** µg/kg	J HS, FD
			Benzo(a)anthracene	**6,450** µg/kg	J HS, FD
			Benzo(a)pyrene	**1,200** µg/kg	J HS, FD
			Benzo(g,h,i)perylene	**219** µg/kg	J HS, FD
			Benzo(b+k)fluoranthenes	**2,970** µg/kg	J HS, FD
			Chrysene	**5,810** µg/kg	J HS, FD
			Dibenz(a,h)anthracene	**123** µg/kg	J HS, FD
			Fluoranthene	**74,200** µg/kg	J HS, FD
			Fluorene	**88,300** µg/kg	J HS, FD
			Indeno(1,2,3-cd)pyrene	**306** µg/kg	J HS, FD
			Naphthalene	**322,000** µg/kg	J HS, FD
			Phenanthrene	**216,000** µg/kg	J HS, FD
			Pyrene	**39,400** µg/kg	J HS, FD
		NWTPH-DX	Diesel Range Organics	**1,800** mg/kg	N SB
			Oil Range Organics	**149** mg/kg	N SB

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
MW20-16-17 DUP	7/21/2011	8270D-SIM	Acenaphthene	**22,400** µg/kg	J HS, FD
			Acenaphthylene	**568** µg/kg	J HS, FD
			Anthracene	**8,590** µg/kg	J HS, FD
			Benzo(a)anthracene	**2,650** µg/kg	J HS, FD
			Benzo(a)pyrene	**497** µg/kg	J HS, FD
			Benzo(g,h,i)perylene	**91.4** µg/kg	J HS, FD
			Benzo(b+k)fluoranthenes	**1,230** µg/kg	J HS, FD
			Chrysene	**2,370** µg/kg	J HS, FD
			Dibenz(a,h)anthracene	**54.1** µg/kg	J HS, FD
			Fluoranthene	**23,100** µg/kg	J HS, FD
			Fluorene	**26,600** µg/kg	J HS, FD
			Indeno(1,2,3-cd)pyrene	**132** µg/kg	J HS, FD
			Naphthalene	**109,000** µg/kg	J HS, FD
			Phenanthrene	**65,700** µg/kg	J HS, FD
			Pyrene	**12,300** µg/kg	J HS, FD
		NWTPH-DX	Diesel Range Organics	**2,600** mg/kg	N SB
			Oil Range Organics	**231** mg/kg	N SB
MW-21	8/9/2011	8270D-SIM	Acenaphthene	**89.0** µg/L	J LS
			Acenaphthylene	**0.471** µg/L	J LS
			Anthracene	**2.59** µg/L	J LS
			Benzo(a)anthracene	**0.447** µg/L	J LS
			Benzo(a)pyrene	**0.106** µg/L	J LS
			Benzo(g,h,i)perylene	0.0374 µg/L	UJ LS
			Benzo(b+k)fluoranthenes	**0.229** µg/L	J LS
			Chrysene	**0.372** µg/L	J LS
			Dibenz(a,h)anthracene	0.0374 µg/L	UJ LS
			Fluoranthene	**4.06** µg/L	J LS
			Fluorene	**50.5** µg/L	J LS
			Indeno(1,2,3-cd)pyrene	0.0374 µg/L	UJ LS
			Naphthalene	**109** µg/L	J LS
			Phenanthrene	**30.6** µg/L	J LS
			Pyrene	**1.88** µg/L	J LS
		NWTPH-DX	Diesel Range Organics	**3.65** mg/L	N SB
MW21-21	7/21/2011	8270D-SIM	Acenaphthylene	**18.3** µg/kg	J HD
			Naphthalene	**24.8** µg/kg	J HD
		NWTPH-DX	Diesel Range Organics	**49.8** mg/kg	N SB
MW-22	8/9/2011	NWTPH-DX	Diesel Range Organics	**23.8** mg/L	N SB
MW22-20.5	7/22/2011	NWTPH-DX	Diesel Range Organics	**3,540** mg/kg	N SB
			Oil Range Organics	**324** mg/kg	N SB
MW-23	8/9/2011	8270D-SIM	Benzo(a)pyrene	**0.0917** µg/L	J FD
			Benzo(b+k)fluoranthenes	**0.179** µg/L	J FD
			Naphthalene	**0.894** µg/L	J FD
		NWTPH-DX	Diesel Range Organics	**0.949** mg/L	N SB
MW-23 DUP	8/9/2011	8270D-SIM	Benzo(a)pyrene	**0.13** µg/L	J FD
			Benzo(b+k)fluoranthenes	**0.261** µg/L	J FD
			Naphthalene	**2.25** µg/L	J FD
MW23-13.5	7/19/2011	NWTPH-DX	Diesel Range Organics	**303** mg/kg	N SB
MW-24	8/9/2011	NWTPH-DX	Diesel Range Organics	**11.5** mg/L	N SB
MW24-14.5-15	7/19/2011	8270D-SIM	Acenaphthene	**306,000** µg/kg	J HD
			Benzo(g,h,i)perylene	**8,030** µg/kg	J HD
			Chrysene	**59,800** µg/kg	J HD
			Fluoranthene	**360,000** µg/kg	J HD
			Fluorene	**256,000** µg/kg	J HD
			Naphthalene	**1,170,000** µg/kg	J HD
			Phenanthrene	**758,000** µg/kg	J HD
		NWTPH-DX	Diesel Range Organics	**5,240** mg/kg	N SB
			Oil Range Organics	**1,090** mg/kg	N SB

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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
MW-25	8/9/2011	8270D-SIM	Acenaphthene	**92.5** µg/L	J LS
			Acenaphthylene	**1.38** µg/L	J LS
			Anthracene	**8.09** µg/L	J LS
			Benzo(a)anthracene	**0.417** µg/L	J LS
			Benzo(a)pyrene	**0.112** µg/L	J LS
			Benzo(g,h,i)perylene	0.0404 µg/L	UJ LS
			Benzo(b+k)fluoranthenes	**0.208** µg/L	J LS
			Chrysene	**0.353** µg/L	J LS
			Dibenz(a,h)anthracene	0.0404 µg/L	UJ LS
			Fluoranthene	**8.52** µg/L	J LS
			Fluorene	**66.4** µg/L	J LS
			Indeno(1,2,3-cd)pyrene	0.0404 µg/L	UJ LS
			Naphthalene	**651** µg/L	J LS
			Phenanthrene	**95.2** µg/L	J LS
			Pyrene	**4.10** µg/L	J LS
		NWTPH-DX	Diesel Range Organics	**4.04** mg/L	N SB
MW25-19.5	7/22/2011	8270D-SIM	Fluorene	**41,600** µg/kg	J HM
			Indeno(1,2,3-cd)pyrene	**2,880** µg/kg	J LM
			Naphthalene	**11,300** µg/kg	J HM
		NWTPH-DX	Diesel Range Organics	**3,060** mg/kg	N SB
SB01-5	7/14/2011	NWTPH-DX	Diesel Range Organics	**42.4** mg/kg	N SB
SB02-0.0.3	7/14/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	183 µg/kg	UJ NQ
			C-2 Benzo(a)anthracenes/Chrysenes	183 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	183 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	366 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	183 µg/kg	UJ NQ
			C-1 Fluorenes	183 µg/kg	UJ NQ
			C-2 Fluorenes	183 µg/kg	UJ NQ
			C-3 Fluorenes	183 µg/kg	UJ NQ
			C-1 Naphthalenes	183 µg/kg	UJ NQ
			C-2 Naphthalenes	183 µg/kg	UJ NQ
			C-3 Naphthalenes	183 µg/kg	UJ NQ
			C-4 Naphthalenes	183 µg/kg	UJ NQ
			C-1 Phenanthrenes/Anthracenes	183 µg/kg	UJ NQ
			C-2 Phenanthrenes/Anthracenes	183 µg/kg	UJ NQ
			C-3 Phenanthrenes/Anthracenes	183 µg/kg	UJ NQ
			C-4 Phenanthrenes/Anthracenes	366 µg/kg	UJ NQ
SB03-7	7/14/2011	NWTPH-DX	Diesel Range Organics	**788** mg/kg	N SB
			Oil Range Organics	**803** mg/kg	N SB
SB04-0-0.3	7/14/2011	8270D-SIM	Acenaphthene	**57.7** µg/kg	J HD
			Anthracene	**134** µg/kg	J HD
			Fluoranthene	**432** µg/kg	J HD
			Phenanthrene	**337** µg/kg	J HD
			Pyrene	**312** µg/kg	J HD

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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
SB04-3	7/14/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**5,700** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	**1,580** µg/kg	J NQ
			C-3 Benzo(a)anthracenes/Chrysenes	1,450 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	2,910 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**21,200** µg/kg	J NQ
			C-1 Fluorenes	**9,400** µg/kg	J NQ
			C-2 Fluorenes	**5,400** µg/kg	J NQ
			C-3 Fluorenes	**3,030** µg/kg	J NQ
			C-1 Naphthalenes	**28,400** µg/kg	J NQ
			C-2 Naphthalenes	**50,300** µg/kg	J NQ
			C-3 Naphthalenes	**33,300** µg/kg	J NQ
			C-4 Naphthalenes	**12,700** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**41,800** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**18,400** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**6,700** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	2,910 µg/kg	UJ NQ
		NWTPH-DX	Diesel Range Organics	**1,030** mg/kg	N SB
			Oil Range Organics	**726** mg/kg	N SB
SB05-0-0.3	7/14/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	105 µg/kg	UJ NQ
			C-2 Benzo(a)anthracenes/Chrysenes	105 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	105 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	211 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**135** µg/kg	J NQ
			C-1 Fluorenes	105 µg/kg	UJ NQ
			C-2 Fluorenes	105 µg/kg	UJ NQ
			C-3 Fluorenes	105 µg/kg	UJ NQ
			C-1 Naphthalenes	105 µg/kg	UJ NQ
			C-2 Naphthalenes	**114** µg/kg	J NQ
			C-3 Naphthalenes	**148** µg/kg	J NQ
			C-4 Naphthalenes	105 µg/kg	UJ NQ
			C-1 Phenanthrenes/Anthracenes	**156** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**114** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	105 µg/kg	UJ NQ
			C-4 Phenanthrenes/Anthracenes	211 µg/kg	UJ NQ
		NWTPH-DX	Diesel Range Organics	**35.5** mg/kg	N SB
SB05-4	7/14/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**12,600** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	**3,010** µg/kg	J NQ
			C-3 Benzo(a)anthracenes/Chrysenes	1600 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	3,200 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**57,000** µg/kg	J NQ
			C-1 Fluorenes	**29,200** µg/kg	J NQ
			C-2 Fluorenes	**12,700** µg/kg	J NQ
			C-3 Fluorenes	**7,850** µg/kg	J NQ
			C-1 Naphthalenes	**119,000** µg/kg	J NQ
			C-2 Naphthalenes	**145,000** µg/kg	J NQ
			C-3 Naphthalenes	**76,500** µg/kg	J NQ
			C-4 Naphthalenes	**24,600** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**128,000** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**48,600** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**14,900** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	3,200 µg/kg	UJ NQ
		NWTPH-DX	Diesel Range Organics	**2,070** mg/kg	N SB
			Oil Range Organics	**1,010** mg/kg	N SB
SB05-8	7/14/2011	NWTPH-DX	Diesel Range Organics	**36.8** mg/kg	N SB

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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
SB06-5	7/14/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**1,760** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	723 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	723 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	1,450 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**7,930** µg/kg	J NQ
			C-1 Fluorenes	**3,770** µg/kg	J NQ
			C-2 Fluorenes	**1,730** µg/kg	J NQ
			C-3 Fluorenes	**1,110** µg/kg	J NQ
			C-1 Naphthalenes	**8,430** µg/kg	J NQ
			C-2 Naphthalenes	**19,700** µg/kg	J NQ
			C-3 Naphthalenes	**12,500** µg/kg	J NQ
			C-4 Naphthalenes	**4,620** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**17,100** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**6,860** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**2,440** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	1,450 µg/kg	UJ NQ
		NWTPH-DX	Diesel Range Organics	**551** mg/kg	N SB
SB08-0-0.3	7/13/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	211 µg/kg	UJ NQ
			C-2 Benzo(a)anthracenes/Chrysenes	211 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	211 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	422 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	211 µg/kg	UJ NQ
			C-1 Fluorenes	211 µg/kg	UJ NQ
			C-2 Fluorenes	211 µg/kg	UJ NQ
			C-3 Fluorenes	211 µg/kg	UJ NQ
			C-1 Naphthalenes	211 µg/kg	UJ NQ
			C-2 Naphthalenes	211 µg/kg	UJ NQ
			C-3 Naphthalenes	211 µg/kg	UJ NQ
			C-4 Naphthalenes	211 µg/kg	UJ NQ
			C-1 Phenanthrenes/Anthracenes	211 µg/kg	UJ NQ
			C-2 Phenanthrenes/Anthracenes	211 µg/kg	UJ NQ
			C-3 Phenanthrenes/Anthracenes	211 µg/kg	UJ NQ
			C-4 Phenanthrenes/Anthracenes	422 µg/kg	UJ NQ
SB08-4.5	7/13/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**845** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	721 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	721 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	1,440 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**4,120** µg/kg	J NQ
			C-1 Fluorenes	**2,320** µg/kg	J NQ
			C-2 Fluorenes	**885** µg/kg	J NQ
			C-3 Fluorenes	721 µg/kg	UJ NQ
			C-1 Naphthalenes	**14,000** µg/kg	J NQ
			C-2 Naphthalenes	**13,700** µg/kg	J NQ
			C-3 Naphthalenes	**7,830** µg/kg	J NQ
			C-4 Naphthalenes	**2,520** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**9,590** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**3,280** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**935** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	1,440 µg/kg	UJ NQ
		NWTPH-DX	Diesel Range Organics	**223** mg/kg	N SB
SB08-8	7/13/2011	NWTPH-DX	Diesel Range Organics	**53.3** mg/kg	N SB
SB08A-0-0.3	7/13/2011	8270D-SIM	Acenaphthene	**23.5** µg/kg	J HD
			Benzo(a)pyrene	**47.5** µg/kg	J HD
			Benzo(g,h,i)perylene	**39.6** µg/kg	J HD
			Benzo(b+k)fluoranthenes	**108** µg/kg	J HD
			Fluorene	**31.5** µg/kg	J HD
			Indeno(1,2,3-cd)pyrene	**40.3** µg/kg	J HD
			Phenanthrene	**161** µg/kg	J HD
SB08B-0-0.3	7/13/2011	NWTPH-DX	Oil Range Organics	**131** mg/kg	N SB

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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
SB09-0-0.3	7/14/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	980 µg/kg	UJ NQ
			C-2 Benzo(a)anthracenes/Chrysenes	980 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	980 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	1,960 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**1,880** µg/kg	J NQ
			C-1 Fluorenes	**1,380** µg/kg	J NQ
			C-2 Fluorenes	980 µg/kg	UJ NQ
			C-3 Fluorenes	980 µg/kg	UJ NQ
			C-1 Naphthalenes	**4,370** µg/kg	J NQ
			C-2 Naphthalenes	**3,760** µg/kg	J NQ
			C-3 Naphthalenes	**2,940** µg/kg	J NQ
			C-4 Naphthalenes	**1,340** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**4,240** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**2,020** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	980 µg/kg	UJ NQ
			C-4 Phenanthrenes/Anthracenes	1,960 µg/kg	UJ NQ
SB09-5	7/14/2011	NWTPH-DX	Diesel Range Organics	**1,130** mg/kg	N SB
			Oil Range Organics	**949** mg/kg	N SB
SB10-0-0.3	7/13/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	206 µg/kg	UJ NQ
			C-2 Benzo(a)anthracenes/Chrysenes	206 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	206 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	413 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**551** µg/kg	J NQ
			C-1 Fluorenes	**234** µg/kg	J NQ
			C-2 Fluorenes	206 µg/kg	UJ NQ
			C-3 Fluorenes	206 µg/kg	UJ NQ
			C-1 Naphthalenes	**1,910** µg/kg	J NQ
			C-2 Naphthalenes	**1,050** µg/kg	J NQ
			C-3 Naphthalenes	**684** µg/kg	J NQ
			C-4 Naphthalenes	**233** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**973** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**452** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	206 µg/kg	UJ NQ
			C-4 Phenanthrenes/Anthracenes	413 µg/kg	UJ NQ
SB10-2	7/13/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**3,920** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	**961** µg/kg	J NQ
			C-3 Benzo(a)anthracenes/Chrysenes	**887** µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	1,770 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**19,500** µg/kg	J NQ
			C-1 Fluorenes	**12,900** µg/kg	J NQ
			C-2 Fluorenes	**4,170** µg/kg	J NQ
			C-3 Fluorenes	**2,230** µg/kg	J NQ
			C-1 Naphthalenes	**135,000** µg/kg	J NQ
			C-2 Naphthalenes	**74,500** µg/kg	J NQ
			C-3 Naphthalenes	**34,200** µg/kg	J NQ
			C-4 Naphthalenes	**10,100** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**50,400** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**16,300** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**4,900** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	1,770 µg/kg	UJ NQ
		NWTPH-DX	Diesel Range Organics (No cleanup)	**780** mg/kg	N SB
			Oil Range Organics (No cleanup)	**494** mg/kg	N SB
			Diesel Range Organics	**674** mg/kg	N SB
			Oil Range Organics	**385** mg/kg	N SB
SB10-3	7/13/2011	8260B	Bromomethane	13,700 µg/kg	UJ LL
		WAVPH	n-Dodecane	**7,100** µg/kg	J HC
SB10-8	7/13/2011	NWTPH-DX	Diesel Range Organics	**518** mg/kg	N SB
			Oil Range Organics	**90.4** mg/kg	N SB

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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
SB11-0-0.3	7/13/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	221 µg/kg	UJ NQ
			C-2 Benzo(a)anthracenes/Chrysenes	221 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	221 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	442 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	221 µg/kg	UJ NQ
			C-1 Fluorenes	221 µg/kg	UJ NQ
			C-2 Fluorenes	221 µg/kg	UJ NQ
			C-3 Fluorenes	221 µg/kg	UJ NQ
			C-1 Naphthalenes	221 µg/kg	UJ NQ
			C-2 Naphthalenes	221 µg/kg	UJ NQ
			C-3 Naphthalenes	221 µg/kg	UJ NQ
			C-4 Naphthalenes	221 µg/kg	UJ NQ
			C-1 Phenanthrenes/Anthracenes	221 µg/kg	UJ NQ
			C-2 Phenanthrenes/Anthracenes	221 µg/kg	UJ NQ
			C-3 Phenanthrenes/Anthracenes	221 µg/kg	UJ NQ
			C-4 Phenanthrenes/Anthracenes	442 µg/kg	UJ NQ
		NWTPH-DX	Oil Range Organics	116 mg/kg	UJ HD
SB11-4	7/13/2011	8260B	Bromomethane	14,800 µg/kg	UJ LL
		NWTPH-DX	Diesel Range Organics	**14,000** mg/kg	N SB
			Oil Range Organics	**5,120** mg/kg	N SB
SB11-15.5	7/13/2011	NWTPH-DX	Diesel Range Organics	**2,750** mg/kg	N SB
			Oil Range Organics	**383** mg/kg	N SB
SB11-24	7/13/2011	NWTPH-DX	Diesel Range Organics	**349** mg/kg	N SB
			Oil Range Organics	**61.5** mg/kg	N SB
SB12-3.9	7/14/2011	NWTPH-DX	Diesel Range Organics	**425** mg/kg	N SB
SB13-2.5	7/14/2011	NWTPH-DX	Diesel Range Organics	**1,680** mg/kg	N SB
SB14-0-0.3	7/15/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**5,630** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	**1,330** µg/kg	J NQ
			C-3 Benzo(a)anthracenes/Chrysenes	**443** µg/kg	J NQ
			C-4 Benzo(a)anthracenes/Chrysenes	343 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**28,900** µg/kg	J NQ
			C-1 Fluorenes	**17,000** µg/kg	J NQ
			C-2 Fluorenes	**6,100** µg/kg	J NQ
			C-3 Fluorenes	**3,240** µg/kg	J NQ
			C-1 Naphthalenes	**46,500** µg/kg	J NQ
			C-2 Naphthalenes	**60,200** µg/kg	J NQ
			C-3 Naphthalenes	**35,300** µg/kg	J NQ
			C-4 Naphthalenes	**12,000** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**63,100** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**21,900** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**7,420** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	**1,500** µg/kg	J NQ
		NWTPH-DX	Diesel Range Organics	**1,380** mg/kg	N SB
			Oil Range Organics	**898** mg/kg	N SB

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
SB14-6-7	7/15/2011	8260B	Naphthalene	**2,990** µg/kg	J HD
		8270D-SIM	Benzo(a)pyrene	**7,720** µg/kg	J LM
			Benzo(b)fluoranthene	**15,600** µg/kg	J LM
			Indeno(1,2,3-cd)pyrene	**3,050** µg/kg	J LM
			C-1 Benzo(a)anthracenes/Chrysenes	**10,900** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	**2,490** µg/kg	J NQ
			C-3 Benzo(a)anthracenes/Chrysenes	**835** µg/kg	J NQ
			C-4 Benzo(a)anthracenes/Chrysenes	**534** µg/kg	J NQ
			C-1 Fluoranthrenes/Pyrenes	**48,400** µg/kg	J NQ
			C-1 Fluorenes	**22,200** µg/kg	J NQ
			C-2 Fluorenes	**6,880** µg/kg	J NQ
			C-3 Fluorenes	**4,080** µg/kg	J NQ
			C-1 Naphthalenes	**68,500** µg/kg	J NQ
			C-2 Naphthalenes	**78,100** µg/kg	J NQ
			C-3 Naphthalenes	**49,500** µg/kg	J NQ
			C-4 Naphthalenes	**17,000** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**82,000** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**34,300** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**12,100** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	**2,530** µg/kg	J NQ
		ALEPH	C8-C10 Aliphatics	14,000 µg/kg	U MB
			C10-C12 Aliphatics	**110,000** µg/kg	J LM
			C10-C12 Aromatics	**67,000** µg/kg	J LM
			C21-C34 Aromatics	**880,000** µg/kg	J LC
		NWTPH-DX	Diesel Range Organics	**3,820** mg/kg	N SB
			Oil Range Organics	**2,010** mg/kg	NJ SB, HD
		WAVPH	Benzene	2,600 µg/kg	UJ HT
			Toluene	2,600 µg/kg	UJ HT
			Ethylbenzene	2,600 µg/kg	UJ HT
			m,p-Xylene	5,100 µg/kg	UJ HT
			o-Xylene	2,600 µg/kg	UJ HT
			Methyl Tert-Butyl Ether (MTBE)	2,600 µg/kg	UJ HT
			C5-C6 Aliphatics	26,000 µg/kg	UJ HT
			C6-C8 Aliphatics	26,000 µg/kg	UJ HT
			C8-C10 Aliphatics	26,000 µg/kg	UJ HT
			C10-C12 Aliphatics	26,000 µg/kg	UJ HT
			C8-C10 Aromatics	26,000 µg/kg	UJ HT
			C10-C12 Aromatics	**36,000** µg/kg	J HT
			C12-C13 Aromatics	26,000 µg/kg	UJ HT
			n-Pentane	2,600 µg/kg	UJ HT
			n-Hexane	2,600 µg/kg	UJ HT
			n-Octane	2,600 µg/kg	UJ HT
			n-Decane	2,600 µg/kg	UJ HT
			n-Dodecane	2,600 µg/kg	UJ HT

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
SB15-0-0.3	7/15/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**740** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	**248** µg/kg	J NQ
			C-3 Benzo(a)anthracenes/Chrysenes	145 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	289 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**791** µg/kg	J NQ
			C-1 Fluorenes	145 µg/kg	UJ NQ
			C-2 Fluorenes	145 µg/kg	UJ NQ
			C-3 Fluorenes	145 µg/kg	UJ NQ
			C-1 Naphthalenes	**347** µg/kg	J NQ
			C-2 Naphthalenes	**313** µg/kg	J NQ
			C-3 Naphthalenes	**222** µg/kg	J NQ
			C-4 Naphthalenes	145 µg/kg	UJ NQ
			C-1 Phenanthrenes/Anthracenes	**412** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**258** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**237** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	289 µg/kg	UJ NQ
		NWTPH-DX	Diesel Range Organics	**28.3** mg/kg	N SB
SB15-4	7/15/2011	NWTPH-DX	Diesel Range Organics	**174** mg/kg	N SB
SB15-8.5	7/15/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**7,010** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	5,330 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	5,330 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	10,700 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**32,000** µg/kg	J NQ
			C-1 Fluorenes	**15,600** µg/kg	J NQ
			C-2 Fluorenes	**6,920** µg/kg	J NQ
			C-3 Fluorenes	5,330 µg/kg	UJ NQ
			C-1 Naphthalenes	**210,000** µg/kg	J NQ
			C-2 Naphthalenes	**102,000** µg/kg	J NQ
			C-3 Naphthalenes	**47,300** µg/kg	J NQ
			C-4 Naphthalenes	**14,200** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**67,100** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**25,000** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**9,760** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	10,700 µg/kg	UJ NQ
		NWTPH-DX	Diesel Range Organics	**2,570** mg/kg	N SB
			Oil Range Organics	**889** mg/kg	N SB
SB16-0-0.3	7/15/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**236** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	173 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	173 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	346 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**366** µg/kg	J NQ
			C-1 Fluorenes	173 µg/kg	UJ NQ
			C-2 Fluorenes	173 µg/kg	UJ NQ
			C-3 Fluorenes	173 µg/kg	UJ NQ
			C-1 Naphthalenes	173 µg/kg	UJ NQ
			C-2 Naphthalenes	173 µg/kg	UJ NQ
			C-3 Naphthalenes	173 µg/kg	UJ NQ
			C-4 Naphthalenes	173 µg/kg	UJ NQ
			C-1 Phenanthrenes/Anthracenes	**192** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	173 µg/kg	UJ NQ
			C-3 Phenanthrenes/Anthracenes	173 µg/kg	UJ NQ
			C-4 Phenanthrenes/Anthracenes	346 µg/kg	UJ NQ
SB16-10	7/15/2011	NWTPH-DX	Diesel Range Organics	**99.9** mg/kg	N SB
			Oil Range Organics	**90.4** mg/kg	N SB
SB16-5-6	7/15/2011	NWTPH-DX	Diesel Range Organics	**1,260** mg/kg	N SB
			Oil Range Organics	**1,220** mg/kg	N SB
SB17-0-0.3	7/15/2011	8260B	Bromomethane	847 µg/kg	UJ LL
		NWTPH-DX	Diesel Range Organics	**39.7** mg/kg	N SB
SB17-5-6	7/15/2011	NWTPH-DX	Diesel Range Organics	**417** mg/kg	N SB

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
SB18-0-0.3	7/15/2011	8260B	Bromomethane	1,770 µg/kg	UJ LL
		NWTPH-DX	Diesel Range Organics	**168** mg/kg	N SB
			Oil Range Organics	**413** mg/kg	N SB
SB18-18	7/15/2011	NWTPH-DX	Diesel Range Organics	**63.6** mg/kg	N SB
SB18-4	7/15/2011	NWTPH-DX	Diesel Range Organics	**1,810** mg/kg	N SB
			Oil Range Organics	**694** mg/kg	N SB
SB20-6-7	7/15/2011	NWTPH-DX	Diesel Range Organics	**45.0** mg/kg	N SB
SB21-0-0.3	7/15/2011	8270D-SIM	Indeno(1,2,3-cd)pyrene	**285** µg/kg	J MI
SB21-6-7	7/15/2011	NWTPH-DX	Diesel Range Organics	**238** mg/kg	N SB
SB22-7.5-8	7/15/2011	NWTPH-DX	Diesel Range Organics	**1,790** mg/kg	N SB
			Oil Range Organics	**1,620** mg/kg	N SB
SB24-0-0.3	7/16/2011	NWTPH-DX	Diesel Range Organics	**164** mg/kg	NJ SB, HD
SB25-1.5	7/16/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**1,370** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	**392** µg/kg	J NQ
			C-3 Benzo(a)anthracenes/Chrysenes	178 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	355 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**5,320** µg/kg	J NQ
			C-1 Fluorenes	**1,770** µg/kg	J NQ
			C-2 Fluorenes	**946** µg/kg	J NQ
			C-3 Fluorenes	**626** µg/kg	J NQ
			C-1 Naphthalenes	**5,870** µg/kg	J NQ
			C-2 Naphthalenes	**5,990** µg/kg	J NQ
			C-3 Naphthalenes	**4,800** µg/kg	J NQ
			C-4 Naphthalenes	**2,130** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**8,640** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**4,330** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**3,390** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	**580** µg/kg	J NQ
		NWTPH-DX	Diesel Range Organics	**95.2** mg/kg	N SB
SB26-4-4.5	7/16/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**1,590** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	**560** µg/kg	J NQ
			C-3 Benzo(a)anthracenes/Chrysenes	**350** µg/kg	J NQ
			C-4 Benzo(a)anthracenes/Chrysenes	432 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**7,650** µg/kg	J NQ
			C-1 Fluorenes	**3,800** µg/kg	J NQ
			C-2 Fluorenes	**1,990** µg/kg	J NQ
			C-3 Fluorenes	**1,000** µg/kg	J NQ
			C-1 Naphthalenes	**8,360** µg/kg	J NQ
			C-2 Naphthalenes	**17,700** µg/kg	J NQ
			C-3 Naphthalenes	**10,700** µg/kg	J NQ
			C-4 Naphthalenes	**4,030** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**15,300** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**6,200** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**5,500** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	**1,340** µg/kg	J NQ
		NWTPH-DX	Diesel Range Organics	**105** mg/kg	N SB
			Oil Range Organics	**155** mg/kg	N SB

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Collection Date	Method	Analyte	Concentration	Qualifier and Reason Code
SB27-0-0.3	7/16/2011	NWTPH-DX	Diesel Range Organics	**93.6** mg/kg	N SB
SB28-0-0.3	7/16/2011	8270D-SIM	C-1 Benzo(a)anthracenes/Chrysenes	**1,600** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	**406** µg/kg	J NQ
			C-3 Benzo(a)anthracenes/Chrysenes	182 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	364 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**5,410** µg/kg	J NQ
			C-1 Fluorenes	**1,960** µg/kg	J NQ
			C-2 Fluorenes	**724** µg/kg	J NQ
			C-3 Fluorenes	**498** µg/kg	J NQ
			C-1 Naphthalenes	**14,000** µg/kg	J NQ
			C-2 Naphthalenes	**7,180** µg/kg	J NQ
			C-3 Naphthalenes	**3,430** µg/kg	J NQ
			C-4 Naphthalenes	**1,310** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**7,760** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**3,370** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**1,260** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	**433** µg/kg	J NQ
		NWTPH-DX	Diesel Range Organics	**253** mg/kg	N SB
			Oil Range Organics	**289** mg/kg	N SB
SB28-2	7/16/2011	8270D-SIM	Acenaphthene	**10,800** µg/kg	J LM
			Chrysene	**7,210** µg/kg	J HM
			C-1 Benzo(a)anthracenes/Chrysenes	**3,130** µg/kg	J NQ
			C-2 Benzo(a)anthracenes/Chrysenes	864 µg/kg	UJ NQ
			C-3 Benzo(a)anthracenes/Chrysenes	864 µg/kg	UJ NQ
			C-4 Benzo(a)anthracenes/Chrysenes	1,730 µg/kg	UJ NQ
			C-1 Fluoranthrenes/Pyrenes	**11,400** µg/kg	J NQ
			C-1 Fluorenes	**5,250** µg/kg	J NQ
			C-2 Fluorenes	**2,110** µg/kg	J NQ
			C-3 Fluorenes	**1,310** µg/kg	J NQ
			C-1 Naphthalenes	**8,750** µg/kg	J NQ
			C-2 Naphthalenes	**9,510** µg/kg	J NQ
			C-3 Naphthalenes	**10,800** µg/kg	J NQ
			C-4 Naphthalenes	**4,860** µg/kg	J NQ
			C-1 Phenanthrenes/Anthracenes	**21,600** µg/kg	J NQ
			C-2 Phenanthrenes/Anthracenes	**9,270** µg/kg	J NQ
			C-3 Phenanthrenes/Anthracenes	**3,890** µg/kg	J NQ
			C-4 Phenanthrenes/Anthracenes	1,730 µg/kg	UJ NQ
		NWTPH-DX	Diesel Range Organics	**518** mg/kg	N SB
			Oil Range Organics	**443** mg/kg	N SB
SSED-2	10/6/2011	415.1	Total Organic Carbon	**24,000** mg/kg	J HD
		NWTPH-DX	Diesel Range Organics	**2,830** mg/kg	N SB
			Oil Range Organics	**889** mg/kg	N SB
SSED-5	10/6/2011	NWTPH-DX	Diesel Range Organics	**982** mg/kg	N SB
SSED-6	10/6/2011	NWTPH-DX	Diesel Range Organics	**10,400** mg/kg	N SB
			Oil Range Organics	**4,900** mg/kg	N SB
SSED-7	10/7/2011	NWTPH-DX	Diesel Range Organics	**4,240** mg/kg	N SB
			Oil Range Organics	**2,840** mg/kg	N SB
SSED-9	10/7/2011	NWTPH-DX	Diesel Range Organics	36.4 mg/kg	UJ HD
SSED-MC-1	10/6/2011	NWTPH-DX	Diesel Range Organics	**9,300** mg/kg	N SB
			Oil Range Organics	**1,400** mg/kg	N SB
SSED-MC-4	10/7/2011	NWTPH-DX	Diesel Range Organics	**354** mg/kg	N SB
			Oil Range Organics	**107** mg/kg	N SB

Notes:
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
mg/L = milligrams per liter
Bold = the analyte was detected at the stated concentration

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Qualifier Definitions:

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N = The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ = The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Reason Codes:

FD = Field duplicate results indicate sampling or analytical imprecision.

HC = High calibration verification recovery. Analytical result may be biased high.

HD = Laboratory duplicate results indicate analytical imprecision.

HM = High matrix spike recovery. Analytical result may be biased high.

HS = High surrogate recovery. Analytical result may be biased high.

HT = The maximum recommended analytical hold time was exceeded.

LL = Low laboratory control sample recovery. Analytical result may be biased low.

LM = Low matrix spike recovery. Analytical result may be biased low.

LS = Low surrogate recovery. Analytical result may be biased low.

MB = The analyte was detected in the associated laboratory blank and the concentration detected in the sample was less than five times the concentration detected in the blank.

MI = There is matrix interference that prevents accurate analyte quantification.

NQ = There are no analyte-specific quality control samples.

SB = The sample spectra does not match the standard spectra.

DATA QUALITY REVIEW

Port of St. Helens

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ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
AMEC	AMEC Environment & Infrastructure, Inc.
Apex	Apex Laboratories, LLC
DRO	diesel-range organics
Ecology	Washington Department of Ecology
EPA	United States Environmental Protection Agency
ID	identification
LCS	laboratory control sample
MS	matrix spike
ORO	oil-range organics
PAH	polycyclic aromatic hydrocarbon
QC	quality control
RL	reporting limit

DATA QUALITY REVIEW
Port of St. Helens

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) collected 20 water samples (including 2 field duplicates) from the Port of St. Helens between March 20 and 22, 2012. The samples were submitted to Apex Laboratories, LLC (Apex) in Tigard, Oregon, where they were assigned to sample delivery groups A12B273, A12B287, and A12B310. Apex analyzed the samples for diesel-range organics (DRO) and oil-range organics (ORO) by Washington Department of Ecology (Ecology) Method NWTPH-Dx, metals by United States Environmental Protection Agency (EPA) Method 6020A, and polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270D.

A list of all samples by sample location, sample collection date, and Apex sample identification (ID) is presented in Table 1.

Table 1: Field Samples Submitted to Apex Laboratories

Sample Location	Collection Date	Apex ID	Notes
MW-18	02/20/2012	A12B273-01	
MW-9	02/20/2012	A12B273-02	
MW-23	02/20/2012	A12B273-03	
MW-23 Dup	02/20/2012	A12B273-04	Field duplicate
MW-10	02/20/2012	A12B273-05	
MW-22	02/21/2012	A12B287-01	
MW-22 Dup	02/21/2012	A12B287-02	Field duplicate
MW-1	02/21/2012	A12B287-03	
MW-19	02/21/2012	A12B287-04	
MW-24	02/21/2012	A12B287-05	
MW-25	02/21/2012	A12B287-06	
MW-6A	02/21/2012	A12B287-07	
MW-21	02/21/2012	A12B287-08	
MW-4A	02/21/2012	A12B287-09	
MW-20	02/21/2012	A12B287-10	
MW-4B	02/21/2012	A12B287-11	
MW-2A	02/21/2012	A12B287-12	

Sample Location	Collection Date	Apex ID	Notes
MW-5	02/21/2012	A12B287-13	
MW-3A	02/22/2012	A12B310-01	
MW-3B	02/22/2012	A12B310-02	

2.0 DATA QUALITY REVIEW METHODOLOGY

Quality review of these data followed the National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008) and Inorganic Superfund Data Review (EPA, 2010). The EPA guidelines were written specifically for the Contract Laboratory Program, and have been modified for the purposes of this data quality review where they differ from method-specific quality control (QC) requirements. This data quality review consisted of assessment of summary reports, and does not include review or validation of the raw analytical data.

It is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but reported values may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCSs) are aliquots of analyte-free water or clean solid matrix that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked water or solid matrix is then processed through the same extraction, concentration, cleanup, and/or analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 MATRIX SPIKE RECOVERIES

Matrix spikes (MSs) are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The

spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.4 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free water or clean solid matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA QUALITY REVIEW

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

Samples were received at Apex intact, in good condition, and with proper chain of custody documentation. Apex only lists sample receipt temperature on the laboratory report when samples are received outside the EPA-recommended limit. Sample receipt temperatures were not listed on this report.

6.0 TOTAL PETROLEUM HYDROCARBONS BY NWTPH-DX

DRO and ORO data from this event may be considered usable with the qualifications specified in Sections 6.1 through 6.5.

6.1 HOLDING TIMES

All samples were extracted and analyzed within the 14-day method-recommended maximum holding time for preserved water samples.

6.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with the DRO and ORO analysis of these samples.

6.3 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within the laboratory-specified 70% to 130% limits.

6.4 SURROGATE RECOVERIES

Surrogate recoveries were within laboratory-specified limits, with the following exception:

- Apex was not able to recover the surrogate compound o-terphenyl from sample MW-3A. The sample was analyzed at a 1:10 dilution, which likely reduced the surrogate concentration below the analytical detection limit. It is not possible to evaluate data usability for this sample based on the surrogate recovery.

6.5 DATA REPORTING AND ANALYTICAL PROCEDURES

According to Apex's notes, the chromatograms for the DRO detections in samples MW-2A, MW-3B, MW-6A, MW-9, MW-10, MW-19, MW-20, MW-21, MW-22, MW-23, MW-24, and MW-25 do not match the standard used for quantification. AMEC N qualified these DRO results as being presumptively identified.

According to Apex's notes, the chromatograms for the DRO and ORO detections in samples MW-1, MW-3A, and MW-4A do not match the standards used for quantification. AMEC N qualified these DRO and ORO results as being presumptively identified.

7.0 METALS BY EPA METHOD 6020

Metal data from this event may be considered fully usable without qualification.

7.1 HOLDING TIMES

All samples were analyzed within the 180-day technical holding time.

7.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

7.3 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within the laboratory-specified 80% to 120% limits.

7.4 MATRIX SPIKE RECOVERIES

Apex performed a MS on sample MW-19. Recoveries were within laboratory-specified 75% to 125% limits.

8.0 POLYCYCLIC AROMATIC HYDROCARBONS BY EPA METHOD 8270D

PAH data from this event may be considered usable with the limitations and exceptions described in Sections 8.1 through 8.5.

8.1 HOLDING TIMES

All samples were extracted within the method-specified 7-day maximum holding time for water samples. All sample extracts were analyzed within the 40-day maximum holding time from extraction until analysis.

8.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

8.3 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's limits, with the following exception:

- Naphthalene recoveries were less than the laboratory's 40% to 125% limits at 31% in the LCS and 34% in the LCSD associated with the analysis of samples MW-1, MW-2A, MW-3A, MW-3B, MW-4A, MW-4B, MW-5, MW-6A, MW-9, MW-10, MW-18, MW-19, MW-20, MW-21, MW-22, MW-22 Dup, MW-23, MW-23 Dup, MW-24, and MW-25. Data limitations are summarized below.
  - AMEC J qualified the detected naphthalene results from samples MW-1, MW-2A, MW-3A, MW-3B, MW-4A, MW-4B, MW-5, MW-6A, MW-9, MW-10, MW-19, MW-20, MW-21, MW-22, MW-22 Dup, MW-24, and MW-25 because of possibly low analytical bias.
  - AMEC UJ qualified the nondetected naphthalene results from samples MW-18, MW-23, and MW-23 Dup because of possibly low analytical bias.

8.4 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits, with the following exceptions:

- Recoveries of the surrogate compound p-terphenyl-d14 were greater than the laboratory's 30% to 120% limits in samples MW-3A (136%), MW-22 Dup (138%), and MW-24 (135%). The samples were analyzed at 1:1,000 dilutions that reduced the surrogate concentrations below the analytical reporting limit (RL). It is not possible to fully evaluate data usability for these samples based on the surrogate recoveries.

8.5 DATA REPORTING AND ANALYTICAL PROCEDURES

According to Apex's notes, benzo(b)fluoranthene and benzo(k)fluoranthene coelute. When neither analyte was detected, Apex reported the results separately. When only one of the compounds was detected, but the concentration was less than the combined reporting limit for benzo(b)fluoranthene and benzo(k)fluoranthene, Apex reported the nondetected result as benzo(b+k)fluoranthene(s). When either (or both) analyte(s) were detected at concentrations above the combined reporting limit, the detected result was reported as benzo(b+k)fluoranthene(s).

9.0 FIELD DUPLICATES

Field duplicates were collected at MW-22 and MW-23. Analytes detected in the field duplicate pairs are summarized in Table 2.

Table 2: Field Duplicate Detections

Analyte	RL	Primary Result	Duplicate Result	Relative Percent Difference	Notes
Samples MW-23 and MW-23 Dup					
Arsenic	2.00 µg/L	10.0	9.93	0.70%	
Zinc	4.00 µg/L	4.03	4.00 U	Not calculable	J/UJ-FD
Acenaphthene	1.87 µg/L	109	97.5	11.1%	
Anthracene	1.87 µg/L	10.8	9.82	9.51%	
Fluoranthene	1.87 µg/L	17.1	16.7	2.37%	
Fluorene	1.87 µg/L	73.4	67.2	8.82%	
Phenanthrene	1.87 µg/L	104	92.4	11.8%	
Pyrene	1.87 µg/L	9.12	8.92	2.22%	
Samples MW-22 and MW-22 Dup					
Arsenic	2.00 µg/L	12.2	11.9	2.49%	
Zinc	4.00 µg/L	10.1	5.99	51.1%	J-FD
Acenaphthene	37.7 µg/L	294	340	14.5%	
Fluorene	37.7 µg/L	125	141	12.0%	
Naphthalene	151 µg/L	21,100	21,700	2.80%	
Phenanthrene	37.7 µg/L	126	136	7.63%	

Note:
µg/L = micrograms per liter

Relative percent differences were less than 30%, or the differences between analyte concentrations were less than the applicable RL, with the following exceptions:

- Zinc was detected in sample MW-23 at a concentration of 4.03 µg/L, but was not detected in the field duplicate at a concentration greater than the RL of 4.0 µg/L. AMEC J qualified the detected zinc result from sample MW-23 and UJ qualified the nondetected zinc result from sample MW-23 Dup because of sampling or analytical imprecision.
- Zinc was detected in sample MW-22 at a concentration of 10.1 µg/L and in the field duplicate at a concentration of 5.99 µg/L. The difference between analyte concentrations is greater than the RL of 4.0 µg/L and AMEC J qualified the zinc results from both samples because of sampling or analytical imprecision.

10.0 SUMMARY

AMEC reviewed a total of 456 data records during this data quality review. No data were rejected and 100% of the data should be considered fully usable with the addition of the qualifiers summarized in Table 3.

Table 3: Qualifiers Added During Data Quality Review

Sample ID	Analyte	Concentration	Qualifier
MW-1	DRO	4.56 mg/L	N-SB
	ORO	0.519 mg/L	N-SB
	Naphthalene	30.7 µg/L	J-LL
MW-2A	DRO	76.3 mg/L	N-SB
	Naphthalene	10,500 µg/L	J-LL
MW-3A	DRO	49.1 mg/L	N-SB
	ORO	3.26 mg/L	N-SB
	Naphthalene	13,000 µg/L	J-LL
MW-3B	DRO	0.349 mg/L	N-SB
	Naphthalene	10.5 µg/L	J-LL
MW-4A	DRO	0.287 mg/L	N-SB
	ORO	0.391 mg/L	N-SB
	Naphthalene	4.26 µg/L	J-LL
MW-4B	Naphthalene	1.85 µg/L	J-LL
MW-5	Naphthalene	1.45 µg/L	J-LL
MW-6A	DRO	7.69 mg/L	N-SB
	Naphthalene	331 µg/L	J-LL

Sample ID	Analyte	Concentration	Qualifier
MW-9	DRO	2.55 mg/L	N-SB
MW-10	DRO	0.771 mg/L	N-SB
	Naphthalene	0.906 µg/L	J-LL
MW-18	Naphthalene	0.0755 µg/L	UJ-LL
MW-19	DRO	3.66 mg/L	N-SB
	Naphthalene	864 µg/L	J-LL
MW-20	DRO	0.657 mg/L	N-SB
	Naphthalene	95 µg/L	J-LL
MW-21	DRO	1.38 mg/L	N-SB
	Naphthalene	26.7 µg/L	J-LL
MW-22	DRO	40.9 mg/L	N-SB
	Naphthalene	21,100 µg/L	J-LL
	Zinc	10.1 µg/L	J-FD
MW-22-DUP	Naphthalene	21,700 µg/L	J-LL
	Zinc	5.99 µg/L	J-FD
MW-23	Diesel Range Organics	1.1 mg/L	N-SB
	Naphthalene	3.74 µg/L	UJ-LL
	Zinc	4.03 µg/L	J-FD
MW-23 DUP	Naphthalene	3.74 µg/L	UJ-LL
	Zinc	4 µg/L	UJ-FD
MW-24	DRO	12.4 mg/L	N-SB
	Naphthalene	8,710 µg/L	J-LL
MW-25	DRO	10.1 mg/L	N-SB
	Naphthalene	1,220 µg/L	J-LL

- AMEC J or UJ qualified 24 results (5.3%) as being estimated values because of:
  - Low LCS recoveries (Section 8.3) or
  - Field duplicate imprecision (Section 9.0).
- AMEC N qualified 18 results (3.9%) as being presumptively identified because the sample spectra did not match the standard spectra. (Section 6.5)

REFERENCES

Ecology, 1997. Analytical Methods for Petroleum Hydrocarbons, Publication No. ECY 97-602, June 1997.

EPA, 2010. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, USEPA-540-R-10-011.

EPA, 2008. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, USEPA-540-R-08-01.

EPA, 2007a. Method 6020A, Inductively Coupled Plasma-Mass Spectrometry, Revision 1, February 2007.

EPA, 2007c. Method 8270D, Semivolatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), Revision 4, February 2007.

LIMITATIONS

This report was prepared exclusively for Port of St. Helens by AMEC Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data quality review is intended to be used by Port of St. Helens for the Port of St. Helens Site only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

DATA QUALITY REVIEW

Port of St. Helens

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ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
AMEC	AMEC Environment & Infrastructure, Inc.
Apex	Apex Laboratories, LLC
DRO	diesel-range organics
Ecology	Washington Department of Ecology
EPA	United States Environmental Protection Agency
ID	identification
LCS	laboratory control sample
MS	matrix spike
ORO	oil-range organics
PAH	polycyclic aromatic hydrocarbon
QC	quality control
RL	reporting limit

DATA QUALITY REVIEW
Port of St. Helens

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) collected 21 water samples (including 2 field duplicates) from the Port of St. Helens on May 3 and 4, 2012. The samples were submitted to Apex Laboratories, LLC (Apex) in Tigard, Oregon, where they were assigned to sample delivery groups A12E100 and A12E118. Apex analyzed the samples for diesel-range organics (DRO) and oil-range organics (ORO) by Washington Department of Ecology (Ecology) Method NWTPH-Dx, metals by United States Environmental Protection Agency (EPA) Method 6020A, and polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270D.

A list of all samples by sample location, sample collection date, and Apex sample identification (ID) is presented in Table 1.

Table 1: Field Samples Submitted to Apex Laboratories

Sample Location	Collection Date	Apex ID	Notes
MW-18	05/03/2012	A12E100-01	
MW-9	05/03/2012	A12E100-02	
MW-23	05/03/2012	A12E100-03	
MW-23 Dup	05/03/2012	A12E100-04	Field duplicate
MW-10	05/03/2012	A12E100-05	
MW-24	05/03/2012	A12E100-06	
MW-7	05/03/2012	A12E100-07	
MW-6A	05/03/2012	A12E100-08	
MW-25	05/03/2012	A12E118-01	
MW-2A	05/03/2012	A12E118-02	
MW-4B	05/04/2012	A12E118-03	
MW-4A	05/04/2012	A12E118-04	
MW-19	05/04/2012	A12E118-05	
MW-1	05/04/2012	A12E118-06	
MW-21	05/04/2012	A12E118-07	
MW-5	05/04/2012	A12E118-08	
MW-20	05/04/2012	A12E118-09	

Sample Location	Collection Date	Apex ID	Notes
MW-3B	05/04/2012	A12E118-10	
MW-22	05/04/2012	A12E118-11	
MW-22 DUP	05/04/2012	A12E118-12	Field duplicate
MW-3A	05/04/2012	A12E118-13	

2.0 DATA QUALITY REVIEW METHODOLOGY

Quality review of these data followed the National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008) and Inorganic Superfund Data Review (EPA, 2010). The EPA guidelines were written specifically for the Contract Laboratory Program, and have been modified for the purposes of this data quality review where they differ from method-specific quality control (QC) requirements. This data quality review consisted of assessment of summary reports, and does not include review or validation of the raw analytical data.

It is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but reported values may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCSs) are aliquots of analyte-free water or clean solid matrix that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked water or solid matrix is then processed through the same extraction, concentration, cleanup, and/or analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 MATRIX SPIKE RECOVERIES

Matrix spikes (MSs) are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The

spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.4 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free water or clean solid matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA QUALITY REVIEW

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

Samples were received at Apex intact, in good condition, and with proper chain of custody documentation. Apex only lists sample receipt temperature on the laboratory report when samples are received outside the EPA-recommended limit. Sample receipt temperatures were not listed on these reports.

6.0 TOTAL PETROLEUM HYDROCARBONS BY NWTPH-DX

DRO and ORO data from this event may be considered usable with the qualifications specified in Sections 6.1 through 6.5.

6.1 HOLDING TIMES

All samples were extracted and analyzed within the 14-day method-recommended maximum holding time for preserved water samples.

6.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with the DRO and ORO analysis of these samples.

6.3 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within laboratory-specified limits.

6.4 SURROGATE RECOVERIES

Surrogate recoveries were within laboratory-specified limits, with the following exception:

- Apex was not able to recover the surrogate compound o-terphenyl from samples MW-2A and MW-3A. The samples were analyzed at 1:20 and 1:100 dilutions, respectively, which likely reduced the surrogate concentrations below the analytical detection limit. It is not possible to evaluate data usability for these samples based on surrogate recoveries.

6.5 DATA REPORTING AND ANALYTICAL PROCEDURES

According to Apex's notes, ORO recovery was high in the calibration verification standard associated with the analysis of samples MW-6A, MW-23, MW-24, and MW-25. AMEC J qualified the detected ORO results from these samples because of potentially high analytical bias. (J-CH)

According to Apex's notes, the chromatograms for the DRO detections in samples MW-1, MW-2A, MW-3A, MW-4A, MW-6A, MW-9, MW-10, MW-19, MW-20, MW-21, MW-22, MW-23, MW-24, and MW-25 do not match the standard used for quantification. AMEC N qualified these diesel results as being presumptively identified. (N-SB)

According to Apex's notes, the ORO detections in samples MW-2A, MW-6A, MW-23, MW-24, and MW-25 are from analytes that primarily elute in the DRO retention time range, also eluting in the ORO retention time range. AMEC N qualified these ORO results as being presumptively identified. (N-SB)

According to Apex's notes, the chromatogram for the diesel detection in sample MW-20 does not match the standard used for quantification, but may resemble weathered diesel or a similar product. AMEC N qualified this diesel result as being presumptively identified. (N-SB)

7.0 METALS BY EPA METHOD 6020

Metal data from this event may be considered fully usable without qualification.

7.1 HOLDING TIMES

All samples were analyzed within the 180-day technical holding time.

7.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

7.3 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within the laboratory-specified 80% to 120% limits.

7.4 LABORATORY DUPLICATES

Apex performed duplicate analyses of samples MW-2A and MW-10. RPDs between primary and duplicate results were less than the laboratory-specified maximum of 20%.

7.5 MATRIX SPIKE RECOVERIES

Apex performed MSs on samples MW-3A, MW-4A, and MW-6A. Recoveries were within the laboratory-specified 75% to 125% limits.

8.0 POLYCYCLIC AROMATIC HYDROCARBONS BY EPA METHOD 8270D

PAH data from this event may be considered usable with the limitations and exceptions described in Sections 8.1 through 8.5.

8.1 HOLDING TIMES

All samples were extracted within the method-specified 7-day maximum holding time for water samples. All sample extracts were analyzed within the 40-day maximum holding time from extraction until analysis.

8.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

8.3 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's limits.

8.4 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits.

8.5 DATA REPORTING AND ANALYTICAL PROCEDURES

According to Apex's notes, benzo(b)fluoranthene and benzo(k)fluoranthene coelute. When neither analyte was detected, Apex reported the results separately. When only one of the compounds was detected, but the concentration was less than the combined reporting limit for benzo(b)fluoranthene and benzo(k)fluoranthene, Apex reported the nondetected result as benzo(b+k)fluoranthene(s). When either (or both) analyte(s) were detected at concentrations above the combined reporting limit, the detected result was reported as benzo(b+k)fluoranthene(s).

9.0 FIELD DUPLICATES

Field duplicates were collected at MW-22 and MW-23. Analytes detected in the field duplicate pairs are summarized in Table 2.

Table 2: Field Duplicate Detections

Analyte	RL	Primary Result	Duplicate Result	Relative Percent Difference	Notes
Samples MW-22 and MW-22 Dup					
Acenaphthene	76.2 µg/L	214	239	11%	
Fluorene	76.2 µg/L	92.1	102	10%	
Naphthalene	152 µg/L	11,600	12800	10%	
Phenanthrene	76.2 µg/L	76.2 U	87.5	Not calculable	
Arsenic	2.00 µg/L	12.7	12.9	1.6%	
Zinc	4.00 µg/L	4.48	4.00 U	Not calculable	
Samples MW-23 and MW-23 Dup					
Acenaphthene	1.87 µg/L	75.5	63.9	17%	
Anthracene	1.87 µg/L	10.1	8.34	19%	
Fluoranthene	1.87 µg/L	14.5	12.7	13%	
Fluorene	1.87 µg/L	55.2	46.6	17%	
Phenanthrene	1.87 µg/L	81.8	51.6	45%	J-FD
Pyrene	1.87 µg/L	7.5	6.56	13%	
Arsenic	2.00 µg/L	11.5	11.3	1.8%	

Notes:

µg/L = micrograms per liter

RL = reporting limit

Relative percent differences were less than 30%, or the differences between analyte concentrations were less than the applicable RL, with the following exception:

- There was greater than 30% RPD between the detected phenanthrene results detected in sample MW-23 and its field duplicate MW-23 Dup. AMEC J qualified the phenanthrene results from samples MW-23 and MW-23 Dup because of sampling or analytical imprecision. (J-FD)

10.0 SUMMARY

AMEC reviewed a total of 500 data records during this data quality review. No data were rejected and 100% of the data should be considered fully usable with the addition of the qualifiers summarized in Table 3.

Table 3: Qualifiers Added During Data Quality Review

Sample ID	Analyte	Concentration	Qualifier
MW-1	DRO	5.37 mg/L	N-SB
MW-2A	DRO	81.1 mg/L	N-SB
	ORO	3.81 mg/L	N-SB
MW-3A	DRO	113 mg/L	N-SB
MW-4A	DRO	0.238 mg/L	N-SB
MW-6A	DRO	8.30 mg/L	N-SB
	ORO	0.723 mg/L	NJ-SB, CH
MW-9	DRO	2.18 mg/L	N-SB
MW-10	DRO	1.45 mg/L	N-SB
MW-19	DRO	7.64 mg/L	N-SB
MW-20	DRO	1.18 mg/L	N-SB
MW-21	DRO	1.69 mg/L	N-SB
MW-22	DRO	44.6 mg/L	N-SB
MW-23	DRO	1.19 mg/L	N-SB
	ORO	0.459 mg/L	NJ-SB, CH
	Phenanthrene	81.8 µg/L	J-FD
MW-23 Dup	Phenanthrene	51.6 µg/L	J-FD
MW-24	DRO	10.8 mg/L	N-SB
	ORO	0.673 mg/L	NJ-SB, CH
MW-25	DRO	7.91 mg/L	N-SB
	ORO	0.907 mg/L	NJ-SB, CH

Note:

mg/L = milligrams per liter

- AMEC J qualified 2 results (0.4%) as being estimated values because of field duplicate imprecision (Section 9.0).
- AMEC N qualified 15 results (3.0%) as being presumptively identified because the sample spectra did not match the standard spectra. (Section 6.5)
- AMEC NJ qualified 4 results (0.8%) as being both presumptively identified, because the sample spectra did not match the standard spectra, and estimated values, because of high calibration verification standard recovery. (Section 6.5)

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Ecology, 1997. Analytical Methods for Petroleum Hydrocarbons, Publication No. ECY 97-602, June 1997.

EPA, 2010. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, USEPA-540-R-10-011.

EPA, 2008. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, USEPA-540-R-08-01.

EPA, 2007a. Method 6020A, Inductively Coupled Plasma-Mass Spectrometry, Revision 1, February 2007.

EPA, 2007c. Method 8270D, Semivolatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), Revision 4, February 2007.

LIMITATIONS

This report was prepared exclusively for Port of St. Helens by AMEC Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data quality review is intended to be used by Port of St. Helens for the Port of St. Helens Site only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

DATA QUALITY REVIEW

Port of St. Helens

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Table 2: Field Duplicate Detections

Table 3: Qualifiers Added During Data Quality Review

ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
AMEC	AMEC Environment & Infrastructure, Inc.
Apex	Apex Laboratories, LLC
ASTM	ASTM International
DOC	dissolved organic carbon
EPA	United States Environmental Protection Agency
ID	identification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantification
mg/L	milligrams per liter
MS	matrix spike
PAH	polycyclic aromatic hydrocarbon
QC	quality control
RPD	relative percent difference
SM	Standard Methods
TOC	total organic carbon

DATA QUALITY REVIEW
Port of St. Helens

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) collected 79 sediment samples (including 2 field duplicates) and 4 aqueous rinsate blanks from the Port of St. Helens between July 9 and 13, 2012. The samples were submitted to Apex Laboratories, LLC (Apex) in Tigard, Oregon, where they were assigned to sample delivery groups A12G119, A12G148, A12G149, A12G169, A12G170, A12G193, A12G213, and A12G214. Apex archived 50 of the sediment samples and analyzed the remaining 29 sediment samples for polycyclic aromatic hydrocarbons (PAHs) and PAH homologs by modified United States Environmental Protection Agency (EPA) Method 8270D and total organic carbon (TOC) by modified Standard Methods (SM) 5310B. Apex separated porewater from the sediments and analyzed the porewater for PAHs and PAH homologs using ASTM International (ASTM) D7363-07 and dissolved organic carbon (DOC) by SM 5310B. Apex analyzed the rinsate blanks for PAHs by EPA Method 8270D.

A list of the analyzed samples by sample location, Apex sample identification (ID), matrix, and sample collection date is presented in Table 1.

2.0 DATA QUALITY REVIEW METHODOLOGY

Quality review of these data followed the National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008). The EPA guideline was written specifically for the Contract Laboratory Program, and has been modified for the purposes of this data quality review where it differs from method-specific quality control (QC) requirements. This data quality review consisted of assessment of summary reports, and does not include review or validation of the raw analytical data.

It is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but reported values may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCSs) are aliquots of analyte-free water or clean solid matrix that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked water or solid matrix is then processed through the same extraction, concentration, cleanup, and/or analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 MATRIX SPIKE RECOVERIES

Matrix spikes (MSs) are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.4 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free water or clean solid matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

Rinsate blanks are prepared by passing analyte-free water through or over sample collection equipment and collecting the water in sample containers. Rinsate blanks are analyzed for the analytical suite required for the project. Rinsate blanks are used to monitor for possible sample contamination during the sample collection process and serve as a check on the effectiveness of field decontamination procedures.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA QUALITY REVIEW

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

Samples were received at Apex intact, in good condition, and with proper chain of custody documentation. Apex only lists sample receipt temperature on the laboratory report when samples are received outside the EPA-recommended limit. Sample receipt temperatures were not listed on these reports.

6.0 POLYCYCLIC AROMATIC HYDROCARBONS AND PAH HOMOLOGS BY EPA METHOD 8270D

PAH and PAH homolog data from this event may be considered usable with the limitations and exceptions described in Sections 6.1 through 6.8.

6.1 HOLDING TIMES

All samples were extracted within the method-specified 14-day maximum holding time for sediment samples. All sample extracts were analyzed within the 40-day maximum holding time from extraction until analysis, with the following exception:

- Sediment sample PWS-02_1-4 was collected on July 10, 2012, but was not extracted until July 25, 2012, 1 day past the maximum recommended 14 day hold time. AMEC J qualified the detected results and UJ qualified the nondetected results from this sample because of the missed hold time. (J/UJ-HT)

6.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

6.3 RINSATE BLANKS

Target analytes were not detected in the rinsate blanks associated with these samples, with the following exceptions:

- Benzo(a)anthracene (0.0285 micrograms per liter [µg/L]), dibenzofuran (0.0204 µg/L), fluoranthene (0.119 µg/L), fluorene (0.0290 µg/L), phenanthrene (0.121 µg/L), and pyrene (0.0800 µg/L) were detected in the rinsate blank associated with sediment samples PWS-01_8-9, PWS-02_1-4, PWS-02_8-10, PWS-04_1-4, PWS-04_8-11, and PWS-07_8-11. The concentrations detected in the rinsate blank were orders of magnitude lower than the detections the associated field samples and data usability is not adversely affected.

6.4 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's limits.

6.5 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits, with the following exception:

- Recovery of the surrogate compound benzo(a)pyrene-d_{12} was high at 212% in sediment sample PWS-02_8-10. Based on the associations listed in the National Functional Guidelines for Superfund Organic Methods Data Review, AMEC J qualified the detected benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, benzo(e)pyrene, and indeno(1,2,3-cd)pyrene results from this sample because of potentially high analytical bias. (J-HS)

6.6 LABORATORY DUPLICATES

Apex analyzed sediment samples PWS-04_1-4, PWS-13_8-11, and PWS-21_8-10 in duplicate. Relative percent differences (RPDs) between the primary and duplicate detected results were within the laboratory-specified maximum of 30% with the following exceptions.

- In sediment sample PWS-04_1-4, RPDs between the primary and duplicate results for anthracene and C1-fluorenes were greater than the laboratory-specified maximum of 30% at 48% and 32%, respectively. Data limitations are summarized below:
  - AMEC J qualified the detected anthracene result from sediment sample PWS-04_1-4 because of analytical imprecision.
  - The difference between the detected C1-fluorenes concentrations was less than the limit of quantification (LOQ) of 69.1 micrograms per kilogram (µg/kg) and data usability is not adversely affected.
- In sediment sample PWS-13_8-11, RPDs between the primary and duplicate results for benzo(k)fluoranthene (36%), C1-chrysenes/benzo(a)anthracenes (46%), 1-methylnaphthalene (35%), and C3-phenanthreanes/anthracenes (32%) were greater than the laboratory-specified maximum of 30%. Data limitations are summarized below:
  - AMEC J qualified the detected benzo(k)fluoranthene result from sediment sample PWS-13_8-11 because of analytical imprecision. (J-HD)
  - The differences between the detected C1-chrysenes/benzo(a)anthracenes (139 µg/kg and 223 µg/kg), 1-methylnaphthalene (53.8 µg/kg and 37.8 µg/kg), and C3-phenanthreanes/anthracenes (96.6 µg/kg and 133 µg/kg) results were less than the respective LOQs of 94.3 µg/kg, 18.9 µg/kg, and 94.3 µg/kg and data usability is not adversely affected.

6.7 MATRIX SPIKES

Apex performed MSs on samples PWS-02_1-4, PWS-19_8-11, and PWS-16B_8-11. Recoveries were within the laboratory-specified limits with the following exceptions:

- Benzo(a)anthracene (131%), benzo(b)fluoranthene (124%), chrysene (138%), fluoranthene (177%), and pyrene (166%) recoveries were high in the MS performed on sample PWS-02_1-4. The background analyte concentrations in the unspiked native

sample ranged between approximately 26 and 98 times the spike concentrations. It is not possible to evaluate data usability for these analytes based on MS recoveries.

6.8 DATA REPORTING AND ANALYTICAL PROCEDURES

Apex J qualified analytes with concentrations between the limit of detection (LOD) and the LOQ. AMEC agrees that these results are quantitatively uncertain and has maintained Apex's J qualifiers. (J-DL)

7.0 POLYCYCLIC AROMATIC HYDROCARBONS AND PAH HOMOLOGS BY ASTM D7363-07

PAH and PAH homolog data from this event may be considered usable with the limitations and exceptions described in Sections 7.1 through 7.6.

7.1 HOLDING TIMES

All samples were extracted within the method-specified 7-day maximum holding time for water samples. All sample extracts were analyzed within the 40-day maximum holding time from extraction until analysis.

7.2 CALIBRATION VERIFICATIONS

Apex presented the following list of calibration verification standards (CVSs) that did not meet method-specified criteria and the associated samples in the case narrative:

- Benzo(a)anthracene (62%), chrysene (150%), fluoranthene (126%) and pyrene (128%) recoveries were outside the method-specified 75% to 125% limits for four-ring PAHs in the CVSs associated with the analysis of porewater samples PWS-11_8-11 and PWS-16_8-11. Data limitations are summarized below.
  - AMEC UJ qualified the nondetected benzo(a)anthracene results from samples PWS-11_8-11 and PWS-16_8-11 because of potentially low analytical bias. (UJ-LC)
  - AMEC J qualified the detected fluoranthene, and pyrene results from sample PWS-11_8-11 because of potentially high analytical bias. (J-CH)
  - Chrysene was not detected in either sample and fluoranthene and pyrene were not detected in sample PWS-16_8-11. Data usability is not adversely affected by the potentially high analytical bias.

- Benzo(a)anthracene recovery was low at 69% in the CVS associated with the analysis of porewater samples PWS-01_8-9, PWS-02_8-10, PWS-04_8-11, PWS-07_8-11, PWS-15_8-11, and PWS-20_8-11 Dup. Data limitations are summarized below.
  - AMEC UJ qualified the nondetected benzo(a)anthracene results from samples PWS-01_8-9, PWS-04_8-11, PWS-07_8-11, PWS-15_8-11, and PWS-20_8-11 Dup because of potentially low analytical bias. (UJ-LC)
  - AMEC J qualified the detected benzo(a)anthracene result from sample PWS-02_8-10 because of potentially low analytical bias. (J-LC)
- Anthracene recovery was greater than the method-specified 80% to 120% limits for three-ring PAHs at 122% and benzo(a)anthracene recovery was low at 69% in the CVS associated with the analysis of porewater samples PWS-02_1-4, PWS-03_8-11, PWS-05_8-11, PWS-06_8-11, PWS-13_1-4, PWS-13_8-11, PWS-18_8-11, PWS-19_8-11, and PWS-20_8-11. Data limitations are summarized below.
  - Benzo(a)anthracene was not detected in the associated samples and AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LC)
  - AMEC J qualified the detected anthracene results from samples PWS-03_8-11 and PWS-05_8-11 because of potentially high analytical bias. (J-CH)
  - Anthracene was not detected in the remaining samples and data usability is not adversely affected by the potentially high analytical bias.
- Benzo(a)anthracene and chrysene recoveries were low at 50% and 69%, respectively, in the CVS associated with the analysis of porewater samples PWS-08_8-11, PWS-09_8-11, PWS-10_8-11, PWS-12_8-11, and PWS-12_8-11 Dup. Data limitations are summarized below.
  - Benzo(a)anthracene was not detected in the associated samples and AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LC)
  - AMEC J qualified the detected chrysene result from sample PWS-10_8-11 because of potentially low analytical bias. (J-LC)
  - Chrysene was not detected in the remaining samples and AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LC)
  - Chrysenes/benzo(a)anthracenes homologs were not detected in the associated samples and AMEC UJ qualified the nondetected chrysenes/benzo(a)anthracenes homolog results because of potentially low analytical bias. (UJ-LC)
- Benzo(a)anthracene (44%), chrysene (43%), and pyrene (74%) recoveries were low in the CVS associated with the analysis of samples PWS-11B_8-11, PWS-16B_8-11, PWS-25_8-11, PWS-26_8-11, and PWS-27_8-11. Data limitations are summarized below.
  - Benzo(a)anthracene was not detected in the associated samples and AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LC)

- AMEC J qualified the detected chrysene and pyrene results from samples PWS-11B_8-11, PWS-25_8-11, PWS-26_8-11 because of potentially low analytical bias. (UJ-LC)
- Chrysene and pyrene were not detected in the remaining samples and AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LC)
- Chrysenes/benzo(a)anthracenes homologs were not detected in the associated samples and AMEC UJ qualified the nondetected chrysenes/benzo(a)anthracenes homolog results because of potentially low analytical bias. (UJ-LC)

7.3 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples, with the following exceptions:

- Chrysene was detected at a concentration of 0.00504 µg/L in the laboratory blank associated with the analysis of samples PWS-01_8-9, PWS-02_8-10, PWS-04_8-11, PWS-07_8-11, PWS-15_8-11, and PWS-20_8-11 Dup. Chrysene either was not detected in the associated samples, or was detected at a concentration more than five times the concentration detected in the blank. Data usability is not adversely affected.

7.4 LABORATORY CONTROL SAMPLE RECOVERIES

Water solubility for PAHs is inversely proportional to the PAH's molecular weight and number of rings. The method does not include PAHs with more than four rings and AMEC did not evaluate LCS recoveries for these PAHs, which excluded benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, benzo(e)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and perylene results from being evaluated. These analytes are essentially non-water soluble and would not be expected to be present in porewater.

The following two, three, and four-ring PAHs exhibited LCS recoveries outside the laboratory-specified limits:

- Anthracene (20%-LCS Duplicate [LCSD]), benzo(a)anthracene (15%/3%), chrysene (9%/2%), fluoranthene (17%-LCSD), fluorene (64%-LCSD), phenanthrene (45%-LCSD), and pyrene (15%-LCSD) recoveries were low in the LCS and/or LCSD associated with the analysis of porewater samples PWS-11_8-11 and PWS-16_8-11. Data limitations are summarized below.
  - The LCSD recoveries for the two-ring PAHs (acenaphthene, acenaphthylene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene) were higher than the LCS recoveries, while recoveries of the three and four-ring PAHs (anthracene, benzo(a)anthracene, chrysene, fluoranthene, fluorene, phenanthrene, and pyrene) were much lower than the LCS recoveries. In AMEC's professional opinion this is

more indicative of a specific problem with the LCSD, rather than a systemic extraction problem. AMEC therefore chose not to use the LCSD recovery to evaluate data usability for the associated samples.

- AMEC UJ qualified the nondetected benzo(a)anthracene and chrysene results and the chrysenes/benzo(a)anthracenes homolog results from the associated samples because of potentially low analytical bias. (UJ-LL)

- Benzo(a)anthracene and chrysene recoveries were low at 16% and 8%, respectively, in one of the LCSs associated with the analysis of samples PWS-01_8-9, PWS-02_8-10, PWS-04_8-11, PWS-07_8-11, PWS-15_8-11, and PWS-20_8-11 Dup. Data limitations are summarized below.

  - AMEC UJ qualified the nondetected benzo(a)anthracene and chrysene results and the chrysenes/benzo(a)anthracenes homolog results from samples PWS-01_8-9, PWS-04_8-11, PWS-07_8-11, PWS-15_8-11, and PWS-20_8-11 Dup because of potentially low analytical bias. (UJ-LL)

  - AMEC J qualified the detected benzo(a)anthracene, chrysene, and C1-chrysenes/benzo(a)anthracenes results and UJ qualified the nondetected C2- and C3-chrysenes/benzo(a)anthracenes homolog results from sample PWS-02_8-10 because of potentially low analytical bias. (J/UJ-LL)

- Benzo(a)anthracene and chrysene recoveries were low at 7% and 5%, respectively in one LCS and chrysene recovery was low at 10% in the other LCS associated with the analysis of samples PWS-02_1-4, PWS-03_8-11, PWS-05_8-11, PWS-06_8-11, PWS-13_1-4, PWS-13_8-11, PWS-18_8-11, PWS-19_8-11, and PWS-20_8-11. Data limitations are summarized below.

  - Benzo(a)anthracene and chrysenes/benzo(a)anthracenes homologs were not detected in the assocated samples. AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LL)

  - AMEC J qualified the detected chrysene results from sample PWS-03_8-11 because of potentially low analytical bias. (J-LL)

  - Chrysene was not detected in the remaining samples and AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LL)

- Benzo(a)anthracene and chrysene recoveries were low at 19% and 10%, respectively in one LCS and chrysene recovery was low at 12% in the other LCS associated with the analysis of samples PWS-08_8-11, PWS-09_8-11, PWS-10_8-11, PWS-12_8-11, and PWS-12_8-11 Dup. Data limitations are summarized below.

  - Benzo(a)anthracene and chrysenes/benzo(a)anthracenes homologs were not detected in the assocated samples. AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LL)

  - AMEC J qualified the detected chrysene results from sample PWS-10_8-11 because of potentially low analytical bias. (J-LL)

- Chrysene was not detected in the remaining samples and AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LL)

- Chrysene recovery was low at 12% in the LCS and benzo(a)anthracene and chrysene recoveries were low at 17% and 8%, respectively in the LCSD associated with the analysis of samples PWS-11B_8-11, PWS-16B_8-11, PWS-25_8-11, PWS-26_8-11, and PWS-27_8-11. Data limitations are summarized below.

  - Benzo(a)anthracene and chrysenes/benzo(a)anthracenes homologs were not detected in the assocated samples. AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LL)

  - AMEC J qualified the detected chrysene results from samples PWS-11B_8-11, PWS-25_8-11, PWS-26_8-11 because of potentially low analytical bias. (J-LL)

  - AMEC UJ qualified the nondetected chrysene results from samples PWS-16B_8-11 and PWS- 27_8-11 because of potentially low analytical bias. (UJ-LL)

7.5 LABORATORY DUPLICATES

Apex performed duplicate analyses of samples PWS-01_8-9, PWS-09_8-11, PWS-11_8-11, PWS-19_8-11, and PWS-25_8-11. RPDs between primary and duplicate results were less than the laboratory-specified maximum of 30%, with the following exceptions:

- In the duplicate analysis of sample PWS-01_8-9, RPDs between primary and duplicate results were high for C3-naphthalenes and C1-fluorenes at 56% and 33%, respectively. The differences between the primary and lab duplicate C3-naphthalenes (0.479 µg/L and 0.850 µg/L) and C1-fluorenes (0.466 µg/L and 0.653 µg/L) results are less than the respective LOQs of 1.27 µg/L and 0.274 µg/L. Data usability is not adversely affected.

- In the duplicate analysis of sample PWS-09_8-10, Acenaphthene was detected in the primary sample at a concentration of 0.185 µg/L, but was not detected in the laboratory duplicate at a concentration greater than the LOD of 0.150 µg/L. The difference between the LOD and the detected concentration is less than the LOQ of 0.150 µg/L and data usability is not adversely affected.

- In the duplicate analysis of sample PWS-11_8-11, RPDs between primary and duplicate results were high for C2-naphthalenes and C3-naphthalenes at 43% and 74%, respectively. Additionally, chrysene was detected in the laboratory duplicate at a concentration of 0.00789 µg/L, but was not detected in the primary sample. Data limitations are summarized below.

  - The differences between the primary and lab duplicate C2-naphthalene (1.54 µg/L and 0.990 µg/L) and C3-naphthalene (1.00 µg/L and 0.460 µg/L) results are less than the respective LOQs of 0.778 µg/L and 1.27 µg/L. Data usability is not adversely affected.

  - Chrysene was not detected in the primary analysis at a concentration greater than the LOD of 0.00400 µg/L, but was detected in the duplicate analysis at a

concentration of 0.00789 µg/L. The difference between the LOD and the detected concentrations is less than the LOQ of 0.0400 µg/L and in AMEC's professional opinion, data usability is not adversely affected.

- In the duplicate analysis of sample PWS-25_8-11, RPDs between primary and duplicate results were high for chrysene (39%), C2-phenanthrenes/anthracenes (135%), and pyrene (37%). Additionally, C1-phenanthrenes/anthracenes were detected in the primary sample at a concentration of 0.299 µg/L, but were not detected in the laboratory duplicate. Data limitations are summarized below.
  - Chrysene was detected in the primary analysis at a concentration of 0.00920 µg/L and in the laboratory duplicate at a concentration of 0.00619 µg/L. The difference between the two results is less than the LOQ of 0.00400 µg/L and data usability is not adversely affected.
  - C1-Phenanthrenes/anthracenes were detected in the primary analysis at a concentration of 0.299 µg/L, but were not detected in the laboratory duplicate analysis at a concentration greater than the LOD of 0.263 µg/L. The difference between the detected concentration and the LOD is less than the LOQ of 0.263 µg/L and data usability is not adversely affected.
  - C2-Phenanthrenes/anthracenes were detected in the primary analysis at a concentration of 0.315 µg/L and in the laboratory duplicate at a concentration of 0.0608 µg/L. The difference between the two concentrations is less than the LOQ of 0.469 µg/L and data usability is not adversely affected.
  - Pyrene was detected in the primary analysis at a concentration of 0.163 µg/L and in the laboratory duplicate at a concentration of 0.112 µg/L. The difference between the two results, at 0.051 µg/L, was greater than the LOQ of 0.0493 µg/L. AMEC J qualified the detected pyrene result from this sample because of analytical imprecision. (J-HD)

7.6 DATA REPORTING AND ANALYTICAL PROCEDURES

According to Apex's notes, benzo(b)fluoranthene and benzo(k)fluoranthene coelute. When neither analyte was detected, Apex reported the results separately. When only one of the compounds was detected, but the concentration was less than the combined reporting limit for benzo(b)fluoranthene and benzo(k)fluoranthene, Apex reported the nondetected result as benzo(b+k)fluoranthene(s). When either (or both) analyte(s) were detected at concentrations above the combined reporting limit, the detected result was reported as benzo(b+k)fluoranthene(s).

8.0 TOTAL AND DISSOLVED ORGANIC CARBON BY SM 5310B

TOC and DOC data from this event may be considered usable with the limitations and exceptions described in Sections 8.1 through 8.5.

8.1 HOLDING TIMES

All samples were analyzed within the method-specified 28-day maximum holding time for sediment and water samples.

8.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

8.3 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's 90% to 110% limits.

8.4 LABORATORY DUPLICATES

Apex performed duplicate analyses on sediment samples PWS-11_8-11, PWS-12_8-11, and PWS-16B_8-11 for TOC and porewater samples PWS-02_1-4, PWS-04_1-4, and PWS-11_8-11 for DOC. RPDs between the primary and duplicate results were less than the laboratory-specified maximum of 20%, with the following exceptions:

- The RPD between the primary and duplicate TOC results from sediment sample PWS-11_8-11 was high at 25%. AMEC J qualified the detected TOC results from this sample because of analytical imprecision. (J-HD)
- DOC was detected in porewater sample PWS-02_1-4 at a concentration of 2.47 milligrams per liter (mg/L), but was not detected in the laboratory duplicate at a concentration greater than the LOQ of 2.22 mg/L. The difference between the detected analyte concentration and the LOQ is less than the LOQ and data usability is not adversely affected.
- DOC was detected in porewater sample PWS-04_1-4 at a concentration of 1.51 mg/L, but was not detected in the laboratory duplicate at a concentration greater than the LOQ of 2.00 mg/L. The difference between the detected analyte concentration and the LOQ is less than the LOQ and data usability is not adversely affected.
- There was 21% RPD between the primary and duplicate DOC results from porewater sample PWS-11_8-11. The difference between the detected analyte concentrations was less than the LOQ of 2.00 mg/L and data usability is not adversely affected.

8.5 MATRIX SPIKES

Apex did not perform any MSs for the TOC analyses of the sediment samples. Apex performed MSs on porewater sample PWS-02_1-4, PWS-04_1-4, and PWS-11_8-11 for DOC. Recoveries were within the laboratory-specified 75% to 125% limits.

9.0 FIELD DUPLICATES

Field duplicates were collected for sediment and porewater samples PWS-12_8-11 and PWS-20_8-11. Analytes detected in the field duplicate pairs are summarized in Table 2. RPDs between primary and field duplicate results were less than 50%, or differences between analyte concentrations were less than applicable LOQs, with the following exceptions:

- RPDs between the primary and field duplicate results for sediment sample PWS-12_8-11 were high for acenaphthene (59%), benzo(k)fluoranthene (64%), benzo(g,h,i)perylene (64%), benzo(a)pyrene (52%), benzo(e)pyrene (53%), and indeno(1,2,3-cd)pyrene (63%). AMEC J qualified the detected results for these analytes in sediment samples PWS-12_8-11 and PWS-12_8-11 Dup because of sampling or analytical imprecision. (J-FD)

10.0 SUMMARY

AMEC reviewed a total of 2,048 data records during this data quality review and J or UJ qualified 263 data records (13%) as estimated values. No data were rejected and 100% of the data should be considered fully usable with the addition of the qualifiers summarized in Table 3.

REFERENCES

APHA, 2005. Standard Methods for Examination of Water and Wastewater. 21st Edition.

ASTM, 2007. D7363-07, Standard Test Method for Determination of Parent and Alkyl Polycyclic Aromatics in Sediment Pore Water Using Solid-Phase Microextraction and Gas Chromatography/Mass Spectrometry in Selected Ion Monitoring Mode.

EPA, 2008. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, USEPA-540-R-08-01.

EPA, 2007c. Method 8270D, Semivolatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), Revision 4, February 2007.

LIMITATIONS

This report was prepared exclusively for Port of St. Helens by AMEC Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data quality review is intended to be used by Port of St. Helens for the Port of St. Helens Site only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

TABLES

Table 1
Field Samples Submitted to Apex Laboratories
Port of Saint Helens

Sample Location	Apex Sample ID	Matrix	Collection Date	Notes
PWS-11_8-11	A12G119-06	Porewater	7/9/2012	
PWS-16_8-11	A12G119-12	Porewater	7/9/2012	
Rinsate Blank	A12G119-13	Water	7/9/2012	
PWS-11_8-11	A12G119-14	Sediment	7/9/2012	
PWS-16_8-11	A12G119-15	Sediment	7/9/2012	
PWS-21_8-10	A12G148-07	Sediment	7/11/2012	
PWS-07_8-11	A12G149-06	Porewater	7/10/2012	
PWS-01_8-9	A12G149-12	Porewater	7/10/2012	
PWS-04_1-4	A12G149-14	Porewater	7/10/2012	
PWS-04_8-11	A12G149-18	Porewater	7/10/2012	
PWS-02_1-4	A12G149-20	Porewater	7/10/2012	
PWS-02_8-10	A12G149-24	Porewater	7/10/2012	
Rinsate Blank	A12G149-25	Water	7/10/2012	
PWS-07_8-11	A12G149-26	Sediment	7/10/2012	
PWS-01_8-9	A12G149-27	Sediment	7/10/2012	
PWS-04_8-11	A12G149-28	Sediment	7/10/2012	
PWS-02_8-10	A12G149-29	Sediment	7/10/2012	
PWS-04_1-4	A12G149-30	Sediment	7/10/2012	
PWS-02_1-4	A12G149-31	Sediment	7/10/2012	
PWS-15_8-11	A12G169-06	Porewater	7/12/2012	
PWS-15_8-11	A12G169-07	Sediment	7/12/2012	
PWS-10_8-11	A12G170-06	Porewater	7/11/2012	
PWS-20_8-11	A12G170-12	Porewater	7/11/2012	
PWS-20_8-11 Dup	A12G170-14	Porewater	7/11/2012	Field Duplicate
PWS-13_1-4	A12G170-16	Porewater	7/11/2012	
PWS-13_8-11	A12G170-20	Porewater	7/11/2012	
PWS-19_8-11	A12G170-26	Porewater	7/11/2012	
PWS-18_8-11	A12G170-32	Porewater	7/11/2012	
Rinsate Blank	A12G170-33	Water	7/11/2012	
PWS-10_8-11	A12G170-35	Sediment	7/11/2012	
PWS-20_8-11	A12G170-36	Sediment	7/11/2012	
PWS-20_8-11 Dup	A12G170-37	Sediment	7/11/2012	Field Duplicate
PWS-13_8-11	A12G170-38	Sediment	7/11/2012	
PWS-19_8-11	A12G170-39	Sediment	7/11/2012	
PWS-18_8-11	A12G170-40	Sediment	7/11/2012	
PWS-13_1-4	A12G170-41	Sediment	7/11/2012	
PWS-03_8-11	A12G193-06	Porewater	7/12/2012	
PWS-05_8-11	A12G193-12	Porewater	7/12/2012	
PWS-06_8-11	A12G193-18	Porewater	7/12/2012	
PWS-03_8-11	A12G193-19	Sediment	7/12/2012	
PWS-05_8-11	A12G193-20	Sediment	7/12/2012	
PWS-06_8-11	A12G193-21	Sediment	7/12/2012	
PWS-08_8-10	A12G213-06	Porewater	7/12/2012	
PWS-09_8-10	A12G213-12	Porewater	7/12/2012	
PWS-12_8-11	A12G213-18	Porewater	7/12/2012	
PWS-12_8-11 Dup	A12G213-20	Porewater	7/12/2012	Field Duplicate
PWS-22_8-11	A12G213-26	Porewater	7/12/2012	
PWS-08_8-10	A12G213-40	Sediment	7/12/2012	
PWS-09_8-10	A12G213-41	Sediment	7/12/2012	
PWS-12_8-11	A12G213-42	Sediment	7/12/2012	
PWS-12_8-11 Dup	A12G213-43	Sediment	7/12/2012	Field Duplicate

Table 1
Field Samples Submitted to Apex Laboratories
Port of Saint Helens

Sample Location	Apex Sample ID	Matrix	Collection Date	Notes
PWS-25_8-11	A12G214-04	Porewater	7/13/2012	
PWS-26_8-11	A12G214-10	Porewater	7/13/2012	
PWS-27_8-11	A12G214-16	Porewater	7/13/2012	
Rinsate Blank	A12G214-17	Water	7/13/2012	
PWS-11B_8-11	A12G214-19	Porewater	7/13/2012	
PWS-16B_8-11	A12G214-21	Porewater	7/13/2012	
PWS-25_8-11	A12G214-22	Sediment	7/13/2012	
PWS-26_8-11	A12G214-23	Sediment	7/13/2012	
PWS-27_8-11	A12G214-24	Sediment	7/13/2012	
PWS-11B_8-11	A12G214-25	Sediment	7/13/2012	
PWS-16B_8-11	A12G214-26	Sediment	7/13/2012	

Table 2
Field Duplicate Detections
Port of Saint Helens

Analyte	LOQ	Primary Concentration	Duplicate Concentration	RPD	Notes
Sample PWS-20_8-11 (Porewater)					
Dissolved organic carbon	2.00 mg/L	**3.66**	2.00 U	NC	± LOQ
Sample PWS-20_8-11 (Sediment)					
Naphthalene	15.6 µg/kg	**148**	**120**	20.9%	
1-Methylnaphthalene	15.6 µg/kg	**12.5 J**	**12.6 J**	0.80%	
2-Methylnaphthalene	15.6 µg/kg	**30.5**	**35.9**	16%	
Acenaphthene	15.6 µg/kg	**15.8**	**14.3 J**	10%	
Acenaphthylene	15.6 µg/kg	**7.91 J**	**8.59 J**	8.2%	
Fluorene	15.6 µg/kg	**22.1**	**21.6**	2.3%	
Phenanthrene	15.6 µg/kg	**86.6**	**101**	15%	
Anthracene	15.6 µg/kg	**24.1**	**25.3**	4.9%	
Fluoranthene	15.6 µg/kg	**116**	**123**	5.9%	
Pyrene	15.6 µg/kg	**110**	**114**	3.6%	
Benzo(a)anthracene	15.6 µg/kg	**43.9**	**64.6**	38%	
Chrysene	15.6 µg/kg	**54.6**	**73.8**	30%	
Benzo(b)fluoranthene	15.6 µg/kg	**79.1**	**120**	41%	
Benzo(k)fluoranthene	15.6 µg/kg	**27.1**	**40.7**	40%	
Benzo(e)pyrene	15.6 µg/kg	**48.6**	**61.9**	24%	
Benzo(a)pyrene	15.6 µg/kg	**58.4**	**85.2**	37%	
Perylene	15.6 µg/kg	**98.5**	**97.8**	0.71%	
Dibenz(a,h)anthracene	15.6 µg/kg	7.81 U	**9.40 J**	NC	± LOQ
Indeno(1,2,3-cd)pyrene	15.6 µg/kg	**31.6**	**37.8**	18%	
Benzo(g,h,i)perylene	15.6 µg/kg	**27.4**	**33.6**	20%	
Total organic carbon	200 mg/kg	**11,000**	**10,000**	10%	
Sample PWS-12_8-11 (Porewater)					
Acenaphthene	0.150 µg/L	**0.0973 J**	**0.175**	57%	± LOQ
Dissolved organic carbon	2.00 mg/L	**2.10**	2.00 U	NC	± LOQ
Sample PWS-12_8-11 (Sediment)					
Naphthalene	19.6 µg/kg	**170**	**172**	1.2%	
1-Methylnaphthalene	19.6 µg/kg	**22.2**	**16.8 J**	28%	
2-Methylnaphthalene	19.6 µg/kg	**61.7**	**50.9**	19%	
Acenaphthene	19.6 µg/kg	**79.3**	**43.0**	59%	J-FD
Acenaphthylene	19.6 µg/kg	**26.8**	**19.7**	31%	
Fluorene	19.6 µg/kg	**88.0**	**66.4**	28%	
Phenanthrene	19.6 µg/kg	**280**	**238**	16%	
Anthracene	19.6 µg/kg	**111**	**84.8**	27%	
C1-Phenanthrenes/Anthracenes	97.9 µg/kg	**164**	**134**	20%	
C2-Phenanthrenes/Anthracenes	97.9 µg/kg	**130**	**96.3**	30%	
Fluoranthene	19.6 µg/kg	**576**	**386**	40%	
Pyrene	19.6 µg/kg	**536**	**337**	46%	
C1-Fluoranthenes/Pyrenes	97.9 µg/kg	**273**	**197**	32%	
Benzo(a)anthracene	19.6 µg/kg	**230**	**147**	44%	
Chrysene	19.6 µg/kg	**330**	**216**	42%	
C1-Chrysenes/Benzo(a)anthracenes	97.9 µg/kg	**152**	**105**	37%	
C2-Chrysenes/Benzo(a)anthracenes	97.9 µg/kg	**110**	93.3 U	NC	± LOQ
Benzo(b)fluoranthene	29.4 µg/kg	**405**	**244**	50%	
Benzo(k)fluoranthene	29.4 µg/kg	**144**	**74.2**	64%	J-FD
Benzo(e)pyrene	29.4 µg/kg	**222**	**129**	53%	J-FD
Benzo(a)pyrene	29.4 µg/kg	**241**	**142**	52%	J-FD
Perylene	19.6 µg/kg	**168**	**111**	41%	
Dibenz(a,h)anthracene	19.6 µg/kg	**35.0**	**19.1**	59%	± LOQ
Indeno(1,2,3-cd)pyrene	19.6 µg/kg	**169**	**88.0**	63%	J-FD
Benzo(g,h,i)perylene	19.6 µg/kg	**153**	**79.2**	64%	J-FD
Total organic carbon	200 mg/kg	**18,000**	**18,000**	0%	

Table 2
Field Duplicate Detections
Port of Saint Helens

Notes:
Bold = the analyte was detected at the stated concentration
± LOQ = the difference between analyte concentrations is less than the LOQ.
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
LOQ = limit of quantification
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
NC = not calculable
RPD = relative percent diference

Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Reason Code:
FD = Field duplicate results indicate sampling or analytical imprecision.

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-01_8-9	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
			C-3 Naphthalenes	0.479 ug/L	J DL
PWS-01_8-9	Sediment	8270D	Acenaphthylene	13.3 ug/kg	J DL
			Dibenz(a,h)anthracene	7.72 ug/kg	J DL
PWS-02_1-4	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-02_1-4	Sediment	8270D	Acenaphthene	600 ug/kg	J HT
			Acenaphthylene	83.4 ug/kg	J HT
			Anthracene	829 ug/kg	J HT
			Benzo(a)anthracene	594 ug/kg	J HT
			C-1 Benzo(a)anthracenes/Chrysenes	375 ug/kg	J HT
			C-2 Benzo(a)anthracenes/Chrysenes	168 ug/kg	J HT
			C-3 Benzo(a)anthracenes/Chrysenes	168 ug/kg	J HT
			C-4 Benzo(a)anthracenes/Chrysenes	225 ug/kg	UJ HT
			Benzo(b)fluoranthene	858 ug/kg	J HT
			Benzo(k)fluoranthene	296 ug/kg	J HT
			Benzo(g,h,i)perylene	288 ug/kg	J HT
			Benzo(a)pyrene	453 ug/kg	J HT
			Benzo(e)pyrene	454 ug/kg	J HT
			Chrysene	888 ug/kg	J HT
			Dibenz(a,h)anthracene	64.1 ug/kg	J HT
			Fluoranthene	2,190 ug/kg	J HT
			C-1 Fluoranthrenes/Pyrenes	869 ug/kg	J HT
			Fluorene	779 ug/kg	J HT
			C-1 Fluorenes	258 ug/kg	J HT
			C-2 Fluorenes	139 ug/kg	J HT
			C-3 Fluorenes	113 ug/kg	UJ HT
			Indeno(1,2,3-cd)pyrene	295 ug/kg	J HT
			1-Methylnaphthalene	237 ug/kg	J HT
			2-Methylnaphthalene	554 ug/kg	J HT
			Naphthalene	1,130 ug/kg	J HT
			C-2 Naphthalenes	785 ug/kg	J HT
			C-3 Naphthalenes	374 ug/kg	J HT
			C-4 Naphthalenes	184 ug/kg	J HT
			Perylene	126 ug/kg	J HT
			Phenanthrene	2,200 ug/kg	J HT
			C-1 Phenanthrenes/Anthracenes	891 ug/kg	J HT
			C-2 Phenanthrenes/Anthracenes	490 ug/kg	J HT
			C-3 Phenanthrenes/Anthracenes	223 ug/kg	J HT
			C-4 Phenanthrenes/Anthracenes	228 ug/kg	J HT
			Pyrene	1,580 ug/kg	J HT
PWS-02_8-10	Porewater	D7363-07	Benzo(a)anthracene	0.42 ug/L	J LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.0812 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.322 ug/L	UJ LL
PWS-02_8-10	Sediment	8270D	Benzo(b)fluoranthene	6,240 ug/kg	J HS
			Benzo(k)fluoranthene	2,360 ug/kg	J HS
			Benzo(g,h,i)perylene	985 ug/kg	J DL, HS
			Benzo(a)pyrene	3,700 ug/kg	J HS
			Benzo(e)pyrene	2,660 ug/kg	J HS
			Indeno(1,2,3-cd)pyrene	1,100 ug/kg	J HS
			Perylene	778 ug/kg	J DL

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-03_8-11	Porewater	D7363-07	Anthracene	0.097 ug/L	J CH
			Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.0215 ug/L	J LL
			C-2 Phenanthrenes/Anthracenes	0.165 ug/L	J DL
PWS-04_1-4	Sediment	8270D	Anthracene	277 ug/kg	J HD
PWS-04_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-05_8-11	Porewater	D7363-07	Anthracene	0.021 ug/L	J CH
			Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-05_8-11	Sediment	8270D	Dibenz(a,h)anthracene	123 ug/kg	J DL
PWS-06_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-06_8-11	Sediment	8270D	Dibenz(a,h)anthracene	107 ug/kg	J DL
PWS-07_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
			C-2 Phenanthrenes/Anthracenes	0.205 ug/L	J DL
PWS-08_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LC, LL
			Chrysene	0.004 ug/L	UJ LC, LL
			C-3 Naphthalenes	0.233 ug/L	J DL
			C-2 Phenanthrenes/Anthracenes	0.21 ug/L	J DL
PWS-09_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LC, LL
			Chrysene	0.004 ug/L	UJ LC, LL
PWS-10_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.426 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			Chrysene	0.0255 ug/L	J LC, LL
			C-2 Phenanthrenes/Anthracenes	0.013 ug/L	J DL
PWS-10_8-11	Sediment	8270D	Benzo(g,h,i)perylene	169 ug/kg	J DL

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-11_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.02 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
			Fluoranthene	0.101 ug/L	J CH
			C-3 Naphthalenes	1 ug/L	J DL
			Pyrene	0.0732 ug/L	J CH
PWS-11_8-11	Sediment	415.1	Total Organic Carbon	24000 mg/kg	J HD
PWS-11B_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LC, LL
			Chrysene	0.0111 ug/L	J LC, LL
			Pyrene	0.13 ug/L	J LC
PWS-12_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LC, LL
			Chrysene	0.004 ug/L	UJ LC, LL
PWS-12_8-11 DUP	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LC, LL
			Chrysene	0.004 ug/L	UJ LC, LL
PWS-12_8-11	Sediment	8270D	Acenaphthene	79.3 ug/kg	J FD
			Benzo(k)fluoranthene	144 ug/kg	J FD
			Benzo(g,h,i)perylene	153 ug/kg	J FD
			Benzo(a)pyrene	241 ug/kg	J FD
			Benzo(e)pyrene	222 ug/kg	J FD
			Indeno(1,2,3-cd)pyrene	169 ug/kg	J FD
PWS-12_8-11 DUP	Sediment	8270D	Acenaphthene	43 ug/kg	J FD
			Benzo(k)fluoranthene	74.2 ug/kg	J FD
			Benzo(g,h,i)perylene	79.2 ug/kg	J FD
			Benzo(a)pyrene	142 ug/kg	J FD
			Benzo(e)pyrene	129 ug/kg	J FD
			Indeno(1,2,3-cd)pyrene	88 ug/kg	J FD
			1-Methylnaphthalene	16.8 ug/kg	J DL
PWS-13_1-4	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-13_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-13_8-11	Sediment	8270D	Benzo(k)fluoranthene	152 ug/kg	J HD
PWS-15_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-15_8-11	Sediment	8270D	Acenaphthene	9.06 ug/kg	J DL
			Anthracene	12.6 ug/kg	J DL
			Benzo(k)fluoranthene	15.6 ug/kg	J DL
			Benzo(a)pyrene	20.5 ug/kg	J DL
			Benzo(e)pyrene	16.8 ug/kg	J DL
			Fluorene	9.74 ug/kg	J DL
			Indeno(1,2,3-cd)pyrene	7.78 ug/kg	J DL
			1-Methylnaphthalene	7.82 ug/kg	J DL
			2-Methylnaphthalene	9.52 ug/kg	J DL
PWS-16_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-16B_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LC, LL
			Chrysene	0.004 ug/L	UJ LC, LL
			C-2 Phenanthrenes/Anthracenes	0.0579 ug/L	J DL
			Pyrene	0.0493 ug/L	UJ LC
PWS-16B_8-11	Sediment	8270D	Benzo(g,h,i)perylene	148 ug/kg	J DL
PWS-18_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-19_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-19_8-11	Sediment	8270D	Dibenz(a,h)anthracene	15 ug/kg	J DL
PWS-20_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-20_8-11 DUP	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LL
			Chrysene	0.004 ug/L	UJ LL
PWS-20_8-11	Sediment	8270D	Acenaphthylene	7.91 ug/kg	J DL
			1-Methylnaphthalene	12.5 ug/kg	J DL
PWS-20_8-11 DUP	Sediment	8270D	Acenaphthene	14.3 ug/kg	J DL
			Acenaphthylene	8.59 ug/kg	J DL
			Dibenz(a,h)anthracene	9.4 ug/kg	J DL
			1-Methylnaphthalene	12.6 ug/kg	J DL

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-25_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LC, LL
			Chrysene	0.0092 ug/L	J LC, LL
			C-2 Phenanthrenes/Anthracenes	0.315 ug/L	J DL
			Pyrene	0.163 ug/L	J LC, HD
PWS-25_8-11	Sediment	8270D	Dibenz(a,h)anthracene	117 ug/kg	J DL
PWS-26_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LC, LL
			Chrysene	0.00636 ug/L	J LC, LL
			Pyrene	0.101 ug/L	J LC
PWS-27_8-11	Porewater	D7363-07	Benzo(a)anthracene	0.0107 ug/L	UJ LC, LL
			C-1 Benzo(a)anthracenes/Chrysenes	0.00645 ug/L	UJ LC, LL
			C-2 Benzo(a)anthracenes/Chrysenes	0.0125 ug/L	UJ LC, LL
			C-3 Benzo(a)anthracenes/Chrysenes	0.00183 ug/L	UJ LC, LL
			C-4 Benzo(a)anthracenes/Chrysenes	0.0255 ug/L	UJ LC, LL
			Chrysene	0.004 ug/L	UJ LC, LL
			Pyrene	0.0493 ug/L	UJ LC
PWS-27_8-11	Sediment	8270D	Acenaphthene	9.87 ug/kg	J DL
			Fluorene	12.9 ug/kg	J DL

Notes:
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
mg/kg = milligrams per kilogram
Bold = the analyte was detected at the stated concentration

Qualifier Definitions:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Reason Codes:
CH = High calibration verification recovery. Analytical result may be biased high.
DL = Analyte concetration was between the limit of deetction and the limit of quantification.
FD = Field duplicate results indicate sampling or analytical imprecision.
HD = Laboratory duplicate results indicate analytical imprecision.
HS = High surrogate recovery. Analytical result may be biased high.
HT = The maximum recommended analytical hold time was exceeded.
LC = Low calibration verification recovery. Analytical result may be biased low.
LL = Low laboratory control sample recovery. Analytical result may be biased low.

DATA QUALITY REVIEW

Port of St. Helens

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ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
AMEC	AMEC Environment & Infrastructure, Inc.
Apex	Apex Laboratories, LLC
ASTM	ASTM International
CVS	calibration verification standard
EPA	United States Environmental Protection Agency
ID	identification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
NAPL	nonaqueous phase liquid
PAH	polycyclic aromatic hydrocarbon
QC	quality control
RPD	relative percent difference

DATA QUALITY REVIEW
Port of St. Helens

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) collected one nonaqueous phase liquid (NAPL) sample and three water samples from the Port of St. Helens on August 14 and 15, 2012. The samples were submitted to Apex Laboratories, LLC (Apex) in Tigard, Oregon, where they were assigned to sample delivery groups A12H289 and A12H309. Apex analyzed the NAPL sample for polycyclic aromatic hydrocarbons (PAHs) and PAH homologs by modified United States Environmental Protection Agency (EPA) Method 8270D and Apex analyzed the water samples for PAHs and PAH homologs using ASTM International (ASTM) D7363-07.

A list of the analyzed samples by sample location, collection date, matrix, and Apex sample identification (ID) is presented in Table 1.

Table 1: Field Samples Submitted to Apex Laboratories

Sample Location	Collection Date	Matrix	Apex ID
MW-3A-DNAPL	08/15/2012	NAPL	A12H289-01
MW-21	08/15/2012	Water	A12H309-01
MW-24	08/14/2012	Water	A12H309-02
MW-3A	08/15/2012	Water	A12H309-03

2.0 DATA QUALITY REVIEW METHODOLOGY

Quality review of these data followed the National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008). The EPA guideline was written specifically for the Contract Laboratory Program, and has been modified for the purposes of this data quality review where it differs from method-specific quality control (QC) requirements. This data quality review consisted of assessment of summary reports, and does not include review or validation of the raw analytical data.

It is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but reported values may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCSs) are aliquots of analyte-free water or clean solid matrix that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked water or solid matrix is then processed through the same extraction, concentration, cleanup, and/or analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.3 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free water or clean solid matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA QUALITY REVIEW

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

Samples were received at Apex intact, in good condition, and with proper chain of custody documentation. Apex only lists sample receipt temperature on the laboratory report when samples are received outside the EPA-recommended limit. Sample receipt temperatures were not listed on these reports.

6.0 POLYCYCLIC AROMATIC HYDROCARBONS AND PAH HOMOLOGS BY EPA METHOD 8270D

PAH and PAH homolog data from sample MW-3A-DNAPL may be considered fully usable without qualification.

6.1 HOLDING TIMES

Sample MW-3A-DNAPL was extracted within the EPA-recommended 14-day maximum holding time for concentrated waste samples and analyzed within the 40-day maximum holding time from extraction until analysis.

6.2 LABORATORY BLANK

Target analytes were not detected in the laboratory blank associated with the analysis of sample MW-3A-DNAPL.

6.3 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries associated with the analysis of sample MW-3A-DNAPL were within the laboratory's limits.

6.4 SURROGATE STANDARD RECOVERIES

Sample MW-3A-DNAPL was analyzed at a 1:200 dilution due to high target analyte concentrations. AMEC did not evaluate surrogate recoveries from this sample because of the high dilution.

6.5 LABORATORY DUPLICATE

Apex analyzed sample MW-3A-DNAPL in duplicate. Relative percent differences (RPDs) between duplicate results were less than the laboratory-specified maximum of 30%.

7.0 POLYCYCLIC AROMATIC HYDROCARBONS AND PAH HOMOLOGS BY ASTM D7363-07

PAH and PAH homolog data from this event may be considered usable with the limitations and exceptions described in Sections 7.1 through 7.6.

7.1 HOLDING TIMES

All samples were extracted within the method-specified 7-day maximum holding time for water samples. All sample extracts were analyzed within the 40-day maximum holding time from extraction until analysis.

7.2 CALIBRATION VERIFICATIONS

Apex presented the following list of calibration verification standards (CVSs) that did not meet method-specified criteria and the associated samples in the case narrative:

- Benzo(a)anthracene and benzo(b)fluoranthene recoveries were low at 68% and 74%, respectively, and indeno(1,2,3-cd)pyrene recovery was high at 131% in the CVSs associated with the analysis of samples MW-3A, MW-21, and MW-24. Data limitations are summarized below.
  - AMEC J qualified the detected benzo(a)anthracene and UJ qualified the nondetected benzo(b)fluoranthene results from these samples because of potentially low analytical bias. (J/UJ-LC)

- Indeno(1,2,3-cd)pyrene recovery was high and this analyte was not detected in the associated samples. Data usability is not adversely affected by the potentially high analytical bias.

7.3 LABORATORY BLANK

Target analytes were not detected in the laboratory blank associated with these samples, with the following exceptions:

- Benzo(a)anthracene (0.0475 micrograms per liter [µg/L]), chrysene (0.0382 µg/L), and fluoranthene (0.0612 µg/L) were detected in the laboratory blank associated with the analysis of these samples. Data limitations are summarized below.
  - AMEC U qualified the detected benzo(a)anthracene and chrysene results from samples MW-3A (0.0355 µg/L and 0.0204 µg/L, respectively), MW-21 (0.0368 µg/L and 0.0289 µg/L, respectively), and MW-24 (0.0123 µg/L and 0.0166 µg/L, respectively) because the concentrations detected in the samples are less than five times the concentrations detected in the blank. (U-MB)
  - The fluoranthene concentrations detected in these samples were more than five times the concentration detected in the blank and data usability is not adversely affected.

7.4 LABORATORY CONTROL SAMPLE RECOVERIES

The following PAHs exhibited LCS recoveries outside the laboratory-specified limits:

- Benzo(k)fluoranthene (15%-LCS), benzo(g,h,i)perylene (16%-LCS), chrysene (12%/14%), and perylene (12%/14%) recoveries were low in the LCS and/or LCS duplicate (LCSD) associated with the analysis of these samples. Additionally, RPDs between LCS and LCSD results were high for benzo(b)fluoranthene (39%), benzo(a)pyrene (31%), benzo(e)pyrene (33%), and indeno(1,2,3-cd)pyrene (39%). Data limitations are summarized below.
  - AMEC UJ qualified the nondetected benzo(k)fluoranthene, benzo(g,h,i)perylene, and perylene results from these samples because of potentially low analytical bias. (UJ-LL)
  - AMEC J qualified the detected chrysene results from these samples because of potentially low analytical bias. (J-LL)
  - Benzo(b)fluoranthene, benzo(a)pyrene, benzo(e)pyrene, and indeno(1,2,3-cd)pyrene were not detected in these samples and data usability is not adversely affected by the potential analytical imprecision.

7.5 LABORATORY DUPLICATE

Apex performed a duplicate analysis of sample MW-24. RPDs between primary and duplicate results were less than the laboratory-specified maximum of 30%, with the following exceptions:

- RPDs between primary and duplicate results were high for benzo(a)anthracene (103%), chrysene (42%), and C2-phenanthrenes/anthracenes (36%). Data limitations are summarized below.
  - AMEC J qualified the detected benzo(a)anthracene and chrysene results from sample MW-24 because of potential analytical imprecision. (J-HD)
  - The difference between the C2-phenanthrenes/anthracenes results from the primary and duplicate analyses, at 0.957 µg/L and 1.37 µg/L, respectively, was less than the reporting limit of 0.469 µg/L and data usability is not adversely affected.

7.6 DATA REPORTING AND ANALYTICAL PROCEDURES

According to Apex's notes, all alkyl homolog results from ASTM D7363-07 analyses are estimated values because of a lack of reference standards inherent in the method. AMEC J qualified all detected and UJ qualified all nondetected alkyl homolog results from these analyses because of the lack of reference standards. (J/UJ-NQ)

8.0 SUMMARY

AMEC reviewed a total of 240 data records during this data quality review and J or UJ qualified 63 data records (26%) as estimated values. No data were rejected and 100% of the data should be considered fully usable with the addition of the qualifiers summarized in Table 2.

Table 2: Qualifiers Added During Data Quality Review

Sample ID	Analyte	Concentration	Qualifiers and Reason Codes
MW-3A	Benzo(a)anthracene	0.0355 µg/L	UJ MB, LC
	Benzo(b)fluoranthene	0.267 µg/L	UJ LC
	Benzo(k)fluoranthene	0.267 µg/L	UJ LL
	Benzo(g,h,i)perylene	0.267 µg/L	UJ LL
	Chrysene	0.0204 µg/L	UJ MB, LL
	C1-Chrysenes/Benzo(a)anthracenes	0.00900 µg/L	UJ NQ
	C2-Chrysenes/Benzo(a)anthracenes	0.0400 µg/L	UJ NQ
	C3-Chrysenes/Benzo(a)anthracenes	0.100 µg/L	UJ NQ
	C3-Chrysenes/Benzo(a)anthracenes	1.00 µg/L	UJ NQ
	C1-Fluoranthenes/Pyrenes	0.450 µg/L	J NQ
	C1-Fluorenes	17.3 µg/L	J NQ
	C2-Fluorenes	4.20 µg/L	J NQ
	C3-Fluorenes	4.25 µg/L	UJ NQ
	C2-Naphthalenes	276 µg/L	J NQ
	C3-Naphthalenes	103 µg/L	J NQ
	C4-Naphthalenes	24.1 µg/L	J NQ
	Perylene	0.267 µg/L	UJ LL
	C1-Phenanthrenes/Anthracenes	14.6 µg/L	J NQ
	C2-Phenanthrenes/Anthracenes	2.29 µg/L	J NQ
	C3-Phenanthrenes/Anthracenes	0.517 µg/L	UJ NQ
	C4-Phenanthrenes/Anthracenes	1.25 µg/L	UJ NQ
MW-21	Benzo(a)anthracene	0.0368 µg/L	UJ MB, LC
	Benzo(b)fluoranthene	0.267 µg/L	UJ LC
	Benzo(k)fluoranthene	0.267 µg/L	UJ LL
	Benzo(g,h,i)perylene	0.267 µg/L	UJ LL
	Chrysene	0.0289 µg/L	UJ MB, LL
	C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
	C2-Chrysenes/Benzo(a)anthracenes	0.0167 µg/L	UJ NQ
	C3-Chrysenes/Benzo(a)anthracenes	0.100 µg/L	UJ NQ
	C3-Chrysenes/Benzo(a)anthracenes	1.70 µg/L	UJ NQ
	C1-Fluoranthenes/Pyrenes	0.469 µg/L	J NQ
	C1-Fluorenes	15.7 µg/L	J NQ

Sample ID	Analyte	Concentration	Qualifiers and Reason Codes
MW-21	C2-Fluorenes	5.63 µg/L	J NQ
	C3-Fluorenes	4.40 µg/L	UJ NQ
	C2-Naphthalenes	57.5 µg/L	J NQ
	C3-Naphthalenes	55.1 µg/L	J NQ
	C4-Naphthalenes	9.02 µg/L	J NQ
	Perylene	0.267 µg/L	UJ LL
	C1-Phenanthrenes/Anthracenes	11.6 µg/L	J NQ
	C2-Phenanthrenes/Anthracenes	2.57 µg/L	J NQ
	C3-Phenanthrenes/Anthracenes	0.517 µg/L	UJ NQ
	C4-Phenanthrenes/Anthracenes	1.25 µg/L	UJ NQ
MW-24	Benzo(a)anthracene	0.0123 µg/L	UJ MB, LC, HD
	Benzo(b)fluoranthene	0.267 µg/L	UJ LC
	Benzo(k)fluoranthene	0.267 µg/L	UJ LL
	Benzo(g,h,i)perylene	0.267 µg/L	UJ LL
	Chrysene	0.0166 µg/L	UJ MB, LL, HD
	C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
	C2-Chrysenes/Benzo(a)anthracenes	0.0190 µg/L	UJ NQ
	C3-Chrysenes/Benzo(a)anthracenes	0.100 µg/L	UJ NQ
	C3-Chrysenes/Benzo(a)anthracenes	1.30 µg/L	UJ NQ
	C1-Fluoranthenes/Pyrenes	0.187 µg/L	J NQ
	C1-Fluorenes	6.13 µg/L	J NQ
	C2-Fluorenes	2.31 µg/L	J NQ
	C3-Fluorenes	2.50 µg/L	UJ NQ
	C2-Naphthalenes	100 µg/L	J NQ
	C3-Naphthalenes	34.0 µg/L	J NQ
	C4-Naphthalenes	8.87 µg/L	J NQ
	Perylene	0.267 µg/L	UJ LL
	C1-Phenanthrenes/Anthracenes	4.83 µg/L	J NQ
	C2-Phenanthrenes/Anthracenes	0.957 µg/L	J NQ
	C3-Phenanthrenes/Anthracenes	0.517 µg/L	UJ NQ
	C4-Phenanthrenes/Anthracenes	1.25 µg/L	UJ NQ

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LIMITATIONS

This report was prepared exclusively for Port of St. Helens by AMEC Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data quality review is intended to be used by Port of St. Helens for the Port of St. Helens Site only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

DATA QUALITY REVIEW

Port of St. Helens

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ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
AMEC	AMEC Environment & Infrastructure, Inc.
Apex	Apex Laboratories, LLC
ASTM	ASTM International
CVS	calibration verification standard
DOC	dissolved organic carbon
EPA	United States Environmental Protection Agency
ID	identification
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MDL	method detection limit
mg/L	milligrams per liter
MS	matrix spike
PAH	polycyclic aromatic hydrocarbon
QC	quality control
RPD	relative percent difference
RL	reporting limit
SM	Standard Methods
TOC	total organic carbon

DATA QUALITY REVIEW
Port of St. Helens

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) collected 72 sediment samples (including 2 field duplicates) and 4 aqueous rinsate blanks from the Port of St. Helens between October 9 and 16, 2012. The samples were submitted to Apex Laboratories, LLC (Apex) in Tigard, Oregon, where they were assigned to sample delivery groups A12J241, A12G148, A12J257, A12J289, A12J331, A12J356, A12J357, A12J365, A12J367, and A12J450. Apex archived 40 of the sediment samples and analyzed the remaining 32 sediment samples for polycyclic aromatic hydrocarbons (PAHs) and PAH homologs by modified United States Environmental Protection Agency (EPA) Method 8270D and total organic carbon (TOC) by modified Standard Methods (SM) 5310B. Apex separated porewater from the sediments and analyzed the porewater for PAHs and PAH homologs using ASTM International (ASTM) D7363-07 and dissolved organic carbon (DOC) by SM 5310B. Apex also analyzed selected samples for diesel and oil hydrocarbons by Oregon Department of Environmental Quality/ Washington Department of Ecology Method NWTPH-Dx. Apex analyzed the rinsate blanks for PAHs by EPA Method 8270D.

A list of the analyzed samples by sample location, Apex sample identification (ID), matrix, and sample collection date is presented in Table 1.

2.0 DATA QUALITY REVIEW METHODOLOGY

Quality review of these data followed the National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008). The EPA guideline was written specifically for the Contract Laboratory Program, and has been modified for the purposes of this data quality review where it differs from method-specific quality control (QC) requirements. This data quality review consisted of assessment of summary reports, and does not include review or validation of the raw analytical data.

It is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but reported values may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCSs) are aliquots of analyte-free water or clean solid matrix that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked water or solid matrix is then processed through the same extraction, concentration, cleanup, and/or analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 MATRIX SPIKE RECOVERIES

Matrix spikes (MSs) are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.4 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free water or clean solid matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA QUALITY REVIEW

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

Samples were received at Apex intact, in good condition, and with proper chain of custody documentation. Apex only lists sample receipt temperature on the laboratory report when samples are received outside the EPA-recommended limit. Sample receipt temperatures were not listed on these reports.

6.0 POLYCYCLIC AROMATIC HYDROCARBONS AND PAH HOMOLOGS BY EPA METHOD 8270D

PAH and PAH homolog data from this event may be considered usable with the limitations and exceptions described in Sections 6.1 through 6.8.

6.1 HOLDING TIMES

All samples were extracted within the method-specified 14-day maximum holding time for sediment samples. All sample extracts were analyzed within the 40-day maximum holding time from extraction until analysis.

6.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

6.3 RINSATE BLANKS

Target analytes were not detected in the rinsate blanks associated with these samples, with the following exceptions:

- Benzo(a)anthracene (0.0244 micrograms per liter [µg/L]), fluoranthene (0.0391 µg/L), phenanthrene (0.0256 µg/L), and pyrene (0.0300 µg/L) were detected in one of the rinsate blanks associated with samples PWS-8_8-11 and PWS-9_8-11. The concentrations detected in the rinsate blank were too low to affect the detections in the sediment and porewater samples and data usability is not adversely affected.
- Fluorene and phenanthrene were detected at concentrations of 0.0284 µg/L and 0.0688 µg/L, respectively, in the rinsate blank associated with sediment samples LSI-02_8-11, LSI-09_8-11, PWS-12_8-11, PWS-13_8-11, PWS-16_8-11, PWS-20_8-11, and PWS 27_8-11. The concentrations detected in the rinsate blank were too low to affect the detections in the sediment and porewater samples and data usability is not adversely affected.
- Phenanthrene was detected at a concentration of 0.0212 µg/L in the rinsate blank associated with sample LSI-24_8-11. The concentration detected in the rinsate blank was too low to affect the detections in the sediment and porewater samples and data usability is not adversely affected.

6.4 LABORATORY CONTROL SAMPLE RECOVERIES

AMEC did not evaluate LCS recoveries for the water samples analyzed by EPA Method 8270D. The rinsate blanks were the only water samples analyzed using this method and AMEC does not routinely qualify data from field blanks.

LCS recoveries associated with the sediment analyses were within the laboratory's limits, with the following exceptions:

- 2,6-Dimethylnaphthalene (40%/42%), 1-methylnaphthalene (37%/38%), and 2-methylnaphthalene (36%/38%) recoveries were low in the LCS and LCS duplicate (LCSD) associated with the analysis of the rinsate blank collected on October 12, 2012. AMEC does not routinely qualify data from blank samples and in AMEC's professional opinion data usability is not adversely affected.

6.5 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits.

6.6 LABORATORY DUPLICATES

Apex analyzed sediment samples PWS-04_8-11 and PWS-11_8-11 in duplicate. Relative percent differences (RPDs) between duplicate results were less than the laboratory-specified maximum of 30%, with the following exceptions:

- In sediment sample PWS-04_8-11, the RPD between the primary and duplicate results for pyrene was high at 32%. AMEC J qualified the detected pyrene result from this sample because of analytical imprecision. (J-HD)
- In sediment sample PWS-11_8-11, RPDs between the primary and duplicate results were high for acenaphthene (33%), fluorene (35%), C1-fluorenes (37%), 1-methylnaphthalene (41%), 2-methylnaphthalene (46%), naphthalene (53%), and C2-naphthalenes (33%). Data limitations are summarized below:
  - AMEC J qualified the detected acenaphthene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene, and C2-naphthalenes results from sediment sample PWS-11_8-11 because of analytical imprecision. (J-HD)
  - The differences between the detected C1-fluorenes results, at 80.1 micrograms per kilogram (µg/kg) in the primary analysis and 117 µg/kg in the duplicate analysis, was less than the reporting limit (RL) of 79.0 µg/kg and data usability is not adversely affected.

6.7 MATRIX SPIKES

Apex performed MSs on samples LSI-01_8-11 and PWS-02_8-11. Recoveries were within the laboratory-specified limits, with the following exceptions:

- Acenaphthene (468%), anthracene (221%), benzo(a)anthracene (145%), benzo(b)fluoranthene (135%), chrysene (143%), fluoranthene (608%), fluorene (458%), 1-methylnaphthalene (142%), 2-methylnaphthalene (148%), naphthalene (124%), phenanthrene (1,110%), and pyrene (411%) recoveries were high in the MS performed on sample PWS-02_8-11. Data limitations are summarized below.

- AMEC J qualified the detected naphthalene result from sediment sample PWS-02_8-11 because of potentially high analytical bias. (J-HM)

- The background acenaphthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, chrysene, fluoranthene, fluorene, 1-methylnaphthalene, 2-methylnaphthalene, phenanthrene, and pyrene concentrations in the unspiked native sample were higher than the spike concentrations and it is not possible to evaluate data usability based on MS recoveries for these analytes.

6.8 DATA REPORTING AND ANALYTICAL PROCEDURES

Apex J qualified analytes with concentrations between the method detection limit (MDL) and the RL. AMEC agrees that these results are quantitatively uncertain and has maintained Apex's J qualifiers. (J-DL)

Benzo(b)fluoranthene and benzo(k)fluoranthene sometimes coelute. When Apex was unable to completely separate benzo(b)fluoranthene and Benzo(k)fluoranthene, they reported total benzo(b+k)fluoranthene(s) results as well as estimated values for benzo(b)fluoranthene and benzo(k)fluoranthene. AMEC J qualified all of Apex's estimated benzo(b)fluoranthene and benzo(k)fluoranthene results because of the poor chromatographic separation. (J-CS)

AMEC prefers to report the individual benzo(b)fluoranthene and benzo(k)fluoranthene results, rather than the combined benzo(b+k)fluoranthene(s) result, because benzo(b)fluoranthene and benzo(k)fluoranthene have different screening levels. AMEC chose not to report any benzo(b+k)fluoranthene(s) results in the data tables since reporting benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(b+k)fluoranthene(s) would result in double reporting of the benzofluoranthenes results.

7.0 POLYCYCLIC AROMATIC HYDROCARBONS AND PAH HOMOLOGS BY ASTM D7363-07

PAH and PAH homolog data from this event may be considered usable with the limitations and exceptions described in Sections 7.1 through 7.6.

7.1 HOLDING TIMES

All samples were extracted within the method-specified 7-day maximum holding time for water samples. All sample extracts were analyzed within the 40-day maximum holding time from extraction until analysis.

7.2 CALIBRATION VERIFICATIONS

Apex presented the following list of calibration verification standards (CVSs) that did not meet method-specified criteria and the associated samples in the case narrative:

- Benzo(b)fluoranthene (72%), benzo(g,h,i)perylene (57%), dibenz(a,h)anthracene (60%), and indeno(1,2,3-cd)pyrene (57%) recoveries were below the method-specified 75% to 125% limits in the CVSs associated with the analysis of porewater samples PWS-13_8-11, PWS-16_8-11, PWS-20_8-11, and PWS-27_8-11. These analytes were not detected in the associated samples and AMEC UJ qualified the nondetected benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene results from these samples because of potentially low analytical bias. (UJ-LC)

- Acenaphthene (77%), acenaphthylene (73%), fluorene (78%), 1-methylnaphthalene (77%), 2-methylnaphthalene (73%), naphthalene (75%), and phenanthrene (79%) recoveries were below the method specified 80% to 120% limits in the CVS associated with the analysis of porewater samples LSI-09_8-11, PWS-01_8-10, PWS-03_8-11, PWS-04_8-11, PWS-05_8-11, PWS-06_8-11, PWS-08_8-11, PWS-09_8-11, and PWS-12_8-11. It should be noted that the laboratory analyzed a LCS with these samples, which had the same analyte concentrations as the CVS, but was made from a second source standard. The LCS recoveries were within CVS limits and it is likely that the CVS was mis-spiked; however, AMEC chose to qualify data from the associated samples based on the low CVS recoveries. Data limitations are summarized below.
  - AMEC J qualified the detected acenaphthene, acenaphthylene, fluorene, and phenanthrene results and UJ qualified the nondetected 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene results from samples LSI-09_8-11, PWS-01_8-10, and PWS-06_8-11 because of potentially low analytical bias. (J/UJ-LC)
  - AMEC J qualified the detected acenaphthene, fluorene, and phenanthrene results and UJ qualified the nondetected acenaphthylene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene results from samples PWS-03_8-11, PWS-05_8-11, and PWS-08_8-11 because of potentially low analytical bias. (J/UJ-LC)
  - AMEC J qualified the detected acenaphthene and fluorene results and UJ qualified the nondetected acenaphthylene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene, and phenanthrene results from samples PWS-04_8-11 and PWS-09_8-11 because of potentially low analytical bias. (J/UJ-LC)
  - These analytes were not detected in sample PWS-12_8-11 and AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LC)

- Benzo(b)fluoranthene (71%), benzo(g,h,i)perylene (62%), benzo(a)pyrene (72%), benzo(e)pyrene (72%), dibenz(a,h)anthracene (64%), and indeno(1,2,3-cd)pyrene recoveries were below the method-specified 75% to 125% limits in the CVS associated with the analysis of porewater samples LSI-02_8-11, LSI-11_8-11, LSI-20_8-11,

PWS-15_8-11, PWS-26_8-11, and PWS-26_8-11_DUP. These analytes were not detected in the associated samples and AMEC UJ qualified the nondetected results because of potentially low analytical bias. (UJ-LC)

- Benzo(g,h,i)perylene (65%), dibenz(a,h)anthracene (56%), and indeno(1,2,3-cd)pyrene (65%) recoveries were below the method-specified 75% to 125% limits in the CVS associated with the analysis of porewater samples PWS-02_8-11, PWS-11_8-11, PWS-18_8-10, PWS-19_8-11, PWS-25_4-8, PWS-28_8-11, and PWS-30_8-11. These analytes were not detected in the associated samples and AMEC UJ qualified the nondetected result because of potentially low analytical bias. (UJ-LC)

- There was no CVS associated with the analysis of samples LSI-24_8-11, PWS-07_8-10, PWS-07_8-10_Dup, PWS-10_8-11, and PWS-17_8-11. These samples were analyzed in the same sequence as an initial calibration and the analysis of a CVS was not necessary.

7.3 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples, with the following exceptions:

- Anthracene (0.0196 µg/L), benzo(a)anthracene (0.0434 µg/L), benzo(e)pyrene (0.0405 µg/L), and chrysene (0.0261 µg/L) were detected in the laboratory blank associated with the analysis of porewater samples LSI-24_8-11, PWS-7_8-10, PWS-7_8-10_Dup, PWS-10_8-11 and PWS-17_4-7. Data limitations are summarized below.

  - AMEC U qualified the detected anthracene and chrysene results from samples LSI-24_8-11 (0.0220 µg/L and 0.00855 µg/L, respectively) and PWS-7_8-10 (0.0853 µg/L and 0.01678 µg/L, respectively) because the concentrations detected in the samples are less than five times the concentrations detected in the blank. (U-MB)

  - AMEC U qualified the detected benzo(a)anthracene (0.0735 µg/L) and chrysene (0.0543 µg/L) results from sample PWS-7_8-10_Dup because the concentrations detected in the sample are less than five times the concentrations detected in the blank. (U-MB)

  - AMEC U qualified the detected anthracene (0.0748 µg/L), benzo(a)anthracene (0.0200 µg/L), and chrysene (0.0145 µg/L) results from sample PWS-10_8-11 because the concentrations detected in the sample are less than five times the concentrations detected in the blank. (U-MB)

  - AMEC U qualified the detected anthracene result from sample PWS-17_4-7 because the concentration detected in the sample is less than five times the concentrations detected in the blank. (U-MB)

  - The remaining analytes were not detected in the associated samples and data usability is not adversely affected.

7.4 LABORATORY CONTROL SAMPLE RECOVERIES

The following PAHs exhibited LCS recoveries outside the laboratory-specified limits:

- Benzo(a)anthracene (122%), fluoranthene (135%/126%), and pyrene (133%/124%) recoveries were high in th LCS associated with the analysis of porewater samples PWS-13_8-11, PWS-16_8-11, PWS-20_8-11, and PWS-27_8-11. Data limitations are summarized below.
  - AMEC J qualified the detected benzo(a)anthracene, fluoranthene, and pyrene results from sample PWS-13_8-11 because of potentially high analytical bias. (J-HL)
  - AMEC J qualified the detected fluoranthene and pyrene results from sample PWS-16_8-11 because of potentially high analytical bias. (J-HL)
  - AMEC J qualified the detected benzo(a)anthracene results from sample PWS-20_8-11 because of potentially high analytical bias. (J-HL)
  - The remaining analytes were not detected in the associated samples and data usability is not adversely affected by the potentially high analytical bias.
- Naphthalene recovery was high at 148% in the LCSD associated with the analysis of porewater samples LSI-09_8-11, PWS-1_8-10, PWS-3_8-11, PWS-4_8-11, PWS-5_8-11, PWS-6_8-11, PWS-8_8-11, PWS-9_8-11, and PWS-12_8-11. Recovery was high and naphthalene was not detected in the associated samples. Data usability is not adversely affected by the potentially high analytical bias.
- Benzo(a)anthracene recovery was high at 132% in the LCS, pyrene recovery was high at 116% in the LCSD, and RPDs between LCS and LCSD results were high for fluoranthene and pyrene at 37% and 39%, respectively, in the LCS and LCSD associated with the analysis of samples LSI-02_8-11, LSI-11_8-11, LSI-20_8-11, PWS-15_8-11, PWS-26_8-11, and PWS-26_8-11_Dup. Data limitations are summarized below.
  - AMEC J qualified the detected benzo(a)anthracene result from sample LSI-11_8-11 because of potentially high analytical bias. (J-HL)
  - AMEC J qualified the detected pyrene results from samples LSI-02_8-11, LSI-11_8-11, LSI-20_8-11, PWS-26_8-11, and PWS-26_8-11_Dup because of potential analytical imprecision and potentially high analytical bias. (J-HD, HL)
  - AMEC J qualified the detected fluoranthene results from samples LSI-02_8-11, LSI-11_8-11, LSI-20_8-11, PWS-15_8-11, PWS-26_8-11, and PWS-26_8-11_Dup because of potential analytical imprecision. (J-HD)
  - Benzo(a)anthracene, fluoranthene, and pyrene were not detected in the remaining samples and data usability is not adversely affected by the potentially high analytical bias and/or analytical imprecision.

- Benzo(a)anthracene recovery was high at 122% in the LCS associated with the analysis of samples PWS-02_8-11, PWS-11_8-11, PWS-14_4-8, PWS-18_8-10, PWS-28_8-11, and PWS-30_8-11. Data limitations are summarized below.
  - AMEC J qualified the detected benzo(a)anthracene result from samples PWS-02_8-11 and PWS-14_4-8 because of potentially high analytical bias. (J-HL)
  - Benzo(a)anthracene was not detected in the remaining samples and data usability is not adversely affected by the potentially high analytical bias.
- Benzo(a)anthracene (197%), benzo(b)fluoranthene (144%), benzo(k)fluoranthene (151%), benzo(g,h,i)perylene (138%), benzo(a)pyrene (147%), benzo(e)pyrene (136%), chrysene (129%), fluoranthene (138%-LCSD), indeno(1,2,3-cd)pyrene (130%), perylene (138%), and pyrene (136%-LCSD) recoveries were high in the LCS or LCSD associated with the analysis of samples LSI-24_8-11, PWS-7_8-10, PWS-7_8-10_Dup, PWS-10_8-11, and PWS-17_4-7. Data limitations are summarized below.
  - AMEC J qualified the detected chrysene, fluoranthene, and pyrene results from samples LSI-24_8-11 and PWS-7_8-10 because of potentially high analytical bias. (J-HL)
  - AMEC J qualified the detected benzo(a)anthracene, chrysene, fluoranthene, and pyrene results from samples PWS-7_8-10_Dup and PWS-10_8-11 because of potentially high analytical bias. (J-HL)
  - The remaining analytes were not detected in the associated samples and data usability is not adversely affected by the potentially high analytical bias.
- Benzo(a)anthracene recovery was high at 141% in the LCS associated with the analysis of samples LSI-01_8-11, PWS-19_8-11, and PWS-29_8-11. Data limitations are summarized below.
  - AMEC J qualified the detected benzo(a)anthracene results from samples PWS-19_8-11 and PWS-29_8-11because of potentially high analytical bias. (J-HL)
  - Benzo(a)anthracene was not detected in sample LSI-01_8-11 and data usability is not adversely affected by the potentially high analytical bias.

7.5 LABORATORY DUPLICATES

Apex performed duplicate analyses of samples LSI-01_8-11, LSI-11_8-11, PWS-13_8-11, PWS-17_4-7, and PWS-25_4-8. RPDs between primary and duplicate results were less than the laboratory-specified maximum of 30%, with the following exceptions:

- In the duplicate analysis of sample PWS-13_8-11, RPDs between primary and duplicate results were high for chrysene and C4-naphthalenes at 45% and 36%, respectively. AMEC J qualified the detected chrysene and C4-naphthalenes results from this sample because of analytical imprecision. (J-HD)

- The RPD between C3-naphthalene results was high at 38% in the duplicate analysis of sample PWS-17-4-7. The difference between the detected C3-naphthalene results of 0.545 µg/L and 0.370 µg/L was less than the RL of 1.27 µg/L and data usability is not adversely affected.

- In the duplicate analysis of sample PWS-25_4-8, acenaphthene and phenanthrene were detected in the primary analysis but these analytes were not detected in the duplicate analysis. Additionally, RPDs between the primary and duplicate results were high for benzo(a)anthracene (62%), chrysene (31%), and pyrene (33%). Data limitations are summarized below.

  - The differences between the acenaphthene and phenanthrene concentrations detected in the primary analysis, at 0.190 µg/L and 0.170 µg/L, respectively, and the RLs of 0.150 µg/L are less than the RLs and data usability is not adversely affected.

  - AMEC J qualified the detected benzo(a)anthracene, chrysene, and pyrene results from this sample because of potential analytical imprecision. (J-HD)

7.6 DATA REPORTING AND ANALYTICAL PROCEDURES

Apex J qualified analytes with concentrations between the MDL and the RL. AMEC agrees that these results are quantitatively uncertain and has maintained Apex's J qualifiers. (J-DL)

According to Apex's notes, all alkyl homolog results from ASTM D7363-07 analyses are estimated values because of a lack of reference standards inherent in the method. AMEC J qualified all detected and UJ qualified all nondetected alkyl homolog results from these analyses because of the lack of reference standards. (J/UJ-NQ)

According to Apex's notes, Apex modified ASTM D6373-07 and used phenanthrene-d_{10} as an internal standard to quantify benzo(a)anthracene, chrysene, fluoranthene, and pyrene. Due to the modified internal standard reference, these analytes did not meet method-specified calibration criteria. Additionally, at AMEC's request, Apex added benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, benzo(e)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and perylene to the analyte list. AMEC J qualified the detected results and UJ qualified the nondetected results for these analytes because they did not meet method-specified calibration criteria. (J/UJ-BC)

Apex reported results for benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(b+k)fluoranthene(s). AMEC prefers to report the individual benzo(b)fluoranthene and benzo(k)fluoranthene results, rather than the combined benzo(b+k)fluoranthene(s) result, because benzo(b)fluoranthene and benzo(k)fluoranthene have different screening levels. AMEC chose not to report any benzo(b+k)fluoranthene(s) results in the data tables since reporting

benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(b+k)fluoranthene(s) would result in double reporting of the benzofluoranthenes results.

8.0 TOTAL AND DISSOLVED ORGANIC CARBON BY SM 5310B

TOC and DOC data from this event may be considered usable with the limitations and exceptions described in Sections 8.1 through 8.5.

8.1 HOLDING TIMES

All samples were analyzed within the method-specified 28-day maximum holding time for sediment and water samples.

8.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

8.3 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's 90% to 110% limits.

8.4 LABORATORY DUPLICATES

Apex performed duplicate analyses on sediment sample LSI-01_8-11, PWS-13_8-11, PWS-15_8-11, and PWS-28_8-11 for TOC and porewater samples PWS-13_8-11 and PWS-28_8-11 for DOC. RPDs between the primary and duplicate results were less than the laboratory-specified maximum of 20%.

8.5 MATRIX SPIKES

Apex did not perform any MSs for the TOC analyses of the sediment samples. Apex performed MSs on porewater samples PWS-13_8-11 and PWS-28_8-11 for DOC. Recoveries were within the laboratory-specified 75% to 125% limits, with the following exceptions:

- DOC recovery was high at 153% in porewater sample PWS-13_8-11. The background DOC concentration in the unspiked native sample, at 91.2 milligrams per liter (mg/L) was more than four times the spike concentration of 22.2 mg/L and it is not possible to evaluate data usability for this sample based on MS recovery.

9.0 DIESEL AND OIL HYDROCARBONS BY NWTPH-DX

Diesel and oil data from this event may be considered usable with the limitations and exceptions described in Sections 9.1 through 9.5.

9.1 HOLDING TIMES

All samples were analyzed within the method-specified 14-day maximum holding time from collection until extraction and 40 days from extraction until analysis for sediment samples.

9.2 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

9.3 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's 70% to 130% limits.

9.4 LABORATORY DUPLICATES

Apex performed duplicate analyses on sediment samples LSI-01_8-11 and LSI-11_8-11. RPDs between the primary and duplicate results were less than the laboratory-specified maximum of 30%, with the following exception:

- There was 33% RPD between the primary and duplicate diesel results in sample LSI-11_8-11. AMEC J qualified the detected diesel result from this sample because of potential analytical imprecision. (J-HD)

9.5 DATA REPORTING AND ANALYTICAL PROCEDURE

Diesel and oil are quantified against #2 diesel fuel and motor oil. When the chromatographic patterns from field samples do not match these standards, the analytical results may be quantitatively and/or qualitatively uncertain.

- According to Apex's notes, the chromatographic pattern for the oil detection in sample LSI-02_8-11 does not resemble the fuel standard used for quantitation. AMEC N qualified the oil result from this sample as being qualitatively and quantitatively uncertain. (N-SB)

- According to Apex's notes, the chromatograms for the diesel and oil detections in samples LSI-09_8-11, LSI-11_8-11, and LSI-20_8-11 are unresolved complex mixtures of hydrocarbons eluting through the diesel and oil retention time ranges. AMEC N qualified the diesel and oil results from these samples as being quantitatively and quantitatively uncertain. (N-SB)

10.0 FIELD DUPLICATES

Field duplicates were collected for sediment and porewater samples PWS-7-8-10 and PWS-26_8-11. Analytes detected in the field duplicate pairs are summarized in Table 2. RPDs between primary and field duplicate results were less than 50%, or differences between analyte concentrations were less than applicable RLs, with the following exceptions:

- In porewater sample PWS-7_8-10, RPDs between primary and field duplicate results were high for acenaphthene (116%), acenaphthylene (115%), fluoranthene (132%), fluorene (135%), C1-fluorenes (67%), C3-naphthalenes (99%), phenanthrene (147%), C1-phenanthrenes/anthracenes (90%), and pyrene (128%). Additionally, anthracene and C2-naphthalenes were not detected in the primary sample, but were detected in the field duplicate at concentrations approximately 54 and 4 times the RL. AMEC J qualified the detected results and UJ qualified the nondetected results for these analytes in porewater samples PWS-7_8-10 and PWS-7_8-10_Dup because of sampling or analytical imprecision. (J/UJ-FD)

- In sediment sample PWS-7_8-10, RPDs between primary and field duplicate results were high for anthracene and 2-methylnaphthalene at 93% and 82%, respectively. AMEC J qualified the detected anthracene and 2-methylnaphthalene results from sediment samples PWS-7_8-10 and PWS-7_8-10_Dup because of sampling or analytical imprecision. (J-FD)

- In sediment sample PWS-26_8-11, RPDs between primary and field duplicate results were high for benzo(a)anthracene (77%), benzo(b)fluoranthene (58%), benzo(k)fluoranthene (52%), benzo(a)pyrene (64%), benzo(e)pyrene (55%), chrysene (60%), C1-chrysenes/benzo(a)anthracenes (68%), C2-chrysenes/benzo(a)anthracenes (59%), dibenz(a,h)anthracene (57%), C1-fluoranthenes/pyrenes (59%), C3-fluorenes (51%), indeno(1,2,3-cd)pyrene (51%), perylene (59%), C2-phenanthrenes/anthracenes (51%), and C4-phenanthrenes/anthracenes (99%). AMEC J qualified the detected results for these analytes in samples PWS-26_8-11 and PWS-26_8-11_Dup because of sampling or analytical imprecision. (J-FD)

11.0 SUMMARY

AMEC reviewed a total of 2,453 data records during this data quality review and J or UJ qualified 1,094 data records (46%) as estimated values, N or NJ qualified 7 data records (0.29%) as being presumptively identified, and U qualified 3 detected data records (0.12%) as being not detected. The majority of the estimated data was due to method limitations and additional data reported by

request of AMEC. No data were rejected and 100% of the data should be considered fully usable with the addition of the qualifiers summarized in Table 3.

REFERENCES

APHA, 2005. Standard Methods for Examination of Water and Wastewater. 21st Edition.

ASTM, 2007. D7363-07, Standard Test Method for Determination of Parent and Alkyl Polycyclic Aromatics in Sediment Pore Water Using Solid-Phase Microextraction and Gas Chromatography/Mass Spectrometry in Selected Ion Monitoring Mode.

EPA, 2008. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, USEPA-540-R-08-01.

EPA, 2007c. Method 8270D, Semivolatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), Revision 4, February 2007.

LIMITATIONS

This report was prepared exclusively for Port of St. Helens by AMEC Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data quality review is intended to be used by Port of St. Helens for the Port of St. Helens Site only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

TABLES

Table 1
Field Samples Submitted to Apex Laboratories
Port of Saint Helens

Sample Location	Apex Sample ID	Matrix	Collection Date
PWS-13_8-11 Sediment (As Received)	A12J241-03	Sediment	10/9/2012
PWS-13_8-11 Porewater	A12J241-04	Porewater	10/9/2012
PWS-13_8-11	A12J241-05	Sediment	10/9/2012
PWS-20_8-11 Sediment (As Received)	A12J241-08	Sediment	10/9/2012
PWS-20_8-11 Porewater	A12J241-09	Porewater	10/9/2012
PWS-20_8-11	A12J241-10	Sediment	10/9/2012
PWS-27_8-11 Sediment (As Received)	A12J241-13	Sediment	10/9/2012
PWS-27_8-11 Porewater	A12J241-14	Porewater	10/9/2012
PWS-27_8-11	A12J241-15	Sediment	10/9/2012
PWS-16_8-11 Sediment (As Received)	A12J241-18	Sediment	10/9/2012
PWS-16_8-11 Porewater	A12J241-19	Porewater	10/9/2012
PWS-16_8-11	A12J241-20	Sediment	10/9/2012
PWS-12_8-11 Sediment (As Received)	A12J241-23	Sediment	10/9/2012
PWS-12_8-11 Porewater	A12J241-24	Porewater	10/9/2012
PWS-12_8-11	A12J241-25	Sediment	10/9/2012
LSI-09_8-11 Porewater	A12J259-09	Porewater	10/9/2012
LSI-09_8-11	A12J257-10	Sediment	10/9/2012
LSI-02_8-11 Porewater	A12J257-11	Porewater	10/9/2012
LSI-02_8-11	A12J257-12	Sediment	10/9/2012
Rinsate Blank (PWS)	A12J289-01	Water	10/9/2012
PWS-08_8-11 Sediment (As Received)	A12J289-04	Sediment	10/9/2012
PWS-08_8-11 Porewater	A12J289-05	Porewater	10/9/2012
PWS-08_8-11	A12J289-06	Sediment	10/9/2012
PWS-09_8-11 Sediment (As Received)	A12J289-09	Sediment	10/9/2012
PWS-09_8-11 Porewater	A12J289-10	Porewater	10/9/2012
PWS-09_8-11	A12J289-11	Sediment	10/9/2012
PWS-06_8-11 Sediment (As Received)	A12J289-14	Sediment	10/9/2012
PWS-06_8-11 Porewater	A12J289-15	Porewater	10/9/2012
PWS-06_8-11	A12J289-16	Sediment	10/10/2012
PWS-05_8-11 Sediment (As Received)	A12J289-19	Sediment	10/10/2012
PWS-05_8-11 Porewater	A12J289-20	Porewater	10/10/2012
PWS-05_8-11	A12J289-21	Sediment	10/10/2012
PWS-04_8-11 Sediment (As Received)	A12J289-24	Sediment	10/10/2012
PWS-04_8-11 Porewater	A12J289-25	Porewater	10/10/2012
PWS-04_8-11	A12J289-26	Sediment	10/10/2012
PWS-03_8-11 Sediment (As Received)	A12J289-29	Sediment	10/10/2012
PWS-03_8-11 Porewater	A12J289-30	Porewater	10/10/2012
PWS-03_8-11	A12J289-31	Sediment	10/10/2012
PWS-01_8-10 Sediment (As Received)	A12J289-34	Sediment	10/10/2012
PWS-01_8-10 Porewater	A12J289-35	Porewater	10/10/2012
PWS-01_8-10	A12J289-36	Sediment	10/10/2012
LSI-20_8-11 Porewater	A12J331-05	Porewater	10/10/2012
LSI-20_8-11	A12J331-06	Sediment	10/10/2012
LSI-11_8-11 Porewater	A12J331-11	Porewater	10/10/2012
LSI-11_8-11	A12J331-12	Sediment	10/10/2012
Rinsate Blank	A12J331-13	Water	10/9/2012
PWS-15_8-11 Sediment (As Received)	A12J356-03	Sediment	10/11/2012
PWS-15_8-11 Porewater	A12J356-04	Porewater	10/11/2012
PWS-15_8-11	A12J356-05	Sediment	10/11/2012
PWS-26_8-11 Sediment (As Received)	A12J356-08	Sediment	10/11/2012
PWS-26_8-11 Porewater	A12J356-09	Porewater	10/11/2012
PWS-26_8-11	A12J356-10	Sediment	10/11/2012

Table 1
Field Samples Submitted to Apex Laboratories
Port of Saint Helens

Sample Location	Apex Sample ID	Matrix	Collection Date
PWS-26_8-11_DUP Porewater	A12J356-12	Porewater	10/11/2012
PWS-26_8-11_DUP	A12J356-13	Sediment	10/11/2012
PWS-02_8-11 Sediment (As Received)	A12J356-16	Sediment	10/11/2012
PWS-02_8-11 Porewater	A12J356-17	Porewater	10/11/2012
PWS-02_8-11	A12J356-18	Sediment	10/11/2012
PWS-28_8-11 Sediment (As Received)	A12J357-03	Sediment	10/10/2012
PWS-28_8-11 Porewater	A12J357-04	Porewater	10/10/2012
PWS-28_8-11	A12J357-05	Sediment	10/10/2012
PWS-11_8-11 Sediment (As Received)	A12J357-08	Sediment	10/10/2012
PWS-11_8-11 Porewater	A12J357-09	Porewater	10/10/2012
PWS-11_8-11	A12J357-10	Sediment	10/10/2012
PWS-10_8-11 Sediment (As Received)	A12J357-13	Sediment	10/10/2012
PWS-10_8-11 Porewater	A12J357-14	Porewater	10/10/2012
PWS-10_8-11	A12J357-15	Sediment	10/10/2012
PWS-17_4-7 Sediment (As Received)	A12J357-16	Sediment	10/10/2012
PWS-17_4-7 Porewater	A12J357-17	Porewater	10/10/2012
PWS-17_4-7	A12J357-18	Sediment	10/10/2012
Rinsate Blank	A12J357-19	Water	10/10/2012
LSI-24_8-11 Porewater	A12J365-03	Porewater	10/12/2012
LSI-24_8-11	A12J365-04	Sediment	10/12/2012
Rinsate Blank	A12J365-05	Water	10/12/2012
PWS-25_4-8 Sediment (As Received)	A12J367-02	Sediment	10/11/2012
PWS-25_4-8 Porewater	A12J367-03	Porewater	10/11/2012
PWS-25_4-8	A12J367-04	Sediment	10/11/2012
PWS-07_8-10 Sediment (As Received)	A12J367-07	Sediment	10/11/2012
PWS-07_8-10 Porewater	A12J367-08	Porewater	10/11/2012
PWS-07_8-10	A12J367-09	Sediment	10/11/2012
PWS-07_8-10_Dup Porewater	A12J367-11	Porewater	10/11/2012
PWS-07_8-10_Dup	A12J367-12	Sediment	10/11/2012
PWS-18_8-10 Sediment (As Received)	A12J367-15	Sediment	10/11/2012
PWS-18_8-10 Porewater	A12J367-16	Porewater	10/11/2012
PWS-18_8-10	A12J367-17	Sediment	10/11/2012
PWS-19_8-11 Sediment (As Received)	A12J367-20	Sediment	10/11/2012
PWS-19_8-11 Porewater	A12J367-21	Porewater	10/11/2012
PWS-19_8-11	A12J367-22	Sediment	10/11/2012
PWS-14_4-8 Sediment (As Received)	A12J367-23	Sediment	10/11/2012
PWS-14_4-8 Porewater	A12J367-24	Porewater	10/11/2012
PWS-14_4-8	A12J367-25	Sediment	10/11/2012
PWS-30_8-11 Porewater	A12J367-27	Porewater	10/12/2012
PWS-30_8-11	A12J367-28	Sediment	10/12/2012
PWS-29_8-11 Sediment (As Received)	A12J367-29	Sediment	10/12/2012
PWS-29_8-11 Porewater	A12J367-30	Porewater	10/12/2012
PWS-29_8-11	A12J367-31	Sediment	10/12/2012
LSI-01_8-11 Porewater	A12J450-02	Porewater	10/16/2012
LSI-01_8-11	A12J450-03	Sediment	10/16/2012

Table 2
Field Duplicate Detections
Port of Saint Helens

Analyte	LOQ	Primary Concentration	Duplicate Concentration	RPD	Notes
Sample PWS-7_8-10 (Porewater)					
C2-Naphthalenes	0.778 µg/L	0.778 U	**2.82**	NC	J-FD
C3-Naphthalenes	1.27 µg/L	**0.815 J**	**2.40**	99%	J-FD
Acenaphthylene	0.120 µg/L	**0.130**	**0.480**	115%	J-FD
Acenaphthene	0.150 µg/L	**1.21**	**4.57**	116%	J-FD
Fluorene	0.200 µg/L	**0.540**	**2.80**	135%	J-FD
C1-Fluorenes	0.274 µg/L	**0.600**	**1.20**	67%	J-FD
Phenanthrene	0.150 µg/L	**0.500**	**3.27**	147%	J-FD
Anthracene	0.0161 µg/L	0.0853 U	**0.862**	NC	J-FD
C1-Phenanthrenes/Anthracenes	0.263 µg/L	**0.358**	**0.946**	90%	J-FD
C2-Phenanthrenes/Anthracenes	0.469 µg/L	**0.298 J**	**0.377 J**	23%	
Fluoranthene	0.0581 µg/L	**0.239**	**1.16**	132%	J-FD
Pyrene	0.0493 µg/L	**0.141**	**0.638**	128%	J-FD
C1-Fluoranthenes/Pyrenes	0.114 µg/L	0.114 U	**0.226**	NC	± RL
Sample PWS-7_8-10 (Sediment)					
Naphthalene	14.7 µg/kg	**1,990**	**2,530**	24%	
1-Methylnaphthalene	14.7 µg/kg	**307**	**381**	22%	
2-Methylnaphthalene	14.7 µg/kg	**389**	**932**	82%	J-FD
C2-Naphthalenes	73.6 µg/kg	**915**	**877**	4.2%	
C3-Naphthalenes	73.6 µg/kg	**963**	**670**	36%	
C4-Naphthalenes	73.6 µg/kg	**536**	**334**	46%	
Acenaphthene	14.7 µg/kg	**878**	**859**	2.2%	
Acenaphthylene	14.7 µg/kg	**175**	**184**	5.0%	
Fluorene	14.7 µg/kg	**1,050**	**962**	8.7%	
C1-Fluorenes	73.6 µg/kg	**381**	**338**	12%	
C2-Fluorenes	73.6 µg/kg	**290**	**234**	21%	
C3-Fluorenes	73.6 µg/kg	**551**	**424**	26%	
Phenanthrene	14.7 µg/kg	**3,160**	**2,420**	27%	
Anthracene	14.7 µg/kg	**2,690**	**981**	93%	J-FD
C1-Phenanthrenes/Anthracenes	73.6 µg/kg	**2,010**	**1,550**	26%	
C2-Phenanthrenes/Anthracenes	73.6 µg/kg	**1,180**	**962**	20%	
C3-Phenanthrenes/Anthracenes	73.6 µg/kg	**665**	**483**	32%	
C4-Phenanthrenes/Anthracenes	147 µg/kg	**378**	**282**	29%	
Fluoranthene	14.7 µg/kg	**4,430**	**3,290**	30%	
Pyrene	14.7 µg/kg	**3,500**	**2,600**	30%	
C1-Fluoranthenes/Pyrenes	73.6 µg/kg	**2,060**	**1,760**	16%	
Benzo(a)anthracene	14.7 µg/kg	**1,780**	**1,380**	25%	
Chrysene	14.7 µg/kg	**2,070**	**2,560**	21%	
C1-Chrysenes/Benzo(a)anthracenes	73.6 µg/kg	**1,010**	**933**	7.9%	
C2-Chrysenes/Benzo(a)anthracenes	73.6 µg/kg	**521**	**452**	14%	
C3-Chrysenes/Benzo(a)anthracenes	73.6 µg/kg	**488**	**420**	15%	
C4-Chrysenes/Benzo(a)anthracenes	147 µg/kg	**167**	**150**	11%	
Benzo(b)fluoranthene	14.7 µg/kg	**2,680**	**2,690**	0.37%	
Benzo(k)fluoranthene	14.7 µg/kg	**873**	**828**	5.3%	
Benzo(e)pyrene	14.7 µg/kg	**1,280**	**1,430**	11%	
Benzo(a)pyrene	14.7 µg/kg	**1,490**	**1,620**	8.4%	
Perylene	14.7 µg/kg	**411**	**463**	12%	
Dibenz(a,h)anthracene	14.7 µg/kg	**186**	**197**	5.7%	
Indeno(1,2,3-cd)pyrene	14.7 µg/kg	**619**	**758**	20%	
Benzo(g,h,i)perylene	14.7 µg/kg	**450**	**588**	27%	

Table 2
Field Duplicate Detections
Port of Saint Helens

Analyte	LOQ	Primary Concentration	Duplicate Concentration	RPD	Notes
Sample PWS-26_8-11 (Porewater)					
Acenaphthene	0.150 µg/L	**0.550**	**0.560**	1.8%	
Fluorene	0.200 µg/L	0.200 U	**0.220**	NC	
Phenanthrene	0.150 µg/L	**0.210**	**0.190**	10%	
Anthracene	0.0161 µg/L	0.0161 U	**0.0163**	NC	
Fluoranthene	0.0581 µg/L	**0.137**	**0.138**	1%	
Pyrene	0.0493 µg/L	**0.0828**	**0.0836**	1%	
Chrysene	0.00400 µg/L	**0.00431**	**0.00634**	38%	
Sample PWS-26_8-11 (Sediment)					
Naphthalene	14.9 µg/kg	**776**	**1,000**	25%	
1-Methylnaphthalene	14.9 µg/kg	**154**	**163**	5.7%	
2-Methylnaphthalene	14.9 µg/kg	**336**	**382**	13%	
C2-Naphthalenes	74.4 µg/kg	**346**	**361**	4.2%	
C3-Naphthalenes	74.4 µg/kg	**251**	**253**	0.79%	
C4-Naphthalenes	74.4 µg/kg	**130**	**153**	16%	
Acenaphthene	14.9 µg/kg	**322**	**326**	1.2%	
Acenaphthylene	14.9 µg/kg	**52.7**	**70.2**	28%	
Fluorene	14.9 µg/kg	**435**	**428**	1.6%	
C1-Fluorenes	74.4 µg/kg	**146**	**161**	10%	
C2-Fluorenes	74.4 µg/kg	**90.3**	**123**	31%	
C3-Fluorenes	74.4 µg/kg	**129**	**217**	51%	J-FD
Phenanthrene	14.9 µg/kg	**1,090**	**1,200**	10%	
Anthracene	14.9 µg/kg	**436**	**506**	15%	
C1-Phenanthrenes/Anthracenes	74.4 µg/kg	**612**	**833**	31%	
C2-Phenanthrenes/Anthracenes	74.4 µg/kg	**356**	**599**	51%	J-FD
C3-Phenanthrenes/Anthracenes	74.4 µg/kg	**180**	**297**	49%	
C4-Phenanthrenes/Anthracenes	149 µg/kg	**2,590**	**876**	99%	J-FD
Fluoranthene	14.9 µg/kg	**1,220**	**1,770**	37%	
Pyrene	14.9 µg/kg	**854**	**1,280**	40%	
C1-Fluoranthenes/Pyrenes	74.4 µg/kg	**591**	**1,090**	59%	J-FD
Benzo(a)anthracene	14.9 µg/kg	**392**	**886**	77%	J-FD
Chrysene	14.9 µg/kg	**711**	**1,320**	60%	J-FD
C1-Chrysenes/Benzo(a)anthracenes	74.4 µg/kg	**271**	**548**	68%	J-FD
C2-Chrysenes/Benzo(a)anthracenes	74.4 µg/kg	**132**	**243**	59%	J-FD
C3-Chrysenes/Benzo(a)anthracenes	74.4 µg/kg	**113**	**183**	47%	
Benzo(b)fluoranthene	14.9 µg/kg	**736**	**1,340**	58%	J-FD
Benzo(k)fluoranthene	14.9 µg/kg	**275**	**466**	52%	J-FD
Benzo(e)pyrene	14.9 µg/kg	**357**	**631**	55%	J-FD
Benzo(a)pyrene	14.9 µg/kg	**399**	**776**	64%	J-FD
Perylene	14.9 µg/kg	**95.0**	**175**	59%	J-FD
Dibenz(a,h)anthracene	14.9 µg/kg	**55.4**	**99.5**	57%	J-FD
Indeno(1,2,3-cd)pyrene	14.9 µg/kg	**221**	**373**	51%	J-FD
Benzo(g,h,i)perylene	14.9 µg/kg	**206**	**324**	45%	

Notes:
Bold = the analyte was detected at the stated concentration
± LOQ = the difference between analyte concentrations is less than the LOQ.
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
LOQ = limit of quantification
NC = not calculable
RPD = relative percent diference

Qualifier Definitions:
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Reason Code:
FD = Field duplicate results indicate sampling or analytical imprecision.

Table 3
Qualifiers Added During Data Quality Review
Port of Saint Helens

Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
LSI-01_8-11	Sediment	8270D	Acenaphthylene	6.67 µg/kg	J DL
			Benzo(b)fluoranthene	49.7 µg/kg	J CS
			Benzo(k)fluoranthene	15.0 µg/kg	J CS
			Perylene	9.31 µg/kg	J DL
LSI-01_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0530 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0530 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0530 µg/L	UJ BC
			Benzo(a)pyrene	0.0530 µg/L	UJ BC
			Benzo(e)pyrene	0.0530 µg/L	UJ BC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0530 µg/L	UJ BC
			Fluoranthene	0.0581 µg/L	UJ BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0530 µg/L	UJ BC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0530 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
LSI-02_8-11	Sediment	8270D	Benzo(b)fluoranthene	210 µg/kg	J CS
			Benzo(k)fluoranthene	69.9 µg/kg	J CS
			Dibenz(a,h)anthracene	15.7 µg/kg	J DL
		NWTPH-DX	Oil Range Organics	77.0 mg/kg	N SB
LSI-02_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0530 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0530 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0530 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0530 µg/L	UJ BC, LC
			Benzo(e)pyrene	0.0530 µg/L	UJ BC, LC
			Chrysene	0.00893 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0530 µg/L	UJ BC, LC
			Fluoranthene	0.165 µg/L	J BC, HD
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0530 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0530 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.114 µg/L	J BC, HD, HL

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
LSI-09_8-11	Sediment	8270D	Benzo(b)fluoranthene	4,370 µg/kg	J CS
			Benzo(k)fluoranthene	1,630 µg/kg	J CS
		NWTPH-DX	Diesel Range Organics	139 mg/kg	N SB
			Oil Range Organics	254 mg/kg	N SB
LSI-09_8-11	Porewater	D7363-07	Acenaphthene	2.79 µg/L	J LC
			Acenaphthylene	0.170 µg/L	J LC
			Benzo(a)Anthracene	0.0788 µg/L	J BC
			Benzo(b)fluoranthene	0.0530 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0530 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0530 µg/L	UJ BC
			Benzo(a)pyrene	0.0530 µg/L	UJ BC
			Benzo(e)pyrene	0.0530 µg/L	UJ BC
			Chrysene	0.0468 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0530 µg/L	UJ BC
			Fluoranthene	2.19 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.442 µg/L	J NQ
			Fluorene	0.670 µg/L	J LC
			C1- Fluorenes	1.26 µg/L	J NQ
			C2- Fluorenes	0.812 µg/L	J DL, NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0530 µg/L	UJ BC
			1-Methylnaphthalene	0.320 µg/L	UJ LC
			2-Methylnaphthalene	0.270 µg/L	UJ LC
			Naphthalene	1.12 µg/L	UJ LC
			C2-Naphthalenes	1.50 µg/L	J NQ
			C3-Naphthalenes	4.34 µg/L	J NQ
			C4-Naphthalenes	2.02 µg/L	J NQ
			Perylene	0.0530 µg/L	UJ BC
			Phenanthrene	1.35 µg/L	J LC
			C1-Phenanthrenes/Anthracenes	1.02 µg/L	J NQ
			C2-Phenanthrenes/Anthracenes	0.907 µg/L	J NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	1.21 µg/L	J BC
LSI-11_8-11	Sediment	8270D	Benzo(b)fluoranthene	2,590 µg/kg	J CS
			Benzo(k)fluoranthene	775 µg/kg	J CS
		NWTPH-DX	Diesel Range Organics	326 mg/kg	NJ SB, HD
			Oil Range Organics	462 mg/kg	N SB

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
LSI-11_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0487 µg/L	J BC, HL
			Benzo(b)fluoranthene	0.0530 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0530 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0530 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0530 µg/L	UJ BC, LC
			Benzo(e)pyrene	0.0530 µg/L	UJ BC, LC
			Chrysene	0.0435 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0530 µg/L	UJ BC, LC
			Fluoranthene	1.59 µg/L	J BC, HD
			C1- Fluoranthrenes/Pyrenes	0.303 µg/L	J NQ
			C1- Fluorenes	3.02 µg/L	J NQ
			C2- Fluorenes	1.16 µg/L	J NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0530 µg/L	UJ BC, LC
			C2-Naphthalenes	10.7 µg/L	J NQ
			C3-Naphthalenes	14.6 µg/L	J NQ
			C4-Naphthalenes	2.95 µg/L	J NQ
			Perylene	0.0530 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	1.92 µg/L	J NQ
			C2-Phenanthrenes/Anthracenes	0.903 µg/L	J NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.854 µg/L	J BC, HD, HL
LSI-20_8-11	Sediment	NWTPH-DX	Diesel Range Organics	33.5 mg/kg	N SB
			Oil Range Organics	70.6 mg/kg	N SB
LSI-20_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0530 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0530 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0530 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0530 µg/L	UJ BC, LC
			Benzo(e)pyrene	0.0530 µg/L	UJ BC, LC
			Chrysene	0.00840 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0530 µg/L	UJ BC, LC
			Fluoranthene	0.133 µg/L	J BC, HD
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.380 µg/L	J NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0530 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0530 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.113 µg/L	J BC, HD, HL

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
LSI-24-8-11	Porewater	D7363-07	Anthracene	0.0220 µg/L	U MB
			Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0530 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0530 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0530 µg/L	UJ BC
			Benzo(a)pyrene	0.0530 µg/L	UJ BC
			Benzo(e)pyrene	0.0530 µg/L	UJ BC
			Chrysene	0.00855 µg/L	UJ MB, BC, HL
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0530 µg/L	UJ BC
			Fluoranthene	0.117 µg/L	J BC, HL
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0530 µg/L	UJ BC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0530 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0947 µg/L	J BC, HL
PWS-01_8-10	Sediment	8270D	Dibenz(a,h)anthracene	6.26 µg/kg	J DL
PWS-01_8-10	Porewater	D7363-07	Acenaphthene	4.89 µg/L	J LC
			Acenaphthylene	0.350 µg/L	J LC
			Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.0909 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			Fluorene	1.16 µg/L	J LC
			C1- Fluorenes	0.360 µg/L	J NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			1-Methylnaphthalene	0.320 µg/L	UJ LC
			2-Methylnaphthalene	0.270 µg/L	UJ LC
			Naphthalene	1.12 µg/L	UJ LC
			C2-Naphthalenes	1.35 µg/L	J NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			Phenanthrene	0.320 µg/L	J LC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0511 µg/L	J BC

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-02_8-11	Sediment	8270D	Naphthalene	504 µg/kg	J HM
PWS-02_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.505 µg/L	J BC, HL
			Benzo(b)fluoranthene	0.0436 µg/L	J BC, DL
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.288 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	23.4 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	3.65 µg/L	J NQ
			C1- Fluorenes	50.9 µg/L	J NQ
			C2- Fluorenes	10.8 µg/L	J NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	281 µg/L	J NQ
			C3-Naphthalenes	154 µg/L	J NQ
			C4-Naphthalenes	28.4 µg/L	J NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	37.5 µg/L	J NQ
			C2-Phenanthrenes/Anthracenes	9.54 µg/L	J NQ
			C3-Phenanthrenes/Anthracenes	0.629 µg/L	J NQ
			C4-Phenanthrenes/Anthracenes	0.0902 µg/L	J DL, NQ
			Pyrene	12.7 µg/L	J BC
PWS-03_8-11	Porewater	D7363-07	Acenaphthene	0.640 µg/L	J LC
			Acenaphthylene	0.120 µg/L	UJ LC
			Benzo(a)Anthracene	0.0122 µg/L	J BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0206 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.328 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			Fluorene	0.520 µg/L	J LC
			C1- Fluorenes	0.292 µg/L	J NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			1-Methylnaphthalene	0.320 µg/L	UJ LC
			2-Methylnaphthalene	0.270 µg/L	UJ LC
			Naphthalene	1.12 µg/L	UJ LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			Phenanthrene	0.200 µg/L	J LC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.198 µg/L	J BC

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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-04_8-11	Porewater	D7363-07	Acenaphthene	1,990 µg/L	J LC
			Acenaphthylene	562 µg/L	UJ LC
			Benzo(a)Anthracene	1,150 µg/L	UJ BC
			Benzo(b)fluoranthene	0.540 µg/L	UJ BC
			Benzo(k)fluoranthene	0.120 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0107 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0400 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.0400 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0400 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00764 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0125 µg/L	UJ BC
			Fluoranthene	0.00183 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.0255 µg/L	UJ NQ
			Fluorene	0.0400 µg/L	J LC
			C1- Fluorenes	0.120 µg/L	UJ NQ
			C2- Fluorenes	0.114 µg/L	UJ NQ
			C3- Fluorenes	0.230 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.274 µg/L	UJ BC
			1-Methylnaphthalene	0.339 µg/L	UJ LC
			2-Methylnaphthalene	0.0603 µg/L	UJ LC
			Naphthalene	0.0400 µg/L	UJ LC
			C2-Naphthalenes	0.320 µg/L	UJ NQ
			C3-Naphthalenes	0.270 µg/L	UJ NQ
			C4-Naphthalenes	1.12 µg/L	UJ NQ
			Perylene	0.778 µg/L	UJ BC
			Phenanthrene	0.00329 µg/L	UJ LC
			C1-Phenanthrenes/Anthracenes	0.00459 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.0400 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.150 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			Pyrene	0.00371 µg/L	J BC
PWS-04_8-11	Sediment	8270D	Benzo(b)fluoranthene	0.00511 µg/kg	J CS
			Benzo(k)fluoranthene	0.0173 µg/kg	J CS
			Pyrene	0.0714 µg/kg	J HD

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Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-05_8-11	Porewater	D7363-07	Acenaphthene	0.680 µg/L	J LC
			Acenaphthylene	0.120 µg/L	UJ LC
			Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.114 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			Fluorene	0.230 µg/L	J LC
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			1-Methylnaphthalene	0.320 µg/L	UJ LC
			2-Methylnaphthalene	0.270 µg/L	UJ LC
			Naphthalene	1.12 µg/L	UJ LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			Phenanthrene	0.230 µg/L	J LC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0619 µg/L	J BC

Table 3
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-06_8-11	Porewater	D7363-07	Acenaphthene	1.68 µg/L	J LC
			Acenaphthylene	0.130 µg/L	J LC
			Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.126 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			Fluorene	0.330 µg/L	J LC
			C1- Fluorenes	0.279 µg/L	J NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			1-Methylnaphthalene	0.320 µg/L	UJ LC
			2-Methylnaphthalene	0.270 µg/L	UJ LC
			Naphthalene	1.12 µg/L	UJ LC
			C2-Naphthalenes	0.875 µg/L	J NQ
			C3-Naphthalenes	1.11 µg/L	J DL, NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			Phenanthrene	0.200 µg/L	J LC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0726 µg/L	J BC

Table 3
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-07_8-10	Porewater	D7363-07	Acenaphthene	1.21 µg/L	J FD
			Acenaphthylene	0.130 µg/L	J FD
			Anthracene	0.0853 µg/L	UJ MB, FD
			Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0167 µg/L	UJ MB, BC, HL
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.239 µg/L	J BC, HL, FD
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			Fluorene	0.540 µg/L	J FD
			C1- Fluorenes	0.600 µg/L	J NQ, FD
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			C2-Naphthalenes	0.778 µg/L	UJ NQ, FD
			C3-Naphthalenes	0.815 µg/L	J DL, NQ, FD
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			Phenanthrene	0.500 µg/L	J FD
			C1-Phenanthrenes/Anthracenes	0.358 µg/L	J NQ, FD
			C2-Phenanthrenes/Anthracenes	0.298 µg/L	J DL, NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.141 µg/L	J BC, HL, FD
PWS-07_8-10	Sediment	8270D	Anthracene	2,690 µg/kg	J FD
			2-Methylnaphthalene	689 µg/kg	J FD

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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-07_8-10 DUP	Porewater	D7363-07	Acenaphthene	4.57 µg/L	J FD
			Acenaphthylene	0.480 µg/L	J FD
			Anthracene	0.862 µg/L	J FD
			Benzo(a)Anthracene	0.0735 µg/L	UJ MB, BC, HL
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0543 µg/L	UJ MB, BC, HL
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	1.16 µg/L	J BC, HL, FD
			C1- Fluoranthrenes/Pyrenes	0.226 µg/L	J NQ
			Fluorene	2.80 µg/L	J FD
			C1- Fluorenes	1.20 µg/L	J NQ, FD
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			C2-Naphthalenes	2.82 µg/L	J NQ, FD
			C3-Naphthalenes	2.40 µg/L	J NQ, FD
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			Phenanthrene	3.27 µg/L	J FD
			C1-Phenanthrenes/Anthracenes	0.946 µg/L	J NQ, FD
			C2-Phenanthrenes/Anthracenes	0.377 µg/L	J DL, NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.638 µg/L	J BC, HL, FD
PWS-07_8-10 DUP	Sediment	8270D	Anthracene	981 µg/kg	J FD
			Benzo(b)fluoranthene	2,690 µg/kg	J CS
			Benzo(k)fluoranthene	828 µg/kg	J CS
			2-Methylnaphthalene	932 µg/kg	J FD

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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-08_8-11	Porewater	D7363-07	Acenaphthene	0.700 µg/L	J LC
			Acenaphthylene	0.120 µg/L	UJ LC
			Benzo(a)Anthracene	0.0170 µg/L	J BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00931 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.187 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			Fluorene	0.500 µg/L	J LC
			C1- Fluorenes	0.300 µg/L	J NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			1-Methylnaphthalene	0.320 µg/L	UJ LC
			2-Methylnaphthalene	0.270 µg/L	UJ LC
			Naphthalene	1.12 µg/L	UJ LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			Phenanthrene	0.450 µg/L	J LC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.113 µg/L	J BC

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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-09_8-11	Porewater	D7363-07	Acenaphthene	0.450 µg/L	J LC
			Acenaphthylene	0.120 µg/L	UJ LC
			Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0104 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.0722 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			Fluorene	0.270 µg/L	J LC
			C1- Fluorenes	0.284 µg/L	J NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			1-Methylnaphthalene	0.320 µg/L	UJ LC
			2-Methylnaphthalene	0.270 µg/L	UJ LC
			Naphthalene	1.12 µg/L	UJ LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			Phenanthrene	0.150 µg/L	UJ LC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
PWS-10_8-11	Porewater	D7363-07	Anthracene	0.0748 µg/L	U MB
			Benzo(a)Anthracene	0.0200 µg/L	UJ MB, BC, HL
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0145 µg/L	UJ MB, BC, HL
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.505 µg/L	J BC, HL
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.779 µg/L	J NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			C2-Naphthalenes	1.37 µg/L	J NQ
			C3-Naphthalenes	1.47 µg/L	J NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.565 µg/L	J NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.270 µg/L	J BC, HL

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-11_8-11	Sediment	8270D	Acenaphthene	182 µg/kg	J HD
			Benzo(b)fluoranthene	311 µg/kg	J CS
			Benzo(k)fluoranthene	100 µg/kg	J CS
			Fluorene	230 µg/kg	J HD
			1-Methylnaphthalene	107 µg/kg	J HD
			2-Methylnaphthalene	253 µg/kg	J HD
			Naphthalene	682 µg/kg	J HD
			C2-Naphthalenes	242 µg/kg	J HD
PWS-11_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.0642 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
PWS-12_8-11	Sediment	8270D	Benzo(b)fluoranthene	30.3 µg/kg	J CS
			Benzo(k)fluoranthene	10.5 µg/kg	J DL, CS
			Naphthalene	10.9 µg/kg	J DL
			Perylene	11.3 µg/kg	J DL

Table 3
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-12_8-11	Porewater	D7363-07	Acenaphthene	0.150 µg/L	UJ LC
			Acenaphthylene	0.120 µg/L	UJ LC
			Benzo(a)Anthracene	0.0176 µg/L	J BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0144 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.0581 µg/L	UJ BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			Fluorene	0.200 µg/L	UJ LC
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			1-Methylnaphthalene	0.320 µg/L	UJ LC
			2-Methylnaphthalene	0.270 µg/L	UJ LC
			Naphthalene	1.12 µg/L	UJ LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			Phenanthrene	0.150 µg/L	UJ LC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
PWS-13_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0190 µg/L	J BC, HL
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0233 µg/L	J BC, HD
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.266 µg/L	J BC, HL
			C1- Fluoranthrenes/Pyrenes	0.175 µg/L	J NQ
			C1- Fluorenes	1.97 µg/L	J NQ
			C2- Fluorenes	1.99 µg/L	J NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	13.7 µg/L	J NQ
			C3-Naphthalenes	25.1 µg/L	J NQ
			C4-Naphthalenes	3.80 µg/L	J HD, NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	3.01 µg/L	J NQ
			C2-Phenanthrenes/Anthracenes	2.12 µg/L	J NQ
			C3-Phenanthrenes/Anthracenes	0.410 µg/L	J DL, NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.216 µg/L	J BC, HL

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-14_4-8	Sediment	8270D	Benzo(g,h,i)perylene	11.9 µg/kg	J DL
			Indeno(1,2,3-cd)pyrene	15.0 µg/kg	J DL
			Perylene	17.7 µg/kg	J DL
PWS-14_4-8	Porewater	D7363-07	Benzo(a)Anthracene	0.0287 µg/L	J BC, HL
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0192 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	1.03 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.177 µg/L	J NQ
			C1- Fluorenes	3.56 µg/L	J NQ
			C2- Fluorenes	0.715 µg/L	J DL, NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			C2-Naphthalenes	33.0 µg/L	J NQ
			C3-Naphthalenes	11.0 µg/L	J NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	2.03 µg/L	J NQ
			C2-Phenanthrenes/Anthracenes	0.559 µg/L	J NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.458 µg/L	J BC
PWS-15_8-11	Sediment	8270D	Anthracene	10.1 µg/kg	J DL
			Benzo(b)fluoranthene	20.7 µg/kg	J CS
			Benzo(k)fluoranthene	7.82 µg/kg	J DL, CS
			Benzo(g,h,i)perylene	8.72 µg/kg	J DL
			Benzo(a)pyrene	11.2 µg/kg	J DL
			Benzo(e)pyrene	10.7 µg/kg	J DL
			Indeno(1,2,3-cd)pyrene	8.81 µg/kg	J DL
			2-Methylnaphthalene	12.3 µg/kg	J DL

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-15_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC, LC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC, LC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.0655 µg/L	J BC, HD
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
PWS-16_8-11	Sediment	8270D	Benzo(b)fluoranthene	181 µg/kg	J CS
			Benzo(k)fluoranthene	55.3 µg/kg	J CS
PWS-16_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00481 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.159 µg/L	J BC, HL
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.357 µg/L	J NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	1.17 µg/L	J NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0852 µg/L	J BC, HL
PWS-17_4-7	Sediment	8270D	Acenaphthylene	8.91 µg/kg	J DL
			Benzo(b)fluoranthene	47.1 µg/kg	J CS
			Benzo(k)fluoranthene	13.7 µg/kg	J CS

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-17_4-7	Porewater	D7363-07	Anthracene	0.0301 µg/L	U MB
			Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	0.0581 µg/L	UJ BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.327 µg/L	J NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.370 µg/L	J DL, NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
PWS-18_8-10	Sediment	8270D	Benzo(b)fluoranthene	39.6 µg/kg	J CS
			Benzo(k)fluoranthene	13.4 µg/kg	J DL, CS
			Indeno(1,2,3-cd)pyrene	18.3 µg/kg	J DL
			Perylene	15.8 µg/kg	J DL
PWS-18_8-10	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.0581 µg/L	UJ BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
PWS-19_8-11	Sediment	8270D	Acenaphthylene	15.1 µg/kg	J DL
			Dibenz(a,h)anthracene	10.1 µg/kg	J DL
			1-Methylnaphthalene	15.0 µg/kg	J DL

Table 3
Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-19_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0207 µg/L	J BC, HL
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00886 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.0581 µg/L	UJ BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
PWS-20_8-11	Sediment	8270D	Benzo(b)fluoranthene	27.1 µg/kg	J CS
			Benzo(k)fluoranthene	8.92 µg/kg	J DL, CS
			2-Methylnaphthalene	8.02 µg/kg	J DL
PWS-20_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0137 µg/L	J BC, HL
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00594 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.0581 µg/L	UJ BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC

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Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-25_4-8	Porewater	D7363-07	Benzo(a)Anthracene	0.0240 µg/L	J BC, HD
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0154 µg/L	J BC, HD
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.334 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.217 µg/L	J BC, HD
PWS-26_8-11	Sediment	8270D	Benzo(a)Anthracene	392 µg/kg	J FD
			Benzo(b)fluoranthene	736 µg/kg	J FD
			Benzo(k)fluoranthene	275 µg/kg	J FD
			Benzo(a)pyrene	399 µg/kg	J FD
			Benzo(e)pyrene	357 µg/kg	J FD
			Chrysene	711 µg/kg	J FD
			C1-Chrysenes/Benzo(a)anthracenes	271 µg/kg	J FD
			C2-Chrysenes/Benzo(a)anthracenes	132 µg/kg	J FD
			Dibenz(a,h)anthracene	55.4 µg/kg	J FD
			C1- Fluoranthrenes/Pyrenes	591 µg/kg	J FD
			C3- Fluorenes	129 µg/kg	J FD
			Indeno(1,2,3-cd)pyrene	221 µg/kg	J FD
			Perylene	95.0 µg/kg	J FD
			C2-Phenanthrenes/Anthracenes	356 µg/kg	J FD
			C4-Phenanthrenes/Anthracenes	2,590 µg/kg	J FD

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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-26_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC, LC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC, LC
			Chrysene	0.00431 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.137 µg/L	J BC, HD
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0828 µg/L	J BC, HD, HL
PWS-26_8-11_DUP	Sediment	8270D	Benzo(a)Anthracene	886 µg/kg	J FD
			Benzo(b)fluoranthene	1,340 µg/kg	J FD
			Benzo(k)fluoranthene	466 µg/kg	J FD
			Benzo(a)pyrene	776 µg/kg	J FD
			Benzo(e)pyrene	631 µg/kg	J FD
			Chrysene	1,320 µg/kg	J FD
			C1-Chrysenes/Benzo(a)anthracenes	548 µg/kg	J FD
			C2-Chrysenes/Benzo(a)anthracenes	243 µg/kg	J FD
			Dibenz(a,h)anthracene	99.5 µg/kg	J FD
			C1- Fluoranthrenes/Pyrenes	1,090 µg/kg	J FD
			C3- Fluorenes	217 µg/kg	J FD
			Indeno(1,2,3-cd)pyrene	373 µg/kg	J FD
			Perylene	175 µg/kg	J FD
			C2-Phenanthrenes/Anthracenes	599 µg/kg	J FD
			C4-Phenanthrenes/Anthracenes	876 µg/kg	J FD

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Qualifiers Added During Data Quality Review
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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-26_8-11_DUP	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC, LC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC, LC
			Chrysene	0.00634 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.138 µg/L	J BC, HD
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0836 µg/L	J BC, HD, HL
PWS-27_8-11	Sediment	8270D	Acenaphthene	10.4 µg/kg	J DL
			Acenaphthylene	9.34 µg/kg	J DL
			Dibenz(a,h)anthracene	10.3 µg/kg	J DL
			2-Methylnaphthalene	9.72 µg/kg	J DL
PWS-27_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC, LC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00616 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.0581 µg/L	UJ BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
PWS-28_8-11	Sediment	8270D	Anthracene	10.6 µg/kg	J DL
			Dibenz(a,h)anthracene	10.3 µg/kg	J DL
			Fluorene	6.35 µg/kg	J DL
			1-Methylnaphthalene	6.14 µg/kg	J DL
			2-Methylnaphthalene	11.0 µg/kg	J DL

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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-28_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.0581 µg/L	UJ BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC
PWS-29_8-11	Sediment	8270D	Benzo(b)fluoranthene	46.1 µg/kg	J CS
			Benzo(k)fluoranthene	15.8 µg/kg	J DL, CS
			Indeno(1,2,3-cd)pyrene	10.3 µg/kg	J DL
			2-Methylnaphthalene	8.89 µg/kg	J DL
PWS-29_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0562 µg/L	J BC, HL
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.0344 µg/L	J BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC
			Fluoranthene	3.40 µg/L	J BC
			C1- Fluoranthrenes/Pyrenes	0.365 µg/L	J NQ
			C1- Fluorenes	12.8 µg/L	J NQ
			C2- Fluorenes	1.64 µg/L	J NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC
			C2-Naphthalenes	217 µg/L	J NQ
			C3-Naphthalenes	63.0 µg/L	J NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	4.77 µg/L	J NQ
			C2-Phenanthrenes/Anthracenes	1.08 µg/L	J NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	1.49 µg/L	J BC

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Sample ID	Matrix	Method	Analyte	Concentration	Qualifier and Reason Code
PWS-30_8-11	Porewater	D7363-07	Benzo(a)Anthracene	0.0107 µg/L	UJ BC
			Benzo(b)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(k)fluoranthene	0.0400 µg/L	UJ BC
			Benzo(g,h,i)perylene	0.0400 µg/L	UJ BC, LC
			Benzo(a)pyrene	0.0400 µg/L	UJ BC
			Benzo(e)pyrene	0.0400 µg/L	UJ BC
			Chrysene	0.00400 µg/L	UJ BC
			C1-Chrysenes/Benzo(a)anthracenes	0.00645 µg/L	UJ NQ
			C2-Chrysenes/Benzo(a)anthracenes	0.0125 µg/L	UJ NQ
			C3-Chrysenes/Benzo(a)anthracenes	0.00183 µg/L	UJ NQ
			C4-Chrysenes/Benzo(a)anthracenes	0.0255 µg/L	UJ NQ
			Dibenz(a,h)anthracene	0.0400 µg/L	UJ BC, LC
			Fluoranthene	0.0581 µg/L	UJ BC
			C1- Fluoranthrenes/Pyrenes	0.114 µg/L	UJ NQ
			C1- Fluorenes	0.274 µg/L	UJ NQ
			C2- Fluorenes	0.339 µg/L	UJ NQ
			C3- Fluorenes	0.0603 µg/L	UJ NQ
			Indeno(1,2,3-cd)pyrene	0.0400 µg/L	UJ BC, LC
			C2-Naphthalenes	0.778 µg/L	UJ NQ
			C3-Naphthalenes	0.00329 µg/L	UJ NQ
			C4-Naphthalenes	0.00459 µg/L	UJ NQ
			Perylene	0.0400 µg/L	UJ BC
			C1-Phenanthrenes/Anthracenes	0.263 µg/L	UJ NQ
			C2-Phenanthrenes/Anthracenes	0.00371 µg/L	UJ NQ
			C3-Phenanthrenes/Anthracenes	0.00511 µg/L	UJ NQ
			C4-Phenanthrenes/Anthracenes	0.0173 µg/L	UJ NQ
			Pyrene	0.0493 µg/L	UJ BC

Notes:
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
mg/kg = milligrams per kilogram

Qualifier Definitions:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N = The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.
NJ = The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Qualification Reason Codes:
BC = The initial calibration curve did not meet method-specified criteria.
CS = Poor chromatographic separation.
DL = The reported concentration is between the method detection limit and the limit of quantification.
FD = Fiesl duplicate imprecision.
HD = Laboratory duplicate imprecision.
HL = High laboratory control sample recovery. Analytical result may be biased high.
HM = High matrix spike recovery. Analytical result may be biased high.
LC = Low calibration verification standard recovery. Analytical result may be biased low.
MB = The same analyte was detected in the field sample and the laboratory blank and the concentration detected in the sample is less than five times the concentration detected in the blank.
NQ = There are no calibration or verification standards assoicated with this analyte.
SB = There is poor spectral match between the sample chromatogram and the standard chromatogram.

DATA QUALITY REVIEW

Port of St. Helens

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January 28, 2013

Project No. 961M112202.07.5

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Table 3: Qualifiers Added During Data Quality Review

ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
AMEC	AMEC Environment & Infrastructure, Inc.
Apex	Apex Laboratories, LLC
EPA	United States Environmental Protection Agency
ID	identification
LCS	laboratory control sample
MDL	method detection limit
MS	matrix spike
PAH	polycyclic aromatic hydrocarbon
QC	quality control
RL	reporting limit
RPD	relative percent difference

DATA QUALITY REVIEW
Port of St. Helens

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) collected one sediment sample from the Port of St. Helens on October 9, 2012. The sample was submitted to Apex Laboratories, LLC (Apex) in Tigard, Oregon the same day that it was collected. On January 14, 2013 AMEC requested polycyclic aromatic hydrocarbon (PAH) analysis of the sample. Apex assigned the sample to sample delivery group A12J241 and analyzed it for PAHs and PAH homologs by modified United States Environmental Protection Agency (EPA) Method 8270D.

The sample location and Apex sample identification (ID) is presented in Table 1.

Table 1: Field Samples Submitted to Apex

Field Sample ID	Apex ID
PWS-13_8-11 (Jar B)	A12J241-05RE1
PWS-13_8-11 (Jar D)	A12J241-05RE2

2.0 DATA QUALITY REVIEW METHODOLOGY

Quality review of these data followed the National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008). The EPA guideline was written specifically for the Contract Laboratory Program, and has been modified for the purposes of this data quality review where it differs from method-specific quality control (QC) requirements. This data quality review consisted of assessment of summary reports, and does not include review or validation of the raw analytical data.

It is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but reported values may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCSs) are aliquots of analyte-free water or clean solid matrix that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked water or solid matrix is then processed through the same extraction, concentration, cleanup, and/or analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 MATRIX SPIKE RECOVERIES

Matrix spikes (MSs) are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.4 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free water or clean solid matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA QUALITY REVIEW

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 POLYCYCLIC AROMATIC HYDROCARBONS AND PAH HOMOLOGS BY EPA METHOD 8270D

PAH and PAH homolog data from this event may be considered usable with the limitations and exceptions described in Sections 5.1 through 5.7.

5.1 HOLDING TIMES

Samples PWS-13_8-11 was collected on October 9, 2012, submitted to the laboratory on the same day. The sample was initially extracted within the method-specified 14-day holding time and analyzed within the maximum recommended holding time of 40 days from extraction. AMEC did not request re-extraction and reanalysis until January 14, 2013, 97 days after collection. The only remaining sample aliquots had been held at room temperature for up to two months. Apex extracted sample aliquots from the two remaining jars of sample and reported the results as reanalysis 1 (RE1) and reanalysis 2 (RE2). All target analytes were detected in these samples and AMEC J qualified all of the results because of the missed extraction hold time. (J-HT)

5.2 LABORATORY BLANK

Target analytes were not detected in the laboratory blank associated with these samples.

5.3 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's limits.

5.4 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits, with the following exception:

- Recovery of the surrogate compound benzo(a)pyrene-d_{12} was greater than the laboratory-specified 40% to 120% at 126% in sample PWS-13_8-11 RE1. Up to one surrogate from SVOC analyses can be outside of QC limits without adversely affecting data usability and AMEC did not qualify any data based on this QC exceedance.

5.5 LABORATORY DUPLICATES

Apex analyzed sediment sample PWS-13_8-11 RE1 in duplicate. Relative percent differences (RPDs) between the primary and duplicate detected results were within the laboratory-specified maximum of 30% with the following exceptions:

- RPDs between primary and laboratory duplicate results were high for acenaphthene (33%), acenaphthylene (40%), benzo(b)fluoranthene (37%), benzo(k)fluoranthene (50%), chrysene (58%), C1-fluoranthenes/pyrenes (34%), fluorene (42%), 1-methylnaphthalene (50%), 2-methylnaphthalene (64%), naphthalene (50%), and C4-phenanthrenes/anthracenes (41%). AMEC J qualified these results in sample PWS-13_8-11 because of analytical imprecision. (J-HD)

AMEC compared the results from the original analysis of sample PWS-13_8-11 against the results from both PWS-13_8-11 RE1 and PWS-13_8-11 RE2. AMEC also compared the results from samples PWS-13_8-11 RE1 and PWS-13_8-11 RE2 against each other. The comparison of the three analyses is presented in Table 2, but AMEC is limiting the following discussion and qualification based on the duplicate analyses to a comparison of the results from samples PWS-13_8-11 RE1 and PWS-13_8-11 RE2.

- RPDs between PWS-13_8-11 RE1 and PWS-13_8-11 RE2 results were high for acenaphthene (60%), anthracene (66%), benzo(a)anthracene (70%), chrysene (86%), fluoranthene (84%), C1-fluoranthenes/pyrenes (55%), fluorene (66%), 1-methylnaphthalene (62%), 2-methylnaphthalene (75%), naphthalene (86%),

phenanthrene (59%), and pyrene (73%). AMEC J qualified these results from samples PWS-13_8-11 RE1 and PWS-13_8-11 RE2 because of analytical imprecision. (J-HD)

5.6 MATRIX SPIKES

Apex performed a MS on sample PWS-13_8-11 RE2. Recoveries were within the laboratory-specified limits with the following exceptions:

- Benzo(a)anthracene (121%), fluoranthene (151%), naphthalene (143%), phenanthrene (160%), and pyrene (162%) recoveries were high in the MS performed on sample PWS-13_8-11 RE2. The background analyte concentrations in the unspiked native sample ranged between approximately 8 and 28 times the spike concentrations. It is not possible to evaluate data usability for these analytes based on MS recoveries.

5.7 DATA REPORTING AND ANALYTICAL PROCEDURES

Apex reported benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(b+k)fluoranthene(s) results. AMEC prefers to report the individual benzo(b)fluoranthene and benzo(k)fluoranthene results, rather than the combined benzo(b+k)fluoranthene(s) result, because benzo(b)fluoranthene and benzo(k)fluoranthene have different screening levels. AMEC chose not to report any benzo(b+k)fluoranthene(s) results in the data tables since reporting benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(b+k)fluoranthene(s) would result in double reporting of the benzofluoranthenes results.

6.0 SUMMARY

AMEC reviewed a total of 70 data records during this data quality review and J qualified all data records as estimated values due to missed analytical hold times and/or laboratory duplicate imprecision. No data were rejected and 100% of the data should be considered fully usable with the addition of the qualifiers summarized in Table 3.

REFERENCES

EPA, 2008. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, USEPA-540-R-08-01.

EPA, 2007c. Method 8270D, Semivolatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), Revision 4, February 2007.

LIMITATIONS

This report was prepared exclusively for Port of St. Helens by AMEC Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data quality review is intended to be used by Port of St. Helens for the Port of St. Helens Site only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

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Table 2
Comparison of the Results from Samples PWS-13_8-11, PWS-13_8-11 RE1, and PWS-13_8-11 RE2
Port of St. Helens

Analyte	Reporting Limits (µg/kg)			Detected Concentrations (µg/kg)		
	Primary Analysis	Reanalysis 1 (RE1)	Reanalysis 2 (RE2)	Primary Analysis	RE1	RE2
Naphthalene	16.0	32.4	32.1	276	766	305
1-Methylnaphthalene	16.0	32.4	32.1	50.8	111	58.5
2-Methylnaphthalene	16.0	32.4	32.1	103	302	137
C2-Naphthalenes	79.8	162	161	1,660	2,190	1,500
C3-Naphthalenes	79.8	162	161	5,330	5,590	4,140
C4-Naphthalenes	79.8	162	161	3,790	3,680	2,640
Acenaphthene	79.8	32.4	161	247	347	187
Acenaphthylene	16.0	32.4	32.1	29.7	53.7	34.1
Fluorene	16.0	32.4	32.1	208	334	169
C1-Fluorenes	79.8	162	32.1	674	638	396
C2-Fluorenes	79.8	162	161	1,410	1,070	726
C3-Fluorenes	79.8	162	161	1,740	1,420	951
Phenanthrene	16.0	32.4	161	1,240	1,770	965
Anthracene	16.0	32.4	32.1	215	317	159
C1-Phenanthrenes/Anthracenes	79.8	162	32.1	3,790	4,270	2,660
C2-Phenanthrenes/Anthracenes	79.8	162	161	5,680	5,500	3,590
C3-Phenanthrenes/Anthracenes	79.8	162	161	4,600	5,260	3,700
C4-Phenanthrenes/Anthracenes	160	324	161	4,370	2,930	2,180
Fluoranthene	16.0	32.4	321	977	1,630	662
Pyrene	16.0	32.4	32.1	1,010	1,600	748
C1-Fluoranthrenes/Pyrenes	79.8	162	161	1,960	2,340	1,330
Benzo(a)anthracene	16.0	32.4	32.1	496	599	290
Chrysene	16.0	32.4	32.1	885	1,120	449
C1-Chrysenes/Benzo(a)anthracenes	79.8	162	32.1	1,500	1,770	1,220
C2-Chrysenes/Benzo(a)anthracenes	79.8	162	161	1,840	2,060	1,510
C3-Chrysenes/Benzo(a)anthracenes	79.8	162	161	1,410	1,660	1,060
C4-Chrysenes/Benzo(a)anthracenes	160	324	321	557	547	537
Benzo(b)fluoranthene	16.0	32.4	32.1	271	429	302
Benzo(k)fluoranthene	16.0	32.4	32.1	107	138	90.6
Benzo(e)pyrene	16.0	32.4	32.1	241	312	252
Benzo(a)pyrene	16.0	32.4	32.1	280	323	258
Perylene	16.0	32.4	32.1	96.5	123	88.0
Dibenz(a,h)anthracene	16.0	32.4	32.1	44.0	43.2	39.2
Indeno(1,2,3-cd)pyrene	16.0	32.4	32.1	70.1	127	109
Benzo(g,h,i)perylene	16.0	32.4	32.1	85.6	160	135

Table 2
Comparison of the Results from Samples PWS-13_8-11, PWS-13_8-11 RE1, and PWS-13_8-11 RE2
Port of St. Helens

Analyte	Relative Percent Differences			Notes		
	Primary to RE1	Primary to RE2	RE1 to RE2	Primary to RE1	Primary to RE2	RE1 to RE2
Naphthalene	94%	10%	86%	J-HD		J-HD
1-Methylnaphthalene	74%	14%	62%	J-HD		J-HD
2-Methylnaphthalene	98%	28%	75%	J-HD		J-HD
C2-Naphthalenes	28%	10%	37%			
C3-Naphthalenes	4.8%	25%	30%			
C4-Naphthalenes	2.9%	36%	33%			
Acenaphthene	34%	28%	60%			J-HD
Acenaphthylene	58%	14%	45%	± RL		
Fluorene	46%	21%	66%			J-HD
C1-Fluorenes	5.5%	52%	47%		J-HD	
C2-Fluorenes	27%	64%	38%		J-HD	
C3-Fluorenes	20%	59%	40%		J-HD	
Phenanthrene	35%	25%	59%			J-HD
Anthracene	38%	30%	66%			J-HD
C1-Phenanthrenes/Anthracenes	12%	35%	46%			
C2-Phenanthrenes/Anthracenes	3.2%	45%	42%			
C3-Phenanthrenes/Anthracenes	13%	22%	35%			
C4-Phenanthrenes/Anthracenes	39%	67%	29%		J-HD	
Fluoranthene	50%	38%	84%	J-HD		J-HD
Pyrene	45%	30%	73%			J-HD
C1-Fluoranthrenes/Pyrenes	18%	38%	55%			J-HD
Benzo(a)anthracene	19%	52%	70%		J-HD	J-HD
Chrysene	23%	65%	86%		J-HD	J-HD
C1-Chrysenes/Benzo(a)anthracenes	17%	21%	37%			
C2-Chrysenes/Benzo(a)anthracenes	11%	20%	31%			
C3-Chrysenes/Benzo(a)anthracenes	16%	28%	44%			
C4-Chrysenes/Benzo(a)anthracenes	1.8%	3.7%	1.8%			
Benzo(b)fluoranthene	45%	11%	35%			
Benzo(k)fluoranthene	25%	17%	41%			
Benzo(e)pyrene	26%	4.5%	21%			
Benzo(a)pyrene	14%	8.2%	22%			
Perylene	24%	9.2%	33%			
Dibenz(a,h)anthracene	1.8%	12%	10%			
Indeno(1,2,3-cd)pyrene	58%	43%	15%	J-HD		
Benzo(g,h,i)perylene	61%	45%	17%	J-HD		

Notes:
µg/kg = micrograms per kilogram
± RL = The difference between analyte concentrations is less than the applicable reporting limit.

Qualifier Definition:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Reason Code:
HD = Laboratory duplicate imprecision

Table 3
Qualifiers Added During Data Quality Review
Port of St. Helens

Analyte	PWS-13_8-11 RE1		PWS-13_8-11 RE2	
	Concentration	Qualifier and Reason Code	PWS-13_8-11 RE2	Qualifier and Reason Code
Acenaphthene	347 µg/kg	J HT, HD	187 µg/kg	J HT, HD
Acenaphthylene	53.7 µg/kg	J HT, HD	34.1 µg/kg	J HT
Anthracene	317 µg/kg	J HT, HD	159 µg/kg	J HT, HD
Benzo(a)anthracene	599 µg/kg	J HT, HD	290 µg/kg	J HT, HD
Benzo(b)fluoranthene	429 µg/kg	J HT, HD	302 µg/kg	J HT
Benzo(k)fluoranthene	138 µg/kg	J HT, HD	90.6 µg/kg	J HT
Benzo(g,h,i)perylene	160 µg/kg	J HT	135 µg/kg	J HT
Benzo(a)pyrene	323 µg/kg	J HT	258 µg/kg	J HT
Benzo(e)pyrene	312 µg/kg	J HT	252 µg/kg	J HT
Chrysene	1,120 µg/kg	J HT, HD	449 µg/kg	J HT, HD
C1-Chrysenes/Benzo(a)anthracenes	1,770 µg/kg	J HT	1,220 µg/kg	J HT
C2-Chrysenes/Benzo(a)anthracenes	2,060 µg/kg	J HT	1,510 µg/kg	J HT
C3-Chrysenes/Benzo(a)anthracenes	1,660 µg/kg	J HT	1,060 µg/kg	J HT
C4-Chrysenes/Benzo(a)anthracenes	547 µg/kg	J HT	537 µg/kg	J HT
Dibenz(a,h)anthracene	43.2 µg/kg	J HT	39.2 µg/kg	J HT
Fluoranthene	1,630 µg/kg	J HT, HD	662 µg/kg	J HT, HD
C1-Fluoranthrenes/Pyrenes	2,340 µg/kg	J HT, HD	1,330 µg/kg	J HT, HD
Fluorene	334 µg/kg	J HT, HD	169 µg/kg	J HT, HD
C1-Fluorenes	638 µg/kg	J HT	396 µg/kg	J HT
C2-Fluorenes	1,070 µg/kg	J HT	726 µg/kg	J HT
C3-Fluorenes	1,420 µg/kg	J HT	951 µg/kg	J HT
Indeno(1,2,3-cd)pyrene	127 µg/kg	J HT	109 µg/kg	J HT
1-Methylnaphthalene	111 µg/kg	J HT, HD	58.5 µg/kg	J HT, HD
2-Methylnaphthalene	302 µg/kg	J HT, HD	137 µg/kg	J HT, HD
Naphthalene	766 µg/kg	J HT, HD	305 µg/kg	J HT, HD
C2-Naphthalenes	2,190 µg/kg	J HT	1,500 µg/kg	J HT
C3-Naphthalenes	5,590 µg/kg	J HT	4,140 µg/kg	J HT
C4-Naphthalenes	3,680 µg/kg	J HT	2,640 µg/kg	J HT
Perylene	123 µg/kg	J HT	88.0 µg/kg	J HT
Phenanthrene	1,770 µg/kg	J HT, HD	965 µg/kg	J HT, HD
C1-Phenanthrenes/Anthracenes	4,270 µg/kg	J HT	2,660 µg/kg	J HT
C2-Phenanthrenes/Anthracenes	5,500 µg/kg	J HT	3,590 µg/kg	J HT
C3-Phenanthrenes/Anthracenes	5,260 µg/kg	J HT	3,700 µg/kg	J HT
C4-Phenanthrenes/Anthracenes	2,930 µg/kg	J HT, HD	2,180 µg/kg	J HT
Pyrene	1,600 µg/kg	J HT, HD	748 µg/kg	J HT, HD

Note:
µg/kg = micrograms per kilogram

Qualifier Definition:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Reason Codes:
HD = Laboratory duplicate imprecision.
HT = Analytical hold time was exceeded.

DATA QUALITY REVIEW

Port of St. Helens

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November 20, 2013

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Table 2: Field Duplicate Detections

Table 3: Qualifiers Added During Data Quality Review

ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
AMEC	AMEC Environment & Infrastructure, Inc.
Apex	Apex Laboratories, LLC
EPA	United States Environmental Protection Agency
ID	identification
LCS	laboratory control sample
mg/kg	milligrams per kilogram
MS	matrix spike
PAH	polycyclic aromatic hydrocarbon
QC	quality control
RL	reporting limit
RPD	relative percent difference
SIM	selective ion monitoring

DATA QUALITY REVIEW
Port of St. Helens

1.0 INTRODUCTION

AMEC Environment & Infrastructure, Inc. (AMEC) collected 28 sediment samples, including one field duplicate and two samples that were put on hold, and one aqueous equipment blank from the Port of St. Helens between October 14 and 17, 2013. The samples were submitted to Apex Laboratories, LLC (Apex) in Tigard, Oregon on October 22, 2013. Apex assigned the samples to sample delivery group A3J0564 and analyzed them for polycyclic aromatic hydrocarbons (PAHs) by United States Environmental Protection Agency (EPA) Method 8270D selective ion monitoring (SIM) and diesel and oil hydrocarbons by Northwest Method NWTPH-Dx.

Sample locations, Apex sample identifications (IDs), sample matrix, and collection dates are presented in Table 1.

2.0 DATA QUALITY REVIEW METHODOLOGY

Quality review of these data followed the National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008). The EPA guideline was written specifically for the Contract Laboratory Program, and has been modified for the purposes of this data quality review where it differs from method-specific quality control (QC) requirements. This data quality review consisted of assessment of summary reports, and does not include review or validation of the raw analytical data.

It is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data, but reported values may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCSs) are aliquots of analyte-free water or clean solid matrix that are spiked with the analytes of interest for an analytical method, or a representative subset of those

analytes. The spiked water or solid matrix is then processed through the same extraction, concentration, cleanup, and/or analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix.

3.2 MATRIX SPIKE RECOVERIES

Matrix spikes (MSs) are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch.

MS recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.3 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are similar to target analytes in chemical composition and behavior in the analytical process.

3.4 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free water or clean solid matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Equipment blanks are prepared by passing analyte-free water through or over sample collection equipment and collecting the water in sample containers. Equipment blanks are analyzed for the analytical suite required for the project. Equipment blanks are used to monitor for possible sample contamination during the sample collection process and serve as a check on the effectiveness of field decontamination procedures.

Laboratory blanks are processed by the laboratory using exactly the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA QUALITY REVIEW

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 REASON CODES APPLIED DURING DATA QUALITY REVIEW

AMEC applied the following reason codes to qualified results during this data quality review:

HD Laboratory duplicate imprecision.

SB The sample's chromatogram does not match the standard chromatogram.

6.0 POLYCYCLIC AROMATIC HYDROCARBONS BY EPA METHOD 8270D SIM

PAH data from this event may be considered usable with the limitations and exceptions described in Sections 6.1 through 6.8.

6.1 HOLDING TIMES

All samples were extracted within the method-specified maximum holding time of 14 days from collection and all sample extracts were analyzed within the method-specified maximum holding time of 40 days from extraction.

6.2 LABORATORY BLANK

Target analytes were not detected in the laboratory blank associated with these samples.

6.3 EQUIPMENT BLANK

Target analytes were not detected in the equipment blank associated with these samples, with the following exceptions:

- Fluoranthene (0.113 micrograms per liter [µg/L]), phenanthrene (0.185 µg/L), and pyrene (0.0616 µg/L) were detected in the equipment blank. The detections in the blank were orders of magnitude lower than the detections in the field samples and in AMEC's professional opinion, data usability is not adversely affected.

6.4 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's limits.

6.5 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits.

6.6 LABORATORY DUPLICATES

Apex analyzed sediment samples DAI-PWS-01,8-11in and DAI-SB-12-14.5-15.5 in duplicate. Relative percent differences (RPDs) between the primary and duplicate detected results were less than the laboratory-specified maximum of 30% with the following exceptions:

- RPDs between primary and laboratory duplicate results were high for acenaphthene (41%), acenaphthylene (37%), benzo(a)anthracene (32%), benzo(a)pyrene (38%), benzo(b+k)fluoranthene(s) (36%), chrysene (39%), fluoranthene (39%), fluorene (32%), indeno(1,2,3-cd)pyrene (41%), naphthalene (37%), phenanthrene (34%), and pyrene (38%). AMEC J qualified these results in sample DAI-PWS-01-8-11in because of potential analytical imprecision. (J-HD)

6.7 MATRIX SPIKES

Apex performed a MS on sample DAI-SB-05-22-23. Recoveries were within the laboratory-specified limits.

6.8 DATA REPORTING AND ANALYTICAL PROCEDURES

Apex was unable to resolve the peaks for benzo(b)fluoranthene and benzo(k)fluoranthene in samples DAI-PWS-01-8-11in, DAI-PWS-02-8-11in, DAI-SB-02-2-3, DAI-SB-03-7-8, DAI-SB-04-4-5, DAI-SB-05-15-15.5, DAI-SB-10-13.5-14, DAI-SB-12-9-10, DAI-SB-12-14.5-15.5, DAI-SB-13-13-14, DAI-SB-14-13-14, DAI-SB-15-10-11, DAI-SB-15-10-11-DUP, DAI-SB-16-9-10, DAI-SB-17-11-12, DAI-SB-18-13-14, DAI-SB-19-13-14, and DAI-SB-20-8-8.5. Instead of reporting the individual compounds in these samples, Apex reported benzo(b+k)fluoranthene(s).

7.0 DIESEL AND OIL BY NORTHWEST METHOD NWTPH-DX

Diesel and oil results from these samples may be considered usable with the limitations and exceptions summarized in Sections 7.1 through 7.6

7.1 HOLDING TIMES

All samples were extracted within the method-specified maximum holding time of 14 days from collection and all sample extracts were analyzed within the method-specified maximum holding time of 40 days from extraction.

7.2 LABORATORY BLANK

Target analytes were not detected in the laboratory blank associated with these samples.

7.3 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory's limits.

7.4 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within the method-specified 50% to 150% limits, with the following exception:

- Apex was unable to recover the surrogate compound o-terphenyl from sample DAI-SB-21-8.5-9.5. The sample was analyzed at a 1:25 dilution, due to high target analyte concentrations, that reduced the surrogate concentration below the analytical detection limit. It is not possible to evaluate data usability for this sample based on surrogate recovery.

7.5 LABORATORY DUPLICATES

Apex analyzed samples DAI-PWS-02-8-11in, DAI-SB-15-10-11-DUP, and DAI-SB-19-13-14 in duplicate. RPDs between the primary and duplicate detected results were less than the laboratory-specified maximum of 30% with the following exceptions:

- Diesel was detected at a concentration of 17.9 milligrams per kilogram (mg/kg) and oil was detected at a concentration of 41.0 mg/kg in the primary analysis of sample DAI-PWS-02-8-11in. It should be noted that both of these concentrations are less than the reporting limit (RL) and analytical results less than the RL were reported as being not detected. Diesel was not detected in the duplicate analysis at a concentration greater than the RL of 25.0 mg/kg and oil was detected at a concentration of 138 mg/kg. Data limitations are summarized below.
  - The difference between the diesel detection in the primary analysis and the RL is less than the RL, demonstrating acceptable analytical accuracy.
  - There was 109% RPD between the oil results from the primary and duplicate analysis and the difference between the concentrations is greater than the RL of 50.0 mg/kg. AMEC UJ qualified the nondetected oil result from sample DAI-PWS-02-8-11 because of potential analytical imprecision. (UJ-HD)
- Diesel was detected at a concentration of 472 mg/kg in the primary analysis of sample DAI-SB-15-10-11-DUP and at a concentration of 804 mg/kg in the duplicate analysis. The RPD between the detected results was high at 52%. AMEC J qualified the detected oil result from sample DAI-SB-15-10-11-DUP and its field duplicate DAI-SB-15-10-11 because of potential analytical imprecision. (J-HD)
- Diesel was detected at a concentration of 1,840 mg/kg and oil was detected at a concentration of 249 mg/kg in the primary analysis of sample DAI-SB-19-13-14. Diesel and oil were detected at concentrations of 709 mg/kg and 109 mg/kg, respectively, in the duplicate analysis. The RPDs between the primary and duplicate results were greater than the laboratory-specified maximum of 30% at 89% and 78%, respectively. AMEC J qualified the detected diesel and oil results from sample DAI-SB-19-13-14 because of potential analytical imprecision. (J-HD)

7.6 DATA REPORTING AND ANALYTICAL PROCEDURES

According to Apex's notes, the chromatograms for the diesel and oil detections in samples DAI-SB-03-7-8, DAI-SB-10-13.5-14, DAI-SB-16-9-10, DAI-SB-17-11-12, and DAI-SB-19-13-14;

and the diesel detections in samples DAI-SB-12-14.5-15.5, DAI-SB-13-13-14, DAI-SB15-10-11, DAI-SB15-10-11-DUP, and DAI-SB18-13-14 do not exhibit hydrocarbon-like patterns. AMEC N qualified these results as being presumptively identified. (N-SB)

8.0 FIELD DUPLICATE

AMEC collected a field duplicate with sample DAI-SB-15-10-11. RPDs between primary and field duplicate results were acceptable at less than 50%, demonstrating acceptable sampling and analytical precision. Field duplicate detections are presented in Table 2.

9.0 SUMMARY

AMEC reviewed a total of 432 data records during this data quality review and N qualified 11 data records (2.5%) as being presumptively identified because the sample chromatograms did not match the standard chromatograms, J or UJ qualified 13 data records (3%) as estimated values due to potential analytical imprecision, and NJ qualified 4 data records (0.93%) as being presumptively identified and having estimated values because the sample chromatograms did not match the standard chromatograms and potential analytical imprecision. No data were rejected and 100% of the data should be considered fully usable with the addition of the qualifiers summarized in Table 3.

REFERENCES

EPA, 2008. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, USEPA-540-R-08-01.

EPA, 2007. Method 8270D, Semivolatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS), Revision 4, February 2007.

NWTPH-Dx. Semi-Volatile Petroleum Products Method for Soil and Water.

LIMITATIONS

This report was prepared exclusively for Port of St. Helens by AMEC Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data quality review is intended to be used by Port of St. Helens for the Port of St. Helens Site only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

TABLES

Table 1
Field Samples Submitted to Apex Laboratories
Port of St. Helens

Sample Location	Apex Sample ID	Matrix	Collection Date	Notes
DAI-SB-01-8-9	A3J0564-01	Sediment	10/14/2013	Not analyzed
DAI-SB-02-2-3	A3J0564-02	Sediment	10/14/2013	
DAI-SB-03-7-8	A3J0564-03	Sediment	10/14/2013	
DAI-PWS-01-8-11	A3J0564-04	Sediment	10/14/2013	
DAI-PWS-02-8-11	A3J0564-05	Sediment	10/14/2013	
DAI-SB-04-4-5	A3J0564-06	Sediment	10/15/2013	
DAI-SB-20-8-8.5	A3J0564-07	Sediment	10/15/2013	
DAI-SB-21-8.5-9.5	A3J0564-08	Sediment	10/15/2013	
Rinsate Blank	A3J0564-09	Water	10/15/2013	
DAI-SB-05-15-15.5	A3J0564-10	Sediment	10/16/2013	
DAI-PWS-03-8-11	A3J0564-11	Sediment	10/16/2013	Not analyzed
DAI-SB-06-12-13	A3J0564-12	Sediment	10/16/2013	
DAI-SB-07-9-10	A3J0564-13	Sediment	10/16/2013	
DAI-SB-08-7-8	A3J0564-14	Sediment	10/16/2013	
DAI-SB-09-7.5-8.0	A3J0564-15	Sediment	10/16/2013	
DAI-SB-10-13.5-14	A3J0564-16	Sediment	10/16/2013	
DAI-SB-05-22-23	A3J0564-17	Sediment	10/16/2013	
DAI-SB-12-14.5-15.5	A3J0564-18	Sediment	10/17/2013	
DAI-SB-13-13-14	A3J0564-19	Sediment	10/17/2013	
DAI-SB-14-13-14	A3J0564-20	Sediment	10/17/2013	
DAI-SB-12-9-10	A3J0564-21	Sediment	10/17/2013	
DAI-SB-15-10-11	A3J0564-22	Sediment	10/17/2013	
DAI-SB-15-10-11-DUP	A3J0564-23	Sediment	10/17/2013	Field duplicate
DAI-SB-16-9-10	A3J0564-24	Sediment	10/17/2013	
DAI-SB-17-11-12	A3J0564-25	Sediment	10/17/2013	
DAI-SB-18-13-14	A3J0564-26	Sediment	10/17/2013	
DAI-SB-18-9-10	A3J0564-27	Sediment	10/17/2013	
DAI-SB-19-13-14	A3J0564-28	Sediment	10/17/2013	

Note:
ID = identification

Table 2
Field Duplicate Detections
Port of St. Helens

Analyte	LOQ	Primary Concentration	Duplicate Concentration	RPD	Notes
Samples DAI-SB-15-10-11 and DAI-SB-15-10-11 Dup					
Diesel	124 mg/kg	492	472	4.1%	
% Solids	1.00 %	62.8	60.0	4.6%	
Acenaphthene	1,540 µg/kg	78,700	113,000	36%	
Acenaphthylene	15.4 µg/kg	736	1,100	40%	
Anthracene	1,540 µg/kg	23,900	36,300	41%	
Benzo(a)anthracene	1,540 µg/kg	11,600	16,600	35%	
Benzo(a)pyrene	15.4 µg/kg	3,230	4,840	40%	
Benzo(b+k)fluoranthene(s)	30.9 µg/kg	6,800	10,100	39%	
Benzo(g,h,i)perylene	15.4 µg/kg	656	944	36%	
Chrysene	1,540 µg/kg	10,900	15,400	34%	
Dibenz(a,h)anthracene	15.4 µg/kg	263	375	35%	
Fluoranthene	1,540 µg/kg	76,000	107,000	34%	
Fluorene	1,540 µg/kg	69,900	101,000	36%	
Indeno(1,2,3-cd)pyrene	15.4 µg/kg	908	1,300	36%	
Naphthalene	1,540 µg/kg	140,000	200,000	35%	
Phenanthrene	1,540 µg/kg	193,000	274,000	35%	
Pyrene	1,540 mg/kg	48,000	67,500	34%	

Notes:
µg/kg = micrograms per kilogram
% = percent
LOQ = limit of quantification
mg/kg = milligrams per kilogram
RPD = relative percent difference

Table 3
Qualifiers Added During Data Quality Review
Port of St. Helens

Sample ID	Method	Analyte	Concentration	Qualifier and Reason Code
DAI-PWS-01-8-11	8270D-SIM	Acenaphthene	2,550 µg/kg	J HD
		Acenaphthylene	75.8 µg/kg	J HD
		Benzo(a)Anthracene	354 µg/kg	J HD
		Benzo(a)Pyrene	110 µg/kg	J HD
		Benzo(b+k)fluoranthene(s)	287 µg/kg	J HD
		Chrysene	475 µg/kg	J HD
		Fluoranthene	3,540 µg/kg	J HD
		Fluorene	2,840 µg/kg	J HD
		Indeno(1,2,3-cd)Pyrene	49.1 µg/kg	J HD
		Naphthalene	5,180 µg/kg	J HD
		Phenanthrene	7,790 µg/kg	J HD
		Pyrene	2,340 µg/kg	J HD
DAI-PWS-02-8-11	NWTPH-Dx	Oil	52.8 mg/kg	UJ HD
DAI-SB-03-7-8	NWTPH-Dx	Diesel	553 mg/kg	N SB
		Oil	78.2 mg/kg	N SB
DAI-SB-10-13.5-14	NWTPH-Dx	Diesel	2,630 mg/kg	N SB
		Oil	358 mg/kg	N SB
DAI-SB-12-14.5-15.5	NWTPH-Dx	Diesel	326 mg/kg	N SB
DAI-SB-13-13-14	NWTPH-Dx	Diesel	353 mg/kg	N SB
DAI-SB-15-10-11	NWTPH-Dx	Diesel	492 mg/kg	NJ SB, HD
DAI-SB-15-10-11-DUP	NWTPH-Dx	Diesel	472 mg/kg	NJ SB, HD
DAI-SB-16-9-10	NWTPH-Dx	Diesel	694 mg/kg	N SB
		Oil	97.9 mg/kg	N SB
DAI-SB-17-11-12	NWTPH-Dx	Diesel	1,550 mg/kg	N SB
		Oil	246 mg/kg	N SB
DAI-SB-18-13-14	NWTPH-Dx	Diesel	115 mg/kg	N SB
DAI-SB-19-13-14	NWTPH-Dx	Diesel	1,840 mg/kg	NJ SB, HD
		Oil	249 mg/kg	NJ SB, HD

Notes:
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ID = identification

Qualifier Definitions:
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N = The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.
NJ = The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.
UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Reason Codes:
HD = Laboratory duplicate results indicate analytical imprecision.
SB = The sample chromatogram does not match the standard chromatogram.

Data Quality Review
Phase 3 Offshore Data Gap Investigation
Port of St. Helens/Former Creosote Site
1550 Railroad Avenue, St. Helens, Oregon

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Cross Check of Cfree C4-Naphthalene Calculations in FSES Sample ID A170725

Comparison of Calculated Alkylated PAH Porewater Concentrations

Acronyms and Abbreviations

34 PAHs	18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives (aka Forensics Alky PAHs)
63 PAHs	63 Parent and alkyl substituted PAHs
ACS	American Chemical Society
alky	alkylated PAHs homologues
Apex Labs	Apex Laboratories, Inc.
ARI	Analytical Resources, Inc.
ASTM	American Society for Testing and Materials
Black Carbon	soot, chars, and other carbonaceous particles in sediment
bml	below mudline
BTEX	benzene, toluene, ethylbenzene, and total xylenes
Cfree	freely dissolved water concentrations
CVS	calibration verification standard
DEQ	Oregon Department of Environmental Quality
DQOs	data quality objectives
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
ES&T	Environmental Science and Technology
FCV	final chronic value
FSES	Food Safety and Environmental Stewardship program at Oregon State University
GC/MS	gas chromatography/mass spectrometry
ID	identification
IW	interstitial water
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LDPE	low density polyethylene
MDL	method detection limit
MIM	multiple-ion monitoring
mg/kg	milligrams per kilogram
MS	matrix spike
NIST	National Institute of Standards and Technology
OPAHs	oxygenated polycyclic aromatic hydrocarbons (22 analytes)
OSU	Oregon State University
PAHs	polycyclic aromatic hydrocarbons

PCP	pentachlorophenol
PDB	passive diffusive bags
PE	polyethylene
pg/µL	picrograms per microliters
PRCs	performance reference compounds
PSD	Passive Sampling Device
PWS	porewater sample
QA/QC	quality assurance/quality control
QC	quality control
RL	reporting limit
RPD	relative percent difference
SIM	selected ion monitoring
SM	Standard Methods
SOP	standard operating procedure
SPME	solid phase micro-extraction
SRM	Standard Reference Material
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TU	toxic unit
VOCs	volatile organic compounds
VPH	volatile petroleum hydrocarbons
Σ	Summation
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ΣIWTU	interstitial water toxic unit summation
'>'	greater than

1.0 INTRODUCTION

On September 5 and 6, 2017, Cascadia in conjunction with personnel with the Food Safety and Environmental Stewardship (FSES) program at Oregon State University (OSU) implemented the Phase 3 offshore data gap investigation with assistance from Cascade Dive Co. of Vancouver, Washington. On September 5 and 6, 2017, Cascadia and FSES placed 15 *in-situ* passive samplers[1] (i.e., sediment probes containing low density polyethylene [LDPE] passive sampling media) to assess the freely dissolved concentrations of polycyclic aromatic hydrocarbons (PAHs) in sediment porewater. Surface water LDPE passive samplers were deployed at 8 of the 15 *in-situ* passive sampling locations and included triplicate water cages at Phase 3 sampling location PWS-10. Additionally, each Phase 3 sampling location included a separate *in-situ* passive diffusive bag (PDB) sampler[2] for assessing freely dissolved concentrations of total petroleum hydrocarbon (TPH).

During the deployment of each Phase 3 passive sampling device, the upper 12 inches of sediment was collected using clear Teflon® sampling tubes for visual examination, field screening, and chemical analysis. A homogenized sample of the upper 12 inches of sediment was placed in laboratory-prepared sampling containers and submitted to Apex Laboratories, LLC (Apex Labs) in Tigard, Oregon, where they were assigned to sample delivery groups A7I0159, A7I0162, A7I0849, and A7K00243. In addition to the project samples, Apex Labs purchased and analyzed standard reference material (SRM) SRM1491a, SRM2260a, SRM 1991 and Gulf of Mexico Crude Oil SRM 2779 under work orders A7I0570 and A7K0243. The sediment and SRM samples were analyzed for PAHs and PAH homologs (i.e., measurement of 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) by modified United States Environmental Protection Agency (EPA) Method 8270D. In addition, the sediment samples were analyzed for volatile organic compounds (VOCs) by EPA Method 5035A/8260C, total organic carbon (TOC) by modified Standard Methods (SM) 5310B and % Solids by EPA Method 8000C. Apex Labs subcontracted chemical analysis of the sediment samples for Carbon Black (% Soot) using ES&T publications by Accardi-Dey and Gshwend, 2003; and Gustafsson (et. al.), 1997 to Alpha Analytical, Inc. (Alpha) in Mansfield, Maine, and Washington Department of Ecology Method Volatile Petroleum Hydrocarbons (WA VPH) by EPA Method 5035 with photoionization detector (PID) to Analytical Resources, Inc. (ARI) in

[1] The term "passive sampler" is used in this report to refer to the sampling hardware (either sediment probes or surface water cages) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU Standard Operating Procedures (SOPs) to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These *in situ* passive samplers are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in sediment porewater or surface water.

[2] As requested by DEQ, the Phase 3 investigation of sediment porewater also included deployment of PDB samplers in separate adjacent sediment probes (passive samplers) to accumulate dissolved TPH in a controlled manner. Measurements of dissolved TPH concentrations in sediment porewater were extracted from ASTM Type 1 Deionizer water inside the PDBs. PDBs consist of low density polyethylene bags filled with relatively de-oxygenated distilled water. When placed in water or sediment containing water, dissolved phase organic compounds diffuse through the wall of the bag in response to the concentration gradient between the porewater in the sediment and the distilled water in the bag.

Tukwila, Washington. Also, Apex Labs subcontracted chemical analysis of a subset of the sediment samples for Washington Department of Ecology Method Extractable Organic Hydrocarbons (WA EPH) by EPA 3546 with flame ionization detector (FID) to ARI.

As described in the Phase 3 Work Plan, the passive samplers prepared and provided by FSES consisted of LDPE sheets impregnated with performance reference compounds (PRCs) housed inside sealed stainless-steel probes. The stainless-steel probes consisted of two separate slotted intervals, each containing LDPE sampling media. The slotted intervals were separated by blank sections of the stainless-steel probe so that the slotted interval/LDPE sampling media targeted separate and discrete sediment intervals. Each LDPE sediment probe was manually inserted approximately 32 inches into the sediment, with slotted sampling intervals and media targeting the intervals between 3 and 8 inches below mudline (bml) and 24 and 29 inches bml. Also, FSES prepared and provided stainless steel cages containing LDPE for surface water sampling approximately 12 inches (1 foot) above the mudline at 8 of the 15 Phase 3 sampling locations and included triplicate water cages at PWS-10. The PDBs prepared and provided by EON Products, Inc. were deployed inside polyvinyl chloride (PVC) probes manually inserted 12 inches into the sediment with a slotted sampling interval between 4 and 10 inches bml. The passive samplers were then left in the sediment and/or overlying water for approximately 21 days and allowed to approach equilibrium.

At the time of retrieval, the divers removed the passive samplers and passed them to FSES and Cascadia personnel on the sample vessel for sample handling and transport to the appropriate laboratory for chemical analysis of freely dissolved PAHs and TPH. Specifically, FSES personnel removed the passive LDPE sampling media from the protective housing, rinsed them with water from the Site to remove sediment or biofouling, as necessary and in accordance with Standard Operating Procedure (SOP) 108.1, before packaging for transport to the FSES laboratory at OSU. Upon retrieval of the PDBs, Cascadia field staff removed the Equilibrator™ from the PVC casing and immediately punctured the LDPE bag with a discharge straw to fill standard water sampling containers provided by Apex Labs.

At OSU, post-deployment cleaning of all LDPE samples occurred on October 12, 2017. Batches of LDPE samples were extracted as per SOP 406.02 between October 17 and 26, 2017, and the extracts stored at 4° Celsius (C) until analysis. Aliquots from each extract were injected on triple-quadrapole (PAHs, alkyl-PAHs) or single quadrapole (hopanes and cholestanes and OPAHs) gas chromatograph mass spectrometers.

Apex Labs analyzed an aliquot of the PDB water samples for benzene, toluene, ethylbenzene, total xylenes, and naphthalene (BTEX+N) by EPA 8260C using multiple-ion monitoring (MIM). Apex Labs subcontracted chemical analysis of the 15 PDB water samples for WA VPH to ARI.

Results of the bulk sediment chemical analytical testing conducted as part of the Phase 3 Data Gap Investigation are summarized in Table 1 (TOC, Black Carbon, 34 PAHs), Table 2 (VOCs), and Table 3 (VPH/EPH) of the progress report. Results of the sediment porewater and surface water chemical

analytical testing conducted as part of the Phase 3 Data Gap Investigation are summarized in Tables 4 and 5 (34 PAHs in sediment porewater and surface water, respectively), Table 7 (VPH, BTEX+N); and Tables 8 and 9 (OPAHs in sediment porewater and surface water, respectively). The remaining porewater and surface water chemical analytical data (e.g., 63 PAHs, hopanes/cholestanes, NIST SRM 2279) have been provided in Appendix D; however, they have not been summarized in the tables.

2.0 DATA QUALITY REVIEW METHODOLOGY

Quality review of these data followed the National Functional Guidelines for Superfund Organic Methods Data Review (EPA, 2008). The EPA guideline was written specifically for the Contract Laboratory Program and has been modified for the purposes of this data quality review where it differs from method-specific quality control (QC) requirements. This data quality review consisted of assessment of summary reports and does not include review or validation of the raw analytical data.

It is important to recognize that no analytical data are guaranteed to be correct, even if all QC audits are passed. Strict QC serves to increase confidence in data but reported values may potentially contain error.

3.0 EXPLANATION OF DATA QUALITY INDICATORS

Summary explanations of the specific data quality indicators reviewed during this data quality review are presented below.

3.1 HOLDING TIMES

The holding time is the maximum amount of time the sample can be stored before analytes start to degrade and are not representative of initial sampling concentrations. Holding times are defined by analytical methods.

3.2 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCS) are aliquots of analyte-free water or clean solid matrix that are spiked with the analytes of interest for an analytical method, or a representative subset of those analytes. The spiked water or solid matrix is then processed through the same extraction, concentration, cleanup, and/or analytical procedures as the samples they accompany. LCS recovery is an indication of a laboratory's ability to successfully perform an analytical method in an interference-free matrix. It is routinely performed in duplicate (LCSD) and a comparison of the spiked analyte recoveries in the LCS and LCSD will are evaluated to assess precision.

3.3 MATRIX SPIKE RECOVERIES

Matrix spikes (MS) are prepared by adding known amounts of the analytes of interest for an analytical method, or a representative subset of those analytes, to an aliquot of sample. The spiked sample is then processed through the same extraction, concentration, cleanup, and analytical procedures as the unspiked samples in an analytical batch. It is routinely performed in duplicate as the MSD.

MS and MSD recovery and precision are an indication of a laboratory's ability to successfully recover an analyte in the matrix of a specific sample or closely related sample matrices. It is important not to apply MS results for any specific sample to other samples without understanding how the sample matrices are related.

3.4 SURROGATE SPIKE RECOVERIES

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency in each individual sample. Surrogate compounds are compounds not normally found in environmental samples, but which are like target analytes in chemical composition and behavior in the analytical process.

3.5 BLANK CONCENTRATIONS

Blank samples are aliquots of analyte free water or clean solid matrix that are used as negative controls to verify that the sample collection, storage, preparation, and analysis system does not produce false positive results.

Laboratory blanks are processed by the laboratory using the same procedures as the field samples. Target analytes should not be found in laboratory blanks.

3.6 DUPLICATES

Precision is measured by how close values of duplicate analyses are to each other. These duplicate analyses are prepared from separate aliquots of the same sample and are analyzed at the same (or similar) time. Precision in the field ensures that samples taken are representative of field concentrations; this is demonstrated by field duplicates. Analytical precision is the ability of the laboratory to reproduce results that are similar to each other; this is measured through duplicate analysis of environmental and batch QC samples. Precision is estimated by the relative percent difference (RPD) between the original analysis and the duplicate analysis.

4.0 DEFINITIONS OF QUALIFIERS THAT MAY BE ADDED DURING DATA QUALITY REVIEW

U The analyte was analyzed for but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.

NJ The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 CHAIN OF CUSTODY AND SAMPLE RECEIPT CONDITION DOCUMENTATION

5.1 SAMPLE RECEIPT AT APEX LABS

Samples were received at Apex Labs in good condition and with proper chain of custody documentation. Apex only lists sample receipt temperature on the laboratory report when samples are received outside the EPA-recommended limit. Sample receipt temperatures were not listed on these reports.

5.2 SAMPLE RECEIPT AT ALPHA

Samples were received at Alpha in good condition and with proper chain of custody documentation.

5.3 SAMPLE RECEIPT AT ARI

Samples were received at ARI in good condition and with proper chain of custody documentation.

5.4 SAMPLE RECEIPT AT OSU FSES

Samples were received at OSU FSES in good condition and with proper chain of custody documentation.

6.0 34 PAHS (18 PARENT AND 16 GROUPS OF PROMINENT C1 TO C4 ALKY PAH DERIVATIVES) BY EPA METHOD 8270D/MOD

The Phase 3 sediment PAH and PAH homolog data may be considered usable with the limitations and exceptions described in Sections 6.1 through 6.8.

6.1 HOLDING TIMES

All sediment samples were extracted within the method-specified 14-day maximum holding time for sediment samples. All sample extracts were analyzed within the 40-day maximum holding time from extraction until analysis.

6.2 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries associated with the sediment analyses were within the laboratory's limits.

6.3 MATRIX SPIKES

Apex Labs performed MS analysis on sediment sample PWS-090517-14. Recoveries were within the laboratory-specified limits, with the following exceptions:

1. Naphthalene (124%) and 2-methylnaphthalene (148%) recoveries were high in the MS and Cascadia J qualified these analytes in sediment sample PWS 090517-14 because of potentially high analytical bias.
2. The background phenanthrene and fluoranthene concentrations in the unspiked native sample were higher than the spike concentrations and it's not possible to evaluate data usability based on MS recoveries for these analytes.
3. Pyrene (20%) and benzo(k)fluoranthene (46%) recoveries were low in the MS and Cascadia J qualified these analytes in sediment sample PWS 090517-14 because of potentially low analytical bias.

6.4 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits, with the following exceptions:

- The percent recover of benzo(a)pyrene-d12 in sample PWS-090517-9 was outside (i.e., slightly above) control limits. If a surrogate recovery is above criteria, a high extraction efficiency bias is assumed in the sample for the group of analytes represented by this surrogate. The high molecular weight PAHs represented by benzo(a)pyrene-d12 in surface sediment sample PWS-090517-9 may be biased high. Since the other four surrogate recoveries were within control limits, the reported data was not qualified.

6.5 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

6.6 LABORATORY DUPLICATES

Apex Labs analyzed sediment sample PWS-090517-3 in duplicate. Relative percent differences (RPDs) between duplicate results were less than the laboratory-specified maximum of 30%, with the following exceptions:

4. The RPDs between the primary and duplicate results were slightly high for naphthalene (32%) and acenaphthene (37%). Cascadia J qualified the detected naphthalene and acenaphthylene results from this sample because of non-homogenous sample matrix.
5. Due to matrix interference, analytes benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene were flagged as estimated (M-02). Subsequently, Cascadia J qualified these detected analyte results from this sample.

6.7 DATA REPORTING, ANALYTICAL PROCEDURES, AND SRM ANALYSES

Apex Labs J qualified analytes with concentrations between the method detection limit (MDL) and the reporting limit (RL). Cascadia agrees that these results are quantitatively uncertain and has maintained Apex Lab's J qualifiers.

Dibenzofuran part of Apex Lab's standard list of PAHs by EPA Method 8270D/Mod. However, the EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for dibenzofuran. Therefore, it has not been included in 34 PAH grouping used to assess risk to benthic invertebrates (EPA, 2003, 2012) nor the calculations of total PAHs.

In accordance with DEQ's September 1, 2017 comments to the work plan, Apex Labs purchased SRM 2779 Gulf of Mexico Crude Oil (i.e., crude oil collected near the Deepwater Horizon oil rig accident) and analyzed the oil sample on its GC/MS (without a clean-up/isolation step) for select PAHs (51 analytes) using its modified EPA Method 8270D. For a particular analyte, the performance on the reference material is deemed acceptable if the laboratory result is within 30% of the assigned value listed in the Certificate of Analysis for SRM 2779. The Apex Labs results were within 30% of the assigned value, except as noted below:

- Detected concentrations of C2-, C3-, and -4-naphthalenes were greater than 130% of the assigned value indicating a high bias. There may be issues with the choice of representative compounds used for quantification of these alkylated PAHs, as well as the interpretation of the chromatograms as to what peaks should and should not be included in the summation for the alkylated groups.
- The detected concentration of pyrene was less than 70% of the assigned value indicating a low bias.
- The detected concentration of benz(a)anthracene was greater than 130% of the assigned value indicating a high bias.

Apex Labs analyzed SRM 2779 in duplicate. RPDs between duplicate results were less than the laboratory-specified maximum of 30%, with the following notes:

6. cis-decalin, acenaphthalene, acenaphthylene, and dibenzofuran were flagged (R-02) because the reporting limit for these analytes had been raised to account for interferences from coeluting compounds present in the sample.
7. Pyrene, fluoranthene, benz(a)anthracene, and benzo(e)pyrene were flagged as estimated (J) because the analytes were not detected above the reported sample quantitation limit.
8. Reported concentration for chrysene is estimated (M-05) because its peak separation for structural for structural isomers is insufficient for accurate quantification.

In addition to SRM 2779, Apex Labs purchased SRM 1191, SRM 149, and SRM 2260, and analyzed theses oil samples on its GC/MS using its modified EPA Method 8270D. Detected concentrations of many parent and alkylated PAHs were outside the 30% criteria of the assigned value. Reportedly, SRMs 1491 and 2260a were in toluene which created some column loading issues. A comparison of Apex Labs concentrations to each SRM value is provided in its Amended Report A7K0243. A detailed analysis of the SRM Apex Labs data is beyond the scope of this data quality review. In general, such an exercise can help assess the comparability, repeatability, and trueness of the PAH data being produced by Apex Labs provided the exercise materials (SRMs) are similar in matrix, form, and analyte concentration to the Site samples. However, the creosote-related PAHs in the Site's sediment samples are highly weathered and are not similar to the SRMs in matrix, form, and analyte concentration. Therefore, Cascadia has not qualified the Phase 3 sediment data based the results of the SRM PAH analyses.

6.8 FIELD DUPLICATE

A field duplicate was collected for sediment sample PWS-090517-10 (labeled PWS-090517-DUP). The results exhibited acceptable analytical precision with less than 50% RPD between duplicate results with the following exception:

- RPDs between primary and field duplicate results were high for naphthalene and 2-methylnaphthalene. Cascadia J qualified the detected results for these analytes in sediment samples PWS-090517-10 and PWS-090517-DUP because of sampling or analytical imprecision.

7.0 TOTAL ORGANIC CARBON BY STANDARD METHOD 5310B

The Phase 3 sediment TOC data may be considered usable and details regarding specific method QC are described in Sections 7.1 through 7.5.

7.1 HOLDING TIMES

All samples were analyzed within the 28-day technical holding time.

7.2 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within the laboratory-established 85% to 115% limits for unqualified data.

7.3 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

7.4 LABORATORY DUPLICATES

Apex Labs performed duplicate analyses of samples PWS-090517-3 and PWS-090617-2. The results exhibited acceptable analytical precision with less than 20% RPD between duplicate results.

7.5 FIELD DUPLICATE

A field duplicate was collected for sediment sample PWS-090517-10 (labeled PWS-090517-DUP). The results exhibited acceptable analytical precision with less than 50% RPD between duplicate results.

8.0 CARBON BLACK (% SOOT)

As mentioned above, Apex Labs subcontracted analytical testing of bulk sediment samples for Carbon Black (aka Black Carbon or % Soot) to Alpha. The Phase 3 sediment Carbon Black (aka % Soot) data may be considered usable with the limitations and exceptions described in Sections 8.1 through 8.6.

8.1 HOLDING TIMES

All sediment samples were analyzed outside the recommended holding time (72 hours). Cascadia has J qualified the black carbon data on Table 1.

8.2 LABORATORY CONTROL SAMPLE RECOVERY

LCS recoveries were within the laboratory-established 75% to 125% limits for unqualified data.

8.3 MATRIX SPIKES

Alpha performed a MS analysis on a non-project sample. Recoveries were within the laboratory-specified limits for unqualified data.

8.4 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples for unqualified data.

8.5 LABORATORY DUPLICATES

Alpha performed duplicate analyses of project samples (i.e., Rep 1 and Rep 2). The results exhibited acceptable analytical precision and none of the data qualified.

8.6 FIELD DUPLICATE

A field duplicate was collected for sediment sample PWS-090517-10 (labeled PWS-090517-DUP). The results exhibited acceptable analytical precision with less than 50% RPD between duplicate results.

9.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

The Phase 3 bulk sediment and PDB water VOC data may be considered usable with the limitations and exceptions described in Sections 9.1 through 9.7.

9.1 HOLDING TIMES

All samples were analyzed within the technical holding time of 14 days from sample collection.

9.2 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory-specified 80% to 120% limits, with the following exceptions:

- The recovery of acetone (79%) was slightly below the +/- 20% criteria listed in EPA 8260C; however, this there is adequate sensitivity to ensure detection of this analyte in the project samples at the reporting level.
- Bromoform (125%), chloroethane (149%), trichlorofluoromethane (154%), and 2,2-dichloropropane (121%) recoveries were above the +/- 20% criteria listed in EPA 8260C. These analytes were not detected in the associated samples. Data usability is not adversely affected by the possibly high analytical bias.

9.3 MATRIX SPIKES

Apex Labs performed a MS on sediment sample PWS-090617-12. Recoveries were within the laboratory-specified limits.

9.4 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits:

9.5 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

9.6 LABORATORY DUPLICATES

Apex Labs performed a duplicate analysis of sediment sample PWS-090617-2 and water sample PDB-092617-2. Target analytes were not detected in the primary sample or laboratory duplicate. The lab duplicate PDB-092617-2 was analyzed outside of the method specified 12-hour tune window. Data usability is not adversely affected by this batch QC finding.

9.7 DATA REPORTING

Apex Labs J qualified the naphthalene detection in sediment sample PWS-090517-14 because the detected value was between the MDL and the RL. Cascadia agrees that this result is quantitatively uncertain and has maintained Apex Lab's J qualifier.

The volatiles GC/MS data for each PDB water sample analyzed by EPA 8260C underwent additional evaluation using multiple-ion monitoring (MIM). MIM techniques were used to search for low level aliphatic hydrocarbons in the range of C10-C12. Reportedly, the PDB water samples were free of interference and non-detect down to 2 micrograms per liter (µg/L) for aliphatic hydrocarbons within the C10-C12 range.

10.0 VPH AND EPH BY WASHINGTON DEPARTMENT OF ECOLOGY METHODS

The Phase 3 bulk sediment and PDB water VPH and EPH data may be considered usable with the limitations and exceptions described in Sections 10.1 through 10.5. As mentioned above, Apex Labs subcontracted analytical testing of bulk sediment samples for VPH/EPH to ARI. Bulk samples collected on September 6, 2017 (i.e., PWS-090617-1, -2, -12, -13, -15) were not analyzed for EPH because Apex Labs failed to list it on its ARI work order.

10.1 HOLDING TIMES

All VPH samples were analyzed within the technical holding time of 14 days from sample collection. DEQ's request to add EPH analysis was received on September 26, 2017, approximately 21 days after collecting the bulk sediment samples. Therefore, EPH was performed on Phase 3 sediment samples PWS-0905-17-3 thru -11 an PWS-090517-14 outside of the method's recommended pre-extraction holding time of 14 days and the EPH analytical results were H-flagged by ARI.

10.2 LABORATORY CONTROL SAMPLE RECOVERIES

LCS recoveries were within the laboratory-specified limits

10.3 SURROGATE STANDARD RECOVERIES

Surrogate recoveries were within laboratory-specified limits.

10.4 LABORATORY BLANKS

Target analytes were not detected in the laboratory blanks associated with these samples.

10.5 LABORATORY DUPLICATES

ARI performed a duplicate analysis of LCS samples. Target analytes were detected in the primary sample and laboratory duplicate samples within the laboratory-specified 30% to 160% limits and RPDs are below the 30% limit.

11.0 DETERMINATION OF FREELY DISSOLVED PARENT AND METHYL SUBSTITUTED PAHS, OPAHS, FORENSIC ALKYL PAHS, AND HOPANE AND CHOLESTANE USING LDPE PASSIVE SAMPLING MEDIA

All concentrations reported from LDPE PSD samples, are freely dissolved water concentrations (C_{free}), except hopane and cholestanes values which represent instrument concentrations. For C_{free} calculations, no assumptions were necessary with regard to the sampling kinetics for any compound because the full kinetic model incorporating PRCs was used when calculating PAH surface water and porewater concentrations. The PRCs used on this project were 9,10-Anthraquinone-d8-QC, benzo(b)fluoranthene-d12, fluorene-d10, PCB 116-d5, PCB 156-d3, PCB 65-d5, pyrene-d10-QC. For a complete and detailed description of the C_{free} calculation see SOP 407.01. For a complete and detailed description of FSES determination of parent and alkyl substituted PAHs (63 compounds) by gas chromatography-tandem mass spectrometry see SOP 418.00. For a complete and detailed description of FSES determination of oxygenated PAHs (22 OPAHs) by gas chromatography-tandem mass spectrometry see SOP 414.00. For a complete and detailed description of FSES determination of forensic alkyl PAHs (34 PAHs) by gas chromatography-tandem mass spectrometry see SOP 427.00. For a complete and detailed description of FSES determination of hopane and cholestane compounds by SIM GC/MS see SOP 416.00.

11.1 FIELD QC SAMPLES

A field triplicate sample collected at target surface water sample location #10 (i.e., three sample cages collected independently during PSD deployment). The purpose was to evaluate the precision of sampling procedures. As discussed below in Section 11.2, site 10 surface water rep 2 was compromised during dialysis. Additionally, trip blanks, field blanks, instrument blanks, and lab-process blanks were generated and analyzed, and met all data quality objectives (DQOs) defined in the corresponding SOPs. The results of blank analyses were provided by the FSES lab. Background subtraction using values derived from blanks are designated with a B flag in the Certificate of Analysis (COA) reports. Cascadia has maintained FSES B qualifiers on Tables 4 and 5.

11.2 LDPE CLEANING, SUB-SAMPLING, AND EXTRACTION

Upon arrival at the FSES laboratory, samples were logged in and the LDPE PSDs were stored at -20° Celsius (C) until extraction. The LDPE PSDs were cleaned to remove biofouling, water, and other potential analytical interferences. The samples were brought back to room temperature before cleaning. Cleaning was conducted under a solvent hood at the FSES laboratory following the procedures outlined in the SOP 108.01 *Cleaning Field Deployed Polyethylene PSDs*. This procedure included submersing the PSDs sequentially in three different solvents. Once cleaned, the PSDs were cut into pieces using clean scissors and stored in amber jars until extraction. The OSU chemists filled out a bench sheet documenting the cleaning process, which included a post-deployment cleaning blank with each batch of project samples. Copies of the bench sheets documenting the cleaning process were not provided by FSES. According to narrative in the FSES Final Report, LDPE sample 170750, corresponding to site 10 deep porewater, was compromised when one of the LDPE strips was dropped in the hood during processing.

The method for extracting organic compounds from the PSDs by use of a two-step hexane dialysis is described in the OSU SOP 406.02 *Extraction of Organic Compounds from Polyethylene PSDs*. Once dialysis is completed, the extracts are transferred and concentrated in hexanes. Reportedly, the OSU chemist filled out a bench/QC summary sheet documenting the extraction process for all field and laboratory QC samples to ensure batch extraction quality. Copies of these bench/QC summary sheets were not provided by FSES. According to narrative in the FSES Final Report, batches of project samples were extracted between October 17 and 26, 2017, and the extracts stored at 4° C until analysis. Due to a turbo-vap optical sensor failure, one sample went dry rather than stopping at 1 milliliter (ml). This sample was subsequently removed from further analysis (LIMS ID# 170747 – site 10 surface water rep 2). Results of this sample were omitted from the FSES Final Report.

11.3 LABORATORY QA/QC PROCEDURES

Laboratory QA/QC was maintained through the use of standard EPA methods and other accepted methods and standard analytical procedures for the target analytes. The method-specific and other analytical and laboratory QC procedures and protocols followed are detailed in the SOPs. These procedures incorporate the collection and analysis of the following laboratory QA/QC components:

- Internal QC samples
- Continuing calibration verification (CCVs)
- Extraction blanks
- MS and duplicates samples
- Laboratory blank spikes Reagent blanks
- Calibration check samples

The laboratory QA/QC results were not provided by FSES. Therefore, Cascadia did not qualify the data beyond the J and B qualifiers contained in the Certificates of Analysis provided as appendices

to the FSES Final Report. As indicated in the header FSES report Appendix 2, concentrations reported were generated using the 63-PAH method described in SOP 418 Determination of Parent and Alkyl Substituted PAHs by GC-MS/MS. Because this method was developed and is calibrated using purified analytical standards rather than an SRM, it is inherently more accurate and precise.

11.3.1 PAHs – Quality Control Summary

As reported in the Final Summary Report, 36 QC samples were included in the 63 PAH analysis of surface water and porewater. Over 45% of all samples analyzed as part of this project were QC samples. Fourteen continuing verification standard (CVs) were run. Eighteen instrumental blanks (IBs) were included in the analysis. Reportedly, all IBs were below limits of detection (LOD) for all analytes. Analysis included trip, field, and process blanks to assess any potential background concentration. According to FSES, all DQOs were met for all data presented in the Final Report dated February 8, 2018.

11.3.2 OPAHs – Quality Control Summary

Reportedly, 25 quality control samples were run for the OPAH analysis. Over 35% of all samples analyzed as part of this project were QC samples. Eleven CVs were run and all 11 had greater than 60% of analytes within 30% of true values and thus met DQOs. Eleven IBs were included in the analysis. Analysis included trip, field, and process blanks to assess any potential background concentrations. According to FSES, all DQOs were met for all data presented.

11.3.3 Forensic Alkyl PAHs – Quality Control Summary

Reportedly, a total of 17 samples corresponding to various QC were run for the forensic alkyl PAH method. Eight CVs were run as part of the analysis. Over 27% of all samples analyzed as part of this project were QC samples. All CVs had greater than 80% of analytes within 20% of true values and thus met DQOs. Nine IBs were included in the analysis. All IBs were below LOD for all analytes. As indicated in SOP 427.00, which is based on the empirical ASTM D7363-13a method, the primary standard was NIST SRM 1991 Mix Coal Tar/Petroleum Extract in Methylene Chloride.

Consistent with Apex Labs, the FSES laboratory measured parent and alkyl PAHs in SRM 2279 using SOP 427.00. Two CV and two IBs were analyzed and all met DQOs. Three replicate analyses were performed. Mean precision as 22 representative SRM analytes was 3.05%. Typical DQOs for comparison to an SRM would be to match the true value +/- two standard deviations (SDs). In many cases SDs associated with the reference value published by NIST for alkylated PAHs in the COA are very high (in some cases as much as 40% of the true value) and are calculated with as many as 22 degrees of freedom. A range centered on the true value and limited by +/- 2 SDs would result in a factor of four from the low end of the concentration range to the high end of the concentration range. According to FSES, this is not a suitable DQO. Consequently, measures of instrument precision are provided in the FSES Final Report. As indicated in the header in the original report, the initial SRM analysis was done using SOP 427.00 Determination of Forensic Alkyl PAHs using GC-MS/MS, which is based on the empirical ASTM D7363-13a method which uses NIST

SRM 1991 as the standard. The empirical nature of the method reduces sensitivity, accuracy and precision.

11.3.4 Hopanes and Cholestanes – Quality Control Summary

Reportedly, a total of 20 QC samples were run for the hopanes analysis. Ten CVs were run, and all had greater than 80% of analytes within 20% of true values and thus met DQOs. Over 33% of all samples analyzed as part of this project were QC samples. Ten IBs were included in the analysis. Reportedly, all IBs were below LOD for all analytes.

12.0 SUMMARY

In an effort to further evaluate and validate OSU's porewater alkylated PAH data, Cascadia performed the activities/tasks:

- Review OSU's current freely dissolved PAH concentration calculation approach.
- Request additional information from OSU to confirm the specific calculation approach used by OSU for the alkylated PAHs. Specifically
    - obtained complete sample information for deep porewater sample 1 (OSU sample ID A170725); which
    - included instrument concentrations, freely dissolved calculated concentrations, initial and final PRC concentrations, deployment time, deployment temperature, and which PRC(s) were used to calculate freely dissolved concentrations.
- Build an Excel calculator to match the approach used by OSU to calculate freely dissolved porewater concentrations of alkylated PAHs for the St. Helens project.
- Calculate porewater concentrations for deep porewater sample 1 (OSU sample ID A170725).
    - Specifically, calculated freely dissolved porewater concentrations of naphthalene, C3-naphthalenes, and C4-naphthalenes for this sample. All calculated concentrations were within 10% of concentrations reported by OSU. Concentrations calculated as part of this validation exercise were consistently 8-9% lower than concentrations reported by OSU.
- Calculate TU values using calculated porewater concentrations. Compared toxic unit (TU) values using porewater concentrations calculated as part of this validation exercise to TU values using porewater concentrations reported by OSU. TU contributions calculated as part of this exercise were 8-9% lower than TU values calculated with porewater concentrations reported by OSU.

No data were rejected and 100% of the Phase 3 data should be considered fully usable with the addition of the qualifiers provided in Tables 5-7, 5-8, 5-11 of the Updated Supplemental RI report.

Copies of the spreadsheet output used to confirm OSU's FSES freely dissolved concentrations and the corresponding equations/partitioning coefficients are included in Appendix D.

REFERENCES

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LIMITATIONS

This report was prepared exclusively for Port of Columbia County (formerly the Port of St. Helens) by Cascadia Associates, LLC (Cascadia). The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Cascadia services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This data quality review is intended to be used by Port of Columbia County for the former Pope & Talbot Creosote Site only, subject to the terms and conditions of its contract with Cascadia. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

ATTACHMENTS

OSU FSES SUMMARY OF PAH ENVIRONMENTAL CONCENTRATION CALCULATIONS

Time-weighted average gas-phase air and soil air concentrations were determined using an empirical uptake model using performance reference compounds (PRCs) to predict sampling rates (Huckins et al., 2006). PRCs have representative physicochemical properties. The model makes no assumptions about whether compounds have reached equilibrium between the air and the sampler material. We have calculated the equilibrium-corrected concentrations using PRCs to determine *in situ* sampling rates, rather than waiting for the LDPE to reach complete equilibrium with the soil air.

Soil air and air concentrations ($C_{(soil)air}$, ng m^{-3}) were calculated

$$C_{(soil)air} = \frac{N_{PAH}}{V_s K_{sa}^T \left[1 - e^{\left(\frac{-R_s t}{V_s K_{sa}^T}\right)}\right]} \quad \text{Eq. S1}$$

where N_{PAH} (ng) is the mass of a target PAH in LDPE extract, V_s (m^3) is the volume of sampler, K_{sa}^T is the sampler-air partition coefficient (See *Explanation 1* below), R_s is the sampling rate (m^3 day^{-1}, see *Explanation 2* below), and t (days) is the duration of deployment.

Explanation 1: K_{sa}^T

K_{sa}^T is calculated in several steps. First, K_{sw}, the sampler-water partition coefficient is estimated from an empirical relationship (Huckins et al., 2006)

$$\log K_{sw} = -2.61 + 2.321 * \log K_{ow} - 0.1618 * (\log K_{ow})^2 \quad \text{Eq. S2}$$

Next, K_{sa}^{298} is determined (Lohmann, 2012)

$$K_{sa}^{298} = \frac{K_{sw}}{H'_{298}} \quad \text{Eq. S3}$$

where H'_{298} is the unitless Henry's law constant at 298 K. It is computed (Bamford et al., 1999)

$$H'_{298} = \frac{H_{298}}{RT} \quad \text{Eq. S4}$$

where R is the gas constant (8.206 x 10^{-5} atm m^3 mol^{-1} K^{-1}), T is temperature (K), and H_{298} is Henry's law constant with units (atm m^3 mol^{-1}). Finally, K_{sa}^{298} is temperature-corrected to K_{sa}^T using a modified van 't Hoff equation (Khairy and Lohmann, 2012)

$$K_{sa}^T = K_{sa}^{298} * e^{\left[\frac{\Delta H_{vap}}{R} * \left(\frac{1}{T} - \frac{1}{298}\right)\right]} \quad \text{Eq. S5}$$

where R is the gas constant (8.31 x 10^{-3} kJ mol^{-1} K^{-1}), T is the mean temperature (K) of air or soil air over the length of deployment, and ΔH_{vap} is the enthalpy of vaporization (kJ mol^{-1}). ΔH_{vap} is calculated for each PAH using the relationship developed by Khairy and Lohmann (2012) using 15 model PAHs

$$\Delta H_{vap} = -9.3891 * \log P_L + 69.354 \quad \text{Eq. S6}$$

where $\log P_L$ is the logarithm of the vapor pressure (Pa). ΔH_{vap} inputs for the 15 model PAHs are given in Roux et al. (2008). Vapor pressures for all PAHs are estimated from molecular weight (MW, g mol^{-1}) (Ma et al., 2010)

$$\log P_L = -0.054 * MW + 8.52 \quad \text{Eq. S7}$$

Explanation 2: R_s

R_s is estimated with performance reference compounds that are added in known amounts to each sampler before field deployment using Eq. 8-10. First, the PRC exchange rate constant, k_e (d^{-1}) is estimated using (Huckins et al., 2006)

$$k_e = \frac{-\ln\left(\frac{N_{PRC}}{N_{0,PRC}}\right)}{t} \quad \text{Eq. S8}$$

where N_{PRC} is the mass of PRC remaining in the strip after field deployment (ng), $N_{0,PRC}$ was the mass of PRC in the strip before field deployment (ng), and *t* was the length of deployment (days). Fluorene-d10 was the PRC used in soil air calculations, and pyrene-d10 was used for air. Second, the PRC sampling rate, $R_{s,PRC}$, was estimated (Huckins et al., 2006)

$$R_{s,PRC} = V_s K_{sa}^T k_e \quad \text{Eq. S9}$$

Next, $R_{s,PRC}$, was related to R_s, the sampling rate for each PAH, using

$$R_s = R_{s,PRC} * \frac{\beta}{\beta_{PRC}} \quad \text{Eq. S10}$$

where β values are based on an empirical relationship with $\log K_{oa}$ (Huckins et al., 2006)

$$\log \beta = 0.154 * \log K_{oa} - 0.80 \quad \text{Eq. S11}$$

OSU FSES Air/Water Concentration Calculations

Calculations to determine the vapor phase and freely dissolved concentrations of PAHs was based on the model described by *Huckins et al. [4]*. This model uses performance reference compounds (PRCs) to determine in-situ uptake rates of target compounds which takes into account variable environmental conditions such as wind speeds, temperatures, and humidity levels. Vapor phase (C_a) and freely dissolved (C_w) PAH concentrations are given by the following equations:

$$C_a = \frac{N_{analyte}}{\mathrm{V}_s K_{sa(T)}\left(1 - \exp\left(-\frac{R_s t}{\mathrm{V}_s K_{sa}}\right)\right)} \quad \text{Eq. S1}$$

$$C_w = \frac{N_{analyte}}{\mathrm{V}_s K_{sw}\left(1 - \exp\left(-\frac{R_s t}{\mathrm{V}_s K_{sw}}\right)\right)} \quad \text{Eq. S2}$$

where $N_{analyte}$ is the mass of the compound of interest present in the sampler (ng), V_s is the sampler volume (cm^3), t is the duration of sampling (s), and $K_{sa\,(T)}$ and K_{sw} are the sampler-air and sampler-water partition coefficients respectively and R_s is the PRC derived sampling rates. Using individual octanol-water partition coefficients (K_{ow}), values for K_{sw} were calculated according to the following empirical relationship reported by Huckins, Petty and Booij (*3*):

$$Log\ K_{sw} = a_0 + 2.321(logK_{ow}) - 0.1618(logK_{ow})^2 \quad \text{Eq. S3}$$

$$a_0 = -2.61\ for\ PAHs$$

Temperature was assumed to have minimal impact on the sampler-water partition coefficient in the temperature range of this study. Sampler-water partition coefficients were convererted to K_{sa} values at 298K ($\mathrm{K}_{sa(298)}$) using the ideal gas constant (R), temperature ($T = 298K$) and Henry's Law Constant (H) according to the following equation:

$$K_{sa\,(298)} = \frac{K_{sw}(RT)}{H} \quad \text{Eq. S4}$$

A temperature corrected sampler-air partition coefficient ($\mathrm{K}_{sa\ (T)}$) was determined using the Van't Hoff equation:

$$K_{sa\,(T)} = K_{sa\,(298)} * exp^{\frac{-\Delta H_{vap}}{R}\left(\frac{1}{T} - \frac{1}{298}\right)} \quad \text{Eq. S5}$$

where T is the average temperature of deployment and $\Delta\mathrm{H}_{vap}$ is the enthalpy of vaporization which can be related to the subcooled liquid vapor pressure (P_L) following the methodology of Khairy, Lohman et al, 2012 *[5]* who present the following linear relationship:

$$\Delta\mathrm{H}_{vap} = 69.354 - 9.3891 * logP_L \quad \text{Eq. S6}$$

Construction of this regression are based on values for $\Delta\mathrm{H}_{vap}$ from Roux, Temprado et al., 2008 [*6*] and values for sub-cooled liquid vapor pressure derived from Ma, Lei et al, 2010 [*7*] based on the following linear correlation with molecular weight (MW):

$$\log\mathrm{P}_L = 8.52 - 0.054 * MW \quad \text{Eq. S7}$$

Sampling rates for target analytes in water (R_{sw}) and air (R_{sa}) are calculated by first determining PRC sampling rates in water ($R_{sw,PRC}$) and air ($R_{sa,PRC}$) based upon PRC dissipation according to the following equation:

$$R_{sw,PRC} = -\frac{\ln(\frac{N}{N_0})}{t} K_{sw} V_s \quad \text{Eq. S8}$$

$$R_{sa,PRC} = -\frac{\ln(\frac{N}{N_0})}{t} K_{sa(T)} V_s \quad \text{Eq. S9}$$

where N_0 and N are the amounts of PRC at the beginning and end of sampling respectively. Target sampling rates ($R_{s,analyte}$) were related to PRC sampling rates ($R_{s,PRC}$) according to the following equations:

$$R_{sw,analyte} = R_{sw,PRC} * \frac{\alpha_{analyte}}{\alpha_{PRC}} \quad \text{Eq. S10}$$

$$R_{sa,analyte} = R_{sa,PRC} * \frac{\beta_{analyte}}{\beta_{PRC}} \quad \text{Eq. S11}$$

where α is a compound specific function of K_{oa} according to the following empirical relationship:

$$\log \alpha = 0.0130 \log K_{OW}^3 - 0.3137 \log K_{OW}^2 + 2.244 \log K_{OW} \quad \text{Eq. S12}$$

and β is a compound specific function of K_{ow} according to the following empirical relationship:

$$\log \beta = 0.154x \; log K_{oa} - 0.8 \quad \text{Eq. S13}$$

LDPE were spiked with three different PRCs as described in materials and methods. For analyte sampling rate calculations, one PRC was used for each sampler with selection based on PRC dissipation between 10% and 90%.

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Environmental Batch QC Report

Food Safety and Environmental Stewardship Program

Batch Number: 010418-001

Batch Template: Alkyl PAHs - Cfree PoreWater 2017 (pending 17Sep17

Project(s): F17-14: St. Helens Contract

Report Date: 1:05 PM May 20 2019

☑	**Batch**
☐	092717-001: LDPE Clean-up 2014
☐	101717-001: LDPE Dialysis 2014
☐	101917-001: LDPE Dialysis 2014
☐	102517-001: LDPE Dialysis 2014

Approval Signatures

Chemist **Date:**

FSES Director Approval: Kim A. Anderson **Date:**

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Table 1. Calculation Constants and Equations

Unitless Henry's Law (use R #2):

$$H_{unitless} = \frac{H_{298}}{R \; x \; 298}$$

Logartimic PAH Adjusted Vapor Pressure (P_L)

$$P_L = MW \; x \; -0.054 + 8.52$$

Vaporization Enthalpy (ΔH)

$$\Delta H_{ksw} = LogP_L \; x \; -9.3891 + 69.354$$

Table 1: Pertinent Constants			
PAHs α_o	-2.61	R ($KJ \cdot K^{-1} \cdot mol^{-1}$)	8.31E-03
PCBs (4,4'-DDE) α_o	-2.61	R ($atm \cdot m^3 \cdot K^{-1} \cdot mol^{-1}$)	8.20E-05
polar pesticides α_o	-3.2	[Salt] (M)	0.5
P_{PE} ($Kg \cdot L^{-1}$)	0.91	K_s (M^{-1})	0.35
PI (Ma et al,2010;Roux et al, 2008)	-0.054, 8.52	LogKsw (Kg/L)	1.22, -1.22
ΔH vaporizarion	-9.3891, 69.354	ΔH Ksw (KJ/mol)	-25

Sampling Rate (R_s) of PRC's:

$$R_{s,\,PRC} = \frac{V_s \; x \; 10^{logKswPRC} \; x \; k_e}{1000}$$

Sampling Rate ($R_{s,analyte}$) of Target Compound:

$$R_{s,\,analyte} = R_{s,\,PRC} \; x \; \frac{\alpha_{analyte}}{\alpha_{PRC}}$$

where:

$$log\alpha = 0.0130 logK^3_{ow} - 0.3173 logK^2_{ow} + 2.244 logK_{ow}$$

PRC Release Rate Constant (k_e):

$$k_e = \frac{-ln \frac{t_E}{t_0}}{E}$$

Sampler Water Partition Coefficient (K_{sw}):

$$LogK_{sw} = \alpha_0 + 2.321(logK_{ow}) - 0.1618(logK_{ow})^2$$

Sampler Water Partition Coefficient $logK_{sw}$ (Kg/L):

$$logK_{sw}\left(\frac{Kg}{L}\right) = logK_{ow} \; x \; 1.22 + (-1.22)$$

Sampler Air Partition Coefficient (K_{sa}):

$$LogK_{sa} = \frac{\log(10^{logK_{sw}})}{K_{oa}}$$

Temperature Correction (ALWAYS NEEDED):

$$LogK_{sw_T} = \log\left(10^{logK_{sw}}\right) x \; e^{\frac{\Delta H_{Ksw}}{R}} \; x \left(\frac{1}{298} - \frac{1}{T+273.13}\right)$$

Salinity Correction (OPTIONAL):

$$logK_{sw_T - salinity} = \log\left(10^{logK_{swT}}\right) \; x \; 10^{[Salt] \; x \; Ks}$$

Volume (V_s) of the Sampler (for LDPE):

$$V_s = (\#\ of\ PE\ Strips) \; x \; (5.0 cm^3)$$

Mass (g) of the Sampler (for Wristbands):

weight measured at the balance during conditioning

Water Concentration ($C_{w,analyte}$) for Target Compound:

$$C_{w,\,analyte} = \frac{analyte\ accumulation}{\left(V_s \; x \; K_{sw,analyte} \; x \left(1 - \exp\left(-\frac{R_{s,analyte} \; x \; E}{V_s \; x \; K_{sw,analyte}}\right)\right)\right)} \; x \; 1000$$

Air Concentration ($C_{a,analyte}$) for Target Compound:

$$C_{a,\,analyte} = \frac{analyte\ accumulation}{\left(V_s \; x \; K_{sa,analyte} \; x \left(1 - \exp\left(-\frac{R_{s,analyte} \; x \; E}{V_s \; x \; K_{sa,analyte}}\right)\right)\right)} \; x \; 1000$$

Concentration ($C_{wb,analyte}$) for Target Compound (LIQUID EXTRACTION for Wristbands):

$$\frac{\text{analyte (ng)}}{\text{wristband (g)}} = \left(\frac{\text{analyte (pg)}}{\text{sample } (\mu L)} - \frac{BG\ (pg)}{sample\ (\mu L)}\right) x \; \frac{1000\ (\mu L)}{1\ (mL)} \; x \; \frac{1\ (ng)}{1000\ (pg)} \; x \; \frac{Sample\ Vol\ (mL)}{Sample\ Mass\ (g)}$$

Concentration ($C_{wb,analyte}$) for Target Compound (THERMAL DESORPTION for Wristbands):

$$\frac{ng\ analyte}{g\ WB} = \frac{[inst\ (ng)] - [inst\ BG\ (ng)]}{WB\ mass\ (g)}$$

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Table 2. Target Analyte Physical Chemical Properties

Chemical Name	M.W (g/mol)	log K_{ow}	log K_{oa}	H_{298} (atm*m/mole)	Chemical Name	M.W (g/mol)	log K_{ow}	log K_{oa}	H_{298} (atm*m/mole)
C1-Naphthalenes	142.2	3.3	5.045	5.80E-04	chrysene	228.28	5.81	9.48	5.01E-06
C2-Naphthalenes	156.2	3.3	5.045	6.41E-04	benzo[b]fluoranthene	252.3	5.78	10.351	8.10E-07
C3-Naphthalenes	170.2	3.3	5.045	6.41E-04	benzo[k]fluoranthene	252.3	6.11	10.732	8.10E-07
C4-Naphthalenes	184.3	3.3	5.045	1.13E-03	benzo[e]pyrene	252.3	6.44	11.351	8.10E-07
C1-Fluorenes	180.2	4.18	6.585	1.67E-04	benzo[a]pyrene	252.3	6.13	10.859	8.10E-07
C2-Fluorenes	194.3	4.18	6.585	1.67E-04	perylene	252.32	6.25	10.076	8.10E-07
C3-Fluorenes	208.3	4.18	6.585	1.67E-04	indeno[1,2,3-cd]pyrene	276.33	6.7	11.547	1.31E-07
C4-Fluorenes	223.3	4.18	6.585	1.67E-04	dibenzo[a,h]anthracene	278.347	6.75	11.779	4.89E-07
C1-phenanthrenes & C1-anthracenes	193.3	4.46	7.222	5.13E-05	benzo[ghi]perylene	276.33	6.63	11.499	1.31E-07
C2-phenanthrenes & C2-anthracenes	208.3	4.46	7.222	5.13E-05	A/(Ph+A)				
C3-phenanthrenes & C3-anthracenes	223.3	4.46	7.222	5.13E-05	Ph/A				
C4-phenanthrenes & C4-anthracenes	238.4	4.46	7.222	5.13E-05	(C1-Ph+C1-A)/(Ph+A)				
C1-fluoranthenes & C1-pyrenes	217.3	5.16	8.601	8.30E-06	(Ph+A)/(C1-Ph+C1-A+Ph+A)				
C1-benzo(a)anthracenes & C1-chrysenes & C1-triphenylene	243.3	5.81	9.48	5.01E-06	FL/Py				
C2-benzo(a)anthracenes & C2-chrysenes & C2-triphenylene	258.3	5.81	9.48	5.01E-05	FL/(FL+Py)				
C3-benzo(a)anthracenes & C3-chrysenes & C3-triphenylenes	273.4	5.81	9.48	5.01E-06	(FL+Py)/(FL+Py+C1-FL+C1-Py)				
C4-benzo(a)anthracenes & C4-chrysenes & C4-triphenylene	288.4	5.81	9.48	5.01E-06	(C1-FL+C1-Py)/Py				
C1-dibenzothiophenes	199.3	4.38	7.24	2.79E-05	(C1-FL+C1-Py)/(FL+Py)				
C2-dibenzothiophenes	214.3	4.38	7.24	2.79E-05	((C2+C3+C4)Ph&A)/(FL+Ph+A)				
C3-dibenzothiophenes	228.4	4.38	7.24	2.79E-05	BaA/Ch				
C4-dibenzothiophenes	244.4	4.38	7.24	2.79E-05	BaA/228				
naphthalene	128.17	3.3	5.045	5.26E-04	D2/P2				
acenaphthylene	152.19	3.94	6.272	5.48E-05	D3/P3				
acenaphthene	154.2	3.92	6.044	2.82E-04	Py/BaP				
fluoranthene	202.26	5.16	8.601	8.30E-06	IP/ghi				
fluorene	166.223	4.18	6.585	1.67E-04	IP/IP+ghi				
dibenzothiophene	184.26	4.38	7.24	2.79E-05	BeP/BaP				
phenanthrene	178.23	4.46	7.222	5.13E-05	Alkyl/Parent PAHs				
anthracene	178.23	4.45	7.093	5.13E-05	L/H				
pyrene	202.25	4.88	8.193	8.30E-06	LPAH/HPAH				
benz[a]anthracene	228.288	5.76	9.069	5.01E-06	Pyrogenic index				

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Batch Number: 010418-001 **Food Safety and Environmental Stewardship Program**

Batch Template: Alkyl PAHs - Cfree PoreWater 2017 (pending 17Sep17 **Batch QC Report**

Sample Name:	deep porewater site 1		**COC:**	17SEP26-01	**Test Method:**	Alkyl PAH - Cfree PoreWater 2017 (pending 17Sep17) v1		**Client Location:**	St. Helens Site 1
FSES Sample ID:	A170725	**Sampled Date:**	9/26/2017 1:46:00 PM	**Matrix:**	PSD-Pore Water	**BG Corr Appl:**	**YES**	**Salt Water?**	**NO**
PRC Used	**Benzo[b]fluoranthene-D12**		**# oF PSDS**	**1**	**PRC Amt Remaining (ng):**		**1220**	**Avg Temp(K)**	**19.38**
Prc Amt Spiked	**1530 ng**	**PRC Frac. Retained (%)**		**79.7%**	**Exposure Dur. in Days (E):**		**20**	**Extr Vol. (mL)**	**1**

Chemical Name	Inst Conc (ng/L)	BG Corr (ng/L)	Concentration (ng/L)	Chemical Name	Inst Conc (ng/L)	BG Corr (ng/L)	Concentration (ng/L)
C1-Naphthalenes	7070	7061	2010B	chrysene	123		0.163
C2-Naphthalenes	28000	27936	7950B	benzo[b]fluoranthene	29.1		0.0385
C3-Naphthalenes	40000	39797	11300B	benzo[k]fluoranthene	16.9		0.0233
C4-Naphthalenes	26900	26639	7580B	benzo[e]pyrene	21.7		0.0340
C1-Fluorenes	11000	10930	262B	benzo[a]pyrene	20.8		0.0289
C2-Fluorenes	8160	8052	193B	perylene	25		0.0362
C3-Fluorenes	2900		69.6	indeno[1,2,3-cd]pyrene	0.26		<0.000468U
C4-Fluorenes	1		<12.0U	dibenzo[a,h]anthracene	1.02		<0.00189U
C1-phenanthrenes & C1-anthracenes	4960	4945	54.1B	benzo[ghi]perylene	0.34		<0.000588U
C2-phenanthrenes & C2-anthracenes	3970		43.4	A/(Ph+A)	-	-	0.0274
C3-phenanthrenes & C3-anthracenes	3240		35.4	Ph/A	-	-	35.5
C4-phenanthrenes & C4-anthracenes	4530	562	6.14B	(C1-Ph+C1-A)/(Ph+A)	-	-	0.177
C1-fluoranthenes & C1-pyrenes	1420		2.88	(Ph+A)/(C1-Ph+C1-A+Ph+A)	-	-	0.849
C1-benzo(a)anthracenes & C1-chrysenes & C1-triphenylene	85.6		0.113	FL/Py	-	-	1.22
C2-benzo(a)anthracenes & C2-chrysenes & C2-triphenylene	7		0.00863	FL/(FL+Py)	-	-	0.550
C3-benzo(a)anthracenes & C3-chrysenes & C3-triphenylenes	1		<0.00132U	(FL+Py)/(FL+Py+C1-FL+C1-Py)	-	-	0.852
C4-benzo(a)anthracenes & C4-chrysenes & C4-triphenylene	1		<0.00132U	(C1-FL+C1-Py)/Py	-	-	0.384
C1-dibenzothiophenes	178		2.44	(C1-FL+C1-Py)/(FL+Py)	-	-	0.173
C2-dibenzothiophenes	223		3.05	((C2+C3+C4)Ph&A)/(FL+Ph+A)	-	-	0.271
C3-dibenzothiophenes	64.1		<0.908U	BaA/Ch	-	-	0.793
C4-dibenzothiophenes	1		<1.71U	BaA/228	-	-	0.442
naphthalene	190		54.0B	D2/P2	-	-	0.0703
acenaphthylene	469		22.1	D3/P3	-	-	0.0128J
acenaphthene	69700		3470	Py/BaP	-	-	259
fluoranthene	4510		9.14	IP/ghi	-	-	0.795J
fluorene	22800		548	IP/IP+ghi	-	-	0.443J
dibenzothiophene	2040		27.9	BeP/BaP	-	-	1.18
phenanthrene	27100		296	Alkyl/Parent PAHs	-	-	77.1
anthracene	743		8.36	L/H	-	-	671J
pyrene	2120		7.50	LPAH/HPAH	-	-	257J
benz[a]anthracene	142		0.188	Pyrogenic index	-	-	0.117J

For internal use only

Cross Check of Cfree Naphthalene Calculations in FSES sample ID A170725

Variable Description	Variable	Source
E = Exposure Duration (days)	20	OSU Environmental Batch QC Report for Batch 010418-001
Number of PE strips	1	OSU Environmental Batch QC Report for Batch 010418-001
Vs = Volume of sampler	5.00	Equation from OSU Environmental Batch QC Report for Batch 010418-001
T0 = PRC (Benzo[b]fluoranthene-d12) amount in PE at time 0	1530	OSU Environmental Batch QC Report for Batch 010418-001
TE = PRC (Benzo[b]fluoranthene-d12) amount in PE at time E	1220	OSU Environmental Batch QC Report for Batch 010418-001
Ke= PRC Release Rate Constant	0.0113	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Log K_{OW}, PRC (Benzo[b]fluoranthene-d12)	5.78	OSU Partitioning Coefficients
Log K_{SW}, PRC = Sampler-Water Partition Coefficient, Benzo[b]fluoranthene-d12 (Kg/L)	5.83	Equation from OSU Environmental Batch QC Report for Batch 010418-001
MW = molecular weight, Benzo[b]fluoranthene-d12	264	OSU Partitioning Coefficients
ΔH_{ksw} = Vaporization enthalpy (KJ/mol)	-25.00	OSU Environmental Batch QC Report for Batch 010418-001
Log Ksw^{T} = Temperature-corrected Sampler-Water Partition Coefficient, Benzo[b]fluoranthene-d12	5.91	Eq. S5 from OSU Calculation Equations
Rs, PRC = Sampling Rate of PRCs	46.4	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Log K_{OW}, Naphthalene	3.30	OSU Environmental Batch QC Report for Batch 010418-001
Log K_{SW}, analyte = Sampler-Water Partition Coefficient, Naphthalene (Kg/L)	2.81	Equation from OSU Environmental Batch QC Report for Batch 010418-001
MW = molecular weight, Naphthalene	128	OSU Environmental Batch QC Report for Batch 010418-001
T = Deployment Temperature (°C)	19.4	OSU Environmental Batch QC Report for Batch 010418-001
T = Deployment Temperature (K)	293	Calculated
Log Ksw^{T} = Temperature-corrected Sampler-Water Partition Coefficient, Benzo[b]fluoranthene-d12	2.89	Eq. S5 from OSU Calculation Equations from Minick et al 2017
Log a, analyte (Naphthalene)	4.42	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Log a, PRC Benzo[b]fluoranthene-d12	4.88	Equation from OSU Environmental Batch QC Report for Batch 010418-001
a, analyte (Naphthalene)	26121	Calculated
a, PRC Benzo[b]fluoranthene-d12	75883	Calculated
Rs, analyte = Sampling Rate of Target Compound (Naphthalene)	16.0	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Instrument concentration, Naphthalene (ng/L)	190	OSU Environmental Batch QC Report for Batch 010418-001
Cw, analyte = Calculated water concentration, Naphthalene (ng/L)	49.2	Equation from OSU Environmental Batch QC Report for Batch 010418-001
OSU Reported water concentration, Naphthalene (ng/L)	54.0	OSU Environmental Batch QC Report for Batch 010418-001

Cross Check of Cfree C3-Naphthalene Calculations in Sample ID A170725		
Variable Description	Variable	Source
E = Exposure Duration (days)	20	OSU Environmental Batch QC Report for Batch 010418-001
Number of PE strips	1	OSU Environmental Batch QC Report for Batch 010418-001
Vs = Volume of sampler	5.00	Equation from OSU Environmental Batch QC Report for Batch 010418-001
T0 = PRC (Benzo[b]fluoranthene-d12) amount in PE at time 0	1530	OSU Environmental Batch QC Report for Batch 010418-001
TE = PRC (Benzo[b]fluoranthene-d12) amount in PE at time E	1220	OSU Environmental Batch QC Report for Batch 010418-001
Ke= PRC Release Rate Constant	0.0113	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Log K_{OW}, PRC (Benzo[b]fluoranthene-d12)	5.78	OSU Partitioning Coefficients
Log K_{SW}, PRC = Sampler-Water Partition Coefficient, Benzo[b]fluoranthene-d12 (Kg/L)	5.83	Equation from OSU Environmental Batch QC Report for Batch 010418-001
MW = molecular weight, Benzo[b]fluoranthene-d12	264	OSU Partitioning Coefficients
ΔH_{ksw} = Vaporization enthalpy (KJ/mol)	-25.00	OSU Environmental Batch QC Report for Batch 010418-001
Log Ksw^T = Temperature-corrected Sampler-Water Partition Coefficient, Benzo[b]fluoranthene-d12	5.91	Eq. S5 from OSU Calculation Equations
Rs, PRC = Sampling Rate of PRCs	46.4	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Log K_{OW}, C3-Naphthalenes	3.30	OSU Environmental Batch QC Report for Batch 010418-001
Log KSW, analyte = Sampler-Water Partition Coefficient, C3-Naphthalenes (Kg/L)	2.81	Equation from OSU Environmental Batch QC Report for Batch 010418-001
MW = molecular weight, C3-Naphthalenes	170	OSU Environmental Batch QC Report for Batch 010418-001
T = Deployment Temperature (°C)	19	OSU Environmental Batch QC Report for Batch 010418-001
T = Deployment Temperature (K)	292.53	Calculated
Log Ksw^T = Temperature-corrected Sampler-Water Partition Coefficient, Benzo[b]fluoranthene-d12	2.89	Eq. S5 from OSU Calculation Equations from Minick et al 2017
Log a, analyte (C3-Naphthalenes)	4.42	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Log a, PRC Benzo[b]fluoranthene-d12	4.88	Equation from OSU Environmental Batch QC Report for Batch 010418-001
a, analyte (C3-Naphthalenes)	26121	Calculated
a, PRC Benzo[b]fluoranthene-d12	75883	Calculated
Rs, analyte = Sampling Rate of Target Compound (C3-Naphthalenes)	16.0	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Instrument concentration with background correction, C3-Naphthalenes (ng/L)	39797	OSU Environmental Batch QC Report for Batch 010418-001
Cw, analyte = Calculated water concentration, C3-Naphthalenes (ng/L)	10301	Equation from OSU Environmental Batch QC Report for Batch 010418-001
OSU Reported water concentration, C3-Naphthalenes (ng/L)	11300	OSU Environmental Batch QC Report for Batch 010418-001

Cross Check of Cfree C4-Naphthalene Calculations in FSES Sample ID A170725		
Variable Description	Variable	Source
E = Exposure Duration (days)	20	OSU Environmental Batch QC Report for Batch 010418-001
Number of PE strips	1	OSU Environmental Batch QC Report for Batch 010418-001
Vs = Volume of sampler	5.00	Equation from OSU Environmental Batch QC Report for Batch 010418-001
T0 = PRC (Benzo[b]fluoranthene-d12) amount in PE at time 0	1530	OSU Environmental Batch QC Report for Batch 010418-001
TE = PRC (Benzo[b]fluoranthene-d12) amount in PE at time E	1220	OSU Environmental Batch QC Report for Batch 010418-001
Ke= PRC Release Rate Constant	0.0113	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Log K_{OW}, PRC (Benzo[b]fluoranthene-d12)	5.78	OSU Partitioning Coefficients
Log K_{SW}, PRC = Sampler-Water Partition Coefficient, Benzo[b]fluoranthene-d12 (Kg/L)	5.83	Equation from OSU Environmental Batch QC Report for Batch 010418-001
MW = molecular weight, Benzo[b]fluoranthene-d12	264	OSU Partitioning Coefficients
ΔH_{ksw} = Vaporization enthalpy (KJ/mol)	-25.00	OSU Environmental Batch QC Report for Batch 010418-001
Log Ksw^T = Temperature-corrected Sampler-Water Partition Coefficient, Benzo[b]fluoranthene-d12	5.91	Eq. S5 from OSU Calculation Equations
Rs, PRC = Sampling Rate of PRCs	46.4	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Log KOW, C4-Naphthalenes	3.30	OSU Environmental Batch QC Report for Batch 010418-001
Log KSW, analyte = Sampler-Water Partition Coefficient, C4-Naphthalenes (Kg/L)	2.81	Equation from OSU Environmental Batch QC Report for Batch 010418-001
MW = molecular weight, C4-Naphthalenes	184	OSU Environmental Batch QC Report for Batch 010418-001
T = Deployment Temperature (°C)	19.4	OSU Environmental Batch QC Report for Batch 010418-001
T = Deployment Temperature (K)	293	Calculated
Log Ksw^T = Temperature-corrected Sampler-Water Partition Coefficient, Benzo[b]fluoranthene-d12	2.89	Eq. S5 from OSU Calculation Equations from Minick et al 2017
Log a, analyte (C4-Naphthalenes)	4.42	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Log a, PRC Benzo[b]fluoranthene-d12	4.88	Equation from OSU Environmental Batch QC Report for Batch 010418-001
a, analyte (C4-Naphthalenes)	26121	Calculated
a, PRC Benzo[b]fluoranthene-d12	75883	Calculated
Rs, analyte = Sampling Rate of Target Compound (C4-Naphthalenes)	16.0	Equation from OSU Environmental Batch QC Report for Batch 010418-001
Instrument concentration with background correction, C4-Naphthalenes (ng/L)	26639	OSU Environmental Batch QC Report for Batch 010418-001
Cw, analyte = Calculated water concentration, C4-Naphthalenes (ng/L)	6895	Equation from OSU Environmental Batch QC Report for Batch 010418-001
OSU Reported water concentration, C4-Naphthalenes (ng/L)	7580	OSU Environmental Batch QC Report for Batch 010418-001

Comparison of Calculated Alkylated PAH Porewater Concentrations
Port of Columbia County

	Reported Concentration (ng/L) (OSU)	Calculated Concentration (ng/L)	Percent Difference in Concentrations	Calculated TU (Cascadia)	Calculated TU (MFA)	Percent Difference in Calculated TU Values
Naphthalene	54.0	49.2	8.89	0.000277	0.000253	8.66
C-3 Naphthalenes	11300	10300	8.85	0.885	0.807	8.84
C-4 Naphthalenes	7580	6900	8.97	1.27	1.16	8.66

NOTES:
TU = toxicity unit
TU values include DOC-correction
C-3 and C-4 Naphthalenes porewater concentrations calculated using background-corrected concentrations provided by OSU.

APPENDIX E

PUBLIC RECORDS SUPPORTING

BENEFICIAL USE DETERMINATIONS

COLU 52376

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)
Instructions for completing this report are on the last page of this form. Colu 52376

WELL I.D. # L 63119
START CARD # 155830

(1) LAND OWNER Well Number ____
Name Bill Walker
Address PO 765, 58365 old Portland Rd
City St. Helen State OR Zip

(2) TYPE OF WORK
☑ New Well ☒ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☑ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger
☐ Other ____

(4) PROPOSED USE:
☑ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other ____

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☑ No Depth of Completed Well 280 ft.
Explosives used ☐ Yes ☑ No Type ____ Amount ____

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
6	120	280	?			

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☐ Other ____
Backfill placed from 0 ft. to ____ ft. Material ____
Gravel placed from ____ ft. to ____ ft. Size of gravel ____

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	8				☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	4.0	-3	280		☐	☑	☑	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☐ Outside ☒ None
Final location of shoe(s) ?

(7) PERFORATIONS/SCREENS:
☑ Perforations Method Slot
☐ Screens Type ____ Material ____

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
280	220	3x1/8	1 Row ST			☐	☑
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☑ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
20		280	1 hr.

Temperature of water 52 Depth Artesian Flow Found ____
Was a water analysis done? ☐ Yes By whom ____
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other ____
Depth of strata: ____

(9) LOCATION OF WELL by legal description:
County Col Latitude ____ Longitude ____
Township 4N N or S Range 1W E or W. WM.
Section 09 NW 1/4 NW 1/4
Tax Lot 700 Lot ____ Block ____ Subdivision ____
Street Address of Well (or nearest address) 58365 old Portland Rd ST Helen

(10) STATIC WATER LEVEL:
100 ft. below land surface. Date 27 Aug 03
Artesian pressure ____ lb. per square inch Date ____

(11) WATER BEARING ZONES:
Depth at which water was first found 260

From	To	Estimated Flow Rate	SWL
260	265	20	100

(12) WELL LOG:
Ground Elevation ____

Material	From	To	SWL
Basalt Blk	120	280	100

RECEIVED
OCT 10 2003
WATER RESOURCES DEPT.
SALEM, OREGON

RECEIVED
JAN 21 2004
WATER RESOURCES DEPT
SALEM, OREGON

Date started 26 Aug 03 Completed 27 Aug 03

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 1823
Signed Jim Nelson 03 Date 27 Aug 03

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 1480
Signed [illegible] Date 27 Aug 03

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

COLU 53905

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WELL I.D. # L 85826

START CARD # 153326

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number 1
Name ROB HAMILTON
Address 35200 FIRLOCK PARK
City ST. HELENS State OR Zip 97051

(2) TYPE OF WORK ☑ New Well
☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☑ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☑ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☐ Yes ☑ No
Depth of Completed Well 160 ft.
Explosives used: ☐ Yes ☑ No Type Amount

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds
10"	0	35	CMT/BENT	0	35	20 SACKS
6"	30	160				

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☑ Other POUR
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6"	+1	35	250	☑	☐	☑	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	4"	-30	160	200	☐	☑	☑	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☑ Outside ☐ None
Final location of shoe(s) 35

(7) PERFORATIONS/SCREENS
☑ Perforations Method CUT SLOT
☐ Screens Type Material

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
140	160	1/4X6	1 PFT	4"		☐	☑
100	120	1/4X6	1PFT	4"		☐	☑
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☐ Pump ☐ Bailer ☑ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
20 GPM		160	

Temperature of water 52 DEGREES Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL (legal description)
County COLUMBIA
Tax Lot 00800 Lot
Township 4 N Range 1 W WM
Section 8 NW 1/4 SW 1/4
Lat ° ' " or (degrees or decimal)
Long ° ' " or (degrees or decimal)
Street Address of Well (or nearest address) 35200 FIRLOCK PARK
ST. HELENS, OR 97051

(10) STATIC WATER LEVEL
37 ft. below land surface. Date 7/28/2006
ft. below land surface. Date
Artesian pressure lb. per square inch Date

(11) WATER BEARING ZONES
Depth at which water was first found

From	To	Estimated Flow Rate	SWL
145	150	20 GPM	37

(12) WELL LOG Ground Elevation

Material	From	To	SWL
CLAY/COBBLES	0	8	
BROWN SILTY CLAY	8	12	
GRAY SILTY CLAY	12	30	
BLACK BASALT	30	145	37
BLACK BASALT W/B	145	155	
BLACK BASALT	155	160	

RECEIVED
MAR 29 2010
WATER RESOURCES DEPT
SALEM, OREGON

Date Started 7/25/2006 Completed 7/28/2006

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number Date

Signed

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 1480 Date 7/29/2006

Signed

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER 06/16/2004

COLU 54599

Page 1 of 1

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765 & OAR 690-205-0210)

COLU 54599
5/3/2013

WELL I.D. LABEL# L 110263
START CARD # 1019584
ORIGINAL LOG #

(1) LAND OWNER

Owner Well I.D.
First Name ANDREW Last Name NEIMI
Company ALDERWOOD PROPERTIES LLC
Address 58640 MCNULTY WAY
City ST HELENS State OR Zip 97051

(2) TYPE OF WORK

[X] New Well [ ] Deepening [ ] Conversion [ ] Alteration (complete 2a & 10) [ ] Abandonment(complete 5a)

(2a) PRE-ALTERATION

	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
Casing:									

	Material	From	To	Amt	sacks/lbs
Seal:					

(3) DRILL METHOD

[X] Rotary Air [ ] Rotary Mud [ ] Cable [ ] Auger [ ] Cable Mud
[ ] Reverse Rotary [ ] Other

(4) PROPOSED USE

[X] Domestic [ ] Irrigation [ ] Community
[ ] Industrial/ Commericial [ ] Livestock [ ] Dewatering
[ ] Thermal [ ] Injection [ ] Other

(5) BORE HOLE CONSTRUCTION

Special Standard [ ] (Attach copy)
Depth of Completed Well 160.00 ft.

BORE HOLE Dia	From	To	SEAL Material	From	To	Amt	sacks/ lbs
10	0	18	Bentonite Chips	0	18	8	S
6	18	160					

How was seal placed Method [ ] A [ ] B [ ] C [ ] D [ ] E
[X] Other POUR
Backfill placed from ft. to ft. Material
Filter pack from ft. to ft. Material Size
Explosives used: [ ] Yes Type Amount

(5a) ABANDONMENT USING UNHYDRATED BENTONITE

Proposed Amount Actual Amount

(6) CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
(•)	( )	6	[X]	1	18	250	(•)	( )	[X]	[ ]
(•)	( )	4	[ ]	3	160	200	( )	(•)	[X]	[ ]
( )	( )		[ ]				( )	( )	[ ]	[ ]
( )	( )		[ ]				( )	( )	[ ]	[ ]
( )	( )		[ ]				( )	( )	[ ]	[ ]

Shoe [ ] Inside [ ] Outside [ ] Other Location of shoe(s)
Temp casing [ ] Yes Dia From To

(7) PERFORATIONS/SCREENS

Perforations Method saw cut
Screens Type Material

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/ pipe size
Perf	Casing	4	140	160	.25	4	30	

(8) WELL TESTS: Minimum testing time is 1 hour

( ) Pump ( ) Bailer (•) Air ( ) Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)
20		160	1

Temperature 42 °F Lab analysis [ ] Yes By
Water quality concerns? [ ] Yes (describe below) TDS amount

From	To	Description	Amount	Units

(9) LOCATION OF WELL (legal description)

County COLUMBIA Twp 4.00 N N/S Range 1.00 W E/W WM
Sec 8 NW 1/4 of the NW 1/4 Tax Lot 4108014
Tax Map Number Lot
Lat ° ' " or DMS or DD
Long ° ' " or DMS or DD
(•) Street address of well ( ) Nearest address
58640 MCNULTY WAY
ST. HELENS, OR 97051

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Pre-Alteration			[ ]	
Completed Well	4/20/2013		[ ]	9

Flowing Artesian? [ ] Dry Hole? [ ]

WATER BEARING ZONES Depth water was first found 140

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
4/20/2013	140	160	20			9

(11) WELL LOG

Ground Elevation

Material	From	To
basalt brn/clay brn	0	8
basalt blk	8	160

RECEIVED BY OWRD
JUL
SALEM, OR

Date Started 4/18/2013 Complete 4/20/2013

(unbonded) Water Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number Date

Signed

(bonded) Water Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

License Number 1480 Date 5/3/2013

Signed ARTHUR D MCMULLEN (E-filed)
Contact Info (optional) 503 397 2356

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK. Form Version

STATE OF OREGON
WATER RESOURCES DEPARTMENT

SURFACE WATER REGISTRATION STATEMENT
PRE-1909 VESTED WATER RIGHT CLAIM

1.	Name of Registrant: Mailing Address:	Boise Cascade Corporation 1300 Kaster Road St. Helens, Oregon 97051 Attn.: Allan Mick Environmental Manager
	Telephone Number:	(503) 397-2900
2.	Sources of water:	Multnomah Channel, Columbia River[1]
	Tributary to:	Columbia River
3.	Purpose for which water is used:	Industrial processes.
4.	Priority Date	
	a) Date of first use:	December 28, 1867[2]
	b) Date water use development first initiated:	December 28, 1867[3]
	c) Name of party who initiated development:	J.M. & J.H. Ritchey[4]

---

[1] As shown on the maps in Attachment A, there are two diversion points: one from Multnomah Channel for Boise Cascade Corporation's pulp and paper mill, the other from the Columbia River just below its confluence with Multnomah Channel for Boise Cascade Corporation's veneer mill. The pulp and paper mill, the veneer mill, and their diversion points are all on contiguous property owned by Boise Cascade Corporation.

[2] See Attachments B and C.

[3] See Attachments B and C.

[4] See Attachments B and C.

5. Amount of water claimed: 65.03 cubic feet per second (cfs)[5]

6. Location of place of use: Sections 3, 4, 9, and 10, Township 4 North, Range 1 West, W.M.[6]

7. Usual period of use: 1/01 to 12/31

8. Remarks:

a. Documentation. The following documents are attached to and made part of this Registration Statement:

Attachment A: Maps prepared by a Certified Water Rights Examiner.

Attachment B: Summary of Dates of First Use and Development, Quantities, and Parties Who Initiated Development

Attachment C: Affidavit of David G. Gadda, Associate General Counsel, Boise Cascade Corporation

Attachment C-1: Narrative Description of the Development of Water at Boise Cascade Corporation's St. Helens Industrial Site

Attachment C-2: Property Description, Assessor's Maps, and Deeds

Attachment C-3: Miscellaneous Documents

---

[5] See Attachments B and C. Forty-two million gallons per day (64.99 cfs) are claimed for Boise Cascade Corporation's pulp and paper mill; 23,000 gallons per day (0.04 cfs) are claimed for Boise Cascade Corporation's veneer mill.

[6] The veneer mill is located in Section 3. The pulp and paper mill is located in Sections 3, 4, 9, and 10.

b. Nonwaiver. The documents and statements included in this Registration Statement are presented without waiving the Registrant's right to present additional evidence in support of the claims made in the Registration Statement. Neither by claiming the right to appropriate 65.03 cfs of water, nor by any other statement or action, does the Registrant waive any right in the alternative to appropriate water based on its ownership of riparian property.

9. Total fees submitted with claim: $5175

(Based on a claim of 65.03 cfs. This amount was submitted to the Water Resources Department with the Registrant's Petition for an Order Authorizing the Filing of a Registration Statement for an Undetermined Vested Right to Appropriate Surface Water, dated December 3, 1993.)

Notarized Statement Signed by Claimant.

STATE OF IDAHO)
) ss.
County of Ada)

I, J. W. Holleran, having been duly sworn, depose and say that I am the Vice President of Boise Cascade Corporation, the claimant of the existing surface water right described herein, and that I have read the contents of this claim and to the best of my knowledge all of the matters stated herein are true and correct.

Registrant: Boise Cascade Corporation

OK SH By: _____

Title: Vice President

Signed and attested before me this 28th day of December, 1993.

CHERIE H. ANDERSON NOTARY PUBLIC STATE OF IDAHO

_____
Notary Public, State of Idaho
Residing at: Meridian, Idaho
My commission expires: 8/5/97

Certified Water Right Examiner

Name: Mark Madison, CWRE #325
Address: CH2M Hill
825 N.E. Multnomah Street, Suite 1300
Portland, Oregon 97232-2146

Telephone: (503) 235-5000

STATE OF OREGON
WELL LOCATION MAP

This map is supplemental to the WATER SUPPLY WELL REPORT

Oregon Water Resources Department
725 Summer St NE, Salem OR 97301
(503)986-0900

LOCATION OF WELL

Latitude: 45.8448 Datum: WGS84
Longitude: -122.8234
Township/Range/Section/Quarter-Quarter Section:
WM 4N 1W 9 SWNW
Address of Well:
NEAR 36050 CONSTRUCTION WAY

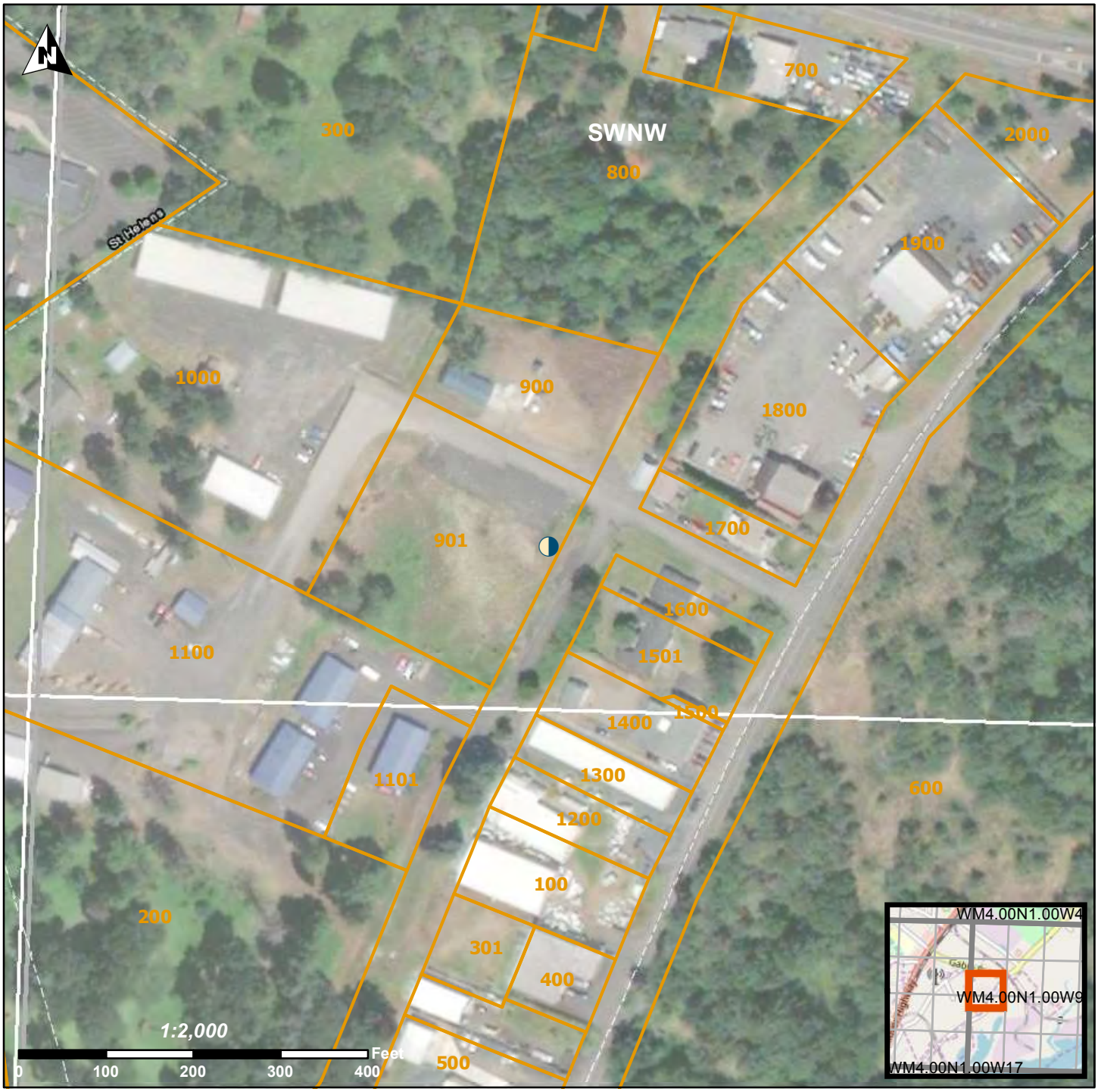
Well Label: L130194

Well Log: COLU 55360

Printed: December 14, 2018

DISCLAIMER: This map is intended to represent the approximate location of the exempt use well provided by the land owner. It is not intended to be construed as survey accurate in any manner.

Generated by OWRD



STATE OF OREGON
WELL LOCATION MAP

This map is supplemental to the WATER SUPPLY WELL REPORT

Oregon Water Resources Department
725 Summer St NE, Salem OR 97301
(503)986-0900

LOCATION OF WELL

Latitude: 45.8495 Datum: WGS84

Longitude: -122.8148

Township/Range/Section/Quarter-Quarter Section:

WM 4N 1W 9 NWNE

Address of Well:

NEAR 1875 OLD PORTLAND ROAD\NST. HELENS, OREGON 97051

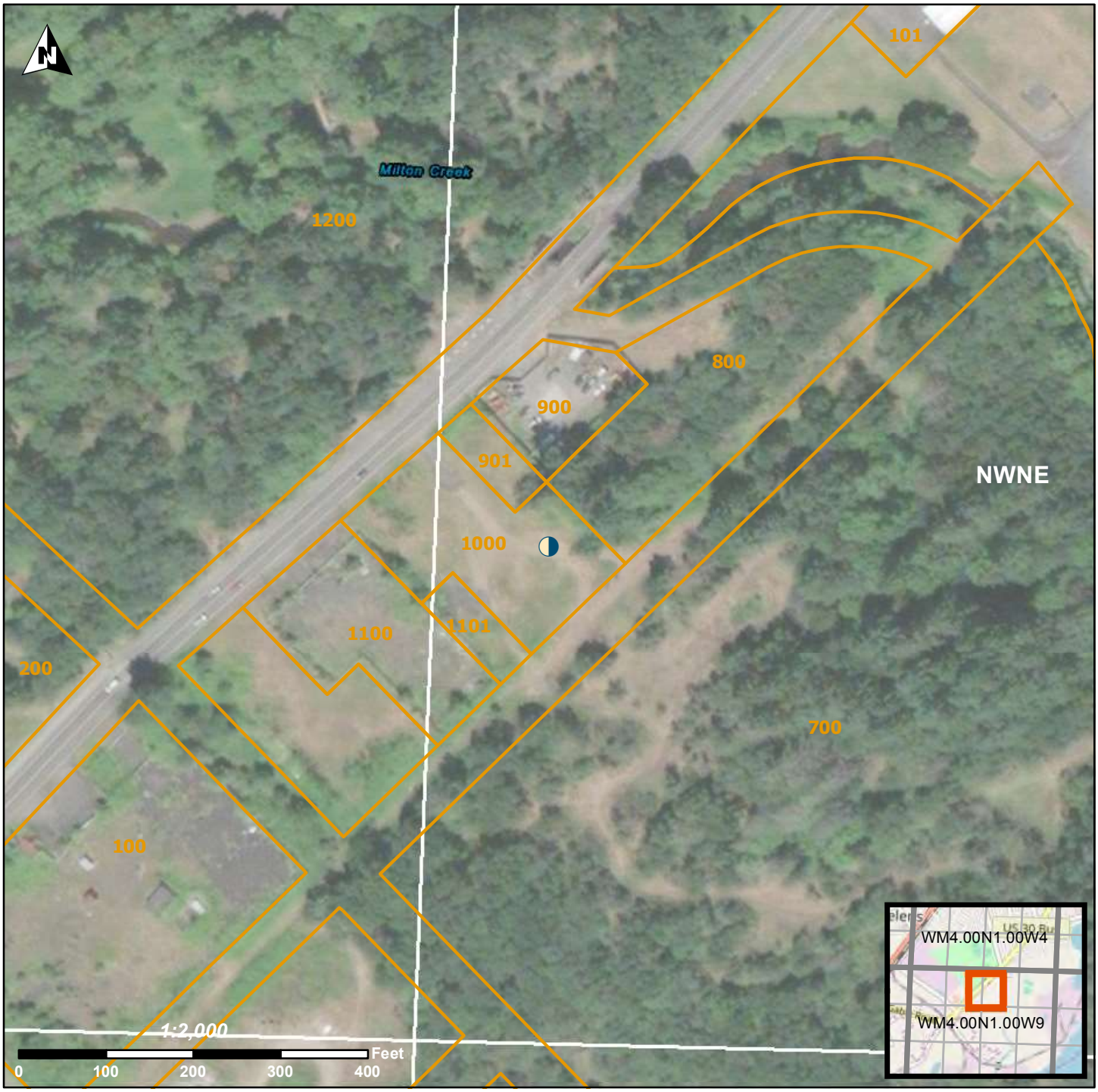
Well Label: L132783

Well Log: COLU 55412

Printed: January 23, 2019

DISCLAIMER: This map is intended to represent the approximate location of the exempt use well provided by the land owner. It is not intended to be construed as survey accurate in any manner.

Generated by OWRD



STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765 & OAR 690-205-0210)

COLU 55360

12/13/2018

WELL I.D. LABEL# L 130194
START CARD # 1040432
ORIGINAL LOG #

(1) LAND OWNER

Owner Well I.D.
First Name RODNEY Last Name MOORE
Company
Address 36050 CONSTRUCTION WAY
City ST. HELENS State OR Zip 97051

(2) TYPE OF WORK

☒ New Well ☐ Deepening ☐ Conversion ☐ Alteration (complete 2a & 10) ☐ Abandonment(complete 5a)

(2a) PRE-ALTERATION

	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
Casing:									

	Material	From	To	Amt	sacks/lbs
Seal:					

(3) DRILL METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other

(4) PROPOSED USE

☒ Domestic ☐ Irrigation ☐ Community
☐ Industrial/ Commericial ☐ Livestock ☐ Dewatering
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)
Depth of Completed Well 305.00 ft.

BORE HOLE

Dia	From	To
10	0	18
6	18	305

SEAL

Material	From	To	Amt	sacks/lbs
Bentonite Chips	0	18	11	S
		Calculated	8	
		Calculated		

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☒ Other POUR
Backfill placed from ft. to ft. Material
Filter pack from 260 ft. to 305 ft. Material S1 SAND Size 10/20
Explosives used: ☐ Yes Type Amount

(5a) ABANDONMENT USING UNHYDRATED BENTONITE

Proposed Amount Actual Amount

(6) CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
●	○	6	☒	2	18	250	●	○	☒	☐
○	●	4	☐	5	305	200	○	●	☒	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

Shoe ☐ Inside ☐ Outside ☐ Other Location of shoe(s)
Temp casing ☐ Yes Dia From + ☐ To

(7) PERFORATIONS/SCREENS

Perforations Method saw cut
Screens Type Material

Perf/ Screen	Casing/ Screen Liner	Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/ pipe size
Perf	Liner	4	265	305	.25	4	60	

(8) WELL TESTS: Minimum testing time is 1 hour

○ Pump ○ Bailer ◉ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)
30		300	1

Temperature 52 °F Lab analysis ☐ Yes By
Water quality concerns? ☐ Yes (describe below) TDS amount 200 ppm

From	To	Description	Amount	Units

(9) LOCATION OF WELL (legal description)

County COLUMBIA Twp 4.00 N N/S Range 1.00 W E/W WM
Sec 9 SW 1/4 of the NW 1/4 Tax Lot 901
Tax Map Number Lot
Lat ° ' " or 45.84480689 DMS or DD
Long ° ' " or -122.82337255 DMS or DD
○ Street address of well ◉ Nearest address
NEAR 36050 CONSTRUCTION WAY

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Pre-Alteration				
Completed Well	9/14/2018			190

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found 280.00

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
9/14/2018	280	285	30			190

(11) WELL LOG

Ground Elevation

Material	From	To
brown clay	0	5
broken basalt	5	12
brown and grey basalt	12	23
green and grey basalt	23	33
brown and white claystone	33	40
grey basalt	40	120
brown basalt	120	125
grey basalt	125	280
black basalt	280	285
grey basalt hard	285	305

Date Started 9/10/2018 Completed 9/14/2018

(unbonded) Water Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 1975 Date 9/14/2018

Signed AARON MORLEY (E-filed)

(bonded) Water Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

License Number 1480 Date 12/13/2018

Signed ARTHUR MCMULLEN (E-filed)

Contact Info (optional) 503 397 2356

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK Form Version: wlk

WATER SUPPLY WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

COLU 55360

12/13/2018

Map of Hole

STATE OF OREGON
WELL LOCATION MAP

This map is supplemental to the WATER SUPPLY WELL REPORT

Oregon Water Resources Department
725 Summer St NE, Salem OR 97301
(503)986-0900

LOCATION OF WELL

Latitude: 45.8448068944 Datum: WGS84
Longitude: -122.82337255092
Township/Range/Section/Quarter-Quarter Section:
WM 4N 1W 9 SWNW
Address of Well:
NEAR 36050 CONSTRUCTION WAY

Well Label: 130194

Printed: September 14, 2018

DISCLAIMER: This map is intended to represent the approximate location the well. It is not intended to be construed as survey accurate in any manner.

Provided by well constructor

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765 & OAR 690-205-0210)

COLU 55412

1/22/2019

WELL I.D. LABEL# L 132783
START CARD # 1041592
ORIGINAL LOG #

(1) LAND OWNER

Owner Well I.D.
First Name GARY Last Name KERVIN
Company
Address PO BOX 780
City SCAPPOOSE State OR Zip 97056

(2) TYPE OF WORK

☒ New Well ☐ Deepening ☐ Conversion ☐ Alteration (complete 2a & 10) ☐ Abandonment(complete 5a)

(2a) PRE-ALTERATION

	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
Casing:									

	Material	From	To	Amt	sacks/lbs
Seal:					

(3) DRILL METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other

(4) PROPOSED USE

☒ Domestic ☐ Irrigation ☐ Community
☐ Industrial/ Commericial ☐ Livestock ☐ Dewatering
☐ Thermal ☐ Injection ☐ Other

(5) BORE HOLE CONSTRUCTION

Special Standard ☐ (Attach copy)
Depth of Completed Well 200.00 ft.

BORE HOLE

Dia	From	To
10	0	20
6	20	200

SEAL

Material	From	To	Amt	sacks/lbs
Bentonite Chips	0	20	7	S
		Calculated	6	
		Calculated		

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☒ Other POUR
Backfill placed from ft. to ft. Material
Filter pack from ft. to ft. Material Size
Explosives used: ☐ Yes Type Amount

(5a) ABANDONMENT USING UNHYDRATED BENTONITE

Proposed Amount Actual Amount

(6) CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
●	○	6	☒	1.5	20	250	●	○	☒	☐
○	●	4	☐	3	200	40	○	●	☐	☒
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

Shoe ☐ Inside ☒ Outside ☐ Other Location of shoe(s) 20
Temp casing ☐ Yes Dia From + To

(7) PERFORATIONS/SCREENS

Perforations Method saw cut
Screens Type Material

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/ pipe size
Perf	Liner	4	160	200	.25	6	60	

(8) WELL TESTS: Minimum testing time is 1 hour

○ Pump ○ Bailer ● Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)
40		200	1

Temperature 41 °F Lab analysis ☐ Yes By
Water quality concerns? ☐ Yes (describe below) TDS amount 192 ppm

From	To	Description	Amount	Units

(9) LOCATION OF WELL (legal description)

County COLUMBIA Twp 4.00 N N/S Range 1.00 W E/W WM
Sec 9 NW 1/4 of the NE 1/4 Tax Lot 1000
Tax Map Number Lot
Lat ° ' " or 45.84953100 DMS or DD
Long ° ' " or -122.81478500 DMS or DD
○ Street address of well ● Nearest address
NEAR 1875 OLD PORTLAND ROAD\NST. HELENS, OREGON 97051

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Pre-Alteration			☐	
Completed Well	12/26/2018		☐	54

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found 170.00

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
12/28/2018	170	180	40		☐	54
					☐	
					☐	
					☐	
					☐	

(11) WELL LOG

Ground Elevation

Material	From	To
basalt weatherd	0	5
tan claystone	5	14
gray basailt	14	98
gray brn sandstone	98	110
gray basailt	110	170
pours gray basalt	170	180
gray basalt	180	200

Date Started 12/26/2018 Completed 12/28/2018

(unbonded) Water Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 1975 Date 1/22/2019

Signed AARON MORLEY (E-filed)

(bonded) Water Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

License Number 1480 Date 1/22/2019

Signed ARTHUR MCMULLEN (E-filed)

Contact Info (optional) 503 397 2356

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK Form Version:

WATER SUPPLY WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

COLU 55412

1/22/2019

Map of Hole

STATE OF OREGON
WELL LOCATION MAP

This map is supplemental to the WATER SUPPLY WELL REPORT

Oregon Water Resources Department
725 Summer St NE, Salem OR 97301
(503)986-0900

LOCATION OF WELL

Latitude: 45.849531 Datum: WGS84
Longitude: -122.814785
Township/Range/Section/Quarter-Quarter Section:
WM 4N 1W 9 NWNE
Address of Well:
NEAR 1875 OLD PORTLAND ROAD
ST. HELENS, OREGON 97051

Well Label: 132783

Printed: January 22, 2019

DISCLAIMER: This map is intended to represent the approximate location the well. It is not intended to be construed as survey accurate in any manner.

Provided by well constructor

APPENDIX F

UPDATED SUPPLEMENTAL HHRA

Appendix F –Updated Supplemental HHRA

Former Pope & Talbot Wood-Treating Site

St. Helens, Oregon

Prepared for:

Port of Columbia County
PO Box 190
Columbia City, Oregon 97018

Prepared by:

Cascadia Associates, LLC
5820 SW Kelly Avenue, Suite B
Portland, Oregon 97239

Project No. 0034-001-005
January 2020

Appendix F – Updated Supplemental HHRA

Former Pope & Talbot Wood-Treating Site

St. Helens, Oregon

Prepared for:

Port of Columbia County
Project No. 0034-001-005
January 2019

Prepared by:

Lindsay Wallis
Staff Environmental Scientist, Cascadia Associates

Kurt Harrington, P.E.
Project Manager, Cascadia Associates

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1.0 INTRODUCTION

This appendix to the Supplemental Remedial Investigation Report (RI) has been prepared by Cascadia Associates, LLC (Cascadia), on behalf of the Port of Columbia County (formerly, the Port of St. Helens; the Port), to update human health risk assessment (HHRA) deliverables previously submitted to Oregon Department of Environmental Quality (DEQ) for the former Pope & Talbot (P&T) wood-treating property located at 1550 Railroad Avenue in St. Helens, Oregon (the "Site"). Correspondence between the Port and DEQ between January and March 2014 formed the basis for the scope of the initial Supplemental HHRA, which was submitted in 2014 and focused on the evaluation of potential risks from sediment and groundwater to previously established receptors based primarily on the datasets generated during the Supplemental RI. This Updated Supplemental HHRA expands upon the 2014 Supplemental HHRA to address DEQ comments on the initial document and in correspondences between March 2015 and January 2019. The potential risks to receptors from soil and surface water as estimated in the 2006 HHRA (Kennedy/Jenks, Inc., 2006) were not updated in the 2014 Supplemental HHRA because no new soil data (above the water table) or surface water data were generated in the time between completion of the 2006 HHRA and the 2014 Supplemental HHRA. At the request of DEQ comments on the 2014 Supplemental HHRA, this Updated Supplemental HHRA includes an evaluation of potential risks from soil exposure using updated risk-based concentrations (RBCs) and to include new receptors (i.e., construction workers). The conclusions from this analysis, in addition to the results from the 2006 HHRA for soil, were incorporated into the risk characterization and uncertainty discussions in the Updated Supplemental HHRA. Additionally, because additional surface water data were collected since the 2014 Draft Supplemental HHRA was completed, the Updated Supplemental HHRA includes a limited evaluation of potential risk due to exposure from surface water.

1.1 OBJECTIVES OF THE UPDATED SUPPLEMENTAL HHRA

The overall objective of the Updated Supplemental HHRA was to evaluate the potential risks to previously identified receptors from exposure to contaminated media associated with historical Site activities based primarily on datasets generated during completion of the Updated Supplemental RI and also other historic datasets to fill in the gaps for a comprehensive evaluation of risk. The Updated Supplemental RI focused on evaluation of soil, sediment, sediment porewater, surface water, and continued monitoring of groundwater on a target suite of analytes that includes polynuclear aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), selected volatile organic compounds (VOCs, specifically benzene, toluene, ethylbenzene, and xylenes [BTEX]), selected metals (arsenic, cadmium, chromium, copper, lead, iron, and zinc), polychlorinated biphenyls (PCBs), and dioxins/furans. Thus, the Updated Supplemental HHRA evaluates potential risks from exposure to PAHs, TPH, selected VOCs, selected metals, PCBs, and dioxins/furans found in soil, sediment, surface water, and/or groundwater (sediment porewater is not a significant medium of exposure for human receptors). Specifically, the Updated Supplemental HHRA does the following:

- Identifies chemicals of potential concern (COPCs) in sediment, soil, surface water, and groundwater;
- Updates the conceptual site model (CSM) to illustrate and clarify potentially complete exposure pathways;
- Compiles the most current toxicity information for COPCs in soil, sediment, surface water, and groundwater;
- Quantitatively evaluates the potential risks to human receptors from the COPCs in soil, sediment, surface water, and groundwater;
- Evaluates potential for bioaccumulation of select analytes from sediment, surface water, and porewater;
- Identifies constituents of concern (COCs) in soil, sediment, surface water, and groundwater and exposure pathways that will need to be addressed in the feasibility study; and
- Incorporates the results of the 2006 HHRA for exposures to soil and surface water as part of the risk characterization and uncertainty discussions to provide a complete evaluation of the potential risks at the Site.

1.2 APPROACH

The approach used to evaluate potential risks in the Updated Supplemental HHRA is consistent with the requirements of Oregon Administrative Rules (340-122-0084) and was based on the following human health risk assessment guidance from DEQ and EPA:

- DEQ Human Health Risk Assessment Guidance (DEQ, 2010);
- DEQ Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites (DEQ, 2003);
- DEQ Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment (DEQ, 2007);
- U.S. Environmental Protection Agency (EPA) Risk Assessment Guidance for Superfund, Part A – Human Health Evaluation Manual (EPA, 1989);
- EPA Risk Assessment Guidance for Superfund, Part E – Dermal Risk Assessment (EPA, 2004); and
- EPA Risk Assessment Guidance for Superfund, Part F – Supplemental Guidance for Inhalation Risk Assessment (EPA, 2009).

In addition, DEQ allowed for the scope of the 2014 Supplemental HHRA to focus on a limited number of media (sediment and groundwater), a limited set of analytes (those that were part of the

Supplemental RI analytical testing program), and a limited number of samples (those from outside areas of inferred non-aqueous phase liquids [NAPL]) as described in its letter dated January 30, 2014 (DEQ, 2014a). The scope of this Updated Supplemental HHRA was expanded to include additional media and analytes at the request of DEQ in a comment letter (DEQ, 2015), the RI summary letter (DEQ, 2019), or in email and/or phone correspondence.

1.3 REPORT ORGANIZATION

This report is organized into the following sections:

- Section 2.0 – Site Background – Provides pertinent background on the physical setting of the Site, beneficial land and water use, and a brief summary of historical investigations, including the 2006 HHRA.
- Section 3.0 – Data Evaluation – Describes the datasets and screening process used to identify the COPCs in sediment, groundwater, porewater, and surface water, and presents a summary of COPCs.
- Section 4.0 – Exposure Analysis – Describes potentially complete exposure pathways, the selection of exposure units, development of exposure point concentrations, and the exposure parameters and equations used to estimate daily intakes.
- Section 5.0 – Toxicity Analysis – Presents the assessment of toxicity information for COPCs in sediment, groundwater, porewater, and surface water evaluated in the Supplemental HHRA.
- Section 6.0 – Risk Characterization – Presents how the risk characterization process is conducted, summarizes the quantitative results for each receptor from exposure to sediment, groundwater, porewater, and surface water, and incorporates the results for soil and surface water as presented in the 2006 HHRA.
- Section 7.0 – Uncertainty Analysis – Identifies and describes where uncertainty in the risk assessment could lead to over- or underestimation of risk.
- Section 8.0 – Conclusions – Summarizes the overall conclusions of the Updated Supplemental HHRA and the 2006 HHRA.

2.0 SITE BACKGROUND

2.1 SITE LOCATION

This 42-acre site is located in Sections 9 and 10, Township 4 North, Range 1 West (S9 and S10, T4N, R1W) inside the city limits of St. Helens, Oregon. Its southern shore is situated at the mouth of Scappoose Bay and its confluence with Multnomah Channel. The Site is bounded on the south and west by surface water (Scappoose Bay, Multnomah Channel, and Milton Creek). Specifically,

Scappoose Bay and the Multnomah Channel of the Willamette River form the southern and eastern Site boundaries. Milton Creek forms the western Site boundary. On the north there is a raised railroad bed and tracks separating the Site from undeveloped land immediately north and northwest thereof, and on the northeast, industrial development (Boise Paper Solutions).

2.2 SITE HISTORY

The industrial-zoned Site was established as a wood-treating facility in 1912 and wood-treating operations continued until 1960. The primary wood-treating compound used was creosote. Pentachlorophenol (PCP) and chromated copper arsenate were apparently used in limited quantities in 1953/1954. The Port purchased the property in 1963 and since then, the Site has either been vacant or leased for the following industrial uses:

1. Pole peeling and pole storage facility (1974 to 1991);
2. Storage yard for a marine construction/dredging company (1993 to 1998);
3. Private wood-working business (2000 to 2005);
4. Marine log salvage and saw mill (2006 to 2008);
5. Log storage, pole peeling, and saw mill (2009 to 2012); and
6. Miscellaneous small-scale private businesses (2014 to present).

2.3 SITE CONDITIONS

The Site is vacant, aside from a shop/warehouse building located in the western half of the Site. The topography of the Site upland areas is relatively flat, with a gentle downward slope toward the northeast. The shoreline along Scappoose Bay/Multnomah Channel and Milton Creek is generally characterized by relatively steep vegetated embankments. The elevation of the Site ranges between approximately 15 and 25 feet (North American Vertical Datum of 1988 [NAVD 88]). The Site margins, particularly the northeastern portion, are prone to annual flooding.

Access to the Site is limited by a number of physical features. Only one public road (Railroad Avenue) leads to the Site and this road crosses a narrow, one-lane bridge. A secondary access point is available for vehicles from the neighboring Boise facility but is not readily accessible by the generic public. Railroad tracks on an elevated grade along the northern property boundary and water bodies on the west (Milton Creek), east (Scappoose Bay) and south (Scappoose Bay) further restrict access.

The Site is split into two areas: (1) Area 1 is comprised of the historical wood treating operations which were located on the western half of the Site, and (2) Area 2 which historically was primarily vacant land located on the east half of the Site. The DEQ issued a conditional No Further Action (NFA) determination for Area 2 in 2008 (DEQ, 2008). Therefore, the Supplemental RI does not address Area 2.

2.4 PHYSICAL SITE SETTING

2.4.1 Soil Conditions

Soil encountered at the Site consists of fill underlain by native soil, which in turn is underlain by basalt bedrock. A summary of these units follows:

- The fill consists predominantly of dredge sand with localized areas of silt, coarse gravel, cobbles, wood chips, and metal and brick debris. For the purposes of the Supplemental RI, this unit is defined as the "Fill Zone".
- Native soil beneath the fill consists primarily of silt with varying amounts of clay and organic matter, and minor amounts of sand and gravel. For the purposes of the Supplemental RI, this unit is defined as the "Native Soil".
- Basalt bedrock was generally encountered at depths between 6 and 35 feet below ground surface (bgs). Bedrock beneath the Site is part of the Grande Ronde flows of the Columbia River Basalt Group. For the purposes of the Supplemental RI, this unit is defined as the "Basalt Bedrock".

Additional detail on each of these units is provided in the Supplemental RI Report (Cascadia, 2019).

2.4.2 Groundwater Conditions

Groundwater conditions at the Site are summarized below:

- Shallow groundwater beneath the Site occurs from immediately below the ground surface to depths of about 12 feet bgs, depending on the season.
- The water table generally replicates the surface topography of the Site, with maximum groundwater elevations in the central portion of the Site and groundwater flow (discharge) to the nearest surface water body.
- Hydraulic conductivity within the Fill Zone is approximately 1 to 2 orders of magnitude greater than the Native Soil. Hydraulic conductivity within the Native Soil is generally 2 to 3 orders of magnitude greater than the underlying Basalt Bedrock, in the limited locations where the basalt had sufficient permeability for testing.

Additional detail on each of these units is provided in the Supplemental RI Report (Cascadia, 2019).

2.4.3 In-Water Conditions

The site is bordered by two water bodies, Scappoose Bay/Multnomah Channel and Milton Creek that are tidally and seasonally influenced. The water depth in Scappoose Bay varies with season and tides but can be as little as a few inches near the shore to as much as 34 feet near its centrally located navigation channel. The water depth of Milton Creek is relatively shallow upstream of the Railroad Avenue vehicle bridge (between 1 and 4 feet depending on season and tide). The bed of

Milton Creek generally widens downstream of the vehicle bridge, and its water depth quickly increases to levels consistent with Scappoose Bay (between 1 foot near the shoreline to over 15 feet at its midpoint). During periods of low surface water, small localized groundwater seeps have been observed along the Area 1 shorelines of Scappoose Bay and Milton Creek.

Shallow sediment conditions (upper 12 inches) along the Area 1 shoreline at the Site were explored during multiple investigations. Sediments are typically silty materials, except between the peninsula and the former transfer table dock where the sediments are primarily sandy materials. The surface of the basalt bedrock occurs at varying depths but is typically deeper than 1 foot below the mudline.

2.4.4 Extent of NAPL

NAPL has been found to occur in soil, groundwater, groundwater seeps, and sediment at the Site. The nature of the NAPL has been investigated and results provided in the 2000 RI Report (GeoEngineers, 2000 [Appendix C, Tables C-17 through C-23]) indicate a NAPL composition consistent with recent Supplemental RI NAPL analytical results for creosote-related constituents. The extent of NAPL at the Site has been inferred based on field observations during the multiple investigation events conducted during the Supplemental RI. The extent is shown on Figure F-1. The nature of the Site NAPL is dominated by TPH within the diesel-range, although chromatograms do not match a typical diesel chemical signature, and PAHs; specifically, naphthalene, phenanthrene, 2-methylnaphthalene, and others. Additional discussion of the nature and extent of NAPL is presented in Section 5.3 of the Supplemental RI Report (Cascadia, 2019).

Areas of observed or inferred NAPL are already assumed to pose an unacceptable risk because these areas of free product are considered highly concentrated and are discharging through seeps to sediment and surface water where human and ecological receptors can be exposed to this material. As agreed by DEQ (DEQ, 2014a), the Updated Supplemental HHRA focuses on evaluating areas outside of the inferred NAPL to support appropriate remedial evaluation and selection in the Feasibility Study (FS). The NAPL areas will be addressed separately in the FS as hotspot areas for remediation and are not quantitatively evaluated in the Updated Supplemental HHRA for potential risks.

2.5 BENEFICIAL LAND AND WATER USE

2.5.1 Current and Reasonably Likely Future Land Use

The Site is currently zoned for heavy industrial land use, but there are no active operations at the Site. The Port prepared a Strategic Business Plan (SBP) to guide its next 20 years of facilities management and project development (Port of St. Helens, 2012). According to the SBP, land use at the Site will continue to consist of heavy industrial uses, consistent with the City of St. Helens zoning designation of Heavy Industrial.

2.5.2 Current and Reasonably Likely Future Beneficial Water Use

Beneficial water use determinations conducted for the 2000 RI (GeoEngineers, 2000) and the 2014 Supplemental RI (AMEC, 2014) concluded there were no beneficial uses of shallow groundwater at or adjacent to the Site associated with drinking water, industrial use, or agricultural use. Water supply at the Site is provided by the City of St. Helens (Port of St. Helens, 2012). Based on the poor yield of the shallow aquifer (less than 0.5 gallon per minute [GeoEngineers, 2000]) and the availability of municipal water supply, future beneficial uses of groundwater within the LOF are not expected. The only beneficial use of shallow groundwater within the LOF is discharge to surface water.

No on-site surface water uses were identified; however, the former Boise facility downstream of the Site was identified as using surface water for facility processes. Beneficial uses of surface water within the LOF consist of associated aquatic and terrestrial habitat, recreation, and aesthetic quality.

The Heavy Industrial zoning designation may allow for water-intensive land uses (e.g., plant nursery or greenhouses) to occur at the Site or in the immediate vicinity. Therefore, reasonably likely future beneficial surface water uses may include industrial facility uses and will continue to include recreational uses and aquatic and terrestrial habitat support.

2.6 SUMMARY OF PREVIOUS INVESTIGATIONS

Multiple investigations have been completed between 1989 and the present to assess the nature and extent of contamination resulting from historical activities at the Site. Brief summaries of these investigations are provided below.

2.6.1 Site Inspections (1989-1990)

Ecology & Environment, Inc. (E&E) conducted a small sampling effort to evaluate potential impacts to Site soil, sediment, surface water, and seep solids. E&E also collected a small number of offsite soil, sediment, and groundwater samples. PAHs and other organic compounds associated with creosote were identified in samples collected near former wood-treating facilities.

2.6.2 Vadose Zone Investigation (1993)

Harding Lawson Associates (HLA) conducted an investigation of soil conditions above the water table (HLA, 1994). Petroleum hydrocarbons, VOCs, semivolatile organic compounds (SVOCs), including PCP, and metals were found in samples from near former wood-treating facilities.

2.6.3 1996 - 1998 RI Activities

P&T and the Port performed two phases of remedial investigation to evaluate soil, groundwater, surface water, sediment, and seep conditions. Samples were tested for petroleum hydrocarbons, VOCs, PAHs, chlorinated phenols, dioxins/furans, metals, and PCBs. PAHs were the primary

constituents detected. Twenty-two monitoring wells were installed during the RI. Dense non-aqueous phase liquid (DNAPL; creosote petroleum product) was identified in some subsurface soil and in three monitoring wells (MW-2, MW3-A, and MW-3B) near product storage tanks in the former wood treatment plant area.

2.6.4 Multi-Phase Sediment Investigation (2003-2005)

Three phases of sediment investigation were completed by Hart Crowser, Inc. (Hart Crowser) and Kennedy/Jenks, Inc. (KJ) to support a risk evaluation for human and ecological receptors from exposure to PAHs, arsenic, and dioxins/furans in sediment. Bioassay testing was also conducted on selected sediment samples to support the ecological risk assessment.

2.6.5 Human Health Risk Assessment (2006)

KJ prepared a human health risk assessment to evaluate potential risks to human receptors from exposure to media impacted by historical Site activities. The HHRA evaluated risks to an on-Site industrial worker, an excavation worker, a recreational trespasser (defined as an older child), and a sport fisher. Soil, groundwater, sediment and surface water were evaluated based on the data collected during the RI (1996 to 1998), post-RI groundwater monitoring events (through 2004), and post-RI sediment sampling conducted in 2005. Exposure through direct contact, incidental ingestion, inhalation (vapor intrusion and outdoor air), and consumption of fish were evaluated. COPCs included selected VOCs, PAHs, PCBs, dioxins/furans, and metals.

PAHs in groundwater were retained as COCs but with the qualification that there was a high degree of uncertainty in the quantitative assessment of dermal exposure to PAHs in groundwater and this uncertainty should be factored into remedial decision-making.

2.6.6 Supplemental RI (2010-2013)

The Port conducted the initial phases of the Supplemental RI between 2010 and 2013 to further evaluate impacts to sediment and to evaluate impacts to sediment porewater. The following investigations and activities were completed during the Supplemental RI:

- Groundwater Monitoring – Five monitoring events were conducted between 2010 and 2012 to confirm current groundwater conditions, DNAPL occurrence, and the quality of groundwater discharging from Area 1 uplands to the adjacent surface water bodies (Scappoose Bay and Milton Creek). Groundwater samples were analyzed for PAHs, selected VOCs (BTEX), petroleum hydrocarbons, and selected metals.
- Shoreline Inspections – These were conducted along Milton Creek and Scappoose Bay in 2010, 2011, and 2012 during low water/low tide to document visual observations of NAPL and conditions along the Site when the shoreline sediment within the intertidal zone was visible.

- TarGOST ®Investigation – The Tar-specific Green Optical Screening Tool (TarGOST®) was used to aid in delineation of upland and offshore NAPL (AMEC, 2011) through completion of 110 TarGOST® borings and periodically through extraction and logging of soil macrocores directly adjacent to select TarGOST® Geoprobe® borings to compare visual observations with the results from the TarGOST ® boring.

- Delineation of Offshore DNAPL – Offshore borings were completed to confirm the results of the TarGOST ® investigation. Thirty-one borings were advanced in Scappoose Bay and four borings were advanced in Milton Creek using a combination of Vibracore and Sonic drilling/sampling methods. Soil/sediment samples were collected from three or more depth intervals and were tested for diesel-range petroleum hydrocarbons and PAHs. Two surface sediment samples collected near the historical transfer table and dock were analyzed for selected metals (arsenic, cadmium, chromium, iron, lead) and VOCs. Three sediment samples were analyzed for VOCs, extractable petroleum hydrocarbons (EPH), and volatile petroleum hydrocarbons (VPH).

- Delineation of Upland DNAPL – Eight new groundwater monitoring wells were installed to confirm the lateral extent of DNAPL, to further investigate the presence of DNAPL near Milton Creek, and to replace MW-2 to investigate the thickness of DNAPL present in the source area.

- Porewater/Sediment Sampling Investigation and Limited Sediment Investigation (LSI) – Two porewater/sediment sampling events were conducted in 2012, one during high-water conditions (July) and one during low-water conditions (October), to evaluate sediment and sediment porewater in and around areas of creosote-impacted Site sediment. Approximately 30 sediment and porewater samples were collected during each event, including samples collected from upstream and downstream locations away from the Site. Six sediment and sediment porewater samples were collected during the LSI. Sediment and sediment porewater samples were analyzed for PAHs. Sediment samples were also analyzed for TPH.

- Dock Area Investigation – Six sonic borings, 13 direct-push borings, 19 potholes, and 3 hand-auger borings were completed to delineate the lateral and vertical extent of creosote-related contamination in nearshore sediment. Samples were analyzed for petroleum hydrocarbons and PAHs.

2.6.7 Supplemental RI (2015-2019)

Following DEQ comments (DEQ, 2015), a phased offshore data gap investigation was performed in 2017 and 2018, as described in Section 3.7 of the Updated Supplemental RI. Phase 3 of this investigation included supplemental sediment porewater and surface water sampling using *in-situ* passive sampling devices (PSDs) containing low-density polyethylene (LDPE) outside offshore areas of creosote NAPL and sheen in surface sediment in September 2017. The data obtained

during this final phase of the RI were intended to supplement previous RI data, and ultimately, to more clearly define the offshore sediment areas that are sources of potentially significant ecological toxicity and surface water impacts (i.e., priority remedial action areas).

3.0 DATA EVALUATION

The data evaluated in the Supplemental HHRA are described in this section, consistent with the approach agreed to with DEQ as indicated in Section 1.2. A summary of samples and the associated analytical results used in this risk assessment are provided in Attachment F-A.

3.1 SUMMARY OF AVAILABLE DATA

The available data were reviewed to determine what previously had been evaluated in the 2006 HHRA. The sections that follow describe the data evaluation and summarize how the RI and Supplemental RI datasets were used in the Updated Supplemental HHRA.

3.1.1 Media Without New Data Since the 2006 HHRA

The 2014 Supplemental RI did not include additional sampling of surface soil, subsurface soil (above the water table), or surface water, so an updated quantitative assessment of these media was not performed in the 2014 Supplemental HHRA, as agreed with DEQ (DEQ, 2014a). However, to address DEQ comments (DEQ, 2015) and use current best practices, the Updated Supplemental HHRA includes an updated quantitative assessment of risk from PCBs in soil for all receptors, dioxins/furans in sediment for the sport fisher, and all soil COPCs from the 2006 HHRA for the construction worker receptor using the most up-to-date RBCs. An updated assessment of potential risk from PAHs in surface water was also included to reflect the updated data collected since the completion of the initial (2014) HHRA. The results of the updated analyses as well as the 2006 HHRA for these media were incorporated into the discussion of risk characterization and uncertainty provided in Sections 6 and 7.

3.1.2 Samples from Areas of Inferred NAPL

As agreed with DEQ, the Updated Supplemental HHRA does not evaluate data from sediment samples collected within areas of inferred NAPL because exposure to NAPL is considered to have unacceptable risk and therefore does not require further evaluation to be carried forward to the FS. The areas of inferred NAPL are illustrated on Figure F-1, as are the sediment sample locations which are color-coded to identify those that are within the areas of inferred NAPL (shown in red) and those that are outside areas of inferred NAPL (shown in blue).

3.1.3 Upstream / Background Sample Locations

Samples collected from upstream of the Site, from downstream background locations not intended to be representative of Site conditions, or from distal reference locations were not included in the Supplemental HHRA. These samples are:

- Upstream samples – PWS-18, PWS-19, PWS-20, SD-BG-1, SD-BG-2, SD-BG-3, and PWS-090517-3;
- Downstream background samples – PWS-21, SB-BG-4 (background samples in Multnomah Channel), and SD-BG-5 (background sample in the Columbia River); and
- Reference samples – REF-CI-1, REF-CI-2, and REF-WB (reference locations in the Columbia River, upstream of the Site).

Upstream and background samples that are relatively close to the Site are shown on Figure F-2. Other samples listed above that do not appear on Figure F-2 are located farther away from the Site.

3.1.4 Groundwater Data

The 2006 HHRA evaluated groundwater data collected between 1996 and 2004. The Updated Supplemental HHRA evaluates all groundwater data collected from Area 1 between 2005 and 2012, including those collected from monitoring wells within the inferred extent of subsurface DNAPL. Monitoring well locations and inferred extent of subsurface DNAPL extent are shown on Figure F-3. Groundwater from Area 2 was not evaluated because this portion of the Site received an NFA determination from DEQ in 2008, and thus no further assessment was warranted.

3.1.5 Sediment Data

The 2006 HHRA evaluated discrete and composite sample results collected in 1996, as well as a small number of samples collected in 2005, but it excluded multiple sediment samples collected in 2003 and 2004. Therefore, DEQ determined that a comprehensive quantitative assessment of all available sediment data was appropriate (DEQ, 2014a). The quantitative evaluation in the Updated Supplemental HHRA includes all discrete samples from areas outside of inferred NAPL collected between 1996 and 2017 (Figure F-1; blue sample locations).

3.1.6 Sediment Porewater and Surface Water Data

Human receptors are not exposed to sediment porewater as a separate media, so a separate evaluation of porewater was not conducted, as agreed with DEQ via e-mail on March 6, 2014 (DEQ, 2014c), except to compare porewater concentrations to screening levels values (SLVs) protective of people consuming fish that have accumulated site-related chemicals. Surface water samples were also evaluated for protection of people consuming fish from carcinogenic PAHs by comparing them to the same site-specific SLVs as for porewater.

3.1.7 Data Qualification

The quantitative evaluation in the Supplemental HHRA includes the results presented in the data tables provided in Attachment F-A. Results rejected during data validation were excluded. Results qualified with a "J" (estimated value) or "N" (presumptively identified) were included.

3.2 CHEMICAL SCREENING CRITERIA

All compounds detected at least once were considered contaminants of interest (COIs) and were carried into the screening process to determine if they should be considered COPCs. The following sections describe the criteria used to select COPCs.

3.2.1 Selection of Constituent Classes

As agreed with DEQ (DEQ, 2014a), the initial Supplemental HHRA evaluated constituent classes that were the focus of the Supplemental RI, specifically, PAHs, TPH, selected VOCs, and selected metals. The Updated Supplemental HHRA evaluated the same constituent classes as well as PCBs in soil and dioxins and furans in sediment, as requested by DEQ (DEQ, 2015). The constituent classes evaluated in each media are described below, along with the rationale for excluding evaluation of some compounds, consistent with the approach described in DEQ's January 30, 2014 letter:

- Groundwater – PAHs, TPH, selected VOCs (BTEX), and selected metals (arsenic, cadmium, chromium, lead, and zinc) were evaluated. A statistical summary of the groundwater data is provided in Table F-1.
- Sediment – PAHs, TPH, and dioxins/furans were evaluated. A statistical summary of the sediment data is provided in Table F-2A. Further evaluation of VOCs, metals, and dioxins/furans in sediment was not warranted as described below:
  - VOCs – A total of 7 sediment samples were analyzed for VOCs during the Supplemental RI. Six of the 7 samples are located within areas of inferred NAPL, and thus were excluded from quantitative evaluation. One sample falls outside of inferred areas of NAPL (SB-17, located near the edge of the transfer table dock), but no VOCs were detected in this sample.
  - Metals – Sediment samples collected in 2003 and 2011 were analyzed for metals. The 2003 samples were analyzed only for arsenic while the 2011 samples were analyzed for arsenic, cadmium, chromium, iron, and lead. All metals results from these samples are consistent with the site-specific background levels developed as part of the RI. A background level for iron was not established. However, it was not included as a COPC because it is considered an essential nutrient (DEQ, 2010). Table F-2B presents the 2003 and 2011 metals results along with the site-specific background levels.
  - Dioxins/furans – Four sediment samples collected in 2005 were analyzed for dioxins and furans. One of these samples (SD-142) was within the inferred extent of NAPL and therefore excluded from quantitative evaluation. Three samples (SD-131, SD-143, and SD-144) were outside the extent of inferred NAPL, although sample SD-131 lies within the extent of surface petroleum sheen. As shown in Table F-2C, both samples outside the extent of inferred NAPL and/or sheen had no detections that exceeded bioaccumulation SLVs (general and subsistence consumption) for any congeners, with the exception of

one congener in one sample. The sample outside the extent of NAPL but within the extent of sheen had one or more exceedances of bioaccumulation SLVs for general and subsistence consumption. A quantitative evaluation of risk from bioaccumulation of dioxins/furans to sport fishers is provided in Table F-10. A summary of risks from sediment is provided in Table F-11.

- Soil – Per DEQ's comments (DEQ, 2015), soil PCBs were re-evaluated using current risk assessment guidance for all site receptors (industrial worker, excavation worker, and construction worker). The construction worker receptor was also evaluated for VOCs, SVOCs, and metals, per DEQ request (DEQ, 2015). These analyses were done for both surface and subsurface soil using the EPCs determined in the 2006 HHRA and shown in Table F-4E. Results of the soil risk analyses are included in Tables F-13A through F-13G. Results from the 2006 HHRA risk analyses for soil are included in Table F-13H for reference.
- Surface Water – Eight surface water samples were collected concurrently with porewater samples in 2017 and analyzed for 34 PAHs. These concentrations were screened against Preliminary Remediation Goals (PRGs), as shown in Table F-2E.

3.2.2 Frequency of Detection

Constituents detected at least once were included in the evaluation. Similarly, constituents that were never detected were eliminated from the evaluation.

3.2.3 Toxicity Values for Chemical Classes

For certain chemical classes, risks were evaluated to combined, rather than individual, chemical exposure. COPCs that were evaluated as chemical classes are described below.

- Dioxins/furans: Carcinogenic effects of dioxin and furan exposure was evaluated using 2005 World Health Organization Toxic Equivalency Factors (TEFs; Van den Berg, 2006). Individual congener concentrations were multiplied by their specific TEF to determine the 2,3,7,8-TCDD equivalent concentration (TEQ). Non-detect values were replaced with 0 if that congener was not detected in any samples or one-half the detection limit if it was detected in at least one sample. Individual congener TEQs were summed to obtain a total 2,3,7,8-TCDD TEQ. Analytical results and calculated TEQs (and associated TEFs) are shown in Table F-2C.
- Carcinogenic PAHs: Carcinogenic effects of specific PAHs were evaluated using toxic equivalency factors (TEFs) to compare toxicity to benzo(a)pyrene (BaP), as was done for the Portland Harbor Superfund Site and requested in the January 15, 2019 DEQ letter. For individual carcinogenic PAHs (cPAHs), the detected concentration was multiplied by the specific TEF to get an individual TEQ. Individual cPAH TEQs were summed to get a BaP-equivalency TEQ. Calculated BaP TEQs (and associated TEFs) are shown in Table F-2D.

3.2.4 Risk-Based Screening Levels

Constituent concentrations were compared to the current version (DEQ, 2018) of DEQ's RBCs to determine which were carried forward into the risk assessment as COPCs. Where a DEQ RBC is not published, an EPA Regional Screening Level (RSL) was used instead. Additionally, the direct exposure to sediment and fish consumption pathways were screened against PRGs created using exposure assumptions for the adjacent Armstrong site, per DEQ's request (DEQ, 2019). The exposure assumptions and equations used to calculate PRGs are shown in Attachment F-F.

For screening of groundwater constituents in the Updated Supplemental HHRA, the most conservative RBC for the occupational worker or the excavation worker under the volatilization from groundwater and groundwater in excavation exposure pathways was used. When an RBC was not available, the following criteria were used:

- For PAHs with an RBC indicated as ">S", the calculated RBC is greater than the solubility of the compound. Therefore, the solubility value provided in Appendix D of DEQ's Risk-Based Decision Making guidance (RBDM; DEQ, 2018) was conservatively used as the screening value. PAHs with maximum detected concentrations exceeding the solubility limit were retained as COPCs.
- The diesel- and residual-range hydrocarbons RBC for occupational and excavation worker exposures is shown as ">S", indicating the RBC is greater than the respective solubilities. Because petroleum hydrocarbons are a mixture of compounds, there is no single solubility value published and thus all gasoline-, diesel-, and residual-range hydrocarbon results were carried forward into the risk assessment for discussion in the uncertainty section.
- For chromium, the more conservative RBC for chromium VI was used as the screening value, because the DEQ RBC for chromium III is indicated as ">S". Chromium VI is not known or expected to be present at the Site.
- For zinc, no DEQ RBC is published, so an EPA RSL was selected instead. The dermal RSL was selected as the appropriate screening value because ingestion of groundwater is not a complete pathway at the Site, as described above in Section 2.5.2, which summarizes the beneficial water use determination.

Surrogate compounds were used when published screening criteria were not available, as listed below.

- Naphthalene – used for 1-methylnaphthalene and 2-methylnapthalene
- Acenaphthene – used for acenaphthylene
- Fluoranthene – used for benzo(g,h,i)perylene and phenanthrene
- Benzo(k)fluoranthene – used for benzofluoranthenes

All PAHs and TPH detected in sediment were carried forward into the risk assessment because there are no published screening levels relevant to the recreational trespasser exposure scenario.

3.3 SELECTION OF CONSTITUENTS OF POTENTIAL CONCERN

The selection of COPCs is accomplished through a series of three screening steps. The first screening step is an individual screening evaluation that compares the maximum detected concentration of each compound to the appropriate DEQ RBC (or EPA RSL). Compounds with maximum detected concentrations greater than the screening level have a risk ratio that is greater than one. These compounds were retained as COPCs.

The second step evaluates the potential for noncarcinogenic compounds with individual risk ratios less than 1 to potentially contribute to unacceptable risk on a cumulative basis. This step is necessary if the sum of the risk ratios for all noncarcinogenic compounds is greater than 1. The sum of the risk ratios for noncarcinogenic compounds in the Updated Supplemental HHRA was greater than one, so the cumulative screening step was conducted. Two additional compounds were retained as COPCs based on the cumulative screen.

The final screening step is to evaluate the potential for multiple media to contribute to unacceptable risk when multiple media are being evaluated for the same receptor. A multi-media screening was not conducted for the Updated Supplemental HHRA because the receptors and media being evaluated do not overlap.

3.3.1 Groundwater COPCs

The selection of groundwater COPCs is illustrated in Table F-1. Eleven PAHs and TPH were retained as groundwater COPCs. No metals or VOCs were retained as COPCs.

3.3.2 Sediment COPCs

All PAHs, TPH, and dioxins/furans detected in sediment were retained as sediment COPCs.

3.3.3 Soil COPCs

To adequately reflect current risk assessment guidance, risk from PCBs in soil was re-evaluated using current risk-based criteria (DEQ, 2010) for all site receptors (industrial worker, excavation worker, and construction worker). A summary of soil PCB concentrations is provided in Table F-3.

Per DEQ's request (DEQ, 2015), risk from select COPCs to construction workers was also re-assessed. COPCs from the 2006 HHRA were retained as COPCs in the Updated HHRA (acenaphthene, methylene chloride, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, PCP, arsenic and lead). Table F-4D shows soil EPCs used in the Updated Supplemental HHRA. A full list of selection criteria for COPCs is provided in Table 1 of the 2006 HHRA.

4.0 EXPOSURE ANALYSIS

This section presents an updated CSM for the Site (Figure F-6) and provides the exposure assumptions used to evaluate potentially complete exposure pathways. The exposure assumptions used in the Updated Supplemental HHRA are largely consistent with those used in the 2006 HHRA. Changes are described in the sections that follow. The exposure analysis includes an evaluation of reasonable maximum exposure (RME) and central tendency exposure (CTE).

4.1 POTENTIALLY EXPOSED POPULATIONS

The potentially exposed populations are listed below, and are the same as those evaluated in the 2006 HHRA, with the following exceptions:

- On-Site Industrial Worker
- On-Site Excavation Worker
- On-Site Construction Worker – new receptor added at the request of DEQ (DEQ, 2015b)
- Recreational Trespasser
- Adult Boater – new receptor added at the request of DEQ at a July 26, 2011 meeting
- Sport Fisher – including analysis of both adult and child sport fisher added at the request of DEQ (DEQ, 2019)
- Transient– added at the request of DEQ (DEQ, 2019)

A brief summary of each receptor follows.

4.1.1 On-Site Industrial Worker

An on-Site industrial worker may be exposed directly to COPCs in soil and indirectly to COPCs in subsurface soil and groundwater through inhalation pathways (from volatilization or from particulates). The Updated Supplemental HHRA includes an evaluation of indirect exposures through inhalation of vapors from groundwater into indoor air or to outdoor air using maximum detected concentrations in place of RME concentrations. Per DEQ guidance (DEQ, 2010), default DEQ RME and CTE occupational exposure assumptions were used and are presented in the RBC tables provided in Attachment F-B.

4.1.2 On-Site Excavation Worker

An on-Site excavation worker may be exposed directly (through contact with soil or groundwater) and indirectly (from volatilization or from particulates) to COPCs in soil and groundwater. The Supplemental HHRA focuses on evaluation of exposure from groundwater in an excavation because no new soil data from the vadose zone were generated during the Supplemental RI. Default DEQ RME and CTE excavation worker exposure assumptions were used and are presented in the RBC tables provided in Attachment F-B.

4.1.3 On-Site Construction Worker

While not currently a complete exposure pathway, risk to the construction worker receptor was evaluated due to potential for future development on the Site. An on-Site construction worker is a potential future receptor that may be exposed directly through dermal contact, incidental ingestion, and/or inhalation of vapors or particulates to COPCs in soil. The Updated Supplemental HHRA focuses on evaluation of exposure from soil because other exposure pathways are covered in other evaluations (i.e., industrial and excavation worker).

4.1.4 Recreational Trespasser/Adult Boater

The recreational trespasser is a Site-specific receptor that is based on the seasonal behavior of an older child (about 10 years old) who is a local resident that is exposed to beach sediment while trespassing. The 2006 HHRA also qualitatively addressed an adult recreational trespasser, but only quantitatively evaluated the older child receptor because he or she would be the more sensitive receptor. The following Site-specific exposure assumptions were used to evaluate the older child recreational trespasser in the Updated Supplemental HHRA and are consistent with the 2006 HHRA:

- Body weight – 35 kilograms (kg; Site-specific; DEQ, 2005)
- RME exposure frequency – 94 days/year (Site-specific; best professional judgment)
  - Summer – 5 days/week for 13 weeks
  - Spring/Fall – 1 day/week for 26 weeks
  - Winter – 1 day/month for 3 months
- CTE exposure frequency – 38 days/year (Site-specific; best professional judgment)
  - Summer – 2 days/week for 13 weeks
  - Spring/Fall – 2 days/month for 6 months
- RME skin surface area – 3,395 square centimeters (cm^2; Site-specific; EPA 1997 modified)
  - Based on the 90th percentile of 25% of the average skin surface areas for a male child and a female child
- CTE skin surface area – 2,938 cm^2 (Site-specific; EPA 1997 modified)
  - Based on the 50th percentile of 25% of the average skin surface areas for a male child and a female child
- Exposure time – 8 hours/day (Site-specific; best professional judgment)

DEQ also requested that an adult boater be added to the CSM during the July 26, 2011 meeting. The adult boater has similar behavior to the older child recreational trespasser but approaches the Site from the water instead of from land. The older child recreational trespasser was used to quantitatively evaluate potential risks to the adult boater from sediment exposure because the older child recreational trespasser is a more sensitive receptor than the adult boater.

A combination of Site-specific and default assumptions were used to evaluate the recreational trespasser as presented on the Site-specific RBC calculation tables provided in Attachment F-C.

In addition to evaluating risk to the recreational trespasser/boater using the RBC approach, the Updated Supplemental HHRA includes a comparison of detected site concentrations to site-specific PRGs for direct contact to select COPCs (BaP TEQs, naphthalene, and TPH), developed by DEQ (DEQ, 2019) and shown in Attachment F-F.

4.1.5 Sport Fisher (Adult/Child)

The sport fisher is the most likely receptor to be consuming fish. This pathway was evaluated in the 2006 HHRA, but that evaluation pre-dates the DEQ 2007 Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment and thus did not evaluate bioaccumulative constituents. The Updated Supplemental HHRA evaluates exposure to bioaccumulative PAHs and dioxins/furans for general and subsistence consumption for adult and child anglers as requested by DEQ (DEQ, 2014a; DEQ, 2019) to reflect updated guidance (DEQ, 2007), including an evaluation of potential risks/hazards from bioaccumulation of dioxins/furans. The DEQ statewide consumption rate of 175 grams per day (g/day) was used for subsistence consumption exposure calculations and SLVs were re-calculated to reflect this, per DEQ guidance (DEQ, 2014). A consumption rate of 17.5 g/day was used for SLVs for general population exposure scenarios.

The Updated Supplemental HHRA also includes an evaluation of the direct contact with sediment exposure pathway, per DEQ's request (DEQ, 2019). This is done primarily through a comparison of detected Site concentrations to site-specific PRGs for direct contact to and bioaccumulation of select COPCs (BaP TEQ, naphthalene, and TPH), developed by DEQ using site-specific exposure assumptions for the adjacent Armstrong site (DEQ, 2019). Exposure assumptions and calculations for PRGs are shown in Attachment F-F.

4.1.6 Transient

The transient is a site-specific receptor that was added per DEQ's request due to its use in the adjacent Armstrong site (DEQ, 2019). The transient receptor has the same exposure pathways as the recreational trespasser (as shown on the CSM) but has different exposure parameters. The following exposure assumptions were used to evaluate risk to the transient receptor, as described in DEQ (2019):

- Body weight – 80 kg
- Exposure frequency – 14 days/year
- Exposure duration – 1 year
- Skin surface area – 5,700 cm^2

A combination of Site-specific and default assumptions was used to evaluate the transient as presented on the PRG calculations provided in Attachment F-F.

4.2 IDENTIFICATION OF EXPOSURE PATHWAYS

The exposure pathway defines how chemicals physically enter the human body (i.e. through ingestion, dermal contact, or inhalation). An exposure pathway is considered incomplete if the any of the following four elements is missing:

- A source of the chemical
- A transport medium (such soil or groundwater)
- An exposure point (the point where human contact occurs)
- An exposure route (such as ingestion)

Complete exposure pathways for each receptor are described in Sections 4.1.1 through 4.1.6.

4.3 IDENTIFICATION OF EXPOSURE UNITS

Three exposure units were defined for the Updated Supplemental HHRA to support characterization of risk to the identified receptors as defined in the sections below. The exposure units are illustrated on Figures F-1 through F-5.

4.3.1 Area 1 Groundwater Exposure Unit

In 2008, the Site was formally subdivided into two parcels: Area 1 and Area 2 (DEQ, 2008). Area 1 is 25.15 acres in size and was the focus of the Supplemental RI because this portion of the Site includes the former wood treating plant location, former transfer table, loading platforms (including docks), and underground portion of the creosote pipeline. Area 2 covers 17.32 acres and includes the northeastern portion of the Site, which has been minimally impacted by the historical creosote wood treating activities. In 2008, DEQ issued a Conditional NFA determination for Area 2, so no further evaluation of Area 2 was warranted in the Supplemental HHRA.

The Area 1 groundwater and soil exposure unit is defined by the Site boundary and an elevated railroad alignment to the north, the boundary with Area 2 to the west, and by Milton Creek to the east and Scappoose Bay to the south. The monitoring wells located within the Area 1 Groundwater Exposure Unit are illustrated on Figure F-3.

4.3.2 Area 1 and Area 2 Soil Exposure Unit

Per DEQ request, the Updated Supplemental HHRA examined risk from select COPCs in soil samples (DEQ, 2015). Soil samples from Areas 1 and 2 were examined. The soil sampling locations within the Area 1 and Area 2 Soil Exposure Unit are shown on Figure F-5.

4.3.3 Scappoose Bay Exposure Unit

The Scappoose Bay Exposure Unit was defined to include all available sediment data collected for the RI and the Supplemental RI between 1996 and 2013 (excluding composite samples) from locations situated between the mouth of Milton Creek and the confluence of Scappoose Bay with

Multnomah Channel. The sediment sample locations in the Scappoose Bay Exposure Unit are illustrated on Figure F-1. Surface water and porewater sample locations are shown on Figure F-4.

4.3.4 Milton Creek Exposure Unit

The Milton Creek Exposure Unit was defined to include all available sediment data collected for the RI and Supplemental RI between 1996 and 2013 (excluding composite samples) from locations situated between the mouth of Milton Creek and the northern Site boundary. The sediment sample locations included in the Milton Bay Exposure Unit are illustrated on Figure F-1. Surface water and porewater sample locations are shown on Figure F-4.

4.4 EXPOSURE POINT CONCENTRATIONS

Exposure point concentrations (EPCs) were developed for the receptors having complete exposure pathways as described in Section 4.1. EPCs were based on the datasets selected for quantitative evaluation in the Supplemental HHRA as described in Section 3.1 and as further described in the following sections.

4.4.1 Use of Data

The concentrations reported by the laboratory were used in the development of EPCs. Concentrations qualified with a "J" or an "N" were used in the Supplemental HHRA, but added to the uncertainty in the quantitative estimates of risk because either the concentration is estimated or because both the concentration and the identity of the constituent are estimated.

Petroleum hydrocarbon concentrations in groundwater were reported by the laboratory as gasoline-, diesel-, and residual-range hydrocarbon, but all petroleum hydrocarbons detected in groundwater are believed to be representative of a weathered creosote product. Petroleum hydrocarbon results reported as gasoline- and residual-range hydrocarbons are typically accompanied by a note in the laboratory report, indicating the results reported in these ranges are not indicative of the presence of gasoline or heavier end hydrocarbons. The majority of the petroleum hydrocarbons results are reported as diesel-range and are commonly accompanied by a note indicating the product is consistent with creosote or similar hydrocarbon mixture. All gasoline-, diesel-, and residual-range hydrocarbon results were carried forward into the risk assessment for evaluation, however the potential risks from exposures to TPH in groundwater are addressed qualitatively, rather than quantitatively, in the uncertainty discussion.

Petroleum hydrocarbon concentrations in sediment were evaluated quantitatively because the appropriate analytical testing for EPH and VPH was conducted on a small number of sediment samples. Therefore, the appropriate information on carbon fractions allowed the calculation of Site-specific RBCs for TPH as described further in Section 6.1.3.

4.4.2 Duplicate Results

Duplicate results were handled as follows:

- If both results were detections, the higher of the two values was used.
- If both results were non-detections, the lower of the two detection limits was used.
- If one result was non-detect, then the detected value was used.
- Special cases:
  - The B sediment samples collected at PWS-11 and PWS-16 were treated as duplicate samples because they were inadvertently analyzed as separate samples, even though they came from the same location as the primary samples.
  - Two groundwater samples were collected from MW-1 in September 2010. One sample was collected from the mid-point of the screened interval and one was collected from the bottom of the screened interval. The sample collected from the mid-point of the screened interval was used in the Supplemental HHRA to be consistent with sample collection procedures used at other monitoring wells.

4.4.3 Elevated Reporting Limits

Some sediment and groundwater samples analyzed for PAHs had elevated reporting limits. For the purpose of EPC calculation, elevated reporting limits were eliminated for each compound where the elevated reporting limit was greater than the maximum detected concentration for that compound.

4.4.4 Data Distribution Evaluation

Each dataset was tested to determine its distribution type using EPA ProUCL software (version 5.0). The groundwater datasets were found to have primarily lognormal or non-parametric distributions, with one dataset identified as having a gamma distribution. The sediment datasets were found mostly to have either gamma or lognormal distributions, with a few datasets identified as having normal or non-parametric distributions. The distribution type for each dataset is provided in Table F-4A (groundwater), Table F-4B (sediment in Scappoose Bay), and Table F-4C (sediment in Milton Creek). The small sample size of surface water samples precluded the use of analysis with ProUCL.

4.4.5 Calculation of Exposure Point Concentrations

EPCs were calculated for each COPC using ProUCL (version 5.0) and a 2-step process. In the first step, the 95% upper confidence limit (UCL) was calculated to allow ProUCL to identify the distribution and recommend the appropriate statistical method to calculate the UCL. In the second step, the 90% confidence level was specified to calculate 90% UCLs. The UCLs used as the EPCs in the Supplemental HHRA are those generated at the 90% confidence level using the statistical method recommended by ProUCL at the 95% confidence level. In some cases, the 95% UCL was selected as the EPC in the Updated Supplemental HHRA because ProUCL recommended a UCL at a higher confidence level based on the distribution of the data.

Groundwater EPCs are presented in Table F-4A. Sediment EPCs for the Scappoose Bay Exposure Unit are presented in Table F-4B. Sediment EPCs for the Milton Creek Exposure Unit are presented in Table F-4C. The ProUCL output is presented in Attachment F-D. Soil EPCs used were from the 2006 HHRA (KJ, 2006 [Table 6]), per DEQ guidance (DEQ, 2015) and are provided in Table F-4E. An additional soil EPC was calculated for Total PCBs (ProUCL output shown in Attachment F-D) for the additional analyses per DEQ request. The small sample size of surface water samples precluded the use of analysis with ProUCL; the maximum detected concentrations were used in place of the 90% UCL.

5.0 TOXICITY ANALYSIS

The toxicity analysis compiles, reviews, and selects appropriate toxicity values for Site COPCs that estimate the potential effects from exposure. The hierarchy of sources used to select toxicity values is:

1. EPA Integrated Risk Information System database (IRIS, 2014). This database is the preferred source for toxicity values and supersedes all other information sources.
2. EPA Regional Screening Level Table (November 2013). Toxicity values used by EPA to develop RSLs, as published on the November 2013 version of the RSL tables, were used when toxicity information was not available from IRIS. Alternative sources used in the RSLs include the EPA Provisional Peer-Review Toxicity Value (PPRTV) database, Cal EPA Office of Health Hazard Assessment Toxicity Criteria Database (OEHHA, 2014), and the Agency for Toxic Substances and Disease Registry Minimum Risk Levels (ATSDR MRLs, 2013).

The EPA RSL table uses similar sources of toxicity information to those listed in Section 3.3.1 of DEQ's human health risk assessment guidance. EPA updates toxicity values during its semi-annual reviews of the RSL table, so the values published on the RSL table are considered to be current.

Surrogate compounds were chosen for chemicals without published toxicity information, or to represent mixtures for which no toxicity information is published. Surrogate compounds are identified in Tables F-5A (noncarcinogens) and F-5B (carcinogens).

5.1 NONCARCINOGENIC EFFECTS

Noncarcinogenic hazards are estimated using reference doses (RfDs) for oral exposures or reference concentrations (RfCs) for inhalation exposures. Noncarcinogenic adverse effects can be caused by acute exposure, or by longer term exposures (either subchronic or chronic exposure). However, chronic RfDs and RfCs were used in the Supplemental HHRA, unless only a subchronic value was published.

EPA has derived RfDs for the oral pathway and RfCs for inhalation pathways. However, EPA has not developed RfDs specifically for dermal exposure scenarios. Therefore, EPA (2004) and DEQ (2010)

allow oral RfDs to be used for the dermal exposure pathway. The RfDs and RfCs used in the Supplemental HHRA are provided in Table F-5A.

5.2 CARCINOGENIC EFFECTS

Cancer risks are estimated using slope factors or inhalation unit risks. A slope factor represents the quantitative relationship between dose and response to a chemical that is carcinogenic, or potentially carcinogenic, to humans over a lifetime. Slope factors have no minimum threshold and assume that exposure to a particular compound results in an adverse effect (i.e., for all doses, some risk is assumed to be present). EPA defines the inhalation unit risk to be the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 microgram per liter (µg/L) in water, or 1 microgram per cubic meter (µg/m$^{3)}$ in air.

EPA has derived carcinogenic cancer slope factors (SFs) for the oral pathway and inhalation unit risk (IUR) values for inhalation pathways. However, EPA has not developed SFs specifically for dermal exposure scenarios. Therefore, EPA (2004) and DEQ (2010) allow oral SFs to be used for the dermal exposure pathway. The SFs and IURs used in the Supplemental HHRA are provided in Table F-5B.

6.0 RISK CHARACTERIZATION

The risk characterization combines the information gathered during the exposure and toxicity assessments to quantitatively estimate potential risks. The estimated individual and cumulative carcinogenic and noncarcinogenic RME and CTE risks to human health were evaluated in accordance with OAR 340 122 115, and in accordance with DEQ HHRA guidance (DEQ, 2010).

The methods used to estimate carcinogenic risks and noncarcinogenic hazards are described in Section 6.1. Risk estimates for each receptor are summarized in Sections 6.2 through 6.5. Risk estimates from the 2006 HHRA for soil and surface water are summarized in Section 6.6. Section 6.7 provides a summary of risks from the 2006 HHRA for soil and surface water and from the Updated Supplemental HHRA for sediment, soil, and groundwater.

6.1 CALCULATION OF RISK

Risk estimates were developed separately for noncarcinogenic and carcinogenic compounds as described in the following sections.

6.1.1 Calculation of Noncarcinogenic Risk

DEQ guidance recommends the estimation of potential noncarcinogenic health effects through comparison of EPCs to RBCs by incorporating the acceptable hazard quotient of 1. The comparison is made using the following equation:

$$HQ = EPC / RBC *1$$

Where:

HQ = hazard quotient
EPC = exposure point concentration (in milligrams/kilogram [mg/kg] or in µg/L)
RBC = risk-based concentration (mg/kg or µg/L)
1 = acceptable HQ

The RBCs used in the estimation of risks for exposures are those presented on DEQ's RBC table with the "show all values" option selected for both RME and CTE assumptions (Attachment F-B). Site-specific RBCs were developed separately for the older child recreational trespasser to estimate the risks from sediment exposures, as discussed further in Section 6.1.3 below. In cases where individual chemicals potentially act on the same organs or result in the same health endpoint (e.g., respiratory irritants), potential additive effects may be addressed by calculating a hazard index by summing chemical-specific hazard quotients. A hazard index of less than or equal to 1 indicates acceptable levels of exposure for chemicals having an additive effect (EPA, 1989; DEQ, 2010). Therefore, the total hazard index (HI) was calculated by summing the individual hazard quotients for each compound, regardless of toxic endpoint, and then compared to the acceptable HI of 1.

Estimated noncarcinogenic hazards from exposure to groundwater are provided in Tables F-6A through F-6D (on-Site worker), F-7A and F-7B (excavation worker), and summarized in Table F-8. Estimated noncarcinogenic hazards from exposure to sediment are provided in Tables F-9A through F-9D (recreational trespasser) and Table F-10 (sport fisher) and summarized in Table F-11. Estimated noncarcinogenic hazards from exposure to soil are provided in Tables F-13A through F-13F and summarized in Table F-13G.

6.1.2 Calculation of Cancer Risk

DEQ guidance provides for estimation of potential risks through comparison of EPCs to RBCs by incorporating the acceptable risk level of 1×10^{-6}. The comparison is made using the following equation:

$$ELCR = EPC / RBC *1 \times 10^{-6}$$

Where:

ELCR = excess lifetime cancer risk
EPC = exposure point concentration (in mg/kg or µg/L)
RBC = risk-based concentration (mg/kg or µg/L)
1×10^{-6} = acceptable ELCR for individual carcinogens

The RBCs used in the estimation of risks for groundwater exposures are those presented on DEQ's RBC table with the "show all values" option selected for both RME and CTE assumptions

(Attachment F-B). Site-specific RBCs were developed separately for the older child recreational trespasser to estimate the risks from sediment exposures, as discussed further in Section 6.1.3 below. The total ELCR was calculated by summing the individual risks for each compound and then comparing the sum to the acceptable cumulative ELCR of 1×10^{-5}.

Estimated carcinogenic risks from exposure to groundwater are provided in Tables F-6A through F-6D (on-Site worker), F-7A, and F-7B (excavation worker) and summarized in Table F-8. Estimated carcinogenic risks from exposure to sediment are provided in Tables F-9A through F-9D (recreational trespasser) and Table F-10 (sport fisher) and summarized in Table F-11. Estimated carcinogenic hazards from exposure to soil are provided in Tables F-13A through F-13D and summarized in Table F-13G.

6.1.3 Calculation of Site-Specific RBCs for PAHs and TPH

Site-specific RBCs were calculated for the evaluation of risks from exposure to PAHs and TPH in the Supplemental HHRA as described below:

- PAHs – Site-specific RBCs were developed to assess the exposure of an older child recreational trespasser to sediment using a combination of site-specific and default exposure assumptions described in Section 4.1.3 and using DEQ's RBC equations presented in Appendix B of DEQ's Human Health Risk Assessment Guidance (DEQ, 2010) for incorporating early life exposure. The RBC calculations for the older child recreational trespasser are provided in Attachment F-C.

- TPH – Site-specific TPH RBCs were developed for default DEQ receptors using the EPH and VPH data from five sediment samples collected within areas of inferred NAPL (four samples from Scappoose Bay and one sample from Milton Creek). DEQ's TPH RBC calculator was used to calculate the RBCs, and the TPH RBC tables are provided in Attachment F-E. The most conservative TPH RBC developed for the five sediment samples was used in the estimation of risk. Site-specific TPH RBCs were not developed for the recreational trespasser because the DEQ TPH RBC calculator does not readily support calculation of potential risk for a single segment of early life exposure. Specifically, early life sensitivity addresses all of childhood (from birth through 16 years of age) and the recreational trespasser is an older child that is approximately 10 years old, representing just one segment of the early life period. The TPH RBCs for the default residential receptor are conservatively protective of the recreational use evaluated.

6.1.4 Calculation of Noncarcinogenic Hazards from Bioaccumulative PAHs in Sediment

Specific exposure to bioaccumulative PAHs from fish consumption was evaluated in the Supplemental HHRA as requested by DEQ. The bioaccumulative PAHs detected in sediment are not carcinogenic, so carcinogenic risks were not evaluated. Therefore, the hazard index approach was used to estimate potential noncarcinogenic hazards from the bioaccumulative PAHs, fluoranthene

and pyrene, using SLVs selected from Table A-1a in DEQ's Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment. The comparison is made using the following equation:

$$HQ = EPC / SLV *1$$

Where:

HQ = hazard quotient
EPC = exposure point concentration (in mg/kg)
SLV = screening level value (mg/kg)
1 = acceptable HQ

SLVs are also RBCs, but the terminology is specific to the DEQ bioaccumulation guidance (DEQ, 2007). The SLVs used in the estimation of risks for groundwater exposures are the general and subsistence consumption SLVs taken from Table A-1a. However, the subsistence value was modified to account for an increased subsistence consumption rate of 175 g/day from the 142.4 g/day incorporated in the 2007 SLVs, as provided by DEQ (DEQ, 2014b). The mean concentration and the 90% UCL were each evaluated to provide a range of CTE and RME conditions for fish consumption, respectively. However, the maximum sediment concentration was also conservatively evaluated to estimate potential risks from bioaccumulation through consumption of fish that might reside in a very localized area of the most significant sediment impacts. The total HI was calculated by summing the individual hazard quotients for each compound and then comparing the sum to the acceptable HI of 1.

Estimated noncarcinogenic risks from exposure through fish consumption are provided in Table F-10 summarized in Table F-11. The results are discussed in Section 6.5.

6.1.5 Calculation of Carcinogenic and Noncarcinogenic Hazards from Bioaccumulative PAHs in Surface Water

Exposure to specific bioaccumulative PAHs in surface water from fish consumption was evaluated in the Supplemental HHRA as requested by DEQ. The bioaccumulative PAH found in surface water and retained as a COPC (benzo(a)pyrene) was evaluated for both carcinogenic and noncarcinogenic hazards. The ELCR approach, as described in Section 3.1.2, was used to evaluate carcinogenic hazards and the hazard index approach, as described in Section 6.1.4, was used to evaluate noncarcinogenic hazards. The SLVs used for both approaches were PRGs established by DEQ (DEQ, 2019).

6.1.6 Calculation of Cancer Risk from Bioaccumulative PAHs and Dioxins/Furans

As requested by DEQ (DEQ, 2015), specific exposure to bioaccumulative dioxins and furans from fish consumption was examined in the Updated Supplemental HHRA. The bioaccumulative dioxins and furans are carcinogenic; therefore, risks were calculated using the ELCR approach, as described in Section 6.1.2.

The limited number of samples analyzed for dioxins/furans prevented the appropriate use of the 90% UCL, so the maximum detected sediment concentration was used as the RME for dioxins/furans analysis.

6.2 ON-SITE INDUSTRIAL WORKER

The on-Site industrial worker was evaluated for exposure to PAHs and TPH from indirect pathways through volatilization into indoor or outdoor air from groundwater and exposure to PCBs through direct contact from soil. Risk calculations for these indirect groundwater exposure pathways are provided in Tables F-6A through F-6D and summarized in Table F-8. Risk calculations for soil exposure pathways are shown in Table F-13E and F-13F and summarized in Table F-13G. Risk calculations are summarized in Table F-14.

To evaluate risk from groundwater via indirect exposure pathways (i.e., volatilization into indoor or outdoor air) on a smaller area (i.e., representative of a building footprint, rather than site-wide), risk calculations were performed using maximum detected concentrations, rather than RME (i.e., 90% UCL) assumptions.

All ELCRs and HIs for individual PAH COPCs under the evaluated exposure pathways were below DEQ acceptable limits ($1x10^{-6}$ and 1, respectively) with the following exception: vapor intrusion from naphthalene in groundwater, which had an ELCR of $2x10^{-6}$ based on the concentration of naphthalene detected in monitoring wells MW-3A and MW-22 which are known to be within the inferred extent of subsurface DNAPL. When excluding those monitoring wells within the inferred extent of DNAPL (and therefore unacceptable risk), the calculated ELCR using a maximum concentration of 4,710 µg/L (MW-19) for vapor intrusion from naphthalene in groundwater was $5x10^{-7}$, well below the acceptable risk level.

Despite site-specific RBCs for diesel-range and residual-range hydrocarbons that were greater than solubility limits, risks were quantitatively evaluated using the conservative approach of using the solubility in place of the RBC. Using this approach, HIs for diesel- and residual-range hydrocarbons were found to be higher than acceptable limits. Samples with concentrations greater than solubilities may have product present, indicating an already identified unacceptable risk. Monitoring wells outside the delineated boundary of inferred extent of DNAPL with concentrations above solubilities of diesel- and/or residual-range hydrocarbons include MW-1, MW-4A, MW-5, MW-6A, MW-9, MW-19, and MW-20. However, there were no detections of residual-range hydrocarbons in three of these samples, and exceedances appear to be an artifact of elevated detection limits. Detected concentrations in samples were all given either an “N” or “NJ” flag by the lab, indicating that samples were presumptively identified results or presumptively identified results with estimated results, respectively, adding further uncertainty. Exposures to PAHs and TPH in groundwater are discussed further in the uncertainty section.

As shown in Table 8, the total cancer risk from inhalation exposure (combined outdoor and indoor) ranged from $4x10^{-6}$ (based on calculations using the maximum detected concentrations) to $8x10^{-8}$

(based on CTE assumptions). The total HIs ranged from $3.9x10^2$ (based on calculations using the maximum detected concentrations) to $2.7x10^1$ (based on CTE assumptions). As described above, these exceedances of risk are limited to wells within the inferred extent of DNAPL.

Total risk to on-Site industrial workers via direct soil exposure scenarios was below acceptable limits with the following exceptions: total PCBs in the RME scenario. Under this scenario, the calculated HI was found to be 2.1, slightly higher than the acceptable HI of 1. The only exceedances for total PCBs were from the Area 1 samples SS-10, SS-19, and SS-24 and from Area 2 sample SS-08.

6.3 ON-SITE EXCAVATION WORKER

The on-Site excavation worker was evaluated for exposure to PAHs and TPH from direct contact with groundwater in an excavation and indirectly through volatilization from groundwater in the excavation. The on-Site excavation worker was also evaluated for direct contact exposure to soil for PCBs, VOCs, PAHs, and metals. Risk calculations for groundwater exposures to the excavation worker are provided in Tables F-7A and F-7B and summarized in Tables F-8 and F-14. Risk calculations for soil exposures to the excavation worker are shown in Tables F-13C and F-13D and summarized in Tables F-13G and F-14.

No quantitative estimates of health risk were developed for exposures from groundwater in an excavation because the dermal permeability coefficient for PAHs falls outside of the effective predictive domain of the model and dataset used to establish this variable, and calculation of risk estimates can be unrealistically high.

As shown in Table 8, total HIs for groundwater exposure ranged from $3.9x10^2$ (based on RME assumptions) to $2.7x10^1$ (based on CTE assumptions). Exceedances came solely from TPH and the same limitations regarding a quantitative evaluation of risk from TPH that were described in Section 6.3 also hold true for the on-Site excavation worker exposure scenario as well, namely: (1) solubilities were used in place of RBCs, as site-specific RBCs for diesel-range and residual-range hydrocarbons were greater than solubility limits; and (2) detected concentrations of TPH constituents had a high degree of uncertainty as to their identification. Additionally, the quantitative risk analysis included samples from monitoring wells within the inferred extent of DNAPL. When monitoring wells within the inferred extent of DNAPL (and therefore unacceptable risk) were excluded from risk calculations, the calculated HI for gasoline-range hydrocarbons using a maximum concentration of 4,790 (MW-6A) was 0.34, below the acceptable risk level. Therefore, no unacceptable risks to an on-Site excavation worker were found outside the inferred extent of DNAPL for exposure to gasoline-range hydrocarbons in groundwater. Exposures to PAHs and TPH in groundwater are discussed further in the uncertainty section.

All HIs for individual COPCs under the evaluated soil exposure pathways were below DEQ acceptable limits with one exception. Risk due to dermal exposure to soil from arsenic in the RME scenario was exceeded due to one extremely high sample (a sample from MW-10 [MW-10-5.5]). Because this sample was determined to be a statistical outlier (Dixon's Test, $p<0.05$), a second RME

was also calculated without the outlier according to EPA guidance (EPA, 2000; EPA 2013a). Using this RME (5.41 mg/kg), no exceedances were found for any exposure pathway.

6.4 ON-SITE CONSTRUCTION WORKER

The on-Site construction worker was evaluated for exposure to PAHs and TPH from direct contact with soil. Direct contact with groundwater was not evaluated because of overlap with the evaluation of the excavation worker and industrial worker.

Surface soil (less than 6 inches) was evaluated to determine the potential for unacceptable risks to on-Site construction workers from direct exposure to surface soils impacted by PCBs. No unacceptable risks from PCBs in surface soil were identified.

Subsurface soil (3 to 6 feet below ground surface) was evaluated for risks to the on-Site construction worker from direct exposure to subsurface soils impacted by select VOCs, PAHs, and metals. Exceedances based on HIs were found for arsenic exposure under the RME scenario but not under the CTE scenario. Because the subsurface soil arsenic data contained a statistical outlier (MW-10-5.5; Dixon's Test, $p<0.05$), a second RME was also calculated without the outlier according to EPA guidance (EPA, 2000; EPA 2013a). Using this RME (5.41 mg/kg), no exceedances were found for any exposure pathway.

Risk calculations for on-Site construction workers is provided in Tables F-13A and F-13B and summarized in Table F-13G.

6.5 TRANSIENT/RECREATIONAL TRESPASSER/ADULT BOATER

The transient, recreational trespasser, and adult boater exposure groups were evaluated for exposure to PAHs and TPH from direct contact with sediment in the Scappoose Bay and Milton Creek Exposure Units. Site data from nearshore sediment samples outside of areas of visible NAPL contamination were used to screen against transient PRGs (as shown in Table F-2D). Site-specific TPH RBCs for the default residential receptor were used to evaluate potentials risks from TPH based on results from VPH/EPH analysis (as shown in Attachment F-E). Risk calculations for sediment exposures in Scappoose Bay are provided in Tables F-9A and F-9B. Risk calculations for sediment exposures in Milton Creek are provided in Table F-9C and F-9D. A summary of potential health risks from sediment exposure is provided in Tables F-11 and F-14.

Concentrations of all analyzed COPCs (BaP TEQ, naphthalene, and TPH) were below PRGs established for transients, as shown in Table F-2D.

The total cancer risk in Scappoose Bay ranged from $2x10^{-6}$ to $4x10^{-7}$ and the total HIs ranged from $3.7x10^{-1}$ to $5.4x10^{-1}$. The total cancer risk in Milton Creek ranged from $9x10^{-7}$ to $2x10^{-7}$ and the total HIs ranged from $9.7x10^{-5}$ to $2.5x10^{-5}$. No individual compound exceeded a risk of $1x10^{-6}$ or a hazard quotient of 1. No unacceptable individual or cumulative risks or hazards were estimated for the

recreational trespasser from PAHs or TPH in sediment from areas outside of inferred NAPL in Scappoose Bay and in Milton Creek.

6.6 SPORT FISHER

The sport fisher was evaluated for exposure to bioaccumulative PAHs and dioxins/furans in sediment, surface water, and porewater through fish consumption in Scappoose Bay and in Milton Creek through examining adult and child sport fishers individually and cumulatively. The evaluation included general and subsistence consumption rates as well as multiple EPCs, including the mean, the 90% UCL, and the maximum detected concentration. Sediment dioxin/furan data were only available for Scappoose Bay; therefore, total ELCRs were only calculated for Scappoose Bay. Site data from nearshore sediment samples outside of areas of visible NAPL contamination were used to screen against angler PRGs (as shown in Table F-2D). A comparison of concentrations of carcinogenic PAHs in surface water and porewater to PRGs developed to be protective of human health from fish consumption are presented in Table F-2E. Risk calculations for sediment exposures in Scappoose Bay and Milton Creek are provided in Table F-10. A summary of potential health risks from sediment exposure is provided in Table F-11 and F-14.

Total HIs calculated from sediment concentrations for bioaccumulation based on general human consumption ranged from $1.4x10^{-2}$ (Scappoose Bay, maximum detected concentration) to $1.1x10^{-3}$ (Milton Creek, CTE concentration). The total HIs from sediment concentrations for bioaccumulation based on subsistence consumption ranged from $1.4x10^{-1}$ (Scappoose Bay, maximum detected concentration) to $1.1x10^{-2}$ (Milton Creek, CTE concentration). No unacceptable risks were estimated for the sport fisher from exposure to PAHs through fish consumption based on sediment data from areas outside of inferred NAPL in Scappoose Bay and in Milton Creek.

The total ELCR calculated from sediment concentrations for bioaccumulation for Scappoose Bay based on general human consumption was calculated to be $2x10^{-6}$ using the maximum detected concentrations and $3x10^{-6}$ using the CTE scenario. The total ELCR based on subsistence consumption was calculated to be $6x10^{-5}$ using the maximum detected concentration and $3x10^{-5}$ using the CTE scenario.

All ELCRs for individual congeners calculated from sediment concentrations for bioaccumulation based on general population consumption were below DEQ acceptable risk levels, with the exception of 2,3,4,7,8-PeCDF, which was above the acceptable ELCR for both RME and CTE scenarios. The only detection of 2,3,4,7,8-PeCDF was in sample SD-131, the sample within the extent of sheen.

All ELCRs for individual congeners calculated from sediment concentrations for bioaccumulation based on subsistence consumption were below DEQ acceptable risk levels, with the exception of 1,2,3,7,8-PeCDD, 1,2,3,6,7,8-HxCDD, 1,2,3,7,8,9-HxCDD, 2,3,4,7,8-PeCDF, and 1,2,3,4,7,8-HxCDF under the RME and/or CTE scenario. As shown in Table F-2C, exceedances are primarily due to

detections in sample SD-131, the sample within the extent of petroleum sheen; the only other exceedance was found for 1,2,3,6,7,8-HxCDD in sample SD-144.

Concentrations of carcinogenic PAHs in surface water were below established PRGs for all but one sample for benzo(a)pyrene TEQ. The surface water CTE and RME were both below acceptable PRGs. All shallow porewater samples were below acceptable PRGs. Concentrations of benzo(a)pyrene TEQ at two deep porewater samples were higher than acceptable PRGs. All porewater cPAH CTEs were below acceptable limits, however, the benzo(a)pyrene RME was above the PRG.

6.7 SUMMARY OF RISK ESTIMATES FROM THE SUPPLEMENTAL HHRA AND THE 2006 HHRA

Risk estimates for all receptors are presented in Table F-14. The table presents the total carcinogenic risk and total noncarcinogenic HI estimated from the Updated Supplemental HHRA to provide a summary of cumulative health risks for each receptor from all media to which they are exposed.

In the Scappoose Bay, Milton Creek, and the upland exposure unit, limited cumulative exceedances were calculated, as described in the previous sections. A further examination of those exceedances is provided in the following section.

7.0 UNCERTAINTY ANALYSIS

Risk assessment uses multiple sources of information and evaluation methods. Even when the actual chemical intake for an exposed individual may be measured relatively accurately, assumptions are still required to evaluate the associated potential risk (such as in the extrapolation of toxicity data from laboratory animal studies to humans). The use of professional judgment, inferences based on analogy, the use of default values, model estimation techniques, and other assumptions result in uncertainty of varying degrees. The risk assessment process and the uncertainties incorporated in that process are generally constructed such that risk estimates tend towards overestimation of the overall risk. Elements of the risk assessment process contributing to uncertainty in the findings of the Supplemental HHRA are discussed in Sections 7.1 through 7.4.

7.1 DATA EVALUATION

Uncertainties in the data evaluation include adequacy of sampling design, analytical error, data quality issues, and dataset selection.

The adequacy of the sampling design is a potential source of uncertainty because sampling (especially in multiple sampling events) may be designed to locate the worst contamination. This type of sampling design may result in bias toward overestimating average contaminant levels through targeting of samples. Alternatively, a targeted sampling design has the potential to miss

areas of contamination through limited sampling. Sampling designs focused on locating the worst contamination may also target a limited number of sample locations or a relatively small area that can contribute to having a smaller than desirable dataset to use in the quantitative evaluation. In the Updated Supplemental HHRA, the sediment dataset in Milton Creek is relatively small (11 samples) considering that it only slightly exceeded the desired minimum of 10 samples. However, the Milton Creek Exposure Unit also is relatively small, so the uncertainty contributed by a relatively small dataset to a relatively small area is not considered a significant uncertainty. Additionally, the datasets examined in the Updated Supplemental HHRA for certain exposure scenarios used historical data, per DEQ's request. For instance, risks for soil exposure were calculated based on limited samples collected in 1998. Uncertainty exists as to how these concentrations may have changed since then.

Analytical errors and uncertainty are quantified through appropriate quality assurance/quality control (QA/QC) measures, including quality control samples collected in the field as well as QC samples prepared by the laboratory during analysis. These measures help to minimize uncertainty through the review and qualification procedures performed in the laboratory.

The results of data verification indicate that further qualification of some data was appropriate as a result of issues encountered during analytical testing. Further qualification of petroleum hydrocarbons results was common because chromatograms demonstrated that petroleum hydrocarbons concentrations reported in the gasoline and residual ranges were not indicative of the presence of gasoline or heavier end hydrocarbons. In cases where the chromatograms of the sample did not match chromatograms of the standards for those ranges, an "N" qualification was assigned to indicate the reported result was both quantitatively and qualitatively uncertain. Based on the historical knowledge of Site operations, all petroleum hydrocarbons were assumed to represent the primary source material (creosote). Assuming that all reported ranges of petroleum hydrocarbons are the same product potentially overestimates risk because of overlap in the reporting between the carbon ranges, but the same assumption has the potential to underestimate risk if there were other types of petroleum products releases that were not identified during the RI or Supplemental RI.

Dataset selection can contribute to underestimation of risk if data are inappropriately included or excluded from the risk assessment. For some samples, the laboratory was not able to segregate benzo(b)fluoranthene and benzo(k)fluoranthene and instead reported "benzofluoranthenes". Benzofluoranthenes was therefore conservatively included as a separate COI to account for PAHs in the samples where benzo(b) and benzo(k) were not reported separately. However, this approach potentially overestimates the contribution of risk from benzofluoranthenes when the individual PAH and the summed PAH are both retained as COPCs. This was the case in the sediment datasets. However, there were no unacceptable risks estimated from exposure to PAHs in sediment, so this conservative approach contributes a small amount of uncertainty associated with unacceptable risk. For the Updated Supplemental HHRA, data collected in sediment from areas inside the inferred extent of NAPL were excluded from the quantitative evaluation because NAPL is assumed to have

unacceptable risk. This approach underestimates the potential risks quantified from sediment exposure because it focuses only on one portion of the sediment dataset. However, a key assumption in the development of the Updated Supplemental HHRA is that sediments located within the inferred extents of NAPL will be included in the remedy selected during the FS, and thus will receive treatment.

Finally, DEQ requested discussion of the impact of including the non-NAPL data collected at PWS-13 in the uncertainty section. Although the source of impacts in the PWS-13 area is not clear, sediment data from this area were included in the quantitative evaluation as requested by DEQ. However, the sediment results from this location do not represent the highest concentrations in the dataset and thus are unlikely to bias the estimates of health risks from exposure to sediment impacted by Site-related creosote.

7.2 EXPOSURE ANALYSIS

The exposure analysis quantifies the amount of contaminant that is ingested, inhaled, or absorbed based on multiple assumptions about human behavior and about the physical and chemical processes that define how contaminants move in the environment. The assumptions made to quantify exposure are designed to evaluate an RME and a CTE so that it is possible to consider a range of possible, yet health protective, exposure conditions: from a high-end exposure to a more typical exposure. Key exposure assumptions contributing to uncertainty in the Updated Supplemental HHRA are described in the next sections.

7.2.1 Potentially Exposed Populations

Identifying potentially exposed populations is a key element of developing an appropriate CSM that describes who is potentially exposed to Site contaminants and how they might receive that exposure. If the CSM does not correctly describe the potentially exposed populations, then the quantitative risk assessment could underestimate potential risks.

The Updated Supplemental HHRA identifies multiple receptors that are those most likely to be exposed to Site contaminants without any awareness of their presence or potential impacts. These include an older child recreational trespasser/transient, adult boater, and a sport fisher. It is unlikely that a child younger than 6 would readily venture to the Site on a routine basis, given its industrial land use and the limitations of access. Evaluation of the sport fisher considered both general population and subsistence level fish consumption and therefore, is protective of a range of populations.

The Updated Supplemental HHRA also evaluated occupational (i.e., industrial), construction, and excavation worker receptors, even though in all three cases these receptors are very likely to be informed about Site contamination and required to use personal protective equipment to limit potential exposures. The Updated Supplemental HHRA provides a quantitative evaluation of exposure to construction workers, therefore adequately defining redevelopment risks. In addition,

it is unlikely that any construction would take place at the Site without an understanding of Site conditions and incorporating the appropriate protective measures for workers.

7.2.2 Development of Exposure Point Concentrations

The goal of EPC selection is to identify the average concentration in an exposure medium that best represents the concentration in that medium to which the receptor is exposed through long-term (and potential) use of a site. Because the concentrations in Site media vary over space and time, EPCs are estimated from multiple samples of the media. This approach is expected to capture some of the variability that is likely to occur in the measured parameter.

For a few constituents with small datasets, an EPC was not developed for the Updated Supplemental HHRA using ProUCL. For compounds detected just once in a small dataset, the maximum detected concentration was used as the EPC (both RME and CTE). For compounds detected two times in a small dataset, the maximum detected value was used to evaluate the RME and the mean of the detected values was used to evaluate the CTE. The maximum detected concentration was also used as the EPC for certain exposure pathways to evaluate risk over a smaller spatial scale (site-specific, rather than site-wide). The use of a maximum value to evaluate the RME and using the mean of just the detected values likely overestimates risk. Finally, in one scenario (direct contact with subsurface soil), a second RME was calculated without an outlier to better quantify the risks from expected exposures.

7.2.3 Exposure Assumptions

A key exposure assumption used to define the datasets considered in the Supplemental HHRA is that NAPL has inherent unacceptable risk. No quantitative assessment of areas of inferred NAPL was conducted because areas of NAPL are assumed to have unacceptable risk and will be included in the remedy selected during the FS. A quantitative analysis of risks from groundwater within the inferred extent of DNAPL was done and provide a conservative estimate of risk as a result.

DEQ specified default or site-specific values for various exposure parameters were used in the RME and CTE average intake estimates. Many of these exposure parameters purposefully overestimate potential exposure and risk as the risk assessment process has been designed to be protective.

The use of default exposure assumptions in the development of TPH RBCs for the residential receptor overestimate the exposure of the older child recreational trespasser because an older child is not assumed to live at the Site. Thus, the potential risks and hazards from TPH for the older child recreational trespasser are likely to be overestimated.

There are no business operations being conducted at the Site, so the evaluation of exposure to the full-time industrial worker, construction worker, and the excavation worker overestimate the current actual level of exposure.

7.2.4 Groundwater Dermal Exposures

EPA has specific guidance for evaluating the risks from dermal exposures (EPA, 2004). Likewise, DEQ provides specific guidance on the assumptions to make when evaluating groundwater dermal exposures. In both cases there are uncertainties introduced into the quantitative risk assessment that are described in the following sections.

Excavation Worker Exposure Scenario

DEQ's default exposure assumptions for the excavation worker include dermal contact with groundwater for 25% of an 8-hour day. It is unlikely that standard construction practice would prescribe an excavation worker to work in water (with exposure primarily to the hands/arms and legs/feet) for 2 hours each day. It is more likely that the excavation would be de-watered prior to conducting the work in the excavation.

Dermal Absorption Factors

Current DEQ human health risk assessment guidance recommends not to perform a quantitative analysis of dermal exposure to many SVOCs, including PAHs. This is because semi-volatile compounds have physical or chemical properties that fall outside of the effective predictive domain used to estimate the dermal permeability coefficient that describes how contaminants move across the skin barrier. Use of dermal permeability coefficients from outside the effective predictive domain can lead to inappropriately high estimates of risk. Instead, DEQ recommends a qualitative discussion in the uncertainty section for exposures to water from dermal contact.

According to the Toxicological Profile for PAHs (ASTDR, 1995), dermal exposure to PAHs has been shown to "… cause skin disorders in both humans and animals; however, specific effects in humans of individual PAHs, except for benzo(a)pyrene, have not been reported. Mixtures of PAHs are also used to treat some skin disorders in humans". This statement suggests there is some beneficial use for dermal application of PAHs, though this is likely refined petroleum at much lower concentrations than those present at the Site. The studies of PAH dermal exposures demonstrate that there is the potential for adverse impacts to humans from repeated exposure, which in turn suggests there could be unacceptable risk associated with dermal exposures to PAHs (or other semi-volatile compounds) in groundwater at the Site. It is reasonable to assume there are unacceptable risks or hazards from dermal contact with groundwater where NAPL is present, but it is not possible to accurately quantify the magnitude of the risk from dermal contact with water containing PAHs or other semi-volatile compounds (such as TPH consisting of weathered creosote) in areas where NAPL is not present. Therefore, it is reasonable to consider that an administrative or engineering control should be applied to the Site to control future exposures to groundwater. Administrative and engineering controls have already been established for Area 2 and similar controls could easily be applied to Area 1 of the Site.

7.3 TOXICITY DATA

Toxicity information used in the Supplemental HHRA was obtained from industry standard sources, and primarily from the Integrated Risk Information System maintained by EPA. For noncarcinogenic compounds, the published toxicity values are commonly based on results in animal studies to which multiple safety and uncertainty factors (ranging from factors of 100 up to 10,000) are applied to yield a value for human receptors. Additional uncertainty and/or modifying factors are routinely applied to toxicity values to account for protection of susceptible subpopulations, data gaps, and other differences between the toxicity study and the target use of the toxicity value. For example, it is assumed in the development of many toxicity values that chemicals affect the body in the same way regardless of if they are ingested or dermally absorbed, although much of the data for a chemical may be limited to ingestion route only experimental studies. While protective of human health, these safety factors and assumptions incorporate a high level of uncertainty in potential risk estimates, of up to several orders of magnitude, resulting in a potential overestimation of noncancer hazards.

The uncertainty associated with the estimation of cancer risks also contributes a major source of potential uncertainty to risk estimates. For example, some chemicals classified as carcinogens have been shown to produce an increased incidence of cancer in mice, but not rats. Even within different strains of laboratory mice, carcinogenic responses may be noted in one strain, but not another, even though similar exposure pathways and doses are used. While it is protective to assume that any carcinogenic response in laboratory animals is analogous to the human biological system, this assumption will overestimate the number of actual human carcinogens present at a site and will, therefore, overestimate potential carcinogenic site risk. Conversely, this variability could also indicate that some human carcinogens are not carcinogenic in laboratory animals, therefore underestimating potential carcinogenic risk to humans. The standard EPA assumption of toxic response linearity, which assumes “no safe dose” for any carcinogenic compound, is an important assumption (and significant contributor to risk overestimation) used by EPA in developing cancer dose response (slope) values. It is known that for some “carcinogens” there is actually a threshold below which exposure is not associated with the development of cancer.

For some compounds, toxicity information is not available and so a surrogate compound that is structurally similar or more toxic than the target compound is used in the quantitative evaluation. This type of assumption also contributes uncertainty to the risk assessment because it is not known if the compound being evaluated will actually behave the same as the surrogate compound, and in most cases a more conservative, health protective assumption will be applied, thus overestimating the potential risks.

For some compounds, an appropriate surrogate compound cannot be determined, so quantitative evaluation is not possible. In the Supplemental HHRA, this was the case for petroleum hydrocarbons in groundwater because there are no published toxicity values for petroleum hydrocarbon mixtures and analytical testing for EPH and VPH was not conducted. The extent of

petroleum hydrocarbons in groundwater is largely contained within the extent of PAHs in groundwater, and thus potential exposure to TPH would be co-located with exposure to PAHs. Any controls that address exposure to PAHs in groundwater would also control exposure to TPH.

Finally, the toxicity values compiled for the Supplemental HHRA were compared to the toxicity values compiled for the 2006 HHRA to identify changes. There were no changes to the oral toxicity values. No comparison was performed for inhalation reference doses because current risk estimating methods rely on reference concentrations instead and the inhalation exposure pathways were all evaluated in the Supplemental HHRA.

7.4 OVERALL ASSESSMENT OF UNCERTAINTY

The greatest quantitative uncertainty in the risk assessment is associated with dermal exposures to semivolatiles in groundwater, though unacceptable risk from exposure is assumed where there is NAPL present. The use of conservative, health-protective assumptions at multiple stages of the risk assessment process likely contribute to an overall overestimate of actual risks at the Site for all other exposure pathways.

8.0 CONCLUSIONS

The Updated Supplemental HHRA was prepared to evaluate potential risks based on new data generated during and after the development of the Supplemental RI and to incorporate updated guidance. The evaluation focused on six receptors exposed to groundwater, sediment, surface water, porewater, or soil. The outcomes of the Updated Supplemental HHRA indicate the following:

- Industrial Workers – No unacceptable risks were estimated for direct exposure to soil, or from indirect exposure to contaminants in soil or groundwater through inhalation pathways in either indoor or outdoor air with the exception of limited soil samples with PCB contamination (SS-08, SS-10, SS-19, SS-22, and SS-24) and localized groundwater samples (MW-3A and MW-22) within the extent of inferred subsurface DNAPL.
- Excavation Workers – No unacceptable risks were estimated for direct exposure to soil, or for indirect exposure to contaminants in soil from inhalation outside the inferred NAPL areas, with the exception of an exceedance of risk calculated due to the localized high concentration of arsenic in one deep soil sample (MW-10). The potential risks from direct exposure to groundwater in an excavation were not quantified because the COPCs are semi-volatiles and DEQ does not recommend a quantitative assessment of dermal exposures to SVOCs because their dermal permeability coefficients are outside of the effective predictive domain used to model this exposure factor. Instead, a qualitative discussion is provided in the uncertainty section and concludes that:
  - It is reasonable to assume there are unacceptable risks or hazards from dermal contact with groundwater where NAPL is present.

  - It is not possible to accurately quantify the magnitude of the risk from dermal contact with water containing appreciable levels of PAHs or other semi-volatile compounds (such as TPH consisting of weathered creosote) in areas where NAPL is not present.
  - Thus, it is reasonable to consider that an administrative or engineering control should be applied to the Site to control future exposures to groundwater. Administrative and engineering controls have already been established for Area 2 and similar controls could easily be applied to Area 1 of the Site.

- Construction Worker – No unacceptable risks were estimated for direct exposure to soil, or from indirect exposure to contaminants in soil or groundwater through inhalation pathways in either indoor or outdoor air outside the inferred NAPL areas, with the exception of risk calculated due to the localized high concentration of arsenic in one deep soil sample (MW-10).
- Recreational Trespasser/Transient – No unacceptable risks were estimated for direct exposures to sediments or surface water in either Scappoose Bay or Milton Creek outside the inferred NAPL areas. Contact with NAPL is considered an unacceptable risk.
- Adult Boater – There is no unacceptable risk for adult boaters outside the NAPL areas because the exposure pathways for this receptor are the same as those for the recreational trespasser, and there was no unacceptable risk estimated for the recreational trespasser. The recreational trespasser is considered a more sensitive receptor than the adult boater and therefore risk conclusions related to the recreational trespasser are also protective of the adult boater.
- Sport Fisher (Child/Adult) – There is a low level of concern for bioaccumulation of COPCs from sediment, surface water, and/or porewater into fish tissue consumed by humans. Of the limited number of sediment samples analyzed for dioxins and furans, there is unacceptable risk for the sport fisher from the consumption of fish exposed to site-related dioxins and furans in the Scappoose Bay area; however, exceedances were mostly limited to detected concentrations in the sample collected from within the extent of known petroleum sheen. Exposure scenarios for bioaccumulation from surface water and sediment indicate a low level of concern for bioaccumulation of cPAHs. Bioaccumulation from porewater is considered a secondary line of evidence and was used as a supplement to evaluate risk.

9.0 REFERENCES

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TABLES

Table F-1
Groundwater Data Summary and Screening to Select COPCs
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	Detects	Total # of Samples	Frequency of Detection (%)	Minimum Concentration (µg/L)	Mean	Standard Deviation	Maximum Concentration (µg/L)	Location of Maximum Concentration	Minimum MDL or RL (µg/L)	Maximum MDL or RL (µg/L)	Screening Value (µg/L)		Surrogate	Risk Ratio (C/RBC)		Individual Screen C/RBC > 1?	Cumulative Screen (noncarcinogens) C/RBC >0.1 and sum (C/RBC)>1?	Is COI a COPC?	COPC Decision Basis
														ca	nc				
Polynuclear Aromatic Hydrocarbons																			
Acenaphthene	94	102	92	4.78E-02	1.33E+02	1.75E+02	9.72E+02	MW-3A	1.30E-02	1.87E-01	4.24E+03	A*	NA	NA	2.29E-01	No	Yes	Yes	Cumulative screen
Acenaphthylene	27	89	30	1.80E-02	2.84E+00	4.38E+00	1.93E+01	MW-3A	1.30E-02	7.84E+00	4.24E+03	A*	Acenaphthene	NA	4.55E-03	No	No	No	Individual screen based on solubility
Anthracene	84	102	82	1.40E-02	1.57E+01	4.56E+01	2.76E+02	MW-3A	1.20E-02	7.55E+01	4.34E+01	A*	NA	NA	6.36E+00	Yes	Yes	Yes	Individual screen based on solubility
Benzo(a)anthracene	34	102	33	4.54E-02	1.25E+01	2.99E+01	1.18E+02	MW-3A	1.50E-02	7.55E+01	9.40E+00	A*	NA	1.26E+01	NA	Yes	NA	Yes	Individual screen based on solubility
Benzo(a)pyrene	15	91	16	3.79E-02	3.33E+00	8.83E+00	3.24E+01	MW-3A	1.00E-02	1.95E+01	1.62E+00	A*	NA	2.00E+01	NA	Yes	NA	Yes	Individual screen based on solubility
Benzo(b)fluoranthene	2	34	6	7.08E-02	1.45E-01	1.06E-01	2.20E-01	MW-10	1.20E-02	1.87E-01	1.50E+00	A*	NA	1.47E-01	NA	No	NA	No	Individual screen based on solubility
Benzo(g,h,i)perylene	7	86	8	2.50E-02	1.58E+00	2.81E+00	7.42E+00	MW-3A	1.30E-02	3.88E+00	2.06E+02	A*	Fluoranthene	NA	3.60E-02	No	No	No	Individual screen based on solubility
Benzo(k)fluoranthene	3	32	9	1.30E-02	8.77E-02	7.88E-02	1.70E-01	MW-10	1.30E-02	4.80E-02	8.00E-01	A*	NA	2.13E-01	NA	No	NA	No	Individual screen based on solubility
Benzofluoranthenes	14	21	67	8.19E-02	1.10E+01	2.24E+01	7.22E+01	MW-3A	7.48E-02	3.77E-01	8.00E-01	A*	Benzo(k)fluoranthene	9.03E+01	NA	Yes	NA	Yes	Individual screen based on solubility
Chrysene	32	102	31	6.80E-03	1.07E+01	2.58E+01	1.02E+02	MW-3A	6.50E-03	7.55E+01	1.60E+00	A*	NA	6.38E+01	NA	Yes	NA	Yes	Individual screen based on solubility
Dibenzo(a,h)anthracene	3	81	4	9.32E-02	1.40E+00	1.45E+00	2.96E+00	MW-3A	1.10E-02	2.40E+00	2.49E-01	A*	NA	1.19E+01	NA	Yes	NA	Yes	Individual screen based on solubility
Fluoranthene	73	102	72	4.00E-02	4.59E+01	1.44E+02	8.20E+02	MW-3A	7.80E-03	7.55E+01	2.06E+02	A*	NA	NA	3.98E+00	Yes	Yes	Yes	Individual screen based on solubility
Fluorene	88	102	86	4.50E-02	8.75E+01	1.34E+02	7.99E+02	MW-3A	2.80E-02	7.77E-01	1.98E+03	A*	NA	NA	4.04E-01	No	Yes	Yes	Cumulative screen
Indeno(1,2,3-cd)pyrene	7	90	8	8.00E-02	2.04E+00	3.61E+00	9.55E+00	MW-3A	1.40E-02	7.84E+00	2.20E-02	A*	NA	4.34E+02	NA	Yes	NA	Yes	Individual screen based on solubility
Naphthalene	89	102	87	7.73E-02	2.40E+03	4.84E+03	2.28E+04	MW-3A	4.80E-02	3.74E+00	5.00E+02	A	NA	4.56E+01	NA	Yes	NA	Yes	Individual screen based on RBC
Phenanthrene	85	102	83	3.79E-02	1.34E+02	3.22E+02	1.99E+03	MW-3A	3.20E-02	3.74E-01	2.06E+02	A*	Fluoranthene	NA	9.66E+00	Yes	Yes	Yes	Individual screen based on solubility
Pyrene	67	102	66	1.30E-02	2.75E+01	8.74E+01	4.90E+02	MW-3A	1.30E-02	7.55E+01	1.35E+02	A*	NA	NA	3.63E+00	Yes	Yes	Yes	Individual screen based on solubility
Petroleum Hydrocarbons																			
Gasoline Range Hydrocarbons	5	11	45	7.89E+02	7.96E+03	1.16E+04	2.85E+04	MW-3A	1.00E+02	1.00E+02	1.40E+04	A	NA	2.04E+00	NA	Yes	NA	Yes	Individual screen based on RBC
Diesel Range Organics	63	84	75	1.91E+02	2.12E+04	5.27E+04	3.74E+05	MW-3A	1.87E+02	2.39E+02	>S	A	NA	NA	NA	NA	NA	Yes	No screening value - proceed to uncertainty
Residual Range Hydrocarbons	16	84	19	3.91E+02	7.37E+03	2.55E+04	1.03E+05	MW-3A	3.74E+02	1.50E+04	>S	A	NA	NA	NA	NA	NA	Yes	No screening value - proceed to uncertainty
Volatile Organic Compounds																			
Benzene	14	28	50	1.70E-01	9.33E+00	1.49E+01	4.80E+01	MW-3A	1.10E-01	2.50E-01	1.80E+03	A	NA	2.67E-02	NA	No	NA	No	Individual screen based on RBC
Ethylbenzene	14	28	50	1.13E+00	7.38E+01	8.03E+01	2.54E+02	MW-2	1.10E-01	5.00E-01	4.50E+03	A	NA	5.64E-02	NA	No	NA	No	Individual screen based on RBC
m,p-Xylene	5	10	50	5.00E+00	4.42E+01	7.51E+01	1.78E+02	MW-3A	1.00E+00	1.00E+00	2.30E+04	A	Total xylenes	NA	7.74E-03	No	No	No	Individual screen based on RBC
o-Xylene	5	10	50	4.58E+00	3.21E+01	3.80E+01	9.75E+01	MW-3A	5.00E-01	5.00E-01	2.30E+04	A	Total xylenes	NA	4.24E-03	No	No	No	Individual screen based on RBC
Toluene	11	28	39	5.20E-01	2.59E+01	4.39E+01	1.32E+02	MW-3A	8.40E-02	5.00E+00	2.20E+05	A	NA	NA	6.00E-04	No	No	No	Individual screen based on RBC
Total Xylene	9	18	50	7.90E-01	1.16E+02	1.96E+02	5.19E+02	MW-2	2.40E-01	2.60E-01	2.30E+04	A	NA	NA	2.26E-02	No	No	No	Individual screen based on RBC
Dissolved Metals																			
Arsenic	81	88	92	2.02E+00	1.16E+01	1.40E+01	8.07E+01	MW-20	2.0	2.0	6.30E+03	A	NA	1.28E-02	NA	No	NA	No	Individual screen based on RBC
Cadmium	0	83	Not detected	NA	NA	NA	NA	NA	1.0	1.0	1.30E+05	A	NA	NA	NA	NA	NA	No	Not detected
Chromium	6	83	7	2.76E+00	4.46E+00	1.28E+00	5.83E+00	MW-2A	2.0	2.0	9.40E+03	A**	Chromium VI	6.20E-04	NA	No	NA	No	Individual screen based on RBC
Copper	5	83	6	4.86E+00	9.96E+00	5.54E+00	1.85E+01	MW-5	2.0	4.0	5.40E+06	A	NA	NA	3.43E-06	No	No	No	Individual screen based on RBC
Lead	4	83	5	1.09E+00	2.18E+00	1.24E+00	3.49E+00	MW-3B	1.0	1.0	NA	B	NA	NA	NA	NA	NA	No	Pathway not applicable or incomplete
Zinc	32	85	38	4.03E+00	9.75E+01	1.55E+02	6.83E+02	MW-20	4.0	4.0	6.00E+03	C	NA	NA	1.14E-01	No	Yes	No	Individual screen based on RSL

Notes:
µg/L - micrograms per liter.
MDL - method detection limit.
RL - reporting limit.
C/RBC - concentration (maximum concentration is used) divided by risk-based concentration.
RBC - risk-based concentration.
COI - constituent of interest.
COPC - constituent of potential concern.
>S - screening value is greater than the constituent's solubility.
NA - not available/not applicable.
A - Most conservative DEQ RBC for the occupational worker, construction worker, or the excavation worker for volatilization to outdoor air, vapor intrusion into buildings, or groundwater in excavation exposure pathway.
A* - Solubility value is conservatively used as the screening value (solubilities taken from DEQ 2003, Appendix D).
A** - Chromium VI is conservatively used to evaluate dissolved chromium. Chromium VI is not known to be present at the Site.
B - Exposure pathways for lead in groundwater are incomplete for occupational workers and are not applicable for excavation workers (DEQ 2003, Section B.3.4).
C - The dermal contact EPA Regional Screening Level (RSL) is used because ingestion of groundwater is an incomplete pathway at the Site.
ca - carcinogen.
nc - noncarcinogen.

Cascadia Associates, LLC

Table F-2A
Sediment Data Summary
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	Detects	Total # of Samples	Frequency of Detection (%)	Minimum Concentration (mg/kg)	Mean	Standard Deviation	Maximum Concentration (mg/kg)	Location of Maximum Concentration	Minimum MDL or RL (mg/kg)	Maximum MDL or RL (mg/kg)
SCAPPOOSE BAY										
Polynuclear Aromatic Hydrocarbons										
1-Methylnaphthalene	45	48	94	6.14E-03	2.00E-01	3.92E-01	2.11E+00	PWS-06	6.25E-03	8.04E-03
2-Methylnaphthalene	92	105	88	3.90E-03	2.82E-01	6.57E-01	4.89E+00	PWS-06	2.20E-03	2.00E-02
Acenaphthene	104	123	85	3.40E-03	6.33E-01	1.96E+00	1.62E+01	SB27	1.80E-03	5.86E-01
Acenaphthylene	84	119	71	3.60E-03	7.04E-02	9.47E-02	4.90E-01	PWS-03	3.70E-03	4.14E-01
Anthracene	112	123	91	5.90E-03	4.95E-01	8.61E-01	4.95E+00	SB28	5.00E-03	1.73E+00
Benzo(a)anthracene	120	123	98	6.30E-03	5.96E-01	9.92E-01	7.00E+00	SD-131	1.29E-02	3.83E-01
Benzo(a)pyrene	115	123	93	7.70E-03	4.06E-01	6.10E-01	3.60E+00	SD-131	1.29E-02	1.73E+00
Benzo(b)fluoranthene	105	108	97	8.70E-03	7.87E-01	1.30E+00	7.60E+00	PWS-03	1.29E-02	3.83E-01
Benzo(g,h,i)perylene	110	120	92	7.10E-03	2.02E-01	2.91E-01	1.75E+00	PWS-03	7.59E-03	1.73E+00
Benzo(k)fluoranthene	105	108	97	6.00E-03	2.88E-01	4.39E-01	2.65E+00	PWS-03	1.29E-02	3.83E-01
Benzofluoranthenes	29	34	85	2.76E-02	9.56E-01	1.23E+00	5.60E+00	PWS-03	3.83E-01	3.47E+00
Chrysene	119	123	97	9.20E-03	9.30E-01	1.68E+00	1.10E+01	SD-131	1.29E-02	8.26E-01
Dibenzo(a,h)anthracene	79	116	68	4.10E-03	6.99E-02	9.38E-02	4.50E-01	SD-131	3.70E-03	4.14E-01
Fluoranthene	122	123	99	8.90E-03	2.11E+00	3.87E+00	2.00E+01	SD-131	1.29E-02	1.29E-02
Fluorene	106	123	86	4.50E-03	6.38E-01	1.65E+00	1.22E+01	SB27	3.00E-03	5.86E-01
Indeno(1,2,3-cd)pyrene	114	123	93	6.20E-03	2.31E-01	3.31E-01	1.92E+00	PWS-03	1.29E-02	1.73E+00
Naphthalene	111	123	90	3.30E-03	1.12E+00	3.83E+00	2.96E+01	SB28	5.00E-03	5.86E-01
Phenanthrene	117	123	95	7.60E-03	1.85E+00	3.90E+00	2.37E+01	SB27	5.00E-03	3.83E-01
Pyrene	121	123	98	1.50E-02	1.51E+00	2.69E+00	1.50E+01	SD-131	1.29E-02	3.83E-01
Petroleum Hydrocarbons										
Diesel Range Organics	5	22	23	3.35E+01	1.17E+02	9.25E+01	2.53E+02	SB28	2.50E+01	1.11E+02
Residual Range Hydrocarbons	9	22	41	7.06E+01	1.68E+02	7.23E+01	2.89E+02	SB28	5.00E+01	2.21E+02
Dioxins/Furans										
2,3,7,8-TCDD	0	4	0	NA	NA	NA	NA	NA	2.30E-08	8.04E-03
1,2,3,7,8-PeCDD	1	4	25	3.90E-03	NA	NA	4.89E+00	SD-131	2.10E-08	2.00E-02
1,2,3,4,7,8-HxCDD	2	4	50	3.40E-03	6.50E-01	1.96E+00	1.62E+01	SD-131	1.60E-08	5.86E-01
1,2,3,6,7,8-HxCDD	4	4	100	3.60E-03	6.64E-02	9.47E-02	4.90E-01	SD-131	NA	NA
1,2,3,7,8,9-HxCDD	2	4	50	5.90E-03	4.85E-01	8.61E-01	4.95E+00	SD-131	1.80E-08	1.73E+00
1,2,3,4,6,7,8-HpCDD	4	4	100	6.30E-03	5.53E-01	9.92E-01	7.00E+00	SD-131	NA	NA
OCDD	4	4	100	7.70E-03	3.68E-01	6.10E-01	3.60E+00	SD-131	NA	NA
2,3,7,8-TCDF	0	4	0	NA	NA	NA	NA	NA	4.60E-08	3.83E-01
1,2,3,7,8-PeCDF	1	4	25	7.10E-03	NA	NA	1.75E+00	SD-131	1.80E-08	1.73E+00
2,3,4,7,8-PeCDF	1	4	25	6.00E-03	NA	NA	2.65E+00	SD-131	1.80E-08	3.83E-01
1,2,3,4,7,8-HxCDF	4	4	100	2.76E-02	8.92E-01	1.23E+00	5.60E+00	SD-131	NA	NA
1,2,3,6,7,8-HxCDF	1	4	25	9.20E-03	NA	NA	1.10E+01	SD-131	1.80E-08	8.26E-01
2,3,4,6,7,8-HxCDF	1	4	25	4.10E-03	NA	NA	4.50E-01	SD-131	1.80E-08	4.14E-01
1,2,3,7,8,9-HxCDF	1	4	25	8.90E-03	NA	NA	2.00E+01	SD-131	1.30E-08	1.29E-02
1,2,3,4,6,7,8-HpCDF	4	4	100	4.50E-03	6.47E-01	1.65E+00	1.22E+01	SD-131	NA	NA
1,2,3,4,7,8,9-HpCDF	3	4	75	6.20E-03	2.16E-01	3.31E-01	1.92E+00	SD-131	2.00E-08	2.00E-08
OCDF	4	4	100	3.30E-03	1.21E+00	3.83E+00	2.96E+01	SD-131	NA	NA

Please refer to notes on last page of table.

Cascadia Associates, LLC

Table F-2A
Sediment Data Summary
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	Detects	Total # of Samples	Frequency of Detection (%)	Minimum Concentration (mg/kg)	Mean	Standard Deviation	Maximum Concentration (mg/kg)	Location of Maximum Concentration	Minimum MDL or RL (mg/kg)	Maximum MDL or RL (mg/kg)
MILTON CREEK										
Polynuclear Aromatic Hydrocarbons										
1-Methylnaphthalene	1	4	25	8.03E-02	NA	NA	8.03E-02	PWS-17	6.89E-03	8.53E-03
2-Methylnaphthalene	7	9	78	7.50E-03	1.83E-02	1.29E-02	4.58E-02	PWS-17	8.53E-03	2.60E-02
Acenaphthene	8	11	73	9.87E-03	6.98E-02	9.26E-02	2.68E-01	MC04	8.53E-03	2.73E-02
Acenaphthylene	5	11	45	8.91E-03	3.05E-02	3.32E-02	8.60E-02	SD-MC-A	5.00E-03	2.73E-02
Anthracene	8	11	73	1.50E-02	7.11E-02	9.18E-02	2.70E-01	SD-MC-E	5.00E-03	2.73E-02
Benzo(a)anthracene	8	11	73	5.20E-03	1.10E-01	1.56E-01	4.80E-01	SD-MC-A	8.53E-03	2.73E-02
Benzo(a)pyrene	8	11	73	9.50E-03	1.87E-01	3.04E-01	9.00E-01	SD-MC-A	8.53E-03	2.73E-02
Benzo(b)fluoranthene	8	11	73	9.60E-03	1.56E-01	1.95E-01	5.80E-01	SD-MC-A	8.53E-03	2.73E-02
Benzo(g,h,i)perylene	7	11	64	1.40E-02	1.85E-01	3.26E-01	9.10E-01	SD-MC-A	8.53E-03	8.05E-02
Benzo(k)fluoranthene	8	11	73	6.30E-03	1.08E-01	1.82E-01	5.40E-01	SD-MC-A	8.53E-03	2.73E-02
Benzofluoranthenes	2	3	67	5.87E-02	9.09E-02	4.55E-02	1.23E-01	PWS-27	1.71E-02	1.71E-02
Chrysene	8	11	73	8.10E-03	1.65E-01	2.33E-01	7.10E-01	SD-MC-A	8.53E-03	2.73E-02
Dibenzo(a,h)anthracene	4	11	36	7.00E-03	2.61E-02	2.09E-02	5.00E-02	SD-MC-A	5.00E-03	8.05E-02
Fluoranthene	9	11	82	2.00E-02	2.49E-01	3.71E-01	1.20E+00	SD-MC-A	8.53E-03	2.73E-02
Fluorene	9	11	82	1.10E-02	4.97E-02	4.91E-02	1.68E-01	MC04	8.53E-03	2.73E-02
Indeno(1,2,3-cd)pyrene	7	11	64	1.20E-02	1.55E-01	2.52E-01	7.00E-01	SD-MC-A	8.53E-03	8.05E-02
Naphthalene	8	11	73	1.30E-02	6.31E-02	5.94E-02	1.95E-01	PWS-17	8.53E-03	2.73E-02
Phenanthrene	9	11	82	2.30E-02	2.21E-01	3.00E-01	1.00E+00	SD-MC-A	8.53E-03	2.73E-02
Pyrene	9	11	82	1.70E-02	2.41E-01	3.71E-01	1.20E+00	SD-MC-A	8.53E-03	2.73E-02
Petroleum Hydrocarbons										
Diesel Range Organics	0	2	0	NA	NA	NA	NA	NA	7.11E+01	7.71E+01
Residual Range Hydrocarbons	0	2	0	NA	NA	NA	NA	NA	1.42E+02	1.54E+02

Notes:
Only samples from outside the inferred extent of NAPL (Figure F-1) are presented.
mg/kg - milligrams per kilogram.
MDL - method detection limit.
RL - reporting limit.
NA - not available/not applicable.

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Table F-2B
Sediment Metal Analytical Results from 2003 and 2011
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Sample Location	Sample Depth (feet)	Sample Date	Arsenic	Cadmium	Chromium	Iron	Lead
			Concentrations in milligrams per kilogram (mg/kg)				
SD-100	0-4	Dec 2003	**6.1**	NT	NT	NT	NT
SD-101	0-4	Dec 2003	**7.7**	NT	NT	NT	NT
SD-102	0-4	Dec 2003	**8**	NT	NT	NT	NT
SD-103	0-4	Dec 2003	**6**	NT	NT	NT	NT
SD-104	0-4	Dec 2003	**9.4**	NT	NT	NT	NT
SD-105	0-4	Dec 2003	**6.2**	NT	NT	NT	NT
SD-106	0-4	Dec 2003	**6**	NT	NT	NT	NT
SD-107	0-4	Dec 2003	**4.3**	NT	NT	NT	NT
SD-108	0-4	Dec 2003	**6.5**	NT	NT	NT	NT
SD-109	0-4	Dec 2003	**5.4**	NT	NT	NT	NT
SD-110	0-4	Dec 2003	**5.3**	NT	NT	NT	NT
SD-111	0-4	Dec 2003	**10.9**	NT	NT	NT	NT
SD-112	0-4	Dec 2003	**7.7**	NT	NT	NT	NT
SD-113	0-4	Dec 2003	**5.1**	NT	NT	NT	NT
SD-114	0-4	Dec 2003	**6**	NT	NT	NT	NT
SD-115	0-4	Dec 2003	**5.2**	NT	NT	NT	NT
SD-116	0-4	Dec 2003	**5**	NT	NT	NT	NT
SD-117	0-4	Dec 2003	**6.6**	NT	NT	NT	NT
SD-118	0-4	Dec 2003	**8.1**	NT	NT	NT	NT
SD-119	0-4	Dec 2003	**6**	NT	NT	NT	NT
SD-120	0-4	Dec 2003	**5.3**	NT	NT	NT	NT
SB17	0-0.3	7/15/2011	**7.03**	0.295 U	**20.8**	**29,800**	**11.1**
SB18	0-0.3	7/15/2011	**10.8**	**0.715**	**31.6**	**40,900**	**16.3**
SSED-8	0-0.3	10/7/2011	**5.38**	1.85 U	**25.7**	**33,400**	**8.96**
Site-Specific Background Concentrations[1]			10.7	2.2	29.8	NE	52.9

Notes:

Samples SD-100 through SD-120 collected by Hart Crowser on December 2-3, 2003.

Samples SB-17, SB-18, SSED-8 collected by AMEC on the referenced dates in 2011.

[1] As presented in Appendix D of the 2000 RI Report (GeoEngineers, 2000).

Bold = analyte detection**.**

mg/kg = milligrams per kilogram.

NE = not established.

U = the analyte was analyzed for, but was not detected above the reported sample quantitation limit presented in the table.

NT = not tested.

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Table F-2C
Comparison of 2005 Sediment Dioxins/Furans Analytical Results with Bioaccumulation SLVs
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Sample Location	Sample Depth (feet)	Sample Date	2,3,7,8-TCDD	1,2,3,7,8-PeCDD	1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD	1,2,3,7,8,9-HxCDD	1,2,3,4,6,7,8-HpCDD	OCDD	2,3,7,8-TCDF	1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDF	2,3,4,6,7,8-HxCDF	1,2,3,7,8,9-HxCDF	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF	OCDF	Total 2,3,7,8- TCDD TEQ
			Concentrations in picograms per gram (pg/g)																	
SD-131	0.5	4/26/2005	0.044 U	**0.117**	**0.254**	**2.32**	**0.695**	**76.6**	**771**	0.551 U	**0.122**	**0.118**	**0.553**	**0.235**	**0.383**	**0.173**	**11.6**	**0.623**	**63.9**	**1.81**
SD-143	0.5	4/26/2005	0.023 U	0.021 U	0.016 U	**0.130**	0.018 U	**2.35**	**22.9**	0.222 U	0.018 U	0.018 U	**0.092**	0.018 U	0.018 U	0.013 U	**0.54**	0.020 U	**1.66**	**0.0988**
SD-144	0.5	4/26/2005	0.038 U	0.040 U	0.050 U	**0.355**	0.055 U	**10.3**	**116**	0.287 U	0.034 U	0.037 U	**0.224**	0.035 U	0.033 U	0.033 U	**1.67**	**0.149**	**8.71**	**0.286**
WHO 2005 TEF[1]			1	1	0.1	0.1	0.1	0.01	0.0003	0.1	0.03	0.3	0.1	0.1	0.1	0.1	0.01	0.01	0.0003	--
Bioaccumulation SLVs																				
General Consumption			0.0091	0.27	2.7	2.7	2.7	690	23,000	0.77	2.6	0.030	2.7	2.7	2.7	2.7	690	690	23,000	--
Subsistence Consumption[2]			0.00089	0.028	0.28	0.28	0.28	69	2,268	0.076	0.25	0.0030	0.28	0.28	0.28	0.28	68.9	68.9	2,268	--

Notes:

Only samples from outside the inferred extent of NAPL (shown on Figure F-1) are presented.

[1] Toxicity Equivalency Factors (TEFs) from 2005 World Health Organization (WHO) values (Van den Berg, 2006).

[2] Bioaccumulation screening level values (SLVs) adjusted from 2007 SLVs to account for a 175 g/day consumption rate, per DEQ request (DEQ, 2014).

Bold = analyte detection**.**

U = analyte not detected above the stated detection limit.

TEQ calculated by summing TEF adjusted concentrations (calculated by multiplying the detected concentration [or 1/2 the DL for non-detects] by the TEF).

pg/g = picograms per gram.

-- = not established.

Red shading indicates the concentration exceeds one or both of the 2007 bioaccumulation SLVs for consumption of fish by general and subsistence users.

Grey shading indicates the concentration exceeds the adjusted 2007 bioaccumulation SLVs for consumption of fish by subsistence users.

Table F-2D
Comparison of Nearshore Sediment Concentrations with Human Health-Based SLVs
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	Site Data Summary[A]						Preliminary Remediation Goals[B]	
	Milton Creek			Scappoose Bay				
	Min	Mean	Max	Min	Mean	Max	Angler[C]	Transient
	Concentrations in milligrams per kilogram (mg/kg)							
Polynuclear Aromatic Hydrocarbons								
Benzo(a)pyrene	9.50E-03	1.89E-01	9.00E-01	7.70E-03	3.68E-01	3.60E+00	--	4.10E+03
Benzo(a)pyrene TEQ[D]	3.93E-02	2.02E-01	1.12E+00	3.81E-02	5.20E-01	5.18E+00	8.80E+00	9.60E+02
Naphthalene	1.30E-02	6.31E-02	1.95E-01	3.30E-03	1.21E+00	2.96E+01	7.20E+04	2.70E+05
Petroleum Hydrocarbons								
Diesel-range	--	--	--	1.25E+01	4.30E+01	2.53E+02	--	--
Residual-range	--	--	--	2.50E+01	9.20E+01	2.89E+02	--	--
Total TPH[E]	--	--	--	3.75E+01	1.35E+02	5.42E+02	1.40E+04	5.50E+04

Notes:

SLVs = screening level values.
TPH = total petroleum hydrocarbons.
TEQ = toxic equivalency.
TEF = toxic equivalency factor.
-- = not available or not applicable.
Non-detect (ND) values were replaced with 0 if not detected in any samples or one-half the detection limit (DL) if detected in at least one sample.

[A]Data from nearshore sediment samples outside of areas with visible NAPL contamination sampled in 2004-2017. The full dataset is listed in Appendix A.

[B]Preliminary Remediation Goals (PRGs) from DEQ (2019).

[C]Lowest of PRGs established for child, adult, or combined angler scenario.

[D]Benzo(a)pyrene TEQ calculated from TEFs provided in Table 3 of DEQ's Human Health Risk Assessment Guidance (DEQ, 2010).

[E]Total TPH calculated as the sum of diesel-range and residual-range TPH, using half the DLs for NDs.

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Table F-2E
Comparison of Surface Water and Pore Water Concentrations with Human Health-Based SLVs
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

		Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00						
Sample ID	**Passive Sampler Location [1]**	**Benzo(a)anthracene**	**Chrysene**	**Benzo(b)fluoranthene**	**Benzo(k)fluoranthene**	**Benzo(a)pyrene**	**Indeno(1,2,3-cd)pyrene**	**Dibenzo(a,h)anthracene**
TEF		0.1	0.001	0.1	0.01	1	0.1	1
		BaP equivalent concentrations in micrograms per liter (µg/L)						
Pore Water								
Shallow Porewater Site 1	PWS-1	**2.31E-06**	**2.47E-08**	**1.04E-06**	7.79E-09 U	1.74E-06 U	4.99E-08 U	2.01E-06 U
Deep Porewater Site 1	PWS-1	**1.88E-05**	**1.63E-07**	**3.85E-06**	**2.33E-07**	**2.89E-05**	4.68E-08 U	1.89E-06 U
Shallow Porewater Site 2	PWS-2	**3.08E-06**	**4.53E-08**	**7.06E-07**	6.40E-09 U	1.43E-06 U	4.06E-08 U	1.64E-06 U
Deep Porewater Site 2	PWS-2	9.34E-08 U	6.21E-10 U	4.60E-08 U	6.84E-09 U	1.53E-06 U	4.36E-08 U	1.76E-06 U
Shallow Porewater Site 3	PWS-3	9.32E-08 U	6.19E-10 U	4.59E-08 U	6.81E-09 U	1.52E-06 U	4.33E-08 U	1.75E-06 U
Deep Porewater Site 3	PWS-3	8.81E-08 U	5.85E-10 U	4.34E-08 U	6.42E-09 U	1.44E-06 U	4.08E-08 U	1.65E-06 U
Shallow Porewater Site 4	PWS-4	**7.03E-07**	**6.94E-09**	**3.56E-07**	3.90E-09 U	8.72E-07 U	2.41E-08 U	9.74E-07 U
Deep Porewater Site 4	PWS-4	**2.75E-06**	**3.00E-08**	**1.14E-06**	1.30E-08 U	2.92E-06 U	8.44E-08 U	3.41E-06 U
Shallow Porewater Site 5	PWS-5	**1.61E-06**	**2.69E-08**	**1.22E-06**	7.52E-09 U	1.68E-06 U	4.81E-08 U	1.94E-06 U
Deep Porewater Site 5	PWS-5	**1.36E-05**	**1.87E-07**	**2.54E-06**	7.07E-09 U	**2.51E-05**	4.51E-08 U	1.82E-06 U
Shallow Porewater Site 6	PWS-6	**1.93E-06**	**1.94E-08**	**1.14E-06**	9.89E-09 U	2.22E-06 U	6.37E-08 U	2.57E-06 U
Deep Porewater Site 6	PWS-6	9.07E-08 U	**6.11E-09**	**4.68E-07**	**4.95E-08**	1.48E-06 U	4.22E-08 U	1.70E-06 U
Shallow Porewater Site 7	PWS-7	**1.24E-06**	**1.10E-08**	**5.79E-07**	**4.67E-08**	1.21E-06 U	3.40E-08 U	1.37E-06 U
Deep Porewater Site 7	PWS-7	6.58E-08 U	**3.90E-09**	**3.15E-07**	4.63E-09 U	1.03E-06 U	2.90E-08 U	1.17E-06 U
Shallow Porewater Site 8	PWS-8	**2.82E-06**	**3.02E-08**	**1.18E-06**	**7.09E-08**	**6.26E-06**	3.13E-08 U	1.26E-06 U
Deep Porewater Site 8	PWS-8	**2.04E-06**	**1.97E-08**	**8.38E-07**	**8.14E-08**	1.98E-06 U	5.68E-08 U	2.29E-06 U
Shallow Porewater Site 9	PWS-9	**2.80E-06**	**3.14E-08**	**1.26E-06**	**9.77E-08**	2.12E-06 U	6.09E-08 U	2.46E-06 U
Deep Porewater Site 9	PWS-9	**1.66E-06**	**1.58E-08**	**6.92E-07**	**6.67E-08**	1.70E-06 U	4.85E-08 U	1.96E-06 U
Shallow Porewater Site 10	PWS-10	**2.42E-06**	**2.50E-08**	**8.87E-07**	**6.70E-08**	**6.21E-06 J**	4.06E-08 U	1.64E-06 U
Shallow Porewater Site 11	PWS-11	**5.51E-06**	**5.58E-08**	**2.24E-06**	**1.30E-07**	**1.31E-05**	4.48E-08 U	1.81E-06 U
Deep Porewater Site 11	PWS-11	**2.84E-06**	**2.49E-08**	**1.27E-06**	**8.75E-08**	**8.48E-06**	4.56E-08 U	1.84E-06 U
Shallow Porewater Site 12	PWS-12	**2.24E-05**	**4.33E-07**	**1.07E-05**	**5.80E-07**	**5.16E-05**	6.67E-08 U	2.69E-06 U
Deep Porewater Site 12	PWS-12	**2.34E-05**	**2.12E-07**	**7.54E-06**	**4.06E-07**	**5.30E-05**	7.61E-08 U	3.08E-06 U
Shallow Porewater Site 13	PWS-13	**1.04E-05**	**1.06E-07**	**3.72E-06**	**1.83E-07**	**2.39E-05**	4.48E-08 U	1.81E-06 U
Deep Porewater Site 13	PWS-13	**2.10E-05**	**2.01E-07**	**5.84E-06**	**2.98E-07**	**4.18E-05**	5.04E-08 U	2.03E-06 U
Shallow Porewater Site 14	PWS-14	**2.96E-06**	**2.88E-08**	**1.28E-06**	**9.52E-08**	**1.05E-05**	5.18E-08 U	2.09E-06 U
Deep Porewater Site 14	PWS-14	**2.21E-05**	**2.35E-07**	**9.32E-06**	**5.10E-07**	**1.72E-03**	**3.37E-06**	1.70E-06 U
Shallow Porewater Site 15	PWS-15	**4.98E-06**	**4.95E-08**	**2.37E-06**	**1.68E-07**	**1.73E-05**	9.22E-08 U	3.72E-06 U
Deep Porewater Site 15	PWS-15	**1.12E-04**	**1.14E-06**	**3.36E-05**	**1.77E-06**	**2.56E-04**	4.68E-08 U	1.89E-06 U
CTE		9.85E-06	1.08E-07	3.32E-06	1.73E-07	7.89E-05	1.64E-07	2.00E-06
RME		2.70 E-5	5.47E-07	9.71E-06	3.74E-07	3.42E-04	3.37E-06	--

Please refer to notes on last page of table.

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Table F-2E
Comparison of Surface Water and Pore Water Concentrations with Human Health-Based SLVs
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

		Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00						
Sample ID	**Passive Sampler Location [1]**	**Benzo(a)anthracene**	**Chrysene**	**Benzo(b)fluoranthene**	**Benzo(k)fluoranthene**	**Benzo(a)pyrene**	**Indeno(1,2,3-cd)pyrene**	**Dibenzo(a,h)anthracene**
TEF		0.1	0.001	0.1	0.01	1	0.1	1
		BaP equivalent concentrations in micrograms per liter (µg/L)						
Surface Water								
Surface Water Site 2	PWS-2	**1.62E-05**	**1.68E-07**	**4.47E-06**	**2.00E-07**	**1.61E-05**	8.90E-09 U	3.58E-07 U
Surface Water Site 3	PWS-3	**1.18E-05**	**1.37E-07**	**4.93E-06**	**1.91E-07**	**2.26E-05**	8.10E-09 U	3.26E-07 U
Surface Water Site 4	PWS-4	**1.80E-05**	**2.07E-07**	**6.51E-06**	**2.76E-07**	**2.98E-05**	8.60E-09 U	3.48E-07 U
Surface Water Site 9	PWS-9	**3.07E-05**	**3.15E-07**	**1.11E-05**	**3.63E-07**	**5.49E-05**	**1.30E-06**	**3.46E-06**
Surface Water Site 10-1	PWS-10	**2.93E-05**	**2.88E-07**	**9.28E-06**	**3.94E-07**	**4.78E-05**	**1.04E-06**	**2.77E-06**
Surface Water Site 10-3	PWS-10	**2.25E-05**	**2.47E-07**	**7.29E-06**	**2.98E-07**	**4.08E-05**	**8.81E-07**	2.29E-07 U
Surface Water Site 12	PWS-12	**3.53E-05**	**3.28E-07**	**1.18E-05**	**4.91E-07**	**6.64E-05**	**1.16E-06**	2.28E-07 U
Surface Water Site 13	PWS-13	**6.19E-05**	**5.66E-07**	**2.08E-05**	**9.08E-07**	**1.23E-04**	**1.70E-06**	2.59E-07 U
Surface Water Site 14	PWS-14	**8.01E-06**	**9.56E-08**	**3.37E-06**	**1.29E-07**	**1.92E-05**	**4.72E-07**	2.05E-07 U
CTE		2.60E-05	2.61E-07	8.84E-06	3.61E-07	4.67E-05	7.31E-07	9.09E-07
RME		3.60E-05	3.48E-07	1.22E-05	5.06E-07	6.74E-05	1.12E-06	3.46E-06
PRGw,c		1.20E-03	1.20E-01	1.20E-03	1.20E-02	1.20E-04	1.20E-03	1.20E-04
PRGw,nc		--	--	--	--	3.50E-02	--	--

Notes:

[1] The term "passive sampler" refers to the sampling hardware (surface water cages) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU Standard Operating Procedures (SOPs) to refer to the prepared low-density polyethylene (LDPE) sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These in situ passive samplers are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in surface water.

SOP 427.00 = Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.

Data represents non-background corrected values as per DEQ's recommendations.

Passive samplers PWS-3, PWS-4, PWS-5, PWS-6, PWS-7, PWS-8, PWS-9, PWS-10, PWS-11, PWS-14 were deployed on September 5, 2017.

Passive samplers PWS-1, PWS-2, PWS-12, PWS-13, and PWS-15 were deployed on September 6, 2017.

All passive samplers were removed on September 26, 2017.

Total PAHs represent sum of all 63 freely dissolved concentrations (Cfree ∑63) measured on the passive sampler's media.

SLVs = screening level values.

PAHs = petroleum aromatic hydrocarbons.

TEF = toxic equivalency factor; from Table 3 of *Human Health Risk Assessment Guidance* (DEQ, 2010).

U = The analyte was not detected above the applicable reporting or detection limit.

BaP = benzo(a)pyrene.

OSU FSES = Oregon State University Food Safety and Environmental Stewardship Program.

BaP equivalent concentration = C_i*TEF_i for each cPAH analyte ($_i$), using 1/2 the detection limit for non-detects.

CTE - central tendency exposure.

RME = reasonable maximum exposure.

$PRG_{w,c}$ = preliminary remediation goal for water, cancer; calculations for derivation shown in Attachment F.

$PRG_{w,nc}$ = preliminary remediation goal for water, noncancer; calculations for derivation shown in Attachment F.

Shading indicates an exceedance of the applicable PRG.

-- = not applicable or not available.

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Table F-3
Soil PCB Data Summary
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	Detects	Total # of Samples	Frequency of Detection (%)	Minimum Detected Concentration (mg/kg)	Mean	Standard Deviation	Maximum Concentration (mg/kg)	Location of Maximum Concentration	Minimum MDL or RL (mg/kg)	Maximum MDL or RL (mg/kg)
SURFACE SOIL										
Polychlorinated Biphenyls										
Aroclor 1016	0	27	0	NA	NA	NA	NA	NA	1.00E-01	1.00E-01
Aroclor 1221	0	27	0	NA	NA	NA	NA	NA	1.00E-01	1.00E-01
Aroclor 1232	0	27	0	NA	NA	NA	NA	NA	1.00E-01	1.00E-01
Aroclor 1242	0	27	0	NA	NA	NA	NA	NA	1.00E-01	1.00E-01
Aroclor 1248	0	27	0	NA	NA	NA	NA	NA	1.00E-01	1.00E-01
Aroclor 1254	0	27	0	NA	NA	NA	NA	NA	1.00E-01	1.00E-01
Aroclor 1260	16	27	59	1.00E-01	7.46E-01	1.17E+00	4.60E+00	SS-08	1.00E-01	1.00E-01
Total PCBs	16	27	59	1.00E-01	7.46E-01	1.17E+00	4.60E+00	SS-08	1.00E-01	1.00E-01

Notes:
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram
MDL = method detection limit
RL = reporting limit
NA = not available/not applicable
Non-detect values were replaced with 0 if not detected in any samples or one-half the detection limit (DL) if detected in at least one sample.

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Table F-4A
Groundwater Exposure Point Concentrations
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	RME EPC (µg/L)	CTE EPC (µg/L)	Maximum Concentration (µg/L)	Distribution	UCL Method
Polynuclear Aromatic Hydrocarbons					
Acenaphthene	1.97E+02	1.33E+02	9.72E+02	Non-parametric	95% KM (Chebyshev) UCL
Anthracene	3.13E+01	1.57E+01	2.76E+02	Non-parametric	95% KM (Chebyshev) UCL
Benzo(a)anthracene	1.22E+01	1.25E+01	1.18E+02	Non-parametric	95% KM (Chebyshev) UCL
Benzo(a)pyrene	1.78E+00	3.33E+00	3.24E+01	Lognormal	90% KM (Chebyshev) UCL
Benzofluoranthenes	3.33E+01	1.10E+01	7.22E+01	Lognormal	97.5% KM (Chebyshev) UCL
Chrysene	1.01E+01	1.07E+01	1.02E+02	Non-parametric	95% KM (Chebyshev) UCL
Dibenzo(a,h)anthracene[A]	2.96E+00	1.40E+00	2.96E+00	Not calculated due to a limited number of detections	
Fluoranthene	8.67E+01	4.59E+01	8.20E+02	Non-parametric	95% KM (Chebyshev) UCL
Fluorene	1.31E+02	8.75E+01	7.99E+02	Non-parametric	95% KM (Chebyshev) UCL
Indeno(1,2,3-cd)pyrene	5.50E-01	2.04E+00	9.55E+00	Lognormal	90% KM (Chebyshev) UCL
Naphthalene	4.07E+03	2.40E+03	2.28E+04	Non-parametric	95% KM (Chebyshev) UCL
Phenanthrene	2.40E+02	1.34E+02	1.99E+03	Non-parametric	95% KM (Chebyshev) UCL
Pyrene	4.95E+01	2.75E+01	4.90E+02	Non-parametric	95% KM (Chebyshev) UCL
Petroleum Hydrocarbons					
Gasoline Range Hydrocarbons	7.38E+03	7.96E+03	2.85E+04	Gamma	90% KM (t) UCL
Diesel Range Organics	3.81E+04	2.12E+04	3.74E+05	Lognormal	95% KM (Chebyshev) UCL
Residual Range Hydrocarbons	3.02E+03	7.37E+03	1.03E+05	Non-parametric	90% KM (BCA) UCL

Notes:
µg/L = micrograms per liter
RME = reasonable maximum exposure
EPC = exposure point concentration
CTE - central tendency exposure
UCL - upper confidence limit (ProUCL prints provided in Appendix F-D).
[A] Dibenzo(a,h)anthracene was detected only three times so the maximum detection is used as the RME EPC.

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Table F-4B
Sediment Exposure Point Concentrations for the Scappoose Bay Exposure Unit
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent		RME EPC (i.e., UCL) (mg/kg)	CTE EPC (i.e., mean) (mg/kg)	Maximum Concentration (mg/kg)	Distribution	UCL Method
Polynuclear Aromatic Hydrocarbons						
1-Methylnaphthalene		4.09E-01	2.39E-01	2.11E+00	Gamma	90% KM (Chebyshev) UCL
2-Methylnaphthalene		5.29E-01	2.91E-01	4.89E+00	Lognormal	95% KM (Chebyshev) UCL
Acenaphthene		1.29E+00	6.50E-01	1.62E+01	Lognormal	95% KM (Chebyshev) UCL
Acenaphthylene		7.27E-02	6.64E-02	4.90E-01	Lognormal	90% KM (Chebyshev) UCL
Anthracene		7.85E-01	4.85E-01	4.95E+00	Lognormal	95% KM (Chebyshev) UCL
Benzo(a)anthracene		9.44E-01	5.53E-01	7.00E+00	Lognormal	95% KM (Chebyshev) UCL
Benzo(a)pyrene		5.20E-01	3.68E-01	3.60E+00	Lognormal	90% KM (Chebyshev) UCL
Benzo(b)fluoranthene		1.26E+00	7.15E-01	7.60E+00	Lognormal	95% KM (Chebyshev) UCL
Benzo(g,h,ipPerylene		2.63E-01	1.90E-01	1.75E+00	Lognormal	90% KM (Chebyshev) UCL
Benzo(k)fluoranthene		3.94E-01	2.69E-01	2.65E+00	Lognormal	90% KM (Chebyshev) UCL
Benzofluoranthenes		1.42E+00	8.92E-01	5.60E+00	Gamma	90% KM (Chebyshev) UCL
Chrysene		1.52E+00	8.63E-01	1.10E+01	Lognormal	95% KM (Chebyshev) UCL
Dibenzo(a,h)anthracene		7.16E-02	6.70E-02	4.50E-01	Lognormal	90% KM (Chebyshev) UCL
Fluoranthene		3.63E+00	2.05E+00	2.00E+01	Lognormal	95% KM (Chebyshev) UCL
Fluorene		1.19E+00	6.47E-01	1.22E+01	Lognormal	95% KM (Chebyshev) UCL
Indeno(1,2,3-cd)pyrene		2.98E-01	2.16E-01	1.92E+00	Lognormal	90% KM (Chebyshev) UCL
Naphthalene		2.59E+00	1.21E+00	2.96E+01	Lognormal	95% KM (Chebyshev) UCL
Phenanthrene		3.28E+00	1.81E+00	2.37E+01	Lognormal	95% KM (Chebyshev) UCL
Pyrene		2.54E+00	1.46E+00	1.50E+01	Lognormal	95% KM (Chebyshev) UCL
Petroleum Hydrocarbons						
Diesel Range Organics		6.60E+01	1.17E+02	2.53E+02	Normal	90% KM (t) UCL
Residual Range Hydrocarbons		1.27E+02	1.68E+02	2.89E+02	Normal	90% KM (t) UCL
Dioxins/Furans						
2,3,7,8-TCDD	A	0.00E+00	0.00E+00	0.00E+00	Not calculated due to a limited number of samples	
1,2,3,7,8-PeCDD	B	1.17E-07	1.17E-07	1.17E-07		
1,2,3,4,7,8-HxCDD	B	2.54E-08	2.54E-08	2.54E-08		
1,2,3,6,7,8-HxCDD	C	2.32E-07	9.36E-08	2.32E-07		
1,2,3,7,8,9-HxCDD	B	6.95E-08	6.95E-08	6.95E-08		
1,2,3,4,6,7,8-HpCDD	C	7.66E-07	2.97E-07	7.66E-07		
OCDD	C	2.31E-07	9.10E-08	2.31E-07		
2,3,7,8-TCDF	A	0.00E+00	0.00E+00	0.00E+00		
1,2,3,7,8-PeCDF	B	3.66E-09	3.66E-09	3.66E-09		
2,3,4,7,8-PeCDF	B	3.54E-08	3.54E-08	3.54E-08		
1,2,3,4,7,8-HxCDF	C	5.53E-08	2.90E-08	5.53E-08		
1,2,3,6,7,8-HxCDF	B	2.35E-08	2.35E-08	2.35E-08		
2,3,4,6,7,8-HxCDF	B	3.83E-08	3.83E-08	3.83E-08		
1,2,3,7,8,9-HxCDF	B	1.73E-08	1.73E-08	1.73E-08		
1,2,3,4,6,7,8-HpCDF	C	1.16E-07	4.60E-08	1.16E-07		
1,2,3,4,7,8,9-HpCDF	C	6.23E-09	3.86E-09	6.23E-09		
OCDF	C	1.92E-08	7.43E-09	1.92E-08		

Notes:

mg/kg - milligrams per kilogram

RME - reasonable maximum exposure

EPC = exposure point concentration

CTE - central tendency exposure

UCL - upper confidence limit (ProUCL prints provided in Appendix F-D).

[A]Congener not detected in any samples and not used for risk calculations.

[B]Congener was detected in only one sample; detected concentration used for CTE, RME, and Maximum.

[C]Congener was detected in only three samples; maximum detected concentration was used for the RME.

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Table F-4C
Sediment Exposure Point Concentrations for the Milton Creek Exposure Unit
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	RME EPC (i.e., UCL) (mg/kg)	CTE EPC (i.e., mean) (mg/kg)	Maximum Concentration (mg/kg)	Distribution	UCL Method
Polynuclear Aromatic Hydrocarbons					
1-Methylnaphthalene[A]	8.03E-02	8.03E-02	8.03E-02	Not calculated due to a limited number of samples	
2-Methylnaphthalene	2.22E-02	1.83E-02	4.58E-02	Normal	90% KM (t) UCL
Acenaphthene	1.30E-01	6.98E-02	2.68E-01	Gamma	90% KM Chebyshev UCL
Acenaphthylene	2.79E-02	3.05E-02	8.60E-02	Normal	90% KM (t) UCL
Anthracene	1.64E-01	7.11E-02	2.70E-01	Lognormal	95% KM (Chebyshev) UCL
Benzo(a)anthracene	2.03E-01	1.10E-01	4.80E-01	Gamma	90% Adjusted Gamma KM-UCL
Benzo(a)pyrene	4.05E-01	1.87E-01	9.00E-01	Gamma	90% Adjusted Gamma KM-UCL
Benzo(b)fluoranthene	1.90E-01	1.56E-01	5.80E-01	Normal	90% KM (t) UCL
Benzo(g,h,i)perylene	4.36E-01	1.85E-01	9.10E-01	Gamma	90% Adjusted Gamma KM-UCL
Benzo(k)fluoranthene	2.45E-01	1.08E-01	5.40E-01	Gamma	90% Adjusted Gamma KM-UCL
Benzofluoranthenes[B]	1.23E-01	9.09E-02	1.23E-01	Not calculated due to a limited number of samples	
Chrysene	3.05E-01	1.65E-01	7.10E-01	Gamma	90% Adjusted Gamma KM-UCL
Dibenzo(a,h)anthracene	2.14E-02	2.61E-02	5.00E-02	Normal	90% KM (t) UCL
Fluoranthene	5.05E-01	2.49E-01	1.20E+00	Gamma	90% Adjusted Gamma KM-UCL
Fluorene	6.22E-02	4.97E-02	1.68E-01	Normal	90% KM (t) UCL
Indeno(1,2,3-cd)pyrene	3.22E-01	1.55E-01	7.00E-01	Gamma	90% Adjusted Gamma KM-UCL
Naphthalene	7.26E-02	6.31E-02	1.95E-01	Normal	90% KM (t) UCL
Phenanthrene	4.40E-01	2.21E-01	1.00E+00	Gamma	90% KM (Chebyshev) UCL
Pyrene	5.07E-01	2.41E-01	1.20E+00	Gamma	90% Adjusted Gamma KM-UCL
Petroleum Hydrocarbons					
Diesel Range Organics	ND	ND	ND	NA	NA
Residual Range Hydrocarbons	ND	ND	ND	NA	NA

Notes:

mg/kg = milligrams per kilogram

RME = reasonable maximum exposure

EPC = exposure point concentration

CTE = central tendency exposure

UCL = upper confidence limit (ProUCL prints provided in Appendix F-D).

ND = not detected

NA = not applicable

[A] 1-Methylnaphthalene was detected only once; this detection is used as the RME and CTE EPC.

[B] Benzofluoranthenes was detected only twice; the higher detection is used as the RME EPC and the mean is used as the CTE EPC.

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Table F-4D
Surface Water Exposure Point Concentrations
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	CTE EPC (i.e., mean) (µg/L)	Maximum Concentration (µg/L)
Polynuclear Aromatic Hydrocarbons		
Acenaphthene	1.21E-02	2.20E-02
Acenaphthylene	7.04E-04	1.38E-03
Anthracene	1.35E-03	2.68E-03
Benzo(a)anthracene	2.60E-04	6.19E-04
Benzo(a)pyrene	4.67E-05	1.23E-04
Benzo(b)fluoranthene	8.84E-05	2.08E-04
Benzo(g,h,i)perylene	1.28E-05	2.32E-05
Benzo(k)fluoranthene	3.61E-05	9.08E-05
Chrysene	2.61E-04	5.66E-04
Dibenzo(a,h)anthracene	9.09E-07	3.46E-06
Fluoranthene	5.31E-03	1.02E-02
Fluorene	5.12E-03	8.05E-03
Indeno(1,2,3-cd)pyrene	7.31E-06	1.70E-05
Naphthalene	7.49E-03	1.16E-02
Phenanthrene	4.54E-03	6.71E-03
Pyrene	7.11E-03	1.34E-02

Notes:

µg/L = micrograms per liter

RME = reasonable maximum exposure

EPC = exposure point concentration

CTE = central tendency exposure

CTE calculated using the full detection limit in place of non-detect values.

Small sample size prevented the use of UCLs for the derivation of RME EPCs.

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Table F-4E
Soil Exposure Point Concentrations
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

	Reasonable Maximum EPC (mg/kg)	Central Tendency EPC (mg/kg)	Exposure Max Value (mg/kg)	Arithmetic Mean (mg/kg)	UCL (mg/kg)	Distribution	UCL Method
Surface Soil							
Polychlorinated Biphenyls							
Aroclor 1260	1.39	0.70	4.60	0.70	1.39	Non-parametric	90% Chebyshev (Mean, Sd)
Subsurface Soil							
Volatile Organic Compounds							
Methylene Chloride	0.12	0.03	0.60	0.03	0.12	Non-parametric	90% Chebyshev (Mean, Sd)
Semivolatile Organic Compounds							
Acenaphthene	3.70	1.01	18.0	1.01	3.70	Non-parametric	90% Chebyshev (Mean, Sd)
Benzo(a)anthracene	1.44	0.46	6.60	0.46	1.44	Non-parametric	90% Chebyshev (Mean, Sd)
Benzo(a)pyrene	0.59	0.21	2.40	0.21	0.59	Non-parametric	90% Chebyshev (Mean, Sd)
Benzo(b)fluoranthene	0.65	0.25	2.20	0.25	0.65	Non-parametric	90% Chebyshev (Mean, Sd)
Benzo(k)fluoranthene	0.55	0.21	1.80	0.21	0.55	Non-parametric	90% Chebyshev (Mean, Sd)
Chrysene	1.50	0.71	9.70	0.71	1.50	Lognormal	90% Chebyshev (MVUE)
Fluoranthene	3.33	1.47	20.0	1.47	3.33	Lognormal	90% Chebyshev (MVUE)
Fluorene	5.32	1.43	26.0	1.43	5.32	Non-parametric	90% Chebyshev (Mean, Sd)
Indeno(1,2,3-cd)pyrene	0.17	0.09	0.79	0.09	0.17	Lognormal	90% Chebyshev (MVUE)
2-Methylnaphthalene	4.84	1.25	24.0	1.25	4.84	Non-parametric	90% Chebyshev (Mean, Sd)
Naphthalene	0.07	0.03	0.25	0.03	0.07	Non-parametric	90% Chebyshev (Mean, Sd)
Phenanthrene	14.1	3.88	68.0	3.88	14.1	Non-parametric	90% Chebyshev (Mean, Sd)
Pyrene	2.95	1.30	19.0	1.30	2.95	Lognormal	90% Chebyshev (MVUE)
Pentachlorophenol	0.03	0.01	0.12	0.01	0.03	Non-parametric	90% Chebyshev (Mean, Sd)
Metals							
Arsenic	17.3	7.21	74	7.21	17.3	Non-parametric	90% Chebyshev (Mean, Sd)
Lead	220	77.9	900	77.9	220	Non-parametric	90% Chebyshev (Mean, Sd)

Notes:

Table modified from Table 6 in HHRA (AMEC, 2006).
mg/kg = milligrams per kilogram
EPC = exposure point concentration
UCL = upper confidence limit
Sd = standard deviation
MVUE = minimum variance unbiased estimate

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Table F-5A
Noncancer Toxicity Data
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	Oral Reference Doses (RfDs)						Reference Concentrations (RfCs)				
	Chronic/ Subchronic	Value (mg/kg-day)	Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	Source(s) [1]	Date(s) of Search (MM/DD/YYYY)	Value (mg/m^3)	Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	Source(s) [1]	Date(s) of Search (MM/DD/YYYY)
Polynuclear Aromatic Hydrocarbons											
1-Methylnaphthalene	Chronic	7.0E-02	lungs	1,000	ASTDR MRL	4/21/2014	NA	NA	NA	IRIS	4/1/2014
2-Methylnaphthalene	Chronic	4.0E-03	lungs	1,000	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Acenaphthene	Chronic	6.0E-02	liver	3,000	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Acenaphthylene[A]	Chronic	6.0E-02	liver	3,000	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Anthracene	Chronic	3.0E-01	no observed effect	3,000	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Benzo(a)anthracene	NA	NA	NA	NA	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Benzo(a)pyrene	NA	NA	NA	NA	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Benzo(b)fluoranthene	NA	NA	NA	NA	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Benzo(g,h,i)perylene[B]	Chronic	4.0E-02	liver/kidneys	3,000	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Benzo(k)fluoranthene	NA	NA	NA	NA	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Benzofluoranthenes[C]	NA	NA	NA	NA	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Chrysene	NA	NA	NA	NA	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Dibenzo(a,h)anthracene	NA	NA	NA	NA	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Fluoranthene	Chronic	4.0E-02	liver/kidneys	3,000	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Fluorene	Chronic	4.0E-02	blood	3,000	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Naphthalene	Chronic	2.0E-02	body weight	3,000	IRIS	3/28/2014	3.0E-03	respiratory	3,000	IRIS	4/1/2014
Phenanthrene[B]	Chronic	4.0E-02	liver/kidneys	3,000	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Pyrene	Chronic	3.0E-02	kidneys	3,000	IRIS	3/28/2014	NA	NA	NA	IRIS	4/1/2014
Petroleum Hydrocarbons											
Gasoline Range Hydrocarbons	NA	NP	NA	NA	IRIS	3/28/2014	NP	NA	NA	IRIS	4/1/2014
Diesel Range Organics	NA	NP	NA	NA	IRIS	3/28/2014	NP	NA	NA	IRIS	4/1/2014
Residual Range Hydrocarbons	NA	NP	NA	NA	IRIS	3/28/2014	NP	NA	NA	IRIS	4/1/2014

Notes:
IRIS = Integrated Risk Information System
ATSDR MRL = Agency for Toxic Substances & Disease Registry Minimum Risk Level
mg/kg-day = milligrams per kilogram per day
mg/m^3 = milligrams per cubic meter
NA = Not available
NP =

[1] IRIS toxicity values reviewed at the IRIS website. All other values taken from the referenced source as cited on the EPA Regional Screening Level Summary Table, November 2013.
[A] Acenaphthene used as a surrogate
[B] Fluoranthene used as a surrogate
[C] Benzo(k)fluoranthene used as surrogate

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Table F-5B
Cancer Toxicity Data
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Constituent	Oral Cancer Slope Factors (SFs)				Inhalation Unit Risks (IURs)		
	Value $(mg/kd\text{-}day)^{-1}$	Weight of Evidence/ Cancer Guideline Description	Source(s) [1]	Date(s) of Search (MM/DD/YYYY)	Value $(\mu g/m^3)^{-1}$	Source(s) [1]	Date(s) of Search (MM/DD/YYYY)
Semivolatiles							
1-Methylnaphthalene	2.9E-02	NA	PPRTV	4/21/2014	NA	IRIS	4/1/2014
2-Methylnaphthalene	NA	NA	IRIS	3/31/2014	NA	IRIS	4/1/2014
Acenaphthene	NA	NA	IRIS	3/31/2014	NA	IRIS	4/1/2014
Acenaphthylene[A]	NA	D	IRIS	3/31/2014	NA	IRIS	4/1/2014
Anthracene	NA	D	IRIS	3/31/2014	NA	IRIS	4/1/2014
Benzo(a)anthracene	7.3E-01	B2	Env. Office	3/31/2014	1.1E-04	Cal EPA	4/1/2014
Benzo(a)pyrene	7.3E+00	B2	IRIS	3/31/2014	1.1E-03	Cal EPA	4/1/2014
Benzo(b)fluoranthene	7.3E-01	B2	Env. Office	3/31/2014	1.1E-04	Cal EPA	4/1/2014
Benzo(g,h,i)perylene[B]	NA	D	IRIS	3/31/2014	NA	IRIS	4/1/2014
Benzo(k)fluoranthene	7.3E-02	B2	Env. Office	3/31/2014	1.1E-04	Cal EPA	4/1/2014
Benzofluoranthenes[C]	7.3E-02	B2	Env. Office	3/31/2014	1.1E-04	Cal EPA	4/1/2014
Chrysene	7.3E-03	B2	Env. Office	3/31/2014	1.1E-05	Cal EPA	4/1/2014
Dibenzo(a,h)anthracene	7.3E+00	B2	Env. Office	3/31/2014	1.1E-03	Cal EPA	4/1/2014
Fluoranthene	NA	D	IRIS	3/31/2014	NA	IRIS	4/1/2014
Fluorene	NA	D	IRIS	3/31/2014	NA	IRIS	4/1/2014
Indeno(1,2,3-cd)pyrene	7.3E-01	B2	Env. Office	3/31/2014	1.1E-04	Cal EPA	4/1/2014
Naphthalene	NA	C	IRIS	3/31/2014	3.4E-05	Cal EPA	4/1/2014
Phenanthrene[B]	NA	D	IRIS	3/31/2014	NA	IRIS	4/1/2014
Pyrene	NA	D	IRIS	3/31/2014	NA	IRIS	4/1/2014
Petroleum Hydrocarbons							
Diesel Range Organics	NP	NA	IRIS	3/31/2014	NP	IRIS	4/1/2014
Gasoline Range Hydrocarbons	NP	NA	IRIS	3/31/2014	NP	IRIS	4/1/2014
Residual Range Hydrocarbons	NP	NA	IRIS	3/31/2014	NP	IRIS	4/1/2014
Inorganics							
Zinc	NA	D	IRIS	3/31/2014	NA	IRIS	4/1/2014

Notes:

IRIS = Integrated Risk Information System

PPRTV = Provisional Peer-Reviewed Toxicity Value

Cal EPA = California EPA

Env. Office = Environmental Criteria and Assessment Office

mg/kg-day = milligrams per kilogram per day

$\mu g/m^3$ = micrograms per cubic meter

NA = Not available

NP =

Weight of Evidence (USEPA, 1989).

B2 = Probable Human Carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in human

C = Possible Human Carcinogen

D = Not Classifiable as to Human Carcinogenicity

E = Evidence of Non-Carcinogenicity for Humans

[1] IRIS toxicity values reviewed at the IRIS website. All other values taken from the referenced source as cited on the EPA Regional Screening Level Summary Table, November 2013.

[A] Acenaphthene used as a surrogate

[B] Fluoranthene used as a surrogate

[C] Benzo(k)fluoranthene used as surrogate

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Table F-6A
Calculation of RME Risks - Volatilization to Outdoor Air from Constituents in Groundwater
Industrial Worker
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{WO} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{WO} * 1

Constituent	Carcinogen?	Max Detect Concentration (µg/L)	Carcinogenic RME RBC_{WO} (µg/L)	Noncarcinogenic RME RBC_{WO} (µg/L)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons						
Acenaphthene	nc	9.72E+02	NA	5.30E+20	NA	1.8E-18
Anthracene	nc	2.76E+02	NA	1.60E+21	NA	1.7E-19
Benzo(a)anthracene	c	NA	9.40E-06	NA	NA	NA
Benzo(a)pyrene	c	NV	NV	NV	NV	NV
Benzofluoranthenes	c	NV	NV	NV	NV	NV
Chrysene	c	1.02E+02	3.70E+05	NA	3E-10	NA
Dibenzo(a,h)anthracene	c	NV	NV	NV	NV	NV
Fluoranthene	nc	8.20E+02	NA	6.90E+21	NA	1.2E-19
Fluorene	nc	7.99E+02	NA	1.50E+21	NA	5.3E-19
Indeno(1,2,3-cd)pyrene	c	NV	NV	NV	NV	NV
Naphthalene	c, nc	2.28E+04	1.60E+04	5.70E+05	1E-06	4.0E-02
Phenanthrene	nc	1.99E+03	NA	6.90E+21	NA	2.9E-19
Pyrene	nc	4.90E+02	NA	1.10E+22	NA	4.5E-20
Petroleum Hydrocarbons						
Gasoline Range Hydrocarbons	nc	2.85E+04	NA	1.62E+05	NA	1.8E-01
Diesel Range Organics	nc	3.74E+05	NA	6.80E+03	NA	5.5E+01
Residual Range Hydrocarbons	nc	1.03E+05	NA	3.10E+02	NA	3.3E+02
Total					1E-06	3.9E+02

Notes:

RME = reasonable maximum exposure
EPC = exposure point concentration
RBC_{WO} = risk-based concentration for volatilization from groundwater to outdoor air
µg/L = micrograms per liter
c = carcinogen
nc = non-carcinogen
NA = Not applicable
NV = Not volatile
Shaded value indicates an exceedance of DEQ acceptable risk levels. See Section 6.2 in the text for more discussion.
Given RBCs for petroleum hydrocarbons are solubilities (ChemData tab in RBCsTPH11a.xls) and therefore, conservative. If the EPC > RBC (S), free product may be present and contact with water poses an unacceptable risk.

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Table F-6B
Calculation of CTE Risks - Volatilization to Outdoor Air from Constituents in Groundwater
Industrial Worker
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Excess Lifetime Cancer Risk = CTE EPC / CTE RBC_{WO} * 10^{-6}
Hazard Quotient = CTE EPC / CTE RBC_{WO} * 1

Constituent	Carcinogen?	CTE EPC (µg/L)	Carcinogenic CTE RBC_{WO} (µg/L)	Noncarcinogenic CTE RBC_{WO} (µg/L)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons						
Acenaphthene	nc	1.33E+02	NA	5.30E+20	NA	2.5E-19
Anthracene	nc	1.57E+01	NA	1.60E+21	NA	9.8E-21
Benzo(a)anthracene	c	NV	NV	NV	NV	NV
Benzo(a)pyrene	c	NV	NV	NV	NV	NV
Benzofluoranthenes	c	NV	NV	NV	NV	NV
Chrysene	c	1.07E+01	1.60E+06	NA	7E-12	NA
Dibenzo(a,h)anthracene	c	NV	NV	NV	NV	NV
Fluoranthene	nc	4.59E+01	NA	6.90E+21	NA	6.7E-21
Fluorene	nc	8.75E+01	NA	1.50E+21	NA	5.8E-20
Indeno(1,2,3-cd)pyrene	c	NV	NV	NV	NV	NV
Naphthalene	c, nc	2.07E+03	6.50E+04	5.70E+05	3E-08	3.6E-03
Phenanthrene	nc	1.34E+02	NA	6.90E+21	NA	1.9E-20
Pyrene	nc	2.75E+01	NA	1.10E+22	NA	2.5E-21
Petroleum Hydrocarbons						
Gasoline Range Hydrocarbons	nc	7.96E+03	NA	1.62E+05	NA	4.9E-02
Diesel Range Organics	nc	2.12E+04	NA	6.80E+03	NA	3.1E+00
Residual Range Hydrocarbons	nc	7.37E+03	NA	3.10E+02	NA	2.4E+01
Total					3E-08	2.7E+01

Notes:

CTE = central tendency exposure
EPC = exposure point concentration
RBC_{WO} = risk-based concentration for volatilztion from groundwater to outdoor air
µg/L = micrograms per liter
c = carcinogen
nc = non-carcinogen
NA = Not applicable
NV = Not volatile
Shaded value indicates an exceedance of DEQ acceptable risk levels. See Section 6.2 in the text for more discussion.
Given RBCs for petroleum hydrocarbons are solubilities (ChemData tab in RBCsTPH11a.xls) and therefore, conservative. If the EPC > RBC (S), free product may be present and contact with water poses an unacceptable risk.

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Table F-6C
Calculation of RME Risks - Vapor Intrusion from Constituents in Groundwater
Industrial Worker
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{WI} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{WI} * 1

Constituent	Carcinogen?	Max Detect Conc (µg/L)	Carcinogenic RME RBC_{WI} (µg/L)	Noncarcinogenic RME RBC_{WI} (µg/L)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons						
Acenaphthene	nc	9.72E+02	NA	5.30E+20	NA	1.8E-18
Anthracene	nc	2.76E+02	NA	1.60E+21	NA	1.7E-19
Benzo(a)anthracene	c	NV	NV	NV	NV	NV
Benzo(a)pyrene	c	NV	NV	NV	NV	NV
Benzofluoranthenes	c	NV	NV	NV	NV	NV
Chrysene	c	1.02E+02	3.70E+05	NA	3E-10	NA
Dibenzo(a,h)anthracene	c	NV	NV	NV	NV	NV
Fluoranthene	nc	8.20E+02	NA	6.9E+21	NA	1.2E-19
Fluorene	nc	7.99E+02	NA	1.50E+21	NA	5.3E-19
Indeno(1,2,3-cd)pyrene	c	NV	NV	NV	NV	NV
Naphthalene	c, nc	2.17E+04	1.00E+04	3.70E+05	2E-06	5.9E-02
Phenanthrene	nc	1.99E+03	NA	6.90E+21	NA	2.9E-19
Pyrene	nc	4.90E+02	NA	1.10E+22	NA	4.5E-20
Petroleum Hydrocarbons						
Gasoline Range Hydrocarbons	nc	2.85E+04	NA	1.62E+05	NA	1.8E-01
Diesel Range Organics	nc	3.74E+05	NA	6.80E+03	NA	5.5E+01
Residual Range Hydrocarbons	nc	1.03E+05	NA	3.10E+02	NA	3.3E+02
Total					2E-06	3.9E+02

Notes:

RME = reasonable maximum exposure
EPC = exposure point concentration
RBC_{WI} = risk-based concentration for vapor intrusion
* = RBC greater than solubility
µg/L = micrograms per liter
c = carcinogen
nc = non-carcinogen
NA = Not applicable
NV = Not volatile
Shaded value indicates an exceedance of DEQ acceptable risk levels. See Section 6.2 in the text for more discussion.
Given RBCs for petroleum hydrocarbons are solubilities (ChemData tab in RBCsTPH11a.xls) and therefore, conservative. If the EPC > RBC (S), free

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Table F-6D
Calculation of CTE Risks - Vapor Intrusion from Constituents in Groundwater
Industrial Worker
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Excess Lifetime Cancer Risk = CTE EPC / CTE RBC_{WI} * 10^{-6}
Hazard Quotient = CTE EPC / CTE RBC_{WI} * 1

Constituent	Carcinogen?	CTE EPC (µg/L)	Carcinogenic CTE RBC_{WI} (µg/L)	Noncarcinogenic CTE RBC_{WI} (µg/L)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons						
Acenaphthene	nc	1.33E+02	NA	5.30E+20	NA	2.5E-19
Anthracene	nc	1.57E+01	NA	1.60E+21	NA	9.8E-21
Benzo(a)anthracene	c	NV	NV	NV	NV	NA
Benzo(a)pyrene	c	NV	NV	NV	NV	NA
Benzofluoranthenes	c	NV	NV	NV	NV	NA
Chrysene	c	1.07E+01	1.60E+06	NA	7E-12	NA
Dibenzo(a,h)anthracene	c	NV	NV	NV	NV	NA
Fluoranthene	nc	4.59E+01	NA	6.90E+21	NA	6.7E-21
Fluorene	nc	8.75E+01	NA	1.50E+21	NA	5.8E-20
Indeno(1,2,3-cd)pyrene	c	NV	NV	NV	NV	NA
Naphthalene	c, nc	2.07E+03	4.20E+04	3.70E+05	5E-08	5.6E-03
Phenanthrene	nc	1.34E+02	NA	6.90E+21	NA	1.9E-20
Pyrene	nc	2.75E+01	NA	1.10E+22	NA	2.5E-21
Petroleum Hydrocarbons						
Gasoline Range Hydrocarbons	nc	7.96E+03	NA	1.62E+05	NA	4.9E-02
Diesel Range Organics	nc	2.12E+04	NA	6.80E+03	NA	3.1E+00
Residual Range Hydrocarbons	nc	7.37E+03	NA	3.10E+02	NA	2.4E+01
Total					5E-08	2.7E+01

Notes:

CTE = central tendency exposure
EPC = exposure point concentration
RBC_{WI} = risk-based concentration for volatilztion from groundwater to outdoor air
* = RBC greater than solubility
µg/L = micrograms per liter
c = carcinogen
nc = non-carcinogen
NA = Not applicable
NV = Not volatile
Shaded value indicates an exceedance of DEQ acceptable risk levels. See Section 6.2 in the text for more discussion.
Given RBCs for petroleum hydrocarbons are solubilities (ChemData tab in RBCsTPH11a.xls) and therefore, conservative. If the EPC > RBC (S), free product may be present and contact with water poses an unacceptable risk.

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Table F-7A
Calculation of RME Risks - Groundwater in an Excavation
Excavation Worker
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{WE} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{WE} * 1

Constituent	Carcinogen?	Max Detected Conc (µg/L)	Carcinogenic RME RBC_{WE} (µg/L)	Noncarcinogenic RME RBC_{WE} (µg/L)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons [1]						
Acenaphthene	nc	9.72E+02	NC	NC	NC	NC
Anthracene	nc	2.76E+02	NC	NC	NC	NC
Benzo(a)anthracene	c	1.18E+02	NV	NV	NV	NV
Benzo(a)pyrene	c	3.24E+01	NV	NV	NV	NV
Benzofluoranthenes	c	7.22E+01	NC	NC	NC	NC
Chrysene	c	1.02E+02	NC	NC	NC	NC
Dibenzo(a,h)anthracene	c	2.96E+00	NV	NV	NV	NV
Fluoranthene	nc	8.20E+02	NC	NC	NC	NC
Fluorene	nc	7.99E+02	NC	NC	NC	NC
Indeno(1,2,3-cd)pyrene	c	9.55E+00	NV	NV	NV	NV
Naphthalene	c, nc	2.28E+04	NC	NC	NC	NC
Phenanthrene	nc	1.99E+03	NC	NC	NC	NC
Pyrene	nc	4.90E+02	NC	NC	NC	NC
Petroleum Hydrocarbons						
Gasoline Range Hydrocarbons	nc	2.85E+04	NA	1.40E+04	NA	2.0E+00
Diesel Range Organics	nc	3.74E+05	NA	6.80E+03	NA	5.5E+01
Residual Range Hydrocarbons	nc	1.03E+05	NA	3.10E+02	NA	3.3E+02
Total					NA	3.9E+02

Notes:

RME = reasonable maximum exposure
EPC = exposure point concentration
RBC_{WE} = risk-based concentration for contact with groundwater in an excavation
* = RBC greater than solubility
µg/L = micrograms per liter
[1] Cancer risks and noncancer hazards from dermal exposures in water to semi-volatile compounds are not quantitatively evaluated; refer to the uncertainty discussion of dermal exposure for the excavation worker.
c = carcinogen
nc = non-carcinogen
NC = Not calculated
NA = Not applicable
NV = Not volatile
Shaded value indicates an exceedance of DEQ acceptable risk levels. See Section 6.3 in the text for more discussion.
Given RBCs for petroleum hydrocarbons are solubilities (ChemData tab in RBCsTPH11a.xls) and therefore, conservative. If the EPC > RBC (S), free product may be present and contact with water poses an unacceptable risk.

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Table F-7B
Calculation of CTE Risks - Groundwater in an Excavation
Excavation Worker
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Excess Lifetime Cancer Risk = CTE EPC / CTE RBC_{WE} * 10^{-6}
Hazard Quotient = CTE EPC / CTE RBC_{WE} * 1

Constituent	Carcinogen?	CTE EPC (µg/L)	Carcinogenic CTE RBC_{WE} (µg/L)	Noncarcinogenic CTE RBC_{WE} (µg/L)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons [1]						
Acenaphthene	nc	1.33E+02	NC	NC	NC	NC
Anthracene	nc	1.57E+01	NC	NC	NC	NC
Benzo(a)anthracene	c	1.25E+01	NV	NV	NV	NV
Benzo(a)pyrene	c	3.33E+00	NV	NV	NV	NV
Benzofluoranthenes	c	1.10E+01	NC	NC	NC	NC
Chrysene	c	1.07E+01	NC	NC	NC	NC
Dibenzo(a,h)anthracene	c	1.40E+00	NV	NV	NV	NV
Fluoranthene	nc	4.59E+01	NC	NC	NC	NC
Fluorene	nc	8.75E+01	NC	NC	NC	NC
Indeno(1,2,3-cd)pyrene	c	2.04E+00	NV	NV	NV	NV
Naphthalene	c, nc	2.40E+03	NC	NC	NC	NC
Phenanthrene	nc	1.34E+02	NC	NC	NC	NC
Pyrene	nc	2.75E+01	NC	NC	NC	NC
Petroleum Hydrocarbons						
Gasoline Range Hydrocarbons	nc	7.96E+03	NA	1.40E+04	NA	5.7E-01
Diesel Range Organics	nc	2.12E+04	NA	6.80E+03	NA	3.1E+00
Residual Range Hydrocarbons	nc	7.37E+03	NA	3.10E+02	NA	2.4E+01
Total					NA	2.7E+01

Notes:

[1] Cancer risks and noncancer hazards from dermal exposures in water to semi-volatile compounds are not quantitatively evaluated; refer to the uncertainty discussion of dermal exposure for the excavation worker.

* - RBC greater than solubility

c - carcinogen

nc - non-carcinogen

NC = Not calculated

NA = Not applicable

NV = Not volatile

EPC - exposure point concentration

RBC_{WE} - risk-based concentration for contact with groundwater in an excavation

CTE - central tendency exposure

µg/L - micrograms per liter

Shaded value indicates an exceedance of DEQ acceptable risk levels. See Section 6.3 in the text for more discussion.

Given RBCs for diesel-range and residual-range hydrocarbons are solubilities (ChemData tab in RBCsTPH11a.xls) and therefore, conservative. If the EPC > RBC (S), free product may be present and contact with water poses an unacceptable risk.

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Table F-8
Summary of Risks from Groundwater
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Source / Pathway	Excess Lifetime Cancer Risk		Hazard Index	
	Max Detected Conc	CTE	RME/Max Detected Conc[A]	CTE
Industrial Worker				
Outdoor Air / Inhalation	1E-06	3E-08	3.9E+02	2.7E+01
Indoor Air / Inhalation	2E-06	5E-08	3.9E+02	2.7E+01
Sub-Total	4E-06	8E-08	7.7E+02	5.4E+01
Excavation Worker				
Groundwater / Dermal Contact	NA	NA	3.9E+02	2.7E+01

Notes:
[A]RME used for groundwater dermal contact; maximum detected concentration used for indoor/outdoor air inhalation
NA - Cancer risks and noncancer hazards from dermal exposures in water to semi-volatile compounds are not quantitatively evaluated; refer to the uncertainty discussion of dermal exposure for the excavation worker.
RME - Reasonable Maximum Exposure
CTE - Central Tendency Exposure
Shaded value indicates an exceedance of DEQ acceptable risk levels. See Section 6.2 in the text for more discussion.

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Table F-9A
Calculation of RME Risks - Sediment Exposure in Scappoose Bay
Older Child Recreational Trespasser
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SED} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SED} *1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SED} (mg/kg)	Noncarcinogenic RME RBC_{SED} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons						
1-Methylnaphthalene	c, nc	4.09E-01	1.39E+02	7.27E+04	2.94E-09	5.6E-06
2-Methylnaphthalene	nc	5.29E-01	NA	4.15E+03	NA	1.3E-04
Acenaphthene	nc	1.29E+00	NA	6.23E+04	NA	2.1E-05
Acenaphthylene	nc	7.27E-02	NA	6.23E+04	NA	1.2E-06
Anthracene	nc	7.85E-01	NA	3.11E+05	NA	2.5E-06
Benzo(a)anthracene	c	9.44E-01	5.53E+00	NA	1.71E-07	NA
Benzo(a)pyrene	c	5.20E-01	5.53E-01	NA	9.40E-07	NA
Benzo(b)fluoranthene	c	1.26E+00	5.17E+00	NA	2.44E-07	NA
Benzo(g,h,i)perylene	nc	2.63E-01	NA	4.15E+04	NA	6.3E-06
Benzo(k)fluoranthene	c	3.94E-01	5.53E+01	NA	7.12E-09	NA
Benzofluoranthenes	c	1.42E+00	5.53E+01	NA	2.57E-08	NA
Chrysene	c	1.52E+00	3.25E+02	NA	4.67E-09	NA
Dibenzo(a,h)anthracene	c	7.16E-02	5.53E-01	NA	1.29E-07	NA
Fluoranthene	nc	3.63E+00	NA	4.15E+04	NA	8.7E-05
Fluorene	nc	1.19E+00	NA	4.15E+04	NA	2.9E-05
Indeno(1,2,3-cd)pyrene	c	2.98E-01	5.53E+01	NA	5.39E-09	NA
Naphthalene	c, nc	2.59E+00	2.55E+02	2.01E+03	1.02E-08	1.3E-03
Phenanthrene	nc	3.28E+00	NA	4.15E+04	NA	7.9E-05
Pyrene	nc	2.54E+00	NA	3.11E+04	NA	8.1E-05
Petroleum Hydrocarbons						
Diesel Range Organics	nc	6.60E+01	NA	5.30E+02	NA	1.2E-01
Residual Range Hydrocarbons	nc	1.27E+02	NA	5.30E+02	NA	2.4E-01
Total					2E-06	3.7E-01

Notes:

c - carcinogen
nc - non-carcinogen
NA = not available or not applicable
EPC - exposure point concentration
RBC_{SED} - site-specific risk-based concentration for sediment exposure. Calculations provided in Appendix F-C.
RME - reasonable maximum exposure
mg/kg = milligrams per kilogram

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Table F-9B
Calculation of CTE Risks - Sediment Exposure in Scappoose Bay
Older Child Recreational Trespasser
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = CTE EPC / CTE RBC_{SED} * 10^{-6}
Hazard Quotient = CTE EPC / CTE RBC_{SED} *1

Constituent	Carcinogen?	CTE EPC (mg/kg)	Carcinogenic RME RBC_{SED} (mg/kg)	Noncarcinogenic RME RBC_{SED} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons						
1-Methylnaphthalene	c, nc	2.39E-01	3.56E+02	1.86E+05	7E-10	1.3E-06
2-Methylnaphthalene	nc	2.91E-01	NA	1.06E+04	NA	2.7E-05
Acenaphthene	nc	6.50E-01	NA	1.59E+05	NA	4.1E-06
Acenaphthylene	nc	6.64E-02	NA	1.59E+05	NA	4.2E-07
Anthracene	nc	4.85E-01	NA	7.96E+05	NA	6.1E-07
Benzo(a)anthracene	c	5.53E-01	1.41E+01	NA	4E-08	NA
Benzo(a)pyrene	c	3.68E-01	1.41E+00	NA	3E-07	NA
Benzo(b)fluoranthene	c	7.15E-01	1.32E+01	NA	5E-08	NA
Benzo(g,h,i)perylene	nc	1.90E-01	NA	1.06E+05	NA	1.8E-06
Benzo(k)fluoranthene	c	2.69E-01	1.41E+02	NA	2E-09	NA
Benzofluoranthenes	c	8.92E-01	1.41E+02	NA	6E-09	NA
Chrysene	c	8.63E-01	8.19E+02	NA	1E-09	NA
Dibenzo(a,h)anthracene	c	6.70E-02	1.41E+00	NA	5E-08	NA
Fluoranthene	nc	2.05E+00	NA	1.06E+05	NA	1.9E-05
Fluorene	nc	6.47E-01	NA	1.06E+05	NA	6.1E-06
Indeno(1,2,3-cd)pyrene	c	2.16E-01	1.41E+02	NA	2E-09	NA
Naphthalene	c, nc	1.21E+00	6.30E+02	4.99E+03	2E-09	2.4E-04
Phenanthrene	nc	1.81E+00	NA	1.06E+05	NA	1.7E-05
Pyrene	nc	1.46E+00	NA	7.96E+04	NA	1.8E-05
Petroleum Hydrocarbons						
Diesel Range Organics	nc	1.17E+02	NA	5.30E+02	NA	2.2E-01
Residual Range Hydrocarbons	nc	1.68E+02	NA	5.30E+02	NA	3.2E-01
Total					4E-07	5.4E-01

Notes:

c - carcinogen
nc - non-carcinogen
NA = not available or not applicable
EPC - exposure point concentration
RBC_{SED} - site-specific risk-based concentration for sediment exposure
CTE - central tendency exposure
mg/kg = milligrams per kilogram

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Table F-9C
Calculation of RME Risks - Sediment Exposure in Milton Creek
Older Child Recreational Trespasser
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = RME EPC / RME RBC_{SED} * 10^{-6}
Hazard Quotient = RME EPC / RME RBC_{SED} *1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBC_{SED} (mg/kg)	Noncarcinogenic RME RBC_{SED} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons						
1-Methylnaphthalene	c, nc	8.03E-02	1.39E+02	7.27E+04	5.77E-10	1.1E-06
2-Methylnaphthalene	nc	2.22E-02	NA	4.15E+03	NA	5.3E-06
Acenaphthene	nc	1.30E-01	NA	6.23E+04	NA	2.1E-06
Acenaphthylene	nc	2.79E-02	NA	6.23E+04	NA	4.5E-07
Anthracene	nc	1.64E-01	NA	3.11E+05	NA	5.3E-07
Benzo(a)anthracene	c	2.03E-01	5.53E+00	NA	3.67E-08	NA
Benzo(a)pyrene	c	4.05E-01	5.53E-01	NA	7.32E-07	NA
Benzo(b)fluoranthene	c	1.90E-01	5.17E+00	NA	3.68E-08	NA
Benzo(g,h,i)perylene	nc	4.36E-01	NA	4.15E+04	NA	1.0E-05
Benzo(k)fluoranthene	c	2.45E-01	5.53E+01	NA	4.43E-09	NA
Benzofluoranthenes	c	1.23E-01	5.53E+01	NA	2.22E-09	NA
Chrysene	c	3.05E-01	3.25E+02	NA	9.39E-10	NA
Dibenzo(a,h)anthracene	c	2.14E-02	5.53E-01	NA	3.87E-08	NA
Fluoranthene	nc	5.05E-01	NA	4.15E+04	NA	1.2E-05
Fluorene	nc	6.22E-02	NA	4.15E+04	NA	1.5E-06
Indeno(1,2,3-cd)pyrene	c	3.22E-01	5.53E+01	NA	5.82E-09	NA
Naphthalene	c, nc	7.26E-02	2.55E+02	2.01E+03	2.85E-10	3.6E-05
Phenanthrene	nc	4.40E-01	NA	4.15E+04	NA	1.1E-05
Pyrene	nc	5.07E-01	NA	3.11E+04	NA	1.6E-05
Petroleum Hydrocarbons						
Diesel Range Organics	nc	NA	NA	5.30E+02	NA	NA
Residual Range Hydrocarbons	nc	NA	NA	5.30E+02	NA	NA
Total					9E-07	9.7E-05

Notes:

c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
RBC_{SED} - site-specific risk-based concentration for sediment exposure
RME - reasonable maximum exposure
mg/kg = milligrams per kilogram
NA = not available or not applicable

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Table F-9D
Calculation of CTE Risks - Sediment Exposure in Milton Creek
Older Child Recreational Trespasser
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = CTE EPC / CTE RBC_{SED} * 10^{-6}
Hazard Quotient = CTE EPC / CTE RBC_{SED} *1

Constituent	Carcinogen?	CTE EPC (mg/kg)	Carcinogenic RME RBC_{SED} (mg/kg)	Noncarcinogenic RME RBC_{SED} (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Polynuclear Aromatic Hydrocarbons						
1-Methylnaphthalene	c, nc	8.03E-02	3.56E+02	1.86E+05	2E-10	4.3E-07
2-Methylnaphthalene	nc	1.83E-02	NA	1.06E+04	NA	1.7E-06
Acenaphthene	nc	6.98E-02	NA	1.59E+05	NA	4.4E-07
Acenaphthylene	nc	3.05E-02	NA	1.59E+05	NA	1.9E-07
Anthracene	nc	7.11E-02	NA	7.96E+05	NA	8.9E-08
Benzo(a)anthracene	c	1.10E-01	1.41E+01	NA	8E-09	NA
Benzo(a)pyrene	c	1.87E-01	1.41E+00	NA	1E-07	NA
Benzo(b)fluoranthene	c	1.56E-01	1.32E+01	NA	1E-08	NA
Benzo(g,h,i)perylene	nc	1.85E-01	NA	1.06E+05	NA	1.7E-06
Benzo(k)fluoranthene	c	1.08E-01	1.41E+02	NA	8E-10	NA
Benzofluoranthenes	c	9.09E-02	1.41E+02	NA	6E-10	NA
Chrysene	c	1.65E-01	8.19E+02	NA	2E-10	NA
Dibenzo(a,h)anthracene	c	2.61E-02	1.41E+00	NA	2E-08	NA
Fluoranthene	nc	2.49E-01	NA	1.06E+05	NA	2.3E-06
Fluorene	nc	4.97E-02	NA	1.06E+05	NA	4.7E-07
Indeno(1,2,3-cd)pyrene	c	1.55E-01	1.41E+02	NA	1E-09	NA
Naphthalene	c, nc	6.31E-02	6.30E+02	4.99E+03	1E-10	1.3E-05
Phenanthrene	nc	2.21E-01	NA	1.06E+05	NA	2.1E-06
Pyrene	nc	2.41E-01	NA	7.96E+04	NA	3.0E-06
Petroleum Hydrocarbons						
Diesel Range Organics	nc	NA	NA	5.30E+02	NA	NA
Residual Range Hydrocarbons	nc	NA	NA	5.30E+02	NA	NA
Total					2E-07	2.5E-05

Notes:

c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
RBC_{SED} - site-specific risk-based concentration for sediment exposure
CTE - central tendency exposure
mg/kg = milligrams per kilogram
NA = not available or not applicable

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Table F-10
Calculation of Risks from Bioaccumulative Compounds in Sediment
Sport Fisher
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = EPC / SLV * 10^{-6}
Hazard Quotient = EPC / SLV *1

Constituent	Carcinogen?	RME				CTE			
		EPC (mg/kg)	SLV (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient	EPC (mg/kg)	SLV (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
SCAPPOOSE BAY									
Polynuclear Aromatic Hydrocarbons - Subsistence Consumption*									
Fluoranthene	nc	3.63E+00	5.0E+01	NA	7.3E-02	2.05E+00	5.0E+01	NA	4.1E-02
Pyrene	nc	2.54E+00	3.8E+01	NA	6.7E-02	1.46E+00	3.8E+01	NA	3.9E-02
Total				NA	1.4E-01			NA	8.0E-02
Polynuclear Aromatic Hydrocarbons - General Human Consumption									
Fluoranthene	nc	3.63E+00	5.1E+02	NA	7.1E-03	2.05E+00	5.1E+02	NA	4.0E-03
Pyrene	nc	2.54E+00	3.8E+02	NA	6.7E-03	1.46E+00	3.8E+02	NA	3.9E-03
Total				NA	1.4E-02			NA	7.9E-03
Dioxins/Furans - Subsistence Consumption*									
2,3,7,8-TCDD	c	0.00E+00	8.9E-10	0E+00	NA	0.00E+00	8.9E-10	0E+00	NA
1,2,3,7,8-PeCDD	c	1.17E-07	2.8E-08	4E-06	NA	4.92E-08	2.8E-08	2E-06	NA
1,2,3,4,7,8-HxCDD	c	2.54E-07	2.8E-07	9E-07	NA	9.57E-08	2.8E-07	3E-07	NA
1,2,3,6,7,8-HxCDD	c	2.32E-06	2.8E-07	8E-06	NA	9.35E-07	2.8E-07	3E-06	NA
1,2,3,7,8,9-HxCDD	c	6.95E-07	2.8E-07	3E-06	NA	2.44E-07	2.8E-07	9E-07	NA
1,2,3,4,6,7,8-HpCDI	c	7.66E-05	6.9E-05	1E-06	NA	2.98E-05	6.9E-05	4E-07	NA
OCDD	c	7.71E-04	2.3E-03	3E-07	NA	3.03E-04	2.3E-03	1E-07	NA
2,3,7,8-TCDF	c	0.00E+00	7.6E-08	0E+00	NA	0.00E+00	7.6E-08	0E+00	NA
1,2,3,7,8-PeCDF	c	1.22E-07	2.5E-07	5E-07	NA	4.93E-08	2.5E-07	2E-07	NA
2,3,4,7,8-PeCDF	c	1.18E-07	3.0E-09	4E-05	NA	4.85E-08	3.0E-09	2E-05	NA
1,2,3,4,7,8-HxCDF	c	5.53E-07	2.8E-07	2E-06	NA	2.90E-07	2.8E-07	1E-06	NA
1,2,3,6,7,8-HxCDF	c	2.35E-07	2.8E-07	9E-07	NA	8.72E-08	2.8E-07	3E-07	NA
2,3,4,6,7,8-HxCDF	c	3.83E-07	2.8E-07	1E-06	NA	1.36E-07	2.8E-07	5E-07	NA
1,2,3,7,8,9-HxCDF	c	1.73E-07	2.8E-07	6E-07	NA	6.53E-08	2.8E-07	2E-07	NA
1,2,3,4,6,7,8-HpCDI	c	1.16E-05	6.9E-05	2E-07	NA	4.60E-06	6.9E-05	7E-08	NA
1,2,3,4,7,8,9-HpCDI	c	6.23E-07	6.9E-05	9E-09	NA	2.61E-07	6.9E-05	4E-09	NA
OCDF	c	6.39E-05	2.3E-03	3E-08	NA	2.48E-05	2.3E-03	1E-08	NA
Total				6E-05	NA			3E-05	NA

Please see notes at end of table.

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Table F-10
Calculation of Risks from Bioaccumulative Compounds in Sediment
Sport Fisher
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = EPC / SLV * 10^{-6}
Hazard Quotient = EPC / SLV *1

Constituent	Carcinogen?	RME				CTE			
		EPC (mg/kg)	SLV (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient	EPC (mg/kg)	SLV (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Dioxins/Furans - General Human Consumption									
2,3,7,8-TCDD	c	0.00E+00	9.1E-09	0E+00	NA	0.00E+00	9.1E-09	0E+00	NA
1,2,3,7,8-PeCDD	c	1.17E-07	2.7E-07	4E-07	NA	4.92E-08	2.7E-07	2E-07	NA
1,2,3,4,7,8-HxCDD	c	2.54E-07	2.7E-06	9E-08	NA	9.57E-08	2.7E-06	4E-08	NA
1,2,3,6,7,8-HxCDD	c	2.32E-06	2.7E-06	9E-07	NA	9.35E-07	2.7E-06	3E-07	NA
1,2,3,7,8,9-HxCDD	c	6.95E-07	2.7E-06	3E-07	NA	2.44E-07	2.7E-06	9E-08	NA
1,2,3,4,6,7,8-HpCDD	c	7.66E-05	6.9E-04	1E-07	NA	2.98E-05	6.9E-04	4E-08	NA
OCDD	c	7.71E-04	2.3E-02	3E-08	NA	3.03E-04	2.3E-02	1E-08	NA
2,3,7,8-TCDF	c	0.00E+00	7.7E-07	0E+00	NA	0.00E+00	7.7E-07	0E+00	NA
1,2,3,7,8-PeCDF	c	1.22E-07	2.6E-06	5E-08	NA	4.93E-08	2.6E-06	2E-08	NA
2,3,4,7,8-PeCDF	c	1.18E-07	3.0E-08	4E-06	NA	4.85E-08	3.0E-08	2E-06	NA
1,2,3,4,7,8-HxCDF	c	5.53E-07	2.7E-06	2E-07	NA	2.90E-07	2.7E-06	1E-07	NA
1,2,3,6,7,8-HxCDF	c	2.35E-07	2.7E-06	9E-08	NA	8.72E-08	2.7E-06	3E-08	NA
2,3,4,6,7,8-HxCDF	c	3.83E-07	2.7E-06	1E-07	NA	1.36E-07	2.7E-06	5E-08	NA
1,2,3,7,8,9-HxCDF	c	1.73E-07	2.7E-06	6E-08	NA	6.53E-08	2.7E-06	2E-08	NA
1,2,3,4,6,7,8-HpCDF	c	1.16E-05	6.9E-04	2E-08	NA	4.60E-06	6.9E-04	7E-09	NA
1,2,3,4,7,8,9-HpCDF	c	6.23E-07	6.9E-04	9E-10	NA	2.61E-07	6.9E-04	4E-10	NA
OCDF	c	6.39E-05	2.3E-02	3E-09	NA	2.48E-05	2.3E-02	1E-09	NA
Total				2E-06	NA			3E-06	NA
MILTON CREEK									
Polynuclear Aromatic Hydrocarbons - Subsistence Consumption									
Fluoranthene	nc	5.05E-01	6.20E+01	NA	8.1E-03	2.49E-01	5.00E+01	NA	5.0E-03
Pyrene	nc	5.07E-01	4.70E+01	NA	1.1E-02	2.41E-01	3.80E+01	NA	6.3E-03
Total				NA	1.9E-02			NA	1.1E-02
Polynuclear Aromatic Hydrocarbons - General Human Consumption									
Fluoranthene	nc	5.05E-01	5.10E+02	NA	9.9E-04	2.49E-01	5.10E+02	NA	4.9E-04
Pyrene	nc	5.07E-01	3.80E+02	NA	1.3E-03	2.41E-01	3.80E+02	NA	6.3E-04
Total				NA	2.3E-03			NA	1.1E-03

Notes:
c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
SLV = screening level value
CTE - central tendency exposure
RME = reasonable maximum exposure
mg/kg = milligrams per kilogram
NA = not applicable or not available
General consumption SLVs from Table A-1 of *Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment* (DEQ, 2017)
*Subsistence consumption SLVs were updated from SLVs presented in DEQ (2017) using a 175 g/day consumption rate, per DEQ request (DEQ, 2014)
The maximum detected concentration was used in place of the RME for dioxin/furans, due to the limited sample size
Non-detect values replaced with one-half the detection limit for CTE calculations
Shading indicates individual ELRC exceeds DEQ's individual acceptable limit of 1E-6 or total acceptable limit of 1E-5

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Table F-11
Summary of Risks from Sediment
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Source / Pathway	Excess Lifetime Cancer Risk		Hazard Index	
	RME	CTE	RME	CTE
SCAPPOOSE BAY				
Older Child Recreational Tresspasser				
Sediment / Direct Contact	2E-06	4E-07	3.7E-01	5.4E-01
Sport Fisher				
Fish Consumption (subsistence)	6E-05	3E-05	1.4E-01	8.0E-02
Fish Consumption (general)	2E-06	3E-06	1.4E-02	7.9E-03
DEQ Acceptable Risk Level*	1E-05	1E-05	1.0E+00	1.0E+00
MILTON CREEK				
Older Child Recreational Tresspasser				
Sediment / Direct Contact	9E-07	2E-07	9.7E-05	2.5E-05
Sport Fisher				
Fish Consumption (subsistence)	NA	NA	1.9E-02	1.1E-02
Fish Consumption (general)	NA	NA	2.3E-03	1.1E-03
DEQ Acceptable Risk Level*	1E-05	1E-05	1.0E+00	1.0E+00

Notes:

*DEQ acceptable risk level provided is for cumulative acceptable risk. Comparison of individual chemicals to acceptable limits are provided in Tables F-9A and F-9C.

Subsistence consumption SLVs were calculated using a 175 g/day consumption rate, per DEQ request (DEQ, 2014)

General population consumption SLVs were calculated using a 17.5 g/day consumption rate, per DEQ guidance (DEQ, 2017)

CTE - central tendency exposure

RME = reasonable maximum exposure

Shading indicates individual ELRC exceeds the total acceptable limit of 1E-5

NA = not applicable or not available

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Table F-12
Calculation of Risks from Bioaccumulative Compounds in Surface Water
Sport Fisher
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = EPC / SLV * 10^{-6}
Hazard Quotient = EPC / SLV *1

Constituent	Carcinogen?	RME				CTE				Maximum Surface Water Concentration			
		EPC (µg/L)	SLV* (µg/L)	Excess Lifetime Cancer Risk	Hazard Quotient	EPC (µg/L)	SLV* (µg/L)	Excess Lifetime Cancer Risk	Hazard Quotient	EPC (µg/L)	SLV* (µg/L)	Excess Lifetime Cancer Risk	Hazard Quotient
SCAPPOOSE BAY													
Polynuclear Aromatic Hydrocarbons - Subsistence Consumption*													
Benzo(a)pyrene	nc	6.74E-05	3.5E-02	NA	1.9E-03	4.67E-05	3.5E-02	NA	1.3E-03	1.23E-04	3.5E-02	NA	3.5E-03
Benzo(a)pyrene	c	6.74E -05	1.2E-04	6E-07	NA	4.67E-05	1.2E-04	4E-07	NA	1.23E-04	1.2E-04	1E-06	NA
Polynuclear Aromatic Hydrocarbons - General Human Consumption													
Benzo(a)pyrene	nc	6.74E-05	3.5E-01	NA	1.9E-04	4.67E-05	3.5E-02	NA	1.3E-03	1.23E-04	3.5E-02	NA	3.5E-03
Benzo(a)pyrene	c	6.74E -05	1.2E-03	6E-08	NA	4.67E-05	1.2E-04	4E-07	NA	1.23E-04	1.2E-04	1E-06	NA

Notes:
c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
SLV = screening level value
CTE - central tendency exposure
RME = reasonable maximum exposure
µg/L = micrograms per liter
NA = not applicable or not available
*Subsistence consumption SLVs are from DEQ established site-specific PRGs (DEQ, 2019), using a 175 g/day consumption rate. General consumption SLVs updated from DEQ established PRGs (DEQ, 2019), using a 17.5 g/day consumption rate.
Dioxin/furan concentrations calculated using WHO (2005) TEF values. If congeners were non-detect (ND) for all samples, NDs were replaced with 0. If a congener was detected in any sample, ND was replaced with one-half the detection limit. Maximum detected concentrations used in place of RME due to small number of samples collected (n=4)
Shading indicates either 1) individual ELRC exceeds DEQ's individual acceptable limit of 1E-6 or total acceptable limit of 1E-5, or 2) individual hazard quotient exceeds 1

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Table F-13A
Calculation of RME Risks - Direct Contact from Constituents in Soil
Construction Worker
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = RME EPC / RME RBCss * 10^{-6}
Hazard Quotient = RME EPC / RME RBCss * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBCss (mg/kg)	Noncarcinogenic RME RBCss (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Surface Soil						
Polychlorinated Biphenyls						
Aroclor 1260	c, nc	1.39E+00	NA	NA	NA	NA
Total PCBs	c, nc	1.44E+00	NA	4.90E+00	NA	2.9E-01
Total					NA	2.9E-01
Subsurface Soil						
Volatile Organic Compounds						
Methylene Chloride	c	1.20E-01	1.20E+04	NA	1E-11	NA
Semivolatile Organic Compounds						
Acenaphthene	nc	3.70E+00	NA	2.10E+04	NA	1.8E-04
Benzo(a)anthracene	c	1.44E+00	1.70E+02	NA	8E-09	NA
Benzo(a)pyrene	c	5.90E-01	1.70E+01	NA	3E-08	NA
Benzo(b)fluoranthene	c	6.50E-01	1.70E+02	NA	4E-09	NA
Benzo(k)fluoranthene	c	5.50E-01	1.70E+03	NA	3E-10	NA
Chrysene	c	1.50E+00	1.70E+04	NA	9E-11	NA
Fluoranthene	nc	3.33E+00	NA	1.00E+04	NA	3.3E-04
Fluorene	nc	5.32E+00	NA	1.40E+04	NA	3.8E-04
Indeno(1,2,3-cd)pyrene	c	1.70E-01	1.70E+02	NA	1E-09	NA
2-Methylnaphthalene	c	4.84E+00	5.80E+02	NA	8E-09	NA
Naphthalene	c	7.00E-02	5.80E+02	NA	1E-10	NA
Phenanthrene	nc	1.41E+01	NA	NA	NA	NA
Pyrene	nc	2.95E+00	NA	7.50E+03	NA	3.9E-04
Pentachlorophenol	nc	3.00E-02	NA	3.40E+01	NA	8.8E-04
Metals						
Arsenic *(with outlier)**	nc	1.73E+01	NA	1.50E+01	NA	1.2E+00
Arsenic *(without outlier)**	nc	5.41E+00	NA	1.50E+01	NA	3.6E-01
Lead	nc	2.20E+02	NA	8.00E+02	NA	2.8E-01
Total Risk						
With outlier*					6E-08	1.4E+00
Without outlier*					6E-08	6.4E-01

Notes:
c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
RBC_{SS} - risk-based concentration for direct contact with soil
RME - reasonable maximum exposure
mg/kg = milligrams per kilogram
NA - Not applicable
Total PCBs calculated from the sum of Aroclors. Aroclors that were not detected in any samples were given a value of 0.
Total PCB RME UCL calculated as 95% Gamma Adjusted KM-UCL (see Appendix F for ProUCL output)
*RME calculated twice for arsenic: 1) with all data and 2) without the statistical outlier (Dixon's Test, $p<0.05$), per EPA guidance (EPA, 2000; EPA, 2013a)
Shading indicates calculated risk exceeds DEQ acceptable risk level

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Table F-13B
Calculation of CTE Risks - Direct Contact from Constituents in Soil
Construction Worker
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = CTE EPC / CTE RBCss * 10^{-6}
Hazard Quotient = CTE EPC / CTE RBCss * 1

Constituent	Carcinogen?	CTE EPC (mg/kg)	Carcinogenic CTE RBCss (mg/kg)	Noncarcinogenic CTE RBCss (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Surface Soil						
Polychlorinated Biphenyls						
Aroclor 1260	c, nc	7.00E-01	NA	NA	NA	NA
Total PCBs	c, nc	7.30E-01	NA	3.10E+01	NA	2.4E-02
Total					NA	2.4E-02
Subsurface Soil						
Volatile Organic Compounds						
Methylene Chloride	c	3.00E-02	8.00E+04	NA	4E-13	NA
Semivolatile Organic Compounds						
Acenaphthene	nc	1.01E+00	NA	5.30E+20	NA	1.9E-21
Benzo(a)anthracene	c	4.60E-01	1.70E+02	NA	3E-09	NA
Benzo(a)pyrene	c	2.10E-01	1.70E+01	NA	1E-08	NA
Benzo(b)fluoranthene	c	2.50E-01	1.70E+02	NA	1E-09	NA
Benzo(k)fluoranthene	c	2.10E-01	1.70E+03	NA	1E-10	NA
Chrysene	c	7.10E-01	1.70E+04	NA	4E-11	NA
Fluoranthene	nc	1.47E+00	NA	6.90E+21	NA	2.1E-22
Fluorene	nc	1.43E+00	NA	1.50E+21	NA	9.5E-22
Indeno(1,2,3-cd)pyrene	c	9.00E-02	1.70E+02	NA	5E-10	NA
2-Methylnaphthalene	c	1.25E+00	5.80E+02	NA	2E-09	NA
Naphthalene	c, nc	3.00E-02	5.80E+02	5.70E+05	5E-11	5.3E-08
Phenanthrene	nc	3.88E+00	NA	6.90E+21	NA	5.6E-22
Pyrene	nc	1.30E+00	NA	1.10E+22	NA	1.2E-22
Pentachlorophenol	nc	1.00E-02	NA	1.10E+22	NA	9.1E-25
Metals						
Arsenic	nc	7.21E+00	NA	1.50E+01	NA	4.8E-01
Lead	nc	7.79E+01	NA	8.00E+02	NA	9.7E-02
Total					2E-08	5.8E-01

Notes:
c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
RBC_{SS} - risk-based concentration for direct contact with soil
CTE - central tendency exposure
mg/kg = milligrams per kilogram
NA - Not applicable
Total PCBs calculated from the sum of Aroclors. Aroclors that were not detected in any samples were given a value of 0.
Total PCB CTE EPC calculated as the KM mean using ProUCL for censored datasets (with NDs) using Kaplan Meier method

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Table F-13C
Calculation of RME Risks - Direct Contact from Constituents in Soil
Excavation Worker
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = RME EPC / RME RBCss * 10^{-6}
Hazard Quotient = RME EPC / RME RBCss * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBCss (mg/kg)	Noncarcinogenic RME RBCss (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Surface Soil						
Polychlorinated Biphenyls						
Aroclor 1260	c, nc	1.39E+00	NA	NA	NA	NA
Total PCBs	c, nc	1.44E+00	NA	1.40E+02	NA	1.0E-02
Total					NA	1.0E-02
Subsurface Soil						
Volatile Organic Compounds						
Methylene Chloride	c	1.20E-01	340,000	NA	3.53E-13	NA
Semivolatile Organic Compounds						
Acenaphthene	nc	3.70E+00	NA	5.90E+05	NA	6.3E-06
Benzo(a)anthracene	c	1.44E+00	4.80E+03	NA	3.00E-10	NA
Benzo(a)pyrene	c	5.90E-01	4.90E+02	NA	1.20E-09	NA
Benzo(b)fluoranthene	c	6.50E-01	4.90E+03	NA	1.33E-10	NA
Benzo(k)fluoranthene	c	5.50E-01	4.90E+04	NA	1.12E-11	NA
Chrysene	c	1.50E+00	4.90E+05	NA	3E-12	NA
Fluoranthene	nc	3.33E+00	NA	2.80E+05	NA	1.2E-05
Fluorene	nc	5.32E+00	NA	3.90E+05	NA	1.4E-05
Indeno(1,2,3-cd)pyrene	c	1.70E-01	4.90E+03	NA	3.47E-11	NA
2-Methylnaphthalene	c	4.84E+00	1.60E+04	NA	3E-10	NA
Naphthalene	c	7.00E-02	1.60E+04	NA	4E-12	NA
Phenanthrene	nc	1.41E+01	NA	NA	NA	NA
Pyrene	nc	2.95E+00	NA	2.10E+05	NA	1.4E-05
Pentachlorophenol	nc	3.00E-02	NA	9.60E+02	NA	3.1E-05
Metals						
Arsenic *(with outlier)**	nc	1.73E+01	NA	1.50E+01	NA	1.2E+00
Arsenic *(without outlier)**	nc	5.41E+00	NA	1.50E+01	NA	3.6E-01
Lead	nc	2.20E+02	NA	8.00E+02	NA	2.8E-01
Total Risk						
With outlier*					2E-09	1.4E+00
Without outlier*					2E-09	6.4E-01

Notes:
c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
RBC_{SS} - risk-based concentration for direct contact with soil
RME - reasonable maximum exposure
mg/kg = milligrams per kilogram
NA - Not applicable
Total PCBs calculated from the sum of Aroclors. Aroclors that were not detected in any samples were given a value of 0.
Total PCB RME UCL calculated as 95% Gamma Adjusted KM-UCL (see Appendix F for ProUCL output)

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Table F-13D
Calculation of CTE Risks - Direct Contact from Constituents in Soil
Excavation Worker
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = CTE EPC / CTE RBCss * 10^{-6}
Hazard Quotient = CTE EPC / CTE RBCss * 1

Constituent	Carcinogen?	CTE EPC (mg/kg)	Carcinogenic CTE RBCss (mg/kg)	Noncarcinogenic CTE RBCss (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Surface Soil						
Polychlorinated Biphenyls						
Aroclor 1260	c, nc	7.00E-01	NA	NA	NA	NA
Total PCBs	c, nc	7.30E-01	NA	4.30E+02	NA	1.7E-03
Total					NA	1.7E-03
Subsurface Soil						
Volatile Organic Compounds						
Methylene Chloride	c	3.00E-02	NA*	NA	NA	NA
Semivolatile Organic Compounds						
Acenaphthene	nc	1.01E+00	NA	NA*	NA	NA
Benzo(a)anthracene	c	4.60E-01	30,000	NA	2E-11	NA
Benzo(a)pyrene	c	2.10E-01	3,100	NA	7E-11	NA
Benzo(b)fluoranthene		2.50E-01	31,000	NA	8E-12	NA
Benzo(k)fluoranthene	c	2.10E-01	310,000	NA	7E-13	NA
Chrysene	c	7.10E-01	NA*	NA	NA	NA
Fluoranthene	nc	1.47E+00	NA	8.90E+05	NA	1.7E-06
Fluorene	nc	1.43E+00	NA	NA*	NA	NA
Indeno(1,2,3-cd)pyrene	c	9.00E-02	31,000	NA	3E-12	NA
2-Methylnaphthalene		1.25E+00	NA	NA	NA	NA
Naphthalene	c, nc	3.00E-02	32,000	NA	9E-13	NA
Phenanthrene	nc	3.88E+00	NA	NA	NA	NA
Pyrene	nc	1.30E+00	NA	6.70E+05	NA	1.9E-06
Pentachlorophenol	nc	1.00E-02	NA	6.00E+03	NA	1.7E-06
Metals						
Arsenic	nc	7.21E+00	NA	2.70E+03	NA	2.7E-03
Lead	nc	7.79E+01	NA	8.00E+02	NA	9.7E-02
Total					1E-10	1.0E-01

Notes:
c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
RBC_{SS} - risk-based concentration for direct contact with soil
CTE - central tendency exposure
mg/kg = milligrams per kilogram
NA - Not applicable
*RBC exceeds max

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Table F-13E
Calculation of RME Risks - Direct Contact from Constituents in Soil
Industrial Worker
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = RME EPC / RME RBCss * 10^{-6}
Hazard Quotient = RME EPC / RME RBCss * 1

Constituent	Carcinogen?	RME EPC (mg/kg)	Carcinogenic RME RBCss (mg/kg)	Noncarcinogenic RME RBCss (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Surface Soil						
Polychlorinated Biphenyls						
Aroclor 1260	c, nc	1.39E+00	NA	NA	NA	NA
Total PCBs	c, nc	1.22E+00	NA	5.90E-01	NA	2.1E+00
Total					NA	2E+00

Notes:
c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
RBC_{SS} - risk-based concentration for direct contact with soil
RME - reasonable maximum exposure
mg/kg = milligrams per kilogram
NA - Not applicable
Total PCBs calculated from the sum of Aroclors. Aroclors that were not detected in any samples were given a value of 0.
Total PCB RME UCL calculated as 95% Gamma Adjusted KM-UCL (see Appendix F for ProUCL output)

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Table F-13F
Calculation of CTE Risks - Direct Contact from Constituents in Soil
Industrial Worker
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Excess Lifetime Cancer Risk = CTE EPC / CTE RBCss * 10^{-6}
Hazard Quotient = CTE EPC / CTE RBCss * 1

Constituent	Carcinogen?	CTE EPC (mg/kg)	Carcinogenic CTE RBCss (mg/kg)	Noncarcinogenic CTE RBCss (mg/kg)	Excess Lifetime Cancer Risk	Hazard Quotient
Surface Soil						
Polychlorinated Biphenyls						
Aroclor 1260	c, nc	7.00E-01	NA	NA	NA	NA
Total PCBs	c, nc	7.30E-01	NA	1.60E+00	NA	4.6E-01
Total					NA	5E-01

Notes:

c - carcinogen
nc - non-carcinogen
EPC - exposure point concentration
RBC_{ss} - risk-based concentration for direct contact with soil
CTE - central tendency exposure
mg/kg = milligrams per kilogram
NA - Not applicable
Total PCBs calculated from the sum of Aroclors. Aroclors that were not detected in any samples were given a value of 0.
Total PCB RME UCL calculated as 95% Gamma Adjusted KM-UCL (see Appendix F for ProUCL output)

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Table F-13G
Summary of Risks from Soil
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Source / Pathway	Excess Lifetime Cancer Risk		Hazard Index		
	RME	CTE	RME	RME*	CTE
Surface Soil					
Industrial Worker	NA	NA	2.1E+00	NA	4.6E-01
Construction Worker	NA	NA	2.9E-01	NA	2.4E-02
Excavation Worker	NA	NA	1.0E-02	NA	1.7E-03
Subsurface Soil					
Industrial Worker	NA	NA	NA	NA	NA
Construction Worker	6E-08	2E-08	1.4E+00	6.4E-01	5.8E-01
Excavation Worker	2E-09	1E-10	1.4E+00	6.4E-01	1.0E-01
Total Risk from Soil					
Industrial Worker	NA	NA	2.1E+00	NA	4.6E-01
Construction Worker	6E-08	2E-08	1.7E+00	6.4E-01	6.0E-01
Excavation Worker	2E-09	1E-10	1.4E+00	6.4E-01	1.0E-01
DEQ Acceptable Risk Level	**1E-05**	**1E-05**	**1.0E+00**	**1.0E+00**	**1.0E+00**

Notes:

NA - Cancer risks and noncancer hazards from dermal exposures in water to semi-volatile compounds are not quantitatively evaluated; refer to the uncertainty discussion of dermal exposure for the excavation worker.

RME - Reasonable Maximum Exposure
CTE - Central Tendence Exposure
*Two RMEs were calculated for the construction worker and excavation worker scenarios: 1) with all data and 2) without the statistical outlier (Dixon's Test, $p<0.05$), per EPA guidance (EPA, 2000; EPA, 2013a)
Shading indicates calculated total risk exceeds DEQ acceptable risk level. Individual risks screened in Tables F-13A through F-13F

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Table F-13H
Summary of Risks from Soil and Surface Water from the 2006 HHRA
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Receptor	Excess Lifetime Cancer Risk		Hazard Index	
	RME	CTE	RME	CTE
SOIL (as reported on Table 28)				
Surface Soil				
Industrial Worker (i.e., on-Site Worker)	2E-07	9E-08	NA	NA
Excavation Worker	2E-07	9E-08	NA	NA
Subsurface Soil				
Industrial Worker (i.e., on-Site Worker)	6E-09	4E-10	1.0E-03	2.0E-04
Excavation Worker	6E-08	8E-09	3.0E-01	4.0E-05
Total Risk from Soil				
Industrial Worker (i.e., on-Site Worker)	2E-07	9E-08	1.0E-03	2.0E-04
Excavation Worker	3E-07	1E-07	3.0E-01	4.0E-05
DEQ Acceptable Risk Level	***1E-05***	***1E-05***	***1.0E+00***	***1.0E+00***
SURFACE WATER [A] (as reported on Tables 5 and 6 in Appendix D)				
Recreational Trespasser	3E-06	9E-07	5.0E-05	2.0E-05
DEQ Acceptable Risk Level	***1E-05***	***1E-05***	***1.0E+00***	***1.0E+00***

Notes:
NA - Noncarcinogenic hazards from exposure to surface soil were not evaluated in the 2006 HHRA.
[A] The cancer risk and hazard index for surface water include all samples from Scappoose Bay and Milton Creek; the data were not segregated into exposure units.
RME - Reasonable Maximum Exposure
CTE - Central Tendency Exposure

2006 HHRA - Kennedy/Jenks Consultants, Human Health Risk Assessment, Pope & Talbot Port St. Helens Site, November 28, 2006.

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Table F-14
Summary of Risks
Former Pope & Talbot Wood Treating Site
St. Helens, Oregon

Source / Pathway	Excess Lifetime Cancer Risk		Hazard Index			Source	
	RME/Max Detected	CTE	RME/Max Detected	RME*	CTE		
Industrial Worker							
Outdoor Air / Inhalation	1E-06	3E-08	3.9E+02	NA	2.7E+01	Table F-8	2019 Updated HHRA
Indoor Air / Inhalation	2E-06	5E-08	3.9E+02	NA	2.7E+01	Table F-8	2019 Updated HHRA
Surface soil / direct contact	NA	NA	2.1E+00	NA	4.6E-01	Table F-13G	2019 Updated HHRA
Total	**4E-06**	**8E-08**	**7.7E+02**	NA	**5.4E+01**		
Excavation Worker							
Surface soil / direct contact	NA	NA	2.1E+00	NA	4.6E-01	Table F-13G	2019 Updated HHRA
Subsurface soil / direct contact-ingestion-inhalation	2E-09	1E-10	1.4E+00	6.4E-01	1.0E-01	Table F-13G	2019 Updated HHRA
Groundwater / direct contact-inhalation	NA	NA	3.9E+02	NA	2.7E+01	Table F-8	2019 Updated HHRA
Total	**2E-09**	**1E-10**	**3.9E+02**	**6.4E-01**	**2.8E+01**		
Construction Worker							
Surface soil / direct contact	NA	NA	2.9E-01	NA	2.4E-02	Table F-13G	2019 Updated HHRA
Subsurface soil / direct contact-ingestion-inhalation	6E-08	2E-08	1.4E+00	6.4E-01	5.8E-01	Table F-13G	2019 Updated HHRA
Total	**6E-08**	**2E-08**	**1.7E+00**	**6.4E-01**	**6.0E-01**		
Recreational Trespasser in Scappoose Bay							
Sediment / direct contact-ingestion-inhalation	2E-06	4E-07	3.7E-01	NA	5.4E-01	Table F-11	2019 Updated HHRA
Recreational Trespasser in Milton Creek							
Sediment / direct contact-ingestion-inhalation	9E-07	2E-07	9.7E-05	NA	2.5E-05	Table F-11	2019 Updated HHRA
Sport Fisher in Scappoose Bay							
Fish tissue / consumption (general)	2E-06	3E-06	NA	NA	7.9E-03	Table F-11	2019 Updated HHRA
Fish tissue / consumption (subsistence)	6E-05	3E-05	NA	NA	8.0E-02	Table F-11	2019 Updated HHRA
Sport Fisher in Milton Creek							
Fish tissue / consumption (general)	NA	NA	2.3E-03	NA	1.1E-03	Table F-11	2019 Updated HHRA
Fish tissue / consumption (subsistence)	NA	NA	1.9E-02	NA	1.1E-02	Table F-11	2019 Updated HHRA
DEQ Acceptable Risk Level	***1E-05***	***1E-05***	***1.0E+00***	***1.0E+00***	***1.0E+00***		

Notes:

NA explanations include:

- Surface soil / direct contact (industrial worker / excavation worker - Noncarcinogenic hazards were not evaluated in the 2006 HHRA.
- Groundwater / direct contact-inhalation (excavation worker) - Cancer risks and noncancer hazards from dermal exposures in water to semi-volatile compounds are not quantitatively evaluated; refer to the uncertainty discussion of dermal exposure for the excavation worker.
- Fish tissue / consumption (sport fisher) - The bioaccumulative PAHs are not carcinogenic.

RME - reasonable maximum exposure
CTE - central tendency exposure
HHRA - human health risk assessment
[A] The cancer risk and hazard index for surface water include all samples from Scappoose Bay and Milton Creek; the data were not segregated into exposure units.
Shading indicated total acceptable risk level exceeded.
*Two RMEs were calculated for the construction worker and excavation worker scenarios: 1) with all data and 2) without the statistical outlier (Dixon's Test, p<0.05), per EPA guidance (EPA, 2000; EPA, 2013a)

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FIGURES

Area 1

Area 2

Milton Creek

Scappoose Bay

Multnomah Channel

NOTE:
2018 Imagery provided by
Oregon Geospatial Enterprise Office.

0 100 200 Feet

N

LEGEND:

- 2017 Sediment, Porewater and Surface Water

Supplemental RI Sediment Sample Locations

- Inside Inferred NAPL Extent as of October 2013
- Outside Inferred NAPL Extent as of October 2013
- Visible Creosote Sheen Observed in Surface Sediments (2010, 2011, 2012)

Historical Risk Assessment Sediment Sample Location

- Inside Inferred NAPL Extent as of October 2013
- Outside Inferred NAPL Extent as of October 2013
- Former Site Features
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Former Transfer Table Dock
- Offshore Priority Action Area
- Upland Priority Action Area
- Milton Creek Exposure Unit
- Scappoose Bay Exposure Unit
- Area 1 Upland Groundwater Exposure Unit

ESTIMATED EXTENT OF NAPL AND SEDIMENT SAMPLE LOCATIONS

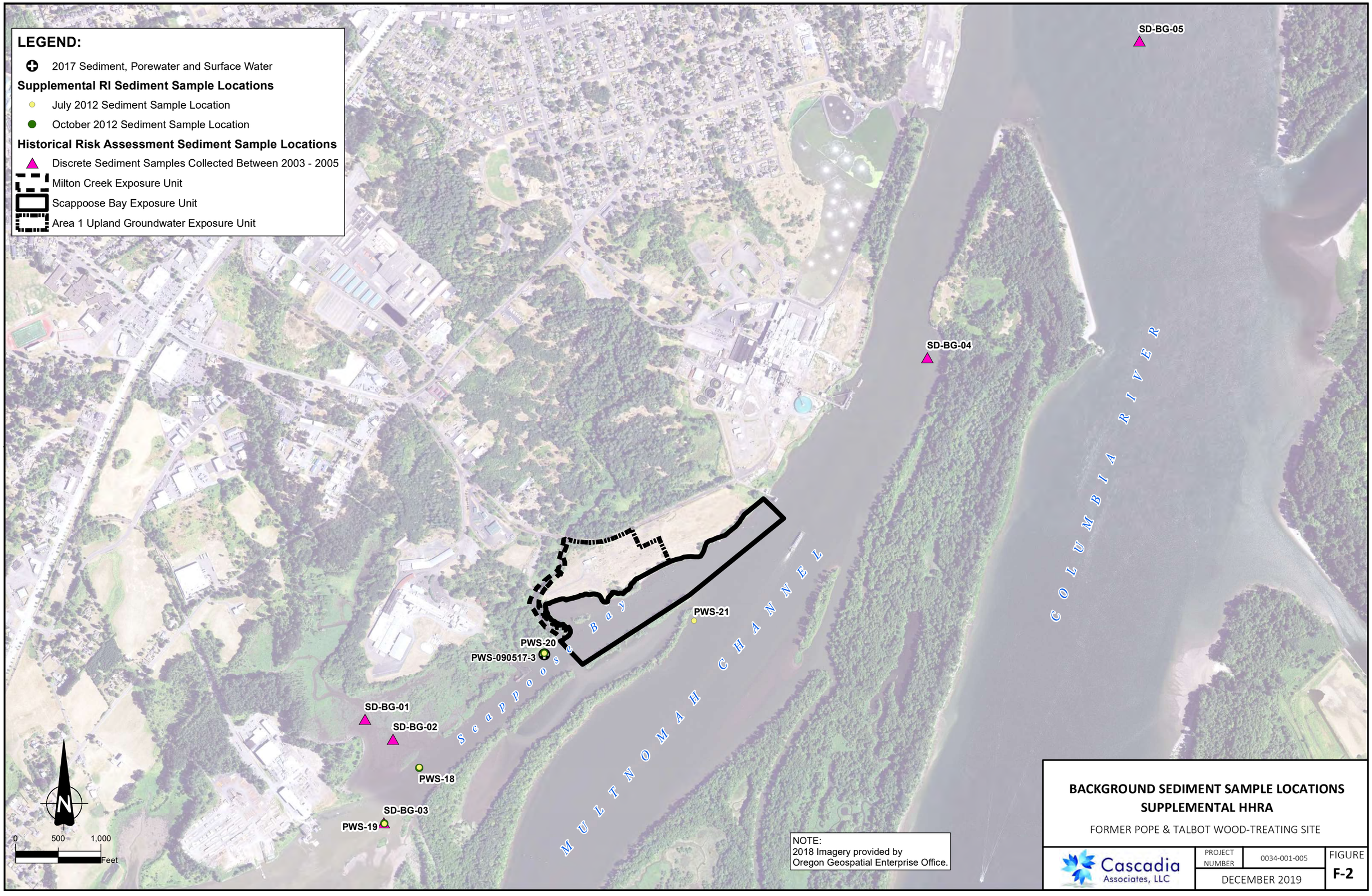
FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE F-1



BACKGROUND SEDIMENT SAMPLE LOCATIONS
SUPPLEMENTAL HHRA

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		F-2

Milton Creek

MW-8

MW-5

MW-4A MW-4B

MW-21

MW-20

MW-1

MW-19

MW-2A

MW-2 (ABANDONED)

MW-3A MW-3B

MW-22

MW-23

MW-24

MW-6A

MW-25

MW-9

MW-18

MW-10

MW-7

AREA 1

AREA 2

Scappoose Bay

Multnomah Channel

N

0 100 200 Feet

NOTE:
2018 Imagery provided by
Oregon Geospatial Enterprise Office.

LEGEND:

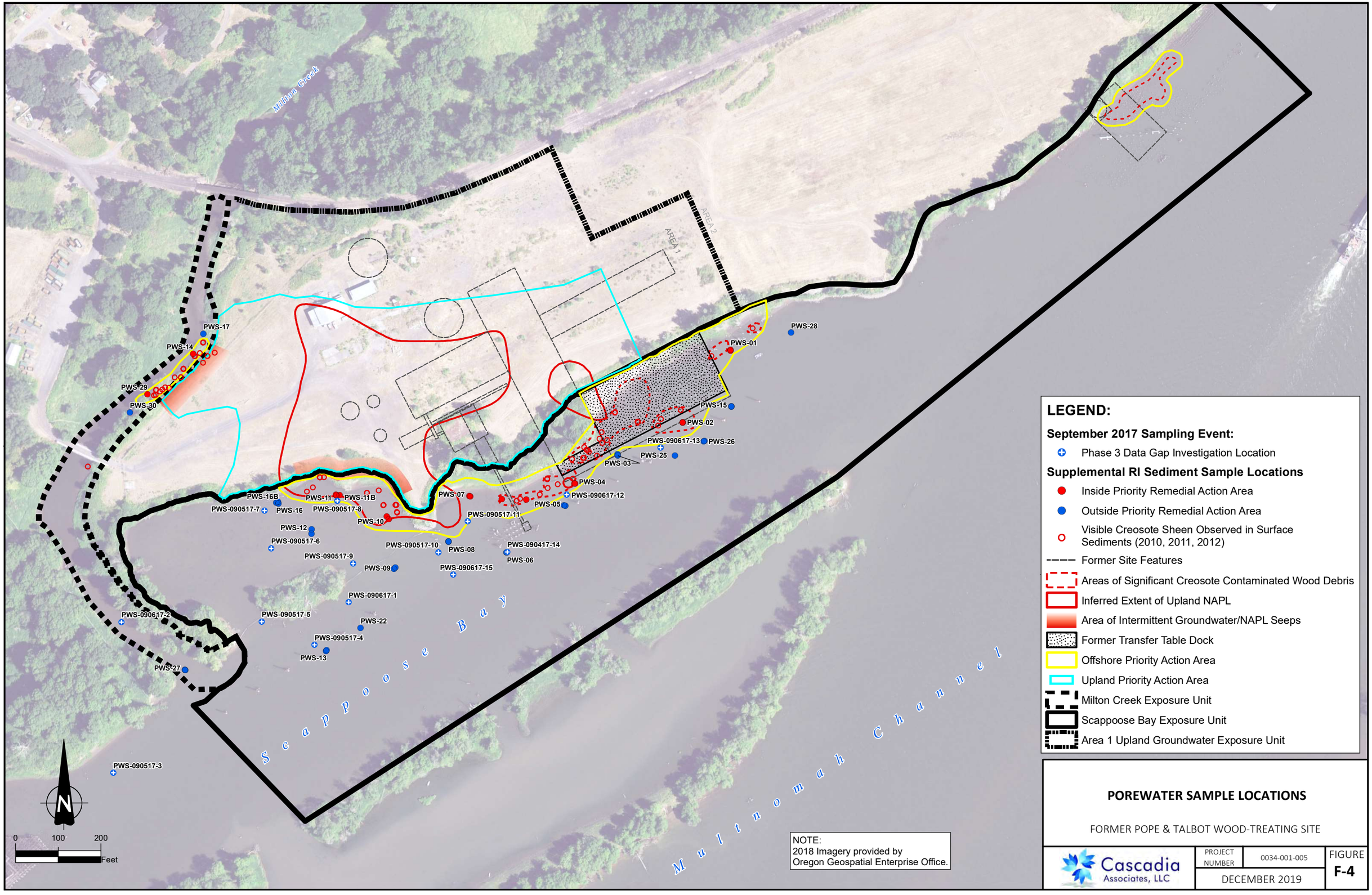
- Monitoring Well (Abandonded)
- Phase I RI Monitoring Well (1996-1998)
- Supplemental RI Monitoring Well (2011)
- Visible Creosote Sheen Observed in Surface Sediments (2010, 2011, 2012)
- Former Site Features
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Offshore Priority Action Area
- Upland Priority Action Area
- Former Transfer Table Dock
- Milton Creek Exposure Unit
- Scappoose Bay Exposure Unit
- Area 1 Upland Groundwater Exposure Unit

GROUNDWATER SAMPLE LOCATIONS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		F-3



LEGEND:

September 2017 Sampling Event:

- Phase 3 Data Gap Investigation Location

Supplemental RI Sediment Sample Locations

- Inside Priority Remedial Action Area
- Outside Priority Remedial Action Area
- Visible Creosote Sheen Observed in Surface Sediments (2010, 2011, 2012)
- Former Site Features
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Former Transfer Table Dock
- Offshore Priority Action Area
- Upland Priority Action Area
- Milton Creek Exposure Unit
- Scappoose Bay Exposure Unit
- Area 1 Upland Groundwater Exposure Unit

NOTE:
2018 Imagery provided by
Oregon Geospatial Enterprise Office.

POREWATER SAMPLE LOCATIONS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		F-4

Milton Creek

SS-1
SS-3
SS-6
SS-4
SS-7
SS-9
SS-19
SS-8
SS-5
SS-11
SS-12
SS-10
SS-20
SS-13
SS-17
SS-14
SS-21
SS-15
SS-23
SS-16
SS-22
SS-18
SS-24

Scappoose Bay

Multnomah Channel

N

0 100 200 Feet

NOTE:
2018 Imagery provided by
Oregon Geospatial Enterprise Office.

LEGEND:

- Near-Surface Soil Sample
- Former Site Features
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland DNAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Former Transfer Table Dock
- Offshore Priority Action Area
- Upland Priority Action Area
- Milton Creek Exposure Unit
- Scappoose Bay Exposure Unit
- Area 1 Upland Groundwater Exposure Unit

LOCATIONS OF NEAR SURFACE SOIL SAMPLES

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		F-5

HUMAN HEALTH RISK ASSESSMENT (HHRA) CONCEPTUAL SITE MODEL (CSM)

PRIMARY SOURCE	PRIMARY RELEASE MECHANISM	SECONDARY SOURCE	SECONDARY RELEASE MECHANISM	PATHWAY	EXPOSURE ROUTE	ONSITE RECEPTORS – CURRENT/FUTURE: INDUSTRIAL WORKER	EXCAVATION WORKER	CONSTRUCTION WORKER	TRANSIENT / RECREATIONAL TRESPASSER [1] / ADULT BOATER [2]	SPORT FISHER
HISTORICAL INDUSTRIAL ACTIVITIES	RELEASES	SURFACE SOIL			INGESTION	●	●	●		
					DIRECT CONTACT	●	●	●		
					INHALATION (INDOOR & OUTDOOR AIR)	●	●	●		
			MIGRATION TO SURFACE WATER	FISH/SHELLFISH	INGESTION					●
		SUBSURFACE SOIL			INGESTION		●	●		
					DIRECT CONTACT		●	●		
					INHALATION (INDOOR & OUTDOOR AIR)	●	●	●		
		BEACH SOIL/SEDIMENT			INGESTION				●	●
					DIRECT CONTACT				●	●
					INHALATION (OUTDOOR AIR)				●	●
		SURFACE WATER DISCHARGE	MIGRATION TO SEDIMENT	FISH/SHELLFISH	INGESTION					●
		SHALLOW GROUNDWATER	VOC VOLATILIZATION	AIR	INHALATION (INDOOR & OUTDOOR)	●				
					DIRECT CONTACT		●	●		
			MIGRATION TO SURFACE WATER	FISH/SHELLFISH	INGESTION					●
					DIRECT CONTACT				●	
			MIGRATION TO SEDIMENT/SEDIMENT PORE WATER		DIRECT CONTACT				●	

LEGEND

● POTENTIALLY COMPLETE PATHWAY; QUANTITATIVE EVALUATION

——→ COMPLETE PATHWAY

- - - - - - - - INCOMPLETE PATHWAY

1 THE RECREATIONAL TRESPASSER IS AN OLDER CHILD AS DESCRIBED IN THE 2006 HHRA.

2 THE ADULT BOATER WOULD BE EXPOSED TO SEDIMENT AND SEDIMENT PORE WATER IN THE SAME MANNER AS THE OLDER CHILD RECREATIONAL TRESPASSER

HUMAN HEALTH RISK ASSESSMENT
CONCEPTUAL SITE MODEL

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

December 2019

FIGURE **F-6**

DRAWN BY: BRJ/SD CHECKED BY: -

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ATTACHMENT A

SAMPLE LIST

ANALYTICAL DATA TABLES FOR

GROUNDWATER AND SEDIMENT

APPENDIX F-A
Sample List

SEDIMENT SAMPLE LOCATIONS (1996 to 2013) (for discrete samples collected between 0-12 inches)				
MILTON CREEK EXPOSURE UNIT		**SCAPPOOSE BAY EXPOSURE UNIT**		
Sample Locations w/in Area of Inferred NAPL	**Sample Locations outside Area of Inferred NAPL**	**Sample Locations w/in Area of Inferred NAPL**	**Sample Locations outside Area of Inferred NAPL**	
PWS-14	MC-03	LSI-09	LSI-01	SD-104
PWS-29	MC-04	LSI-02	PWS-08	SD-104-A
SSED-MC-1	PWS-17	LSI-20	PWS-08	SD-104-B
SSED-MC-3	PWS-27	LSI-24	PWS-09	SD-104-C
SSED-MC-4	PWS-27	PWS-01	PWS-09	SD-105
	PWS-30	PWS-01	PWS-12	SD-105-A
	SD-MC-A	PWS-01	PWS-12	SD-105-B
	SD-MC-B	PWS-01	PWS-13	SD-105-C
	SD-MC-C	PWS-02	PWS-13	SD-106
	SD-MC-D	PWS-02	PWS-15	SD-108
	SD-MC-E	PWS-02	PWS-15	SD-110
		PWS-03	PWS-16	SD-112
		PWS-03	PWS-16	SD-112-A
		PWS-04	PWS-16B	SD-112-B
		PWS-04	PWS-22	SD-112-C
		PWS-07	PWS-25	SD-113
		PWS-07	PWS-25	SD-114
		PWS-10	PWS-26	SD-115
		PWS-10	PWS-26	SD-116
		PWS-11	PWS-28	SD-117
		PWS-11	SB-01	SD-117-A
		PWS-11B	SB-02	SD-117-B
		SB-05	SB-03	SD-117-C
		SB-10	SB-04	SD-119
		SB-11	SB-06	SD-119-A
		SB-14	SB-07	SD-119-B
		SB-15	SB-08	SD-119-C
		SB-16	SB-09	SD-120
		SB-18	SB-12	SD-121
		SB-23	SB-13	SD-122
		SD-107	SB-17	SD-123
		SD-109	SB-19	SD-124
		SD-111	SB-20	SD-125
		SD-118	SB-21	SD-126
		SD-129	SB-22	SD-127
		SD-138	SB-24	SD-128
		SHI-D3	SB-25	SD-130
		SHI-D4	SB-26	SD-131
		SHI-D5	SB-27	SD-132
		SSED-2	SB-28	SD-134
		SSED-5	SHI-D1	SD-133
		SSED-6	SHI-D2	SD-135
		SSED-7	SHI-D6	SD-136
		SSED-8	SD-100	SD-137
		SSED-9	SD-101	SD-139
		SD-142	SD-102	SD-140
			SD-103	SD-141
			SD-103-A	SD-143
			SD-103-B	SD-144
			SD-103-C	

GROUNDWATER SAMPLE LOCATIONS (2005 - 2012)
AREA 1 UPLAND GROUNDWATER EXPOSURE UNIT
MW-1
MW-2 (ABANDONED)
MW-2A
MW-3A
MW-3B
MW-4A
MW-4B
MW-5
MW-6A
MW-7
MW-8
MW-9
MW-10
MW-18
MW-19
MW-20
MW-21
MW-22
MW-23
MW-24
MW-25

Notes:

1. Some sediment sample locations are listed twice because samples were collected in July and October 2012.
2. PWS-01 and PWS-02 are listed three times under sediment because samples using this name were collected in July 2012, October 2012, and October 2013.
3. Inferred areas of NAPL are shown on Figures F-1, F-2, and F-3 by a solid or dashed red line, by the red-shaded areas, or the black stippled pattern that identifies the location of the former transfer table dock.

   The area of the former transfer table dock is conservatively being treated as if surficial wood-related NAPL is present throughout its footprint.

   No quantitative evaluation of sediment within areas of inferred NAPL was performed in the Supplemental HHRA because remedy is planned for these areas.
4. The groundwater data set is not segregated into "NAPL" and "non-NAPL" data sets because there is no groundwater treatment planned.

TABLE F-A1
Groundwater Analytical Results Summary - PAHs

Sample Location	Sample ID	Sample Date	Sample Type	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-1	MW-01_2005/12/14	12/14/2005	P	**267**	1.9 U	**9.9**	0.96 U	0.96 U	0.96 U	0.96 U	0.96 U	NR	0.96 U	1.9 U	**12**	**143**	0.96 U	**353**	**152**	**5.3**
MW-1	MW-01_2005/12/14-DUP	12/14/2005	FD	**278**	1.9 U	**10.5**	0.95 U	0.95 U	0.95 U	0.95 U	0.95 U	NR	0.95 U	1.9 U	**12**	**146**	0.95 U	**365**	**155**	**5.7**
MW-1	MW-01_2006/12/14	12/14/2006	P	**223**	**1.1 J**	**11**	0.59 U	0.41 U	0.49 U	0.53 U	0.53 U	NR	0.26 U	0.4 U	**14**	**129**	0.54 U	**115**	**162**	**5.8**
MW-1	MW-01_2006/12/14-DUP	12/14/2006	FD	**196**	**0.99 J**	**11**	0.59 U	0.41 U	0.49 U	0.53 U	0.53 U	NR	**0.39 J**	0.4 U	**13**	**112**	0.54 U	**97**	**138**	**5.6**
MW-1	MW-1-MID-20100908-N	9/8/2010	P	**160**	1.23 U	**8.94**	**0.126**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	**0.102**	0.0377 U	**9.88**	**97.7**	0.0377 U	**41.9**	**105**	**4.42**
MW-1	MW-1	8/9/2011	P	**141**	**1.16**	**10.1**	**0.218**	0.0404 U	NR	0.0404 U	NR	0.0808 U	**0.161**	0.0404 U	**12.0**	**92.8**	0.0404 U	**62.1**	**113**	**5.13**
MW-1	MW-1_022012	2/20/2012	P	**167**	1.87 U	**10.7**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**11.5**	**98.3**	1.87 U	**30.7 J**	**127**	**5.27**
MW-1	MW-1_050412	5/4/2012	P	**199**	1.89 U	**12.2**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**12**	**124**	1.89 U	**131**	**143**	**5.41**
MW-1	MW-1_081412	8/14/2012	P	**168**	1.87 U	**9.45**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**9.7**	**99**	1.87 U	**158**	**110**	**4.42**
MW-2	MW-02 _2005/12/15	12/14/2005	P	**277**	24 U	**12**	2.4 U	2.4 U	2.4 U	2.4 U	2.4 U	NR	2.4 U	2.4 U	**7.5**	**139**	2.4 U	**13400**	**105**	**4.14**
MW-2	MW-02 _2006/12/14	12/14/2006	P	**160**	**5.6**	**11**	**0.83 J**	0.2 U	0.25 U	0.26 U	0.27 U	NR	**0.49 J**	0.21 U	**6.6**	**167**	0.27 U	**7200**	**71**	**3.1**
MW-2A	MW-2A	8/9/2011	P	**254**	**5.32**	**14.1**	18.7 U	**0.367**	NR	0.187 U	NR	**0.714**	18.7 U	0.187 U	**19.6**	**170**	0.187 U	**5770**	**176**	**9.10**
MW-2A	MW-2A_022112	2/21/2012	P	**309**	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	NR	37.4 U	37.4 U	37.4 U	**175**	37.4 U	**10500 J**	**193**	37.4 U
MW-2A	MW-2A_050312	5/3/2012	P	**179**	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	NR	37.4 U	37.4 U	37.4 U	**108**	37.4 U	**6260**	**123**	37.4 U
MW-2A	MW-2A_081512	8/15/2012	P	**198**	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	NR	37.7 U	37.7 U	37.7 U	**120**	37.7 U	**6000**	**127**	37.7 U
MW-3A	MW-3A-20100908-N	9/8/2010	P	**740**	19.5 U	**207**	**78.0**	19.5 U	NR	19.5 U	NR	**44.6**	**68.7**	19.5 U	**565**	**601**	19.5 U	**22800**	**1340**	**323**
MW-3A	MW-3A	8/9/2011	P	**560**	**10.7**	**113**	**56.8**	**14.4**	NR	**3.10**	NR	**31.3**	**45.0**	**1.14**	**422**	**417**	**3.97**	**9470**	**898**	**218**
MW-3A	MW-3A_022112	2/21/2012	P	**661**	37.4 U	**127**	**56.2**	37.4 U	NR	37.4 U	NR	74.8 U	**41.6**	37.4 U	**332**	**431**	37.4 U	**13000 J**	**916**	**199**
MW-3A	MW-3A_050412	5/4/2012	P	**972**	**19.3**	**276**	**118**	**32.4**	NR	**7.42**	NR	**72.2**	**102**	**2.96**	**820**	**799**	**9.55**	**14700**	**1990**	**490**
MW-3A	MW-3A_081512	8/15/2012	P	**804**	37.7 U	**204**	**91**	37.7 U	NR	37.7 U	NR	75.5 U	**73.1**	37.7 U	**591**	**621**	37.7 U	**12400**	**1500**	**347**
MW-3B	MW-03B_2005/12/15	12/15/2005	P	**2.6**	0.24 U	**0.82**	**0.41 J**	0.24 U	0.24 U	0.24 U	0.24 U	NR	**0.44 J**	0.48 U	**2.9**	**2.1**	0.24 U	**80**	**6.1**	**1.9**
MW-3B	MW-03B_2006/12/14	12/14/2006	P	**1.4**	0.26 U	**0.79 J**	0.29 U	0.2 U	0.25 U	0.26 U	0.27 U	NR	0.13 U	0.21 U	**2**	**1.3**	0.27 U	**13**	**3.5**	**1.2**
MW-3B	MW-3B-20100908-N	9/8/2010	P	**0.974**	0.777 U	**0.898**	**0.828**	**0.284**	NR	**0.0851**	NR	**0.526**	**0.735**	0.0388 U	**2.76**	0.777 U	**0.114**	**67.2**	**2.24**	**1.84**
MW-3B	MW-3B	8/9/2011	P	**0.247 J**	0.0377 UJ	**0.422 J**	**0.111 J**	**0.0473 J**	NR	0.0377 UJ	NR	**0.0819 J**	**0.0900 J**	0.0377 UJ	**0.422 J**	**0.178 J**	0.0377 UJ	**6.83 J**	**0.436 J**	**0.268 J**
MW-3B	MW-3B_022112	2/21/2012	P	**0.344**	0.189 U	**0.715**	**0.242**	0.189 U	NR	0.189 U	NR	0.377 U	0.189 U	0.189 U	**1.34**	**0.273**	0.189 U	**10.5 J**	**1.37**	**0.789**
MW-3B	MW-3B_050412	5/4/2012	P	**1.37**	0.187 U	**0.567**	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	NR	0.187 U	0.187 U	**1.13**	**1.09**	0.187 U	**2.99**	**2.59**	**0.766**
MW-3B	MW-3B_081512	8/15/2012	P	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	NR	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	**0.515**	0.187 U	0.187 U
MW-4A	MW-04A_2005/12/14	12/14/2005	P	**5**	0.048 U	**0.085 J**	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	NR	0.048 U	0.048 U	**0.42**	**3.2**	0.048 U	**2.3**	**0.4**	**0.25**
MW-4A	MW-04A_2006/12/14	12/14/2006	P	**4.4**	**0.024 J**	**0.066**	0.015 U	0.01 U	0.012 U	0.013 U	0.013 U	NR	**0.0068 J**	0.011 U	**0.34**	**3.1**	0.014 U	**1.7**	**0.085**	**0.17**
MW-4A	MW-4A-20100907-N	9/7/2010	P	**7.73**	0.0381 U	**0.0900**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	**0.403**	**3.27**	0.0381 U	**0.0850**	**0.0542**	**0.194**
MW-4A	MW-4A-20100907-ED	9/7/2010	FD	**12.0**	0.0571 U	**0.170**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	**0.501**	**4.87**	0.0381 U	**0.133**	**0.100**	**0.240**
MW-4A	MW-4A	8/8/2011	P	**4.91**	0.0377 U	**0.141**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	0.0377 U	0.0377 U	**0.269**	**1.77**	0.0377 U	**1.60**	**0.111**	**0.145**
MW-4A	MW-4A_022112	2/21/2012	P	**12.7**	0.377 U	0.377 U	0.377 U	0.377 U	0.377 U	0.377 U	0.377 U	NR	0.377 U	0.377 U	**0.412**	**4.46**	0.377 U	**4.26 J**	**0.423**	0.377 U
MW-4A	MW-4A_050412	5/4/2012	P	**9.65**	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	NR	0.374 U	0.374 U	0.374 U	**3.68**	0.374 U	**0.82**	0.374 U	0.374 U
MW-4A	MW-4A_081512	8/15/2012	P	**8.27**	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	0.374 U	NR	0.374 U	0.374 U	0.374 U	**3.32**	0.374 U	**1.05**	0.374 U	0.374 U
MW-4B	MW-4B-20100907-N	9/7/2010	P	**0.250**	0.0381 U	**0.0783**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	**0.0895**	**0.131**	0.0381 U	**0.0979**	**0.0644**	**0.0513**
MW-4B	MW-4B	8/8/2011	P	**0.230 J**	0.0374 UJ	**0.160 J**	**0.0454 J**	0.0374 UJ	0.0374 UJ	0.0374 UJ	0.0374 UJ	NR	0.0374 UJ	0.0374 UJ	**0.317 J**	**0.145 J**	0.0374 UJ	**0.301 J**	**0.195 J**	**0.182 J**
MW-4B	MW-4B_022112	2/21/2012	P	**0.0478**	0.0377 U	**0.0435**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	**1.85 J**	**0.0379**	0.0377 U
MW-4B	MW-4B_050412	5/4/2012	P	0.0374 U	0.0374 U	**0.0396**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	**0.316**	0.0374 U	0.0374 U
MW-4B	MW-4B_081512	8/15/2012	P	**0.0905**	0.0392 U	**0.0657**	0.0392 U	0.0392 U	0.0392 U	0.0392 U	0.0392 U	NR	0.0392 U	0.0392 U	0.0392 U	**0.0564**	0.0392 U	**1.17**	**0.0443**	0.0392 U
MW-5	MW-05_2005/12/14	12/14/2005	P	**0.59**	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U	NR	0.048 U	0.096 U	**0.058 J**	**0.082 J**	0.048 U	0.048 U	0.048 U	**0.12**
MW-5	MW-05_2006/12/14	12/14/2006	P	**0.057**	0.013 U	0.012 U	0.015 U	0.01 U	0.012 U	0.013 U	0.013 U	NR	0.0065 U	0.011 U	0.0078 U	**0.045 J**	0.014 U	0.12 U	0.032 U	**0.013**
MW-5	MW-5-20100907-N	9/7/2010	P	**0.134**	0.0374 U	**0.0605**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	**0.0580**	**0.0850**	0.0374 U	**0.122**	**0.0816**	**0.0753**
MW-5	MW-5	8/8/2011	P	0.0374 U	0.0374 U	**0.101**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	**0.130**	0.0374 U	0.0374 U
MW-5	MW-5_022112	2/21/2012	P	**0.179**	0.0374 U	**0.136**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	**0.0405**	**0.132**	0.0374 U	**1.45 J**	**0.218**	0.0374 U
MW-5	MW-5_050412	5/4/2012	P	**0.0864**	0.0381 U	**0.0535**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	**3.57**	0.0381 U	0.0381 U
MW-5	MW-5_081512	8/15/2012	P	**0.0541**	0.0374 U	**0.0803**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	**2.13**	0.0374 U	0.0374 U

TABLE F-A1
Groundwater Analytical Results Summary - PAHs

Sample Location	Sample ID	Sample Date	Sample Type	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-6A	MW-06A_2005/12/15	12/15/2005	P	**220**	0.96 U	**6.4**	0.96 U	0.96 U	0.96 U	0.96 U	0.96 U	NR	0.96 U	1.9 U	**6.4**	**102**	0.96 U	**187**	**58**	**3.7**
MW-6A	MW-06A_2006/12/14	12/14/2006	P	**235**	**1.7 J**	**6.5**	0.74 U	0.51 U	0.62 U	0.66 U	0.67 U	NR	0.33 U	0.54 U	**6.4**	**108**	0.68 U	**610**	**59**	**2.9**
MW-6A	MW-6A-20100908-N	9/8/2010	P	**90.2**	**1.00**	**3.59**	**0.228**	**0.0621**	NR	0.0421 U	NR	0.0947 U	**0.173**	0.0421 U	**4.24**	**43.7**	0.0421 U	**46.1**	**28.9**	**2.10**
MW-6A	MW-6A	8/9/2011	P	**114 J**	**1.05 J**	**6.71 J**	**0.115 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	NR	**0.116 J**	0.0400 UJ	**4.92 J**	**69.8 J**	0.0400 UJ	**194 J**	**62.3 J**	**2.65 J**
MW-6A	MW-6A_022112	2/21/2012	P	**244**	3.77 U	**8.63**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	**5.18**	**106**	3.77 U	**331 J**	**72.3**	3.77 U
MW-6A	MW-6A_050312	5/3/2012	P	**195**	3.74 U	**6.63**	3.74 U	3.74 U	3.74 U	3.74 U	3.74 U	NR	3.74 U	3.74 U	**4.16**	**88**	3.74 U	**305**	**53.1**	3.74 U
MW-6A	MW-6A_08142012	8/14/2012	P	**158**	3.77 U	**7.01**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	**5.3**	**84.5**	3.77 U	**175**	**59.2**	3.77 U
MW-7	MW-07_2006/12/13	12/13/2006	P	**0.077 J**	**0.018**	**0.067**	0.015 U	0.01 U	0.012 U	0.013 U	0.013 U	NR	0.044 U	0.011 U	**0.04 J**	0.028 U	0.014 U	0.12 U	0.032 U	**0.037 J**
MW-7	MW-7_050312	5/3/2012	P	**0.548**	0.0381 U	**0.312**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	0.0381 U	**0.1**	0.0381 U	**1.95**	0.0381 U	0.0381 U
MW-9	MW-09_2005/12/14	12/14/2005	P	**126**	0.571 U	**5.1**	**0.22**	0.0476 U	0.0476 U	0.0476 U	0.0476 U	NR	**0.17**	0.0952 U	**13**	**58**	0.0476 U	**2**	**22**	**5.2**
MW-9	MW-09_2006/12/14	12/14/2006	P	**85**	**0.31**	**3.8**	**0.13**	0.01 U	0.012 U	0.013 U	**0.013**	NR	**0.1**	0.011 U	**8.1**	**38**	0.014 U	**2**	**14**	**3.2**
MW-9	MW-9-20100907-N	9/7/2010	P	**56.4 J**	0.374 UJ	**4.01 J**	0.374 UJ	0.374 UJ	0.374 UJ	0.374 UJ	0.374 UJ	NR	0.374 UJ	0.374 UJ	**6.64 J**	**29.4 J**	0.374 UJ	**40.7 J**	**18.0 J**	**2.87 J**
MW-9	MW-9	8/8/2011	P	**87.3**	**0.488**	**6.42**	**0.131**	0.0377 U	NR	0.0377 U	NR	0.0755 U	**0.0805**	0.0377 U	**8.10**	**47.7**	0.0377 U	**63.6**	**27.4**	**3.18**
MW-9	MW-9_022012	2/20/2012	P	**131**	**0.801**	**7.6**	**0.136**	0.0374 U	NR	0.0374 U	NR	0.0748 U	**0.0907**	0.0374 U	**8.66**	**62.3**	0.0374 U	**53.3**	**32.8**	**3.48**
MW-9	MW-9_050312	5/3/2012	P	**109**	1.87 U	**6.55**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**7.74**	**55.4**	1.87 U	**14.5**	**28.6**	**3.08**
MW-9	MW-9_08142012	8/14/2012	P	**109**	0.589 U	**6.66**	**0.121**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	**0.0884**	0.0374 U	**8.35**	**60**	0.0374 U	**3.44**	**30.5**	**3.55**
MW-10	MW-10_2005/12/14	12/14/2005	P	**9.9**	0.0476 U	**0.65**	**0.45**	0.0476 U	**0.0708 J**	0.048 U	**0.08**	NR	**0.4**	0.0952 U	**7**	**3.8**	0.0476 U	0.0952 U	**0.82**	**4.7**
MW-10	MW-10_2006/12/13	12/13/2006	P	**23**	**0.066**	**0.81**	**0.64**	**0.15**	**0.22**	**0.025 J**	**0.17**	NR	**0.58**	0.011 U	**5.5**	**9.5**	**0.08**	**0.14**	**2.2**	**3.6**
MW-10	MW-10-20100907-N	9/7/2010	P	**10.0**	**0.121**	**2.11**	**1.73**	**0.350**	NR	**0.0942**	NR	**0.683**	**1.27**	0.0377 U	**13.5**	**5.52**	**0.113**	**0.0773 J**	**4.60**	**8.96**
MW-10	MW-10	8/8/2011	P	**66.7**	**0.375**	**2.77**	**0.308**	**0.0492**	NR	0.0374 U	NR	**0.0930**	**0.214**	0.0374 U	**5.79**	**32.7**	0.0374 U	**0.444**	**16.8**	**3.19**
MW-10	MW-10_022012	2/20/2012	P	**65.7**	0.374 U	**2.88**	**0.427**	0.374 U	0.374 U	0.374 U	0.374 U	NR	0.374 U	0.374 U	**7.09**	**27**	0.374 U	**0.906 J**	**10.9**	**4.07**
MW-10	MW-10_050312	5/3/2012	P	**146**	**1.06**	**4.51**	0.762 U	0.762 U	0.762 U	0.762 U	0.762 U	NR	0.762 U	0.762 U	**9.35**	**72.4**	0.762 U	1.52 U	**34.8**	**5.15**
MW-10	MW-10_08142012	8/14/2012	P	**86.8**	0.755 U	**4.25**	0.755 U	0.755 U	0.755 U	0.755 U	0.755 U	NR	0.755 U	0.755 U	**9.13**	**47**	0.755 U	**2.38**	**25.3**	**5.26**
MW-18	MW-18_2006/12/13	12/13/2006	P	0.013 U	0.013 U	**0.014 J**	0.015 U	0.01 U	0.012 U	0.013 U	0.013 U	NR	0.0065 U	0.011 U	0.0078 U	0.028 U	0.014 U	0.12 U	0.032 U	0.013 U
MW-18	MW-18-20100907-N	9/7/2010	P	0.0381 U	0.0381 U	**0.0451**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0762 U	0.0381 U	0.0381 U
MW-18	MW-18	8/8/2011	P	**0.0617**	0.0377 U	**0.196**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0755 U	0.0377 U	0.0377 U
MW-18	MW-18 DUP	8/8/2011	FD	0.0374 U	0.0374 U	**0.209**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0748 U	0.0374 U	0.0374 U
MW-18	MW-18_022012	2/20/2012	P	0.0377 U	0.0377 U	**0.226**	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	NR	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0377 U	0.0755 U	0.0377 U	0.0377 U
MW-18	MW-18_050312	5/3/2012	P	0.0374 U	0.0374 U	**0.161**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0748 U	0.0374 U	0.0374 U
MW-18	MW-18_08142012	8/14/2012	P	0.0374 U	0.0374 U	**0.233**	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	NR	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0374 U	0.0748 U	0.0374 U	0.0374 U
MW-19	MW-19	8/8/2011	P	**128 J**	**2.95 J**	**8.51 J**	**2.07 J**	**0.447 J**	NR	**0.0906 J**	NR	**1.00 J**	**1.69 J**	0.0408 UJ	**16.0 J**	**83.1 J**	**0.119 J**	**4710 J**	**102 J**	**7.58 J**
MW-19	MW-19_022112	2/21/2012	P	**108**	**2.21**	**8.22**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**9.55**	**71.1**	1.89 U	**864 J**	**82.3**	**4.77**
MW-19	MW-19_050412	5/4/2012	P	**166**	7.84 U	**9.68**	7.84 U	7.84 U	7.84 U	7.84 U	7.84 U	NR	7.84 U	7.84 U	**8.69**	**96.6**	7.84 U	**2300**	**98.1**	7.84 U
MW-19	MW-19_081412	8/14/2012	P	**175**	7.48 U	**11.5**	7.48 U	7.48 U	7.48 U	7.48 U	7.48 U	NR	7.48 U	7.48 U	**7.95**	**105**	7.48 U	**1710**	**88.6**	7.48 U
MW-20	MW-20	8/8/2011	P	**24.8 J**	**0.403 J**	**3.10 J**	**0.125 J**	0.0421 UJ	NR	0.0421 UJ	NR	0.0842 UJ	**0.124 J**	0.0421 UJ	**2.54 J**	**19.2 J**	0.0421 UJ	**7.84 J**	**24.7 J**	**1.25 J**
MW-20	MW-20_022112	2/21/2012	P	**11.2**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	3.77 U	**4.78**	3.77 U	**95 J**	**10.2**	3.77 U
MW-20	MW-20_050412	5/4/2012	P	**19.1**	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	1.9 U	NR	1.9 U	1.9 U	1.9 U	**7.75**	1.9 U	**217**	**11.2**	1.9 U
MW-20	MW-20_081512	8/15/2012	P	**7.34**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	1.89 U	**2.8**	1.89 U	**6.53**	**3.07**	1.89 U
MW-21	MW-21	8/9/2011	P	**89.0 J**	**0.471 J**	**2.59 J**	**0.447 J**	**0.106 J**	NR	0.0374 UJ	NR	**0.229 J**	**0.372 J**	0.0374 UJ	**4.06 J**	**50.5 J**	0.0374 UJ	**109 J**	**30.6 J**	**1.88 J**
MW-21	MW-21_022112	2/21/2012	P	**89.2**	1.89 U	**7.77**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**7.61**	**64.1**	1.89 U	**26.7 J**	**87.1**	**2.94**
MW-21	MW-21_050412	5/4/2012	P	**110**	1.87 U	**10.3**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**9.06**	**82.9**	1.87 U	**28.3**	**104**	**3.52**
MW-21	MW-21_081512	8/15/2012	P	**56.1**	1.96 U	**7.53**	1.96 U	1.96 U	1.96 U	1.96 U	1.96 U	NR	1.96 U	1.96 U	**8.57**	**41.7**	1.96 U	**13.4**	**55.1**	**3.55**
MW-22	MW-22	8/9/2011	P	**127**	**5.59**	**7.85**	**0.590**	0.189 U	NR	0.189 U	NR	0.377 U	**0.433**	0.189 U	**5.44**	**58.9**	0.189 U	**9670**	**44.6**	**2.76**
MW-22	MW-22_022012	2/20/2012	P	**294**	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	NR	37.7 U	37.7 U	37.7 U	**125**	37.7 U	**21100 J**	**126**	37.7 U
MW-22	MW-22-DUP_022012	2/20/2012	FD	**340**	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	37.7 U	NR	37.7 U	37.7 U	37.7 U	**141**	37.7 U	**21700 J**	**136**	37.7 U
MW-22	MW-22_050412	5/4/2012	P	**214**	76.2 U	76.2 U	76.2 U	76.2 U	76.2 U	76.2 U	76.2 U	NR	76.2 U	76.2 U	76.2 U	**92.1**	76.2 U	**11600**	76.2 U	76.2 U
MW-22	MW-22DUP_050412	5/4/2012	FD	**239**	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	NR	75.5 U	75.5 U	75.5 U	**102**	75.5 U	**12800**	**87.5**	75.5 U
MW-22	MW-22_081512	8/15/2012	P	**285 J**	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	NR	75.5 U	75.5 U	**88.7**	**163**	75.5 U	**9020**	**307 J**	75.5 U
MW-22	MW-22DUP_081512	8/15/2012	FD	**202 J**	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	75.5 U	NR	75.5 U	75.5 U	75.5 U	**110**	75.5 U	**8060**	**197 J**	75.5 U

TABLE F-A1
Groundwater Analytical Results Summary - PAHs

Sample Location	Sample ID	Sample Date	Sample Type	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-23	MW-23	8/9/2011	P	**81.3**	**0.470**	**9.70**	**0.618**	**0.0917 J**	NR	0.0374 U	NR	**0.179 J**	**0.457**	0.0374 U	**15.7**	**57.0**	0.0374 U	**0.894 J**	**89.3**	**9.26**
MW-23	MW-23 DUP	8/9/2011	FD	**83.5**	**0.483**	**9.54**	**0.734**	**0.130 J**	NR	0.0374 U	NR	**0.261 J**	**0.538**	0.0374 U	**15.6**	**57.5**	0.0374 U	**2.25 J**	**87.2**	**9.48**
MW-23	MW-23_022012	2/20/2012	P	**109**	1.87 U	**10.8**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**17.1**	**73.4**	1.87 U	3.74 U	**104**	**9.12**
MW-23	MW-23DUP_022012	2/20/2012	FD	**97.5**	1.87 U	**9.82**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**16.7**	**67.2**	1.87 U	3.74 U	**92.4**	**8.92**
MW-23	MW-23_050312	5/3/2012	P	**75.5**	1.87 U	**10.1**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**14.5**	**55.2**	1.87 U	3.74 U	**81.8 J**	**7.45**
MW-23	MW-23DUP_050312	5/3/2012	FD	**63.9**	1.89 U	**8.34**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**12.7**	**46.6**	1.89 U	3.77 U	**51.6 J**	**6.56**
MW-23	MW-23_08142012	8/14/2012	P	**85.7**	0.523 U	**7.76**	**0.479**	**0.0379**	NR	0.0374 U	NR	**0.0947**	**0.385**	0.0374 U	**13**	**61.2**	0.0374 U	**0.446**	**66.8**	**7.01**
MW-23	MW-23DUP_08142012	8/14/2012	FD	**85.6**	1.87 U	**10.8**	1.87 U	1.87 U	1.87 U	1.87 U	1.87 U	NR	1.87 U	1.87 U	**14.5**	**64.2**	1.87 U	3.74 U	**72.3**	**7.66**
MW-24	MW-24	8/9/2011	P	**205**	**2.63**	**10.3**	**2.63**	**1.04**	NR	**0.266**	NR	**1.97**	**2.32**	**0.0932**	38.5 U	**93.8**	**0.324**	**5280**	**113**	**12.4**
MW-24	MW-24_022112	2/21/2012	P	**318**	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	NR	37.4 U	37.4 U	37.4 U	**125**	37.4 U	**8710 J**	**143**	37.4 U
MW-24	MW-24_050312	5/3/2012	P	**149**	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	37.4 U	NR	37.4 U	37.4 U	37.4 U	**60.1**	37.4 U	**4140**	**54.7**	37.4 U
MW-24	MW-24_08142012	8/14/2012	P	**138**	38.8 U	38.8 U	38.8 U	38.8 U	38.8 U	38.8 U	38.8 U	NR	38.8 U	38.8 U	38.8 U	**61.6**	38.8 U	**3180**	**46.2**	38.8 U
MW-25	MW-25	8/9/2011	P	**92.5 J**	**1.38 J**	**8.09 J**	**0.417 J**	**0.112 J**	NR	0.0404 UJ	NR	**0.208 J**	**0.353 J**	0.0404 UJ	**8.52 J**	**66.4 J**	0.0404 UJ	**651 J**	**95.2 J**	**4.10 J**
MW-25	MW-25_022112	2/21/2012	P	**188**	**10.3**	**13.8**	3.88 U	3.88 U	3.88 U	3.88 U	3.88 U	NR	3.88 U	3.88 U	**28.7**	**114**	3.88 U	**1220 J**	**143**	**15.5**
MW-25	MW-25_050312	5/3/2012	P	**96.3**	7.77 U	**9.96**	**8.44**	7.77 U	7.77 U	7.77 U	7.77 U	NR	7.77 U	7.77 U	**53.7**	**61**	7.77 U	**811**	**87.8**	**31.2**
MW-25	MW-25_08142012	8/14/2012	P	**79.4**	7.55 U	**7.61**	7.55 U	7.55 U	7.55 U	7.55 U	7.55 U	NR	7.55 U	7.55 U	**20.2**	**51.6**	7.55 U	**1350**	**52.9**	**11.7**

Acronyms/Abbreviations
µg/L = micrograms per liter
EPA = United States Environmental Protection Agency
FD = field duplicate
J = estimated result
NR = not reported
P = primary sample
PAHs = polycyclic aromatic hydrocarbons
U = not detected at or above the stated level
UJ = not detected at or above the stated level, which is an approximate value

Notes:
BOLD indicates analyte was detected at or above the reporting limit
Data reported to reporting limit
PAHs were analyzed using EPA Method 8270, 8270C-SIM or 8270D-SIM.

TABLE F-A2
Groundwater Analytical Results Summary- TPH and BTEX

Sample Location	Sample ID	Sample Date	Sample Type	Diesel Range Organics	Gasoline Range Hydrocarbons	Residual Range Hydrocarbons	Benzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Total Xylene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-1	MW-01_2005/12/14	12/14/2005	P	NT	NT	NT	**1.95**	**37.4**	**0.94**	NT	NT	**13.8**
MW-1	MW-01_2005/12/14-DUP	12/14/2005	FD	NT	NT	NT	**2.16**	**42.8**	**1.02**	NT	NT	**16.8**
MW-1	MW-01_2006/12/14	12/14/2006	P	NT	NT	NT	**1.8**	**32**	**1.1**	NT	NT	**12**
MW-1	MW-01_2006/12/14-DUP	12/14/2006	FD	NT	NT	NT	**1.9**	**32**	**1.1**	NT	NT	**13**
MW-1	MW-1-MID-20100908-N	9/8/2010	P	**4080 N**	**3640 N**	4670 U	**3.80**	**50.0**	5.00 U	**5.00**	**11.2**	NT
MW-1	MW-1	8/9/2011	P	**4480 N**	NT	472 U	NT	NT	NT	NT	NT	NT
MW-1	MW-1_022012	2/20/2012	P	**4560 N**	NT	**519 N**	NT	NT	NT	NT	NT	NT
MW-1	MW-1_050412	5/4/2012	P	**5370 N**	NT	755 U	NT	NT	NT	NT	NT	NT
MW-1	MW-1_081412	8/14/2012	P	**8490 N**	NT	**503 N**	NT	NT	NT	NT	NT	NT
MW-2	MW-02 _2005/12/15	12/14/2005	P	NT	NT	NT	**32**	**254**	**82**	NT	NT	**519**
MW-2	MW-02 _2006/12/14	12/14/2006	P	NT	NT	NT	**26**	**214**	**49**	NT	NT	**392**
MW-2A	MW-2A	8/9/2011	P	**26100 N**	NT	9900 U	NT	NT	NT	NT	NT	NT
MW-2A	MW-2A_022112	2/21/2012	P	**76300 N**	NT	2990 U	NT	NT	NT	NT	NT	NT
MW-2A	MW-2A_050312	5/3/2012	P	**81100 N**	NT	**3810 N**	NT	NT	NT	NT	NT	NT
MW-2A	MW-2A_081512	8/15/2012	P	**89900 N**	NT	1510 U	NT	NT	NT	NT	NT	NT
MW-3A	MW-3A-20100908-N	9/8/2010	P	**374000 N**	**28500 N**	**103000 N**	**48.0**	**146**	**132**	**178**	**97.5**	NT
MW-3A	MW-3A	8/9/2011	P	**57100 N**	NT	10100 U	NT	NT	NT	NT	NT	NT
MW-3A	MW-3A_022112	2/21/2012	P	**49100 N**	NT	**3260 N**	NT	NT	NT	NT	NT	NT
MW-3A	MW-3A_050412	5/4/2012	P	**113000 N**	NT	15000 U	NT	NT	NT	NT	NT	NT
MW-3A	MW-3A_081512	8/15/2012	P	**116000 N**	NT	3020 U	NT	NT	NT	NT	NT	NT
MW-3B	MW-03B_2005/12/15	12/15/2005	P	NT	NT	NT	**0.68**	**1.13**	**0.52**	NT	NT	**0.79 J**
MW-3B	MW-03B_2006/12/14	12/14/2006	P	NT	NT	NT	0.11 U	0.11 U	0.084 U	NT	NT	0.24 U
MW-3B	MW-3B-20100908-N	9/8/2010	P	**1720 N**	**789 N**	467 U	**3.76**	**6.58**	**3.10**	**5.36**	**4.58**	NT
MW-3B	MW-3B	8/9/2011	P	236 U	NT	472 U	NT	NT	NT	NT	NT	NT
MW-3B	MW-3B_022112	2/21/2012	P	**349 N**	NT	377 U	NT	NT	NT	NT	NT	NT
MW-3B	MW-3B_050412	5/4/2012	P	187 U	NT	**394**	NT	NT	NT	NT	NT	NT
MW-3B	MW-3B_081512	8/15/2012	P	**732**	NT	374 U	NT	NT	NT	NT	NT	NT
MW-4A	MW-04A_2005/12/14	12/14/2005	P	NT	NT	NT	0.15 U	0.11 U	0.16 U	NT	NT	0.26 U
MW-4A	MW-04A_2006/12/14	12/14/2006	P	NT	NT	NT	0.11 U	0.11 U	0.084 U	NT	NT	0.24 U
MW-4A	MW-4A-20100907-N	9/7/2010	P	239 U	100 U	478 U	0.250 U	0.500 U	1.00 U	1.00 U	0.500 U	NT
MW-4A	MW-4A-20100907-ED	9/7/2010	FD	239 U	100 U	478 U	0.250 U	0.500 U	1.00 U	1.00 U	0.500 U	NT
MW-4A	MW-4A	8/8/2011	P	236 U	NT	472 U	NT	NT	NT	NT	NT	NT
MW-4A	MW-4A_022112	2/21/2012	P	**287 N**	NT	**391 N**	NT	NT	NT	NT	NT	NT
MW-4A	MW-4A_050412	5/4/2012	P	**238 N**	NT	**530**	NT	NT	NT	NT	NT	NT
MW-4A	MW-4A_081512	8/15/2012	P	**191 N**	NT	374 U	NT	NT	NT	NT	NT	NT
MW-4B	MW-4B-20100907-N	9/7/2010	P	239 U	100 U	478 U	0.250 U	0.500 U	1.00 U	1.00 U	0.500 U	NT
MW-4B	MW-4B	8/8/2011	P	236 U	NT	472 U	NT	NT	NT	NT	NT	NT
MW-4B	MW-4B_022112	2/21/2012	P	189 U	NT	377 U	NT	NT	NT	NT	NT	NT
MW-4B	MW-4B_050412	5/4/2012	P	187 U	NT	374 U	NT	NT	NT	NT	NT	NT
MW-4B	MW-4B_081512	8/15/2012	P	196 U	NT	392 U	NT	NT	NT	NT	NT	NT
MW-5	MW-05_2005/12/14	12/14/2005	P	NT	NT	NT	0.15 U	0.11 U	0.155 U	NT	NT	0.26 U
MW-5	MW-05_2006/12/14	12/14/2006	P	NT	NT	NT	0.11 U	0.11 U	0.084 U	NT	NT	0.24 U
MW-5	MW-5-20100907-N	9/7/2010	P	236 U	100 U	472 U	0.250 U	0.500 U	1.00 U	1.00 U	0.500 U	NT
MW-5	MW-5	8/8/2011	P	238 U	NT	476 U	NT	NT	NT	NT	NT	NT
MW-5	MW-5_022112	2/21/2012	P	187 U	NT	374 U	NT	NT	NT	NT	NT	NT
MW-5	MW-5_050412	5/4/2012	P	190 U	NT	**477**	NT	NT	NT	NT	NT	NT
MW-5	MW-5_081512	8/15/2012	P	187 U	NT	374 U	NT	NT	NT	NT	NT	NT

TABLE F-A2
Groundwater Analytical Results Summary- TPH and BTEX

Sample Location	Sample ID	Sample Date	Sample Type	Diesel Range Organics	Gasoline Range Hydrocarbons	Residual Range Hydrocarbons	Benzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Total Xylene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-6A	MW-06A_2005/12/15	12/15/2005	P	NT	NT	NT	**3.2**	**66**	**3.9**	NT	NT	**34**
MW-6A	MW-06A_2006/12/14	12/14/2006	P	NT	NT	NT	**5.2**	**108**	**6.5**	NT	NT	**67**
MW-6A	MW-6A-20100908-N	9/8/2010	P	**4110 N**	**4790 N**	4670 U	**3.20**	**78.8**	5.00 U	**9.85**	**32.2**	NT
MW-6A	MW-6A	8/9/2011	P	**4280 N**	NT	2550 U	NT	NT	NT	NT	NT	NT
MW-6A	MW-6A_022112	2/21/2012	P	**7690 N**	NT	755 U	NT	NT	NT	NT	NT	NT
MW-6A	MW-6A_050312	5/3/2012	P	**8300 N**	NT	**723 NJ**	NT	NT	NT	NT	NT	NT
MW-6A	MW-6A_08142012	8/14/2012	P	**8450 N**	NT	**868 N**	NT	NT	NT	NT	NT	NT
MW-7	MW-07_2006/12/13	12/13/2006	P	NT	NT	NT	NT	NT	NT	NT	NT	NT
MW-7	MW-07_2007/01/23	1/23/2007	P	NT	NT	NT	0.11 U	0.11 U	0.084 U	NT	NT	0.24 U
MW-7	MW-7_050312	5/3/2012	P	190 U	NT	381 U	NT	NT	NT	NT	NT	NT
MW-9	MW-09_2005/12/14	12/14/2005	P	NT	NT	NT	**0.17 J**	**1.9**	0.52 U	NT	NT	**2.4**
MW-9	MW-09_2006/12/14	12/14/2006	P	NT	NT	NT	**0.23 J**	**2.3**	**0.58**	NT	NT	**2.9**
MW-9	MW-9-20100907-N	9/7/2010	P	**2250 N**	**2100**	467 U	**0.360**	**29.5**	**4.93**	**22.8**	**15.0**	NT
MW-9	MW-9	8/8/2011	P	**1520 N**	NT	467 U	NT	NT	NT	NT	NT	NT
MW-9	MW-9_022012	2/20/2012	P	**2550 N**	NT	755 U	NT	NT	NT	NT	NT	NT
MW-9	MW-9_050312	5/3/2012	P	**2180 N**	NT	374 U	NT	NT	NT	NT	NT	NT
MW-9	MW-9_08142012	8/14/2012	P	**2340 N**	NT	374 U	NT	NT	NT	NT	NT	NT
MW-10	MW-10_2005/12/14	12/14/2005	P	NT	NT	NT	0.15 U	0.11 U	0.16 U	NT	NT	0.26 U
MW-10	MW-10_2006/12/13	12/13/2006	P	NT	NT	NT	0.11 U	0.11 U	0.084 U	NT	NT	0.24 U
MW-10	MW-10-20100907-N	9/7/2010	P	**288 N**	100 U	476 U	0.250 U	0.500 U	1.00 U	1.00 U	0.500 U	NT
MW-10	MW-10	8/8/2011	P	**730 N**	NT	467 U	NT	NT	NT	NT	NT	NT
MW-10	MW-10_022012	2/20/2012	P	**771 N**	NT	374 U	NT	NT	NT	NT	NT	NT
MW-10	MW-10_050312	5/3/2012	P	**1450 N**	NT	381 U	NT	NT	NT	NT	NT	NT
MW-10	MW-10_08142012	8/14/2012	P	**1030 N**	NT	385 U	NT	NT	NT	NT	NT	NT
MW-18	MW-18_2006/12/13	12/13/2006	P	NT	NT	NT	0.11 U	0.11 U	0.084 U	NT	NT	0.24 U
MW-18	MW-18-20100907-N	9/7/2010	P	238 U	100 U	476 U	0.250 U	0.500 U	1.00 U	1.00 U	0.500 U	NT
MW-18	MW-18	8/8/2011	P	234 U	NT	467 U	NT	NT	NT	NT	NT	NT
MW-18	MW-18_022012	2/20/2012	P	187 U	NT	374 U	NT	NT	NT	NT	NT	NT
MW-18	MW-18_050312	5/3/2012	P	187 U	NT	374 U	NT	NT	NT	NT	NT	NT
MW-18	MW-18_08142012	8/14/2012	P	187 U	NT	374 U	NT	NT	NT	NT	NT	NT
MW-19	MW-19	8/8/2011	P	**12500 N**	NT	10100 U	NT	NT	NT	NT	NT	NT
MW-19	MW-19_022112	2/21/2012	P	**3660 N**	NT	755 U	NT	NT	NT	NT	NT	NT
MW-19	MW-19_050412	5/4/2012	P	**7640 N**	NT	784 U	NT	NT	NT	NT	NT	NT
MW-19	MW-19_081412	8/14/2012	P	**7490 N**	NT	377 U	NT	NT	NT	NT	NT	NT

TABLE F-A2
Groundwater Analytical Results Summary- TPH and BTEX

Sample Location	Sample ID	Sample Date	Sample Type	Diesel Range Organics	Gasoline Range Hydrocarbons	Residual Range Hydrocarbons	Benzene	Ethylbenzene	Toluene	m,p-Xylene	o-Xylene	Total Xylene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-20	MW-20	8/8/2011	P	**870 N**	NT	495 U	NT	NT	NT	NT	NT	NT
MW-20	MW-20_022112	2/21/2012	P	**657 N**	NT	377 U	NT	NT	NT	NT	NT	NT
MW-20	MW-20_050412	5/4/2012	P	**1180 N**	NT	762 U	NT	NT	NT	NT	NT	NT
MW-20	MW-20_081512	8/15/2012	P	**385 N**	NT	377 U	NT	NT	NT	NT	NT	NT
MW-21	MW-21	8/9/2011	P	**3650 N**	NT	467 U	NT	NT	NT	NT	NT	NT
MW-21	MW-21_022112	2/21/2012	P	**1380 N**	NT	377 U	NT	NT	NT	NT	NT	NT
MW-21	MW-21_050412	5/4/2012	P	**1690 N**	NT	374 U	NT	NT	NT	NT	NT	NT
MW-21	MW-21_081512	8/15/2012	P	**3030 N**	NT	377 U	NT	NT	NT	NT	NT	NT
MW-22	MW-22	8/9/2011	P	**23800 N**	NT	9350 U	NT	NT	NT	NT	NT	NT
MW-22	MW-22_022012	2/20/2012	P	**40900 N**	NT	1510 U	NT	NT	NT	NT	NT	NT
MW-22	MW-22_050412	5/4/2012	P	**44600 N**	NT	3050 U	NT	NT	NT	NT	NT	NT
MW-22	MW-22_081512	8/15/2012	P	**41100 N**	NT	1510 U	NT	NT	NT	NT	NT	NT
MW-23	MW-23	8/9/2011	P	**949 N**	NT	472 U	NT	NT	NT	NT	NT	NT
MW-23	MW-23_022012	2/20/2012	P	**1100 N**	NT	748 U	NT	NT	NT	NT	NT	NT
MW-23	MW-23_050312	5/3/2012	P	**1190 N**	NT	**459 NJ**	NT	NT	NT	NT	NT	NT
MW-23	MW-23_08142012	8/14/2012	P	**1150**	NT	374 U	NT	NT	NT	NT	NT	NT
MW-24	MW-24	8/9/2011	P	**11500 N**	NT	2340 U	NT	NT	NT	NT	NT	NT
MW-24	MW-24_022112	2/21/2012	P	**12400 N**	NT	1500 U	NT	NT	NT	NT	NT	NT
MW-24	MW-24_050312	5/3/2012	P	**10800 N**	NT	**673 NJ**	NT	NT	NT	NT	NT	NT
MW-24	MW-24_08142012	8/14/2012	P	**10900**	NT	**902**	NT	NT	NT	NT	NT	NT
MW-25	MW-25	8/9/2011	P	**4040 N**	NT	510 U	NT	NT	NT	NT	NT	NT
MW-25	MW-25_022112	2/21/2012	P	**10100 N**	NT	1550 U	NT	NT	NT	NT	NT	NT
MW-25	MW-25_050312	5/3/2012	P	**7910 N**	NT	**907 NJ**	NT	NT	NT	NT	NT	NT
MW-25	MW-25_08142012	8/14/2012	P	**9510**	NT	**554**	NT	NT	NT	NT	NT	NT

Acronyms/Abbreviations:
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, and xylenes
EPA = United States Environmental Protection Agency
J = estimated result
N = presumptively identified result
NJ = presumptively identified and estimated result
NT = not tested
P = primary sample
TPH = total petroleum hydrocarbons
U = not detected at or above the stated level
UJ = not detected at or above the stated level, which is an approximate value

Notes:
BOLD indicates analyte was detected at or above the reporting limit
Data reported to reporting limit
TPH was analyzed using methods NWTPH-Dx and NWTPH-Gx
BTEX was analyzed using EPA Method 8260 or EPA Method 8015

TABLE F-A3
Groundwater Analytical Results Summary - Metals

Sample Location	Sample ID	Sample Date	Sample Type	Arsenic	Cadmium	Chromium	Copper	Lead	Zinc
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-1	MW-1-MID-20100908-N	9/8/2010	P	**11.8**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-1	MW-1	8/9/2011	P	**11.5**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-1	MW-1_022012	2/20/2012	P	**13.1**	1 U	2 U	4 U	1 U	4 U
MW-1	MW-1_050412	5/4/2012	P	**11.8**	1 U	2 U	2 U	1 U	4 U
MW-1	MW-1_081412	8/14/2012	P	**13.2**	1 U	2 U	2 U	1 U	4 U
MW-2	MW-02 _2005/12/15	12/14/2005	P	**16**	NT	NT	NT	NT	NT
MW-2	MW-02 _2006/12/14	12/14/2006	P	**20**	NT	NT	NT	NT	NT
MW-2A	MW-2A	8/9/2011	P	**3.06**	1.00 U	**3.94**	4.00 U	1.00 U	**20.8**
MW-2A	MW-2A_022112	2/21/2012	P	**11.3**	1 U	**5.83**	4 U	1 U	4 U
MW-2A	MW-2A_050312	5/3/2012	P	**10.9**	1 U	**5.4**	2 U	1 U	4 U
MW-2A	MW-2A_081512	8/15/2012	P	**12.7**	1 U	**5.46**	2 U	1 U	**9.83**
MW-3A	MW-3A-20100908-N	9/8/2010	P	**5.16**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-3A	MW-3A	8/9/2011	P	**5.67**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-3A	MW-3A_022112	2/21/2012	P	**4.97**	1 U	2 U	4 U	1 U	**5.19**
MW-3A	MW-3A_050412	5/4/2012	P	**7.78**	1 U	2 U	2 U	1 U	4 U
MW-3A	MW-3A_081512	8/15/2012	P	**6.07**	1 U	2 U	2 U	1 U	4 U
MW-3B	MW-03B_2005/12/15	12/15/2005	P	**38**	NT	NT	NT	NT	NT
MW-3B	MW-03B_2006/12/14	12/14/2006	P	**33**	NT	NT	NT	NT	NT
MW-3B	MW-3B-20100908-N	9/8/2010	P	**39.1**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-3B	MW-3B	8/9/2011	P	**25.7**	1.00 U	**2.76**	4.00 U	1.00 U	4.00 U
MW-3B	MW-3B_022112	2/21/2012	P	**23.9**	1 U	2 U	4 U	1 U	4 U
MW-3B	MW-3B_050412	5/4/2012	P	**5.1**	1 U	2 U	2 U	**3.49**	**10.1**
MW-3B	MW-3B_081512	8/15/2012	P	**27.4**	1 U	2 U	2 U	1 U	4 U
MW-4A	MW-4A-20100907-N	9/7/2010	P	**4.41**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-4A	MW-4A-20100907-ED	9/7/2010	FD	**4.74**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-4A	MW-4A	8/8/2011	P	**4.28**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-4A	MW-4A_022112	2/21/2012	P	**3.4**	1 U	2 U	4 U	1 U	4 U
MW-4A	MW-4A_050412	5/4/2012	P	**4.03**	1 U	2 U	2 U	1 U	4 U
MW-4A	MW-4A_081512	8/15/2012	P	**4**	1 U	2 U	2 U	1 U	4 U
MW-4B	MW-4B-20100907-N	9/7/2010	P	**5.01**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-4B	MW-4B	8/8/2011	P	**3.01**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-4B	MW-4B_022112	2/21/2012	P	2 U	1 U	2 U	4 U	1 U	4 U
MW-4B	MW-4B_050412	5/4/2012	P	2 U	1 U	2 U	**4.86**	1 U	4 U
MW-4B	MW-4B_081512	8/15/2012	P	**4.02**	1 U	2 U	2 U	1 U	**5.41**
MW-5	MW-05_2005/12/14	12/14/2005	P	NT	NT	NT	NT	NT	**12**
MW-5	MW-05_2006/12/14	12/14/2006	P	NT	NT	NT	NT	NT	**271**
MW-5	MW-5-20100907-N	9/7/2010	P	**2.28**	1.00 U	2.00 U	4.00 U	1.00 U	**243**
MW-5	MW-5	8/8/2011	P	2.00 U	1.00 U	2.00 U	**12.0**	1.00 U	**248**
MW-5	MW-5_022112	2/21/2012	P	2 U	1 U	2 U	**8.76**	**1.16**	**244**
MW-5	MW-5_050412	5/4/2012	P	**2.1**	1 U	**3.34**	**18.5**	**2.99**	**221**
MW-5	MW-5_081512	8/15/2012	P	2 U	1 U	2 U	**5.67**	1 U	**235**
MW-6A	MW-6A-20100908-N	9/8/2010	P	**3.56**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-6A	MW-6A	8/9/2011	P	**2.50**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-6A	MW-6A_022112	2/21/2012	P	**2.94**	1 U	2 U	4 U	1 U	4 U
MW-6A	MW-6A_050312	5/3/2012	P	**2.66**	1 U	2 U	2 U	1 U	4 U
MW-6A	MW-6A_08142012	8/14/2012	P	**3.19**	1 U	2 U	2 U	1 U	4 U
MW-7	MW-7_050312	5/3/2012	P	2 U	1 U	2 U	2 U	1 U	4 U
MW-9	MW-9-20100907-N	9/7/2010	P	**2.17**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-9	MW-9	8/8/2011	P	**3.16**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-9	MW-9_022012	2/20/2012	P	**4.21**	1 U	2 U	4 U	**1.09**	4 U
MW-9	MW-9_050312	5/3/2012	P	**4.12**	1 U	2 U	2 U	1 U	4 U
MW-9	MW-9_08142012	8/14/2012	P	**4.29**	1 U	2 U	2 U	1 U	4 U
MW-10	MW-10_2006/12/13	12/13/2006	P	**14**	NT	NT	NT	NT	NT
MW-10	MW-10-20100907-N	9/7/2010	P	**12.4**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-10	MW-10	8/8/2011	P	**8.88**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-10	MW-10_022012	2/20/2012	P	**9.22**	1 U	2 U	4 U	1 U	4 U
MW-10	MW-10_050312	5/3/2012	P	**7.89**	1 U	2 U	2 U	1 U	4 U
MW-10	MW-10_08142012	8/14/2012	P	**10.8**	1 U	2 U	2 U	1 U	4 U

TABLE F-A3
Groundwater Analytical Results Summary - Metals

Sample Location	Sample ID	Sample Date	Sample Type	Arsenic	Cadmium	Chromium	Copper	Lead	Zinc
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-18	MW-18-20100907-N	9/7/2010	P	**7.76**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-18	MW-18	8/8/2011	P	**6.18**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-18	MW-18 DUP	8/8/2011	FD	**6.67**	1.00 U	2.00 U	4.00 U	1.00 U	4.00 U
MW-18	MW-18_022012	2/20/2012	P	**6.14**	1 U	2 U	4 U	1 U	4 U
MW-18	MW-18_050312	5/3/2012	P	**6.23**	1 U	2 U	2 U	1 U	4 U
MW-18	MW-18_08142012	8/14/2012	P	**7.7**	1 U	2 U	2 U	1 U	4 U
MW-19	MW-19	8/8/2011	P	**2.02**	1.00 U	2.00 U	4.00 U	1.00 U	**148**
MW-19	MW-19_022112	2/21/2012	P	**8.33**	1 U	2 U	4 U	1 U	**4.27**
MW-19	MW-19_050412	5/4/2012	P	**7.91**	1 U	2 U	2 U	1 U	4 U
MW-19	MW-19_081412	8/14/2012	P	**5.5**	1 U	2 U	2 U	1 U	4 U
MW-20	MW-20	8/8/2011	P	**2.54**	1.00 U	2.00 U	4.00 U	1.00 U	**683**
MW-20	MW-20_022112	2/21/2012	P	**73.2**	1 U	2 U	4 U	1 U	**6.12**
MW-20	MW-20_050412	5/4/2012	P	**57.5**	1 U	2 U	2 U	1 U	**5.04**
MW-20	MW-20_081512	8/15/2012	P	**80.7**	1 U	2 U	2 U	1 U	**5.6**
MW-21	MW-21	8/9/2011	P	2.00 U	1.00 U	2.00 U	4.00 U	1.00 U	**10.5**
MW-21	MW-21_022112	2/21/2012	P	**8.71**	1 U	2 U	4 U	1 U	**9.02**
MW-21	MW-21_050412	5/4/2012	P	**9.57**	1 U	2 U	2 U	1 U	**4.91**
MW-21	MW-21_081512	8/15/2012	P	**5.82**	1 U	2 U	2 U	1 U	**4.7**
MW-22	MW-22	8/9/2011	P	**7.70**	1.00 U	2.00 U	4.00 U	1.00 U	**154**
MW-22	MW-22_022012	2/20/2012	P	**12.2**	1 U	2 U	4 U	1 U	**10.1 J**
MW-22	MW-22-DUP_022012	2/20/2012	FD	**11.9**	1 U	2 U	4 U	1 U	**5.99 J**
MW-22	MW-22_050412	5/4/2012	P	**12.7**	1 U	2 U	2 U	1 U	**4.48**
MW-22	MW-22DUP_050412	5/4/2012	FD	**12.9**	1 U	2 U	2 U	1 U	4 U
MW-22	MW-22_081512	8/15/2012	P	**13.4**	1 U	2 U	2 U	1 U	4 U
MW-22	MW-22DUP_081512	8/15/2012	FD	**13.2**	1 U	2 U	2 U	1 U	4 U
MW-23	MW-23	8/9/2011	P	**9.18**	1.00 U	2.00 U	4.00 U	1.00 U	**80.8**
MW-23	MW-23 DUP	8/9/2011	FD	**9.58**	1.00 U	2.00 U	4.00 U	1.00 U	**64.9**
MW-23	MW-23_022012	2/20/2012	P	**10**	1 U	2 U	4 U	1 U	**4.03 J**
MW-23	MW-23DUP_022012	2/20/2012	FD	**9.93**	1 U	2 U	4 U	1 U	4 U
MW-23	MW-23_050312	5/3/2012	P	**11.5**	1 U	2 U	2 U	1 U	4 U
MW-23	MW-23DUP_050312	5/3/2012	FD	**11.3**	1 U	2 U	2 U	1 U	4 U
MW-23	MW-23_08142012	8/14/2012	P	**17.5**	1 U	2 U	2 U	1 U	4 U
MW-23	MW-23DUP_08142012	8/14/2012	FD	**17.4**	1 U	2 U	2 U	1 U	4 U
MW-24	MW-24	8/9/2011	P	**5.89**	1.00 U	2.00 U	4.00 U	1.00 U	**414**
MW-24	MW-24_022112	2/21/2012	P	**9.91**	1 U	2 U	4 U	1 U	**18.4**
MW-24	MW-24_050312	5/3/2012	P	**9.77**	1 U	2 U	2 U	1 U	4 U
MW-24	MW-24_08142012	8/14/2012	P	**10.1**	1 U	2 U	2 U	1 U	**8.16**
MW-25	MW-25	8/9/2011	P	**2.36**	1.00 U	2.00 U	4.00 U	1.00 U	**15.8**
MW-25	MW-25_022112	2/21/2012	P	**5.41**	1 U	2 U	4 U	1 U	4 U
MW-25	MW-25_050312	5/3/2012	P	**5.92**	1 U	2 U	2 U	1 U	4 U
MW-25	MW-25_08142012	8/14/2012	P	**5.94**	1 U	2 U	2 U	1 U	**4.49**

Acronyms/Abbreviations
µg/L = micrograms per liter
EPA = United States Environmental Protection Agency
FD = field duplicate
J = estimated result
NT = not tested
P = primary sample
U = not detected at or above the stated level
UJ = not detected at or above the stated level, which is an approximate value

Notes:
BOLD indicates analyte was detected at or above the reporting limit
Data reported to reporting limit
Metals were analyzed using EPA Method 6010 or 6020

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	PAHs											PAHs							
						1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
						Concentrations in mg/kg																		
SCAPPOOSE BAY																								
PWS-05	PWS-090517-5	09/05/2017	0	1	P	**0.01**	**0.03**	**0.02**	**0.02**	**0.08**	**0.13**	**0.04**	**0.129**	**0.02**	**0.037**	NR	**0.22**	**0.00**	**1.15**	**0.03**	**0.02**	**0.08**	**0.69**	**0.64**
PWS-06	PWS-090517-6	09/05/2017	0	1	P	**0.01**	**0.03**	**0.06**	**0.01**	**0.05**	**0.08**	**0.08**	**0.135**	**0.05**	**0.041**	NR	**0.12**	**0.01**	**0.24**	**0.05**	**0.05**	**0.07**	**0.19**	**0.18**
PWS-08	PWS-090517-8	09/05/2017	0	1	P	**0.05**	**0.13**	**0.16**	**0.05**	**0.19**	**0.25**	**0.19**	**0.342**	**0.12**	**0.0985**	NR	**0.29**	**0.03**	**0.88**	**0.12**	**0.12**	**0.30**	**0.51**	**0.63**
PWS-09	PWS-090517-9	09/05/2017	0	1	P	**0.39**	**0.62**	**4.25**	**0.12**	**2.67**	**2.03**	**0.70**	**1.27**	**0.23**	**0.403**	NR	**1.79**	**0.06**	**11.10**	**4.72**	**0.28**	**0.75**	**15.50**	**6.95**
PWS-12	PWS-090617-12	09/06/2017	0	1	P	**0.07**	**0.17**	**0.33**	**0.14**	**0.98**	**1.79**	**1.91**	**2.95**	**0.64**	**1.18**	NR	**4.15**	**0.20**	**1.97**	**0.39**	**0.79**	**0.42**	**1.51**	**1.37**
PWS-13	PWS-090617-13	09/06/2017	0	1	P	**0.17**	**0.53**	**0.55**	**0.37**	**1.51**	**3.78**	**2.42**	**4.66**	**0.90**	**1.45**	NR	**5.54**	**0.32**	**7.16**	**0.76**	**1.19**	**1.16**	**2.70**	**4.91**
PWS-15	PWS-090617-15	09/06/2017	0	1	P	**0.07**	**0.07**	**0.23**	**0.03**	**0.12**	**0.13**	**0.14**	**0.263**	**0.08**	**0.0748**	NR	**0.20**	**0.02**	**0.46**	**0.22**	**0.09**	**0.13**	**0.48**	**0.32**
LSI-01	LSI-01_8-11	10/16/2012	0.66	0.92	P	**0.0212**	**0.0549**	**0.034**	**0.01**	**0.0478**	**0.0384**	**0.0296**	**0.05**	**0.0243**	**0.02**	**0.0635**	**0.0467**	0.00640 U	**0.155**	**0.0386**	**0.0243**	**0.188**	**0.152**	**0.103**
PWS-05	PWS-05_8-11_SE	7/12/2012	0.66	0.92	P	**0.302**	**0.785**	**0.84**	**0.139**	**0.971**	**1.52**	**1.03**	**1.93**	**0.489**	**0.604**	NR	**2.06**	**0.12**	**4.44**	**0.921**	**0.506**	**2.2**	**3.14**	**3.29**
PWS-05	PWS-5_8-11	10/10/2012	0.66	0.92	P	**0.0992**	**0.21**	**0.283**	**0.0563**	**0.274**	**0.513**	**0.456**	**0.862**	**0.205**	**0.294**	**1.12**	**1.24**	**0.0604**	**1.22**	**0.277**	**0.233**	**0.634**	**0.882**	**0.855**
PWS-06	PWS-06_8-11_SE	7/12/2012	0.66	0.92	P	**2.11**	**4.89**	**3.89**	**0.235**	**3.4**	**2.43**	**0.975**	**2.46**	**0.35**	**0.739**	NR	**3.72**	**0.11**	**16.9**	**4.15**	**0.406**	**17.3**	**13.6**	**10.7**
PWS-06	PWS-6_8-11	10/10/2012	0.66	0.92	P	**0.4**	**0.84**	**0.977**	**0.067**	**0.872**	**0.606**	**0.371**	**0.735**	**0.159**	**0.266**	**0.958**	**0.693**	**0.0534**	**2.38**	**0.969**	**0.184**	**2.05**	**2.77**	**1.67**
PWS-08	PWS-08_8-11_SE	7/12/2012	0.66	0.92	P	**0.471**	**0.982**	**1.05**	**0.0713**	**0.831**	**0.708**	**0.372**	**0.727**	**0.167**	**0.22**	NR	**0.802**	**0.0492**	**3.46**	**1.17**	**0.186**	**2.44**	**4.01**	**2.52**
PWS-08	PWS-8_8-11	10/9/2012	0.66	0.92	P	**0.12**	**0.265**	**0.261**	**0.0523**	**0.344**	**0.414**	**0.366**	**0.747**	**0.18**	**0.274**	**0.978**	**0.615**	**0.0554**	**1.12**	**0.32**	**0.209**	**0.593**	**0.962**	**0.775**
PWS-09	PWS-09_8-11_SE	7/12/2012	0.66	0.92	P	**0.133**	**0.259**	**0.333**	**0.0385**	**0.302**	**0.361**	**0.251**	**0.415**	**0.11**	**0.134**	NR	**0.409**	**0.0297**	**1.43**	**0.327**	**0.124**	**1.16**	**1.27**	**1.1**
PWS-09	PWS-9_8-11	10/9/2012	0.66	0.92	P	**0.0193**	**0.0402**	**0.0494**	0.00942 U	**0.0689**	**0.0836**	**0.0548**	**0.0932**	**0.0329**	**0.0373**	**0.127**	**0.227**	0.00942 U	**0.203**	**0.0675**	**0.0354**	**0.0943**	**0.179**	**0.149**
PWS-12	PWS-12_8-11	10/9/2012	0.66	0.92	P	0.00804 U	0.00804 U	0.00804 U	0.00804 U	0.00804 U	**0.0198**	**0.0183**	**0.03**	**0.0165**	**0.01**	**0.0404**	**0.0273**	0.00804 U	**0.045**	0.00804 U	**0.017**	**0.01**	**0.0203**	**0.0421**
PWS-12	PWS-12_8-11_SE	7/12/2012	0.66	0.92	P	**0.0222**	**0.0617**	**0.08**	**0.0268**	**0.111**	**0.23**	**0.24**	**0.405**	**0.15**	**0.14**	NR	**0.33**	**0.035**	**0.576**	**0.088**	**0.17**	**0.17**	**0.28**	**0.536**
PWS-12	PWS-12_8-11 DU	7/12/2012	0.66	0.92	FD	**0.02**	**0.0509**	**0.04**	**0.0197**	**0.0848**	**0.147**	**0.14**	**0.244**	**0.08**	**0.07**	NR	**0.216**	**0.0191**	**0.386**	**0.0664**	**0.09**	**0.172**	**0.238**	**0.337**
PWS-13	PWS-13_1-4_SE	7/11/2012	0.08	0.33	P	**0.0589**	**0.144**	**0.0947**	**0.0341**	**0.272**	**0.192**	**0.278**	**0.336**	**0.166**	**0.107**	NR	**0.277**	**0.0275**	**0.596**	**0.142**	**0.162**	**0.359**	**0.496**	**0.612**
PWS-13	PWS-13_8-11	10/9/2012	0.66	0.92	P	**0.0508**	**0.103**	**0.247**	**0.0297**	**0.215**	**0.496**	**0.28**	**0.271**	**0.0856**	**0.107**	**0.381**	**0.885**	**0.044**	**0.977**	**0.208**	**0.0701**	**0.276**	**1.24**	**1.01**
PWS-13	PWS-13_8-11_1	10/9/2012	0.66	0.92	FD	**0.11**	**0.30**	**0.35**	**0.05**	**0.32**	**0.60**	**0.32**	**0.43**	**0.16**	**0.14**	**0.57**	**1.12**	**0.04**	**1.63**	**0.33**	**0.13**	**0.77**	**1.77**	**1.60**
PWS-13	PWS-13_8-11_SE	7/11/2012	0.66	0.92	P	**0.0378**	**0.103**	**0.0736**	**0.0238**	**0.108**	**0.238**	**0.25**	**0.464**	**0.126**	**0.15**	NR	**0.314**	**0.0301**	**0.433**	**0.0971**	**0.126**	**0.255**	**0.341**	**0.37**
PWS-15	PWS-15_8-11	10/11/2012	0.66	0.92	P	0.00668 U	**0.01**	**0.0236**	0.00668 U	**0.01**	**0.0214**	**0.01**	**0.02**	**0.01**	**0.01**	**0.0276**	**0.0215**	0.00668 U	**0.0584**	**0.015**	**0.01**	**0.0329**	**0.0405**	**0.048**
PWS-15	PWS-15_8-11_SE	7/12/2012	0.66	0.92	P	**0.01**	**0.01**	**0.01**	0.00759 U	**0.01**	**0.0179**	**0.02**	**0.0265**	0.00759 U	**0.02**	NR	**0.0248**	0.00759 U	**0.0976**	**0.01**	**0.01**	**0.0233**	**0.0736**	**0.0789**
PWS-16	PWS-16_8-11	10/9/2012	0.66	0.92	P	**0.0375**	**0.0844**	**0.0817**	**0.0176**	**0.106**	**0.146**	**0.0809**	**0.18**	**0.0524**	**0.06**	**0.231**	**0.197**	**0.0148**	**0.465**	**0.0989**	**0.0551**	**0.187**	**0.316**	**0.339**
PWS-16	PWS-16_8-11_SE	7/9/2012	0.66	0.92	P	**0.896**	**2.2**	**1.3**	**0.158**	**1.55**	**0.932**	**0.436**	**1**	**0.2**	**0.281**	NR	**1.11**	0.0844 U	**4.9**	**1.56**	**0.229**	**5.44**	**5.75**	**3.48**
PWS-16	PWS-16B_8-11_S	7/13/2012	0.66	0.92	P	**0.15**	**0.395**	**0.28**	**0.0597**	**0.336**	**0.439**	**0.254**	**0.54**	**0.15**	**0.169**	NR	**0.554**	0.0855 U	**1.39**	**0.311**	**0.176**	**0.999**	**0.895**	**1.09**
PWS-22	PWS-22_8-11 SED	7/12/2012	0.66	0.92	P	**0.01**	**0.0333**	**0.0986**	**0.0194**	**0.0762**	**0.22**	**0.12**	**0.23**	**0.05**	**0.07**	NR	**0.277**	**0.0182**	**0.292**	**0.0607**	**0.06**	**0.122**	**0.277**	**0.267**
PWS-25	PWS-25_4-8	10/11/2012	0.33	0.66	P	**0.0732**	**0.17**	**0.161**	**0.0476**	**0.367**	**1.33**	**1.14**	**1.74**	**0.439**	**0.613**	**2.27**	**1.64**	**0.14**	**1.56**	**0.268**	**0.516**	**0.473**	**0.667**	**1.11**
PWS-25	PWS-25_8-11_SE	7/13/2012	0.66	0.92	P	**0.237**	**0.625**	**0.536**	**0.109**	**0.509**	**0.795**	**0.797**	**1.53**	**0.421**	**0.522**	NR	**1.25**	**0.12**	**2.8**	**0.643**	**0.514**	**1.45**	**2.01**	**2.36**
PWS-26	PWS-26_8-11	10/11/2012	0.66	0.92	P	**0.154**	**0.336**	**0.322**	**0.0527**	**0.436**	**0.39**	**0.40**	**0.74**	**0.206**	**0.28**	**0.966**	**0.71**	**0.06**	**1.22**	**0.435**	**0.22**	**0.776**	**1.09**	**0.854**
PWS-26	PWS-26_8-11_DU	10/11/2012	0.66	0.92	FD	**0.163**	**0.382**	**0.326**	**0.0702**	**0.506**	**0.89**	**0.78**	**1.34**	**0.324**	**0.47**	**1.74**	**1.32**	**0.10**	**1.77**	**0.428**	**0.37**	**1**	**1.2**	**1.28**
PWS-26	PWS-26_8-11_SE	7/13/2012	0.66	0.92	P	**0.253**	**0.673**	**0.572**	**0.0506**	**0.477**	**0.353**	**0.29**	**0.515**	**0.183**	**0.172**	NR	**0.502**	0.0819 U	**1.6**	**0.756**	**0.191**	**1.35**	**1.98**	**1.24**
PWS-28	PWS-28_8-11	10/10/2012	0.66	0.92	P	**0.01**	**0.01**	0.00603 U	**0.0165**	**0.01**	**0.0418**	**0.0853**	**0.088**	**0.069**	**0.031**	**0.114**	**0.0658**	**0.01**	**0.132**	**0.01**	**0.056**	**0.0211**	**0.0605**	**0.106**

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	TPH			VPH								
						Diesel Range Organics	Residual Range Hydrocarbons	TPH	$C_{>5}$-C_6 Aliphatics	$C_{>6}$-C_8 Aliphatics	$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{13} Aromatics	PID: 2,5-Dibromotoluene	FID: 2,5-Dibromotoluene
						Concentrations in mg/kg											
SCAPPOOSE BAY																	
PWS-05	PWS-090517-5	09/05/2017	0	1	P	NT	NT	NT	20 U	20 U	20 U	20 U	20 U	20 U	20 U	**106**	**93**
PWS-06	PWS-090517-6	09/05/2017	0	1	P	NT	NT	NT	30.8 U	30.8 U	30.8 U	30.8 U	30.8 U	30.8 U	30.8 U	**108**	**93**
PWS-08	PWS-090517-8	09/05/2017	0	1	P	NT	NT	NT	30.7 U	30.7 U	30.7 U	30.7 U	30.7 U	30.7 U	30.7 U	**107**	**92**
PWS-09	PWS-090517-9	09/05/2017	0	1	P	NT	NT	NT	31.5 U	31.5 U	31.5 U	31.5 U	31.5 U	31.5 U	31.5 U	**112**	**97.3**
PWS-12	PWS-090617-12	09/06/2017	0	1	P	NT	NT	NT	18.6 U	18.6 U	18.6 U	18.6 U	18.6 U	18.6 U	18.6 U	--	--
PWS-13	PWS-090617-13	09/06/2017	0	1	P	NT	NT	NT	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U	--	--
PWS-15	PWS-090617-15	09/06/2017	0	1	P	NT	NT	NT	25.9 U	25.9 U	25.9 U	25.9 U	25.9 U	25.9 U	25.9 U	--	--
LSI-01	LSI-01_8-11	10/16/2012	0.66	0.92	P	25.0 U	50.0 U	37.5	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-05	PWS-05_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-05	PWS-5_8-11	10/10/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-06	PWS-06_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-06	PWS-6_8-11	10/10/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-08	PWS-08_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-08	PWS-8_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-09	PWS-09_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-09	PWS-9_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-12	PWS-12_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-12	PWS-12_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-12	PWS-12_8-11 DU	7/12/2012	0.66	0.92	FD	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-13	PWS-13_1-4_SE	7/11/2012	0.08	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-13	PWS-13_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-13	PWS-13_8-11_1	10/9/2012	0.66	0.92	FD	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-13	PWS-13_8-11_SE	7/11/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-15	PWS-15_8-11	10/11/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-15	PWS-15_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-16	PWS-16_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-16	PWS-16_8-11_SE	7/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-16	PWS-16B_8-11_S	7/13/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-22	PWS-22_8-11 SED	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-25	PWS-25_4-8	10/11/2012	0.33	0.66	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-25	PWS-25_8-11_SE	7/13/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-26	PWS-26_8-11	10/11/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-26	PWS-26_8-11_DU	10/11/2012	0.66	0.92	FD	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-26	PWS-26_8-11_SE	7/13/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-28	PWS-28_8-11	10/10/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	EPH									
						$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>12}$-C_{16} Aliphatics	$C_{>16}$-C_{21} Aliphatics	$C_{>21}$-C_{34} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{16} Aromatics	$C_{>16}$-C_{21} Aromatics	$C_{>21}$-C_{34} Aromatics
						Concentrations in mg/kg									
SCAPPOOSE BAY															
PWS-05	PWS-090517-5	09/05/2017	0	1	P	3.24 H, U	3.24 H, U	3.24 H, U	**18.6 H**	**11 H**	3.24 H, U	3.24 H, U	3.24 H, U	**4.84 H**	**54.6 H**
PWS-06	PWS-090517-6	09/05/2017	0	1	P	4.17 H, U	4.17 H, U	**8.25 H**	**19 H**	**66.8 H**	4.17 H, U	4.17 H, U	**7.9 H**	**42.9 H**	**52.4 H**
PWS-08	PWS-090517-8	09/05/2017	0	1	P	4.46 H, U	4.46 H, U	4.46 H, U	**11.9 H**	**66.3 H**	4.46 H, U	4.46 H, U	4.46 H, U	**11.2 H**	**44.7 H**
PWS-09	PWS-090517-9	09/05/2017	0	1	P	4.13 H, U	**12.9 H**	**53.4 H**	**71.8 H**	**191 H**	4.13 H, U	**4.44 H**	**39.6 H**	**236 H**	**176 H**
PWS-12	PWS-090617-12	09/06/2017	0	1	P	--	--	--	--	--	--	--	--	--	--
PWS-13	PWS-090617-13	09/06/2017	0	1	P	--	--	--	--	--	--	--	--	--	--
PWS-15	PWS-090617-15	09/06/2017	0	1	P	--	--	--	--	--	--	--	--	--	--
LSI-01	LSI-01_8-11	10/16/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-05	PWS-05_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-05	PWS-5_8-11	10/10/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-06	PWS-06_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-06	PWS-6_8-11	10/10/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-08	PWS-08_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-08	PWS-8_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-09	PWS-09_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-09	PWS-9_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-12	PWS-12_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-12	PWS-12_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-12	PWS-12_8-11 DU	7/12/2012	0.66	0.92	FD	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-13	PWS-13_1-4_SE	7/11/2012	0.08	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-13	PWS-13_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-13	PWS-13_8-11_1	10/9/2012	0.66	0.92	FD	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-13	PWS-13_8-11_SE	7/11/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-15	PWS-15_8-11	10/11/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-15	PWS-15_8-11_SE	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-16	PWS-16_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-16	PWS-16_8-11_SE	7/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-16	PWS-16B_8-11_S	7/13/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-22	PWS-22_8-11 SED	7/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-25	PWS-25_4-8	10/11/2012	0.33	0.66	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-25	PWS-25_8-11_SE	7/13/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-26	PWS-26_8-11	10/11/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-26	PWS-26_8-11_DU	10/11/2012	0.66	0.92	FD	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-26	PWS-26_8-11_SE	7/13/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-28	PWS-28_8-11	10/10/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	PAHs										PAHs							
						1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
						Concentrations in mg/kg																		
SCAPPOOSE BAY																								
SB01	SB01-0-0.3	7/14/2011	0	0.3	P	NR	NR	0.0458 U	0.0458 U	**0.0474**	**0.0659**	**0.063**	NR	**0.063**	NR	**0.132**	**0.0986**	0.0458 U	**0.141**	0.0458 U	**0.0581**	0.0458 U	**0.0778**	**0.133**
SB02	SB02-0.0.3	7/14/2011	0	0.3	P	NR	NR	0.0366 U	0.0366 U	**0.0492**	**0.0557**	**0.0436**	NR	**0.0367**	NR	**0.0939**	**0.0669**	0.0366 U	**0.155**	0.0366 U	**0.0376**	**0.0784**	**0.0961**	**0.128**
SB03	SB03_0-0.3	7/14/2011	0	0.3	P	NR	NR	0.0214 U	0.0214 U	**0.0386**	**0.0403**	**0.0326**	NR	**0.0339**	NR	**0.072**	**0.0563**	0.0214 U	**0.119**	0.0214 U	**0.0329**	**0.0337**	**0.0514**	**0.0968**
SB04	SB04-0-0.3	7/14/2011	0	0.3	P	NR	NR	**0.06**	0.0370 U	**0.13**	**0.116**	**0.0996**	NR	**0.0956**	NR	**0.204**	**0.16**	0.0370 U	**0.43**	**0.075**	**0.0875**	**0.0837**	**0.34**	**0.31**
SB06	SB06-0-0.3	7/14/2011	0	0.3	P	NR	NR	0.0398 U	0.0398 U	**0.119**	**0.157**	**0.131**	NR	**0.106**	NR	**0.286**	**0.312**	0.0398 U	**0.329**	**0.044**	**0.104**	**0.0624**	**0.147**	**0.269**
SB07	SB07-0-0.3	7/13/2011	0	0.3	P	NR	NR	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	NR	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	**0.0412**	0.0129 U	0.0129 U
SB08	SB08-0-0.3	7/13/2011	0	0.3	P	NR	NR	**0.0444**	0.0422 U	**0.0833**	**0.107**	**0.0962**	NR	**0.0728**	NR	**0.226**	**0.17**	0.0422 U	**0.276**	0.0422 U	**0.0734**	**0.142**	**0.119**	**0.213**
SB09	SB09-0-0.3	7/14/2011	0	0.3	P	NR	NR	**5.4**	0.196 U	**1.74**	**0.832**	**0.339**	NR	**0.215**	NR	**0.81**	**0.962**	0.196 U	**7.3**	**5.92**	**0.216**	**16.1**	**11.5**	**4.23**
SB12	SB12-0-0.3	7/14/2011	0	0.3	P	NR	NR	0.414 U	0.414 U	**0.429**	**0.588**	0.414 U	NR	0.414 U	NR	0.828 U	**0.823**	0.414 U	**2.17**	0.414 U	0.414 U	0.414 U	**1.23**	**1.58**
SB13	SB13-0-0.3	7/14/2011	0	0.3	P	NR	NR	**0.391**	0.191 U	**0.275**	**0.338**	0.191 U	NR	0.191 U	NR	0.383 U	**0.328**	0.191 U	**1.24**	**0.39**	0.191 U	0.191 U	**1.39**	**0.849**
SB17	SB17-0-0.3	7/15/2011	0	0.3	P	NR	NR	0.586 U	0.586 U	0.586 U	**0.799**	0.586 U	NR	0.586 U	NR	**1.28**	**1.14**	0.586 U	**2.85**	0.586 U	0.586 U	0.586 U	**1.23**	**2.11**
SB19	SB19-0-0.3	7/15/2011	0	0.3	P	NR	NR	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	NR	0.383 U	0.383 U	**0.433**	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U
SB20	SB20-0-0.3	7/15/2011	0	0.3	P	NR	NR	**0.291**	0.165 U	**0.214**	**0.325**	**0.223**	NR	**0.177**	NR	**0.665**	**0.497**	0.165 U	**0.977**	**0.245**	**0.218**	**0.212**	**0.758**	**0.722**
SB21	SB21-0-0.3	7/15/2011	0	0.3	P	NR	NR	0.27 U	0.27 U	0.27 U	**0.462**	**0.428**	NR	0.27 U	NR	**0.856**	**0.566**	0.27 U	**0.78**	0.27 U	**0.29**	0.27 U	**0.372**	**0.757**
SB24	SB24-0-0.3	7/16/2011	0	0.3	P	NR	NR	**2.79**	1.73 U	1.73 U	**2.18**	1.73 U	NR	1.73 U	NR	3.47 U	**1.87**	1.73 U	**10.8**	**2.98**	1.73 U	**2.89**	**14**	**7.54**
SB26	SB26-0-0.3	7/16/2011	0	0.3	P	NR	NR	**1.19**	0.826 U	**0.961**	**0.873**	0.826 U	NR	0.826 U	NR	1.65 U	0.826 U	0.826 U	**3.39**	**1.56**	0.826 U	**2.92**	**4.68**	**2.29**
SB27	SB27-0-0.3	7/16/2011	0	0.3	P	NR	NR	**16.2**	0.758 U	**3.64**	**1.62**	0.758 U	NR	0.758 U	NR	1.52 U	**1.69**	0.758 U	**13.4**	**12.2**	0.758 U	**4.36**	**23.7**	**7.86**
SB28	SB28-0-0.3	7/16/2011	0	0.3	P	NR	NR	**7.81**	**0.397**	**4.95**	**2.92**	**1.53**	**2.95**	**0.818**	**0.899**	NR	**4.8**	**0.222**	**17**	**7.74**	**0.968**	**29.6**	**23.3**	**10.5**
SD-100	SD-100_2003120	12/1/2003	0	0.33	P	NR	**0.013**	**0.013**	0.0056 U	**0.037**	**0.079**	**0.068**	**0.075**	**0.052**	**0.053**	NR	**0.14**	**0.0076**	**0.17**	**0.019**	**0.062**	**0.03**	**0.085**	**0.15**
SD-101	SD-101 _2003120	12/1/2003	0	0.33	P	NR	**0.05**	**0.036**	0.0067 U	**0.048**	**0.087**	**0.078**	**0.086**	**0.059**	**0.059**	NR	**0.13**	**0.0082**	**0.23**	**0.048**	**0.07**	**0.14**	**0.18**	**0.2**
SD-102	SD-102 _2003120	12/1/2003	0	0.33	P	NR	**0.0095**	**0.0093**	0.0078 U	**0.029**	**0.086**	**0.081**	**0.11**	**0.056**	**0.082**	NR	**0.14**	**0.0085**	**0.24**	**0.013**	**0.067**	**0.02**	**0.081**	**0.25**
SD-103	SD-103 _2003120	12/1/2003	0	0.33	P	NR	**0.048**	**0.055**	**0.017**	**0.093**	**0.3**	**0.24**	**0.36**	**0.097**	**0.27**	NR	**0.59**	**0.02**	**0.41**	**0.063**	**0.14**	**0.044**	**0.28**	**0.42**
SD-103-A	SD-103-A _20040	6/1/2004	0	0.33	P	NR	**0.36**	**0.37**	**0.021**	**0.71**	**0.42**	**0.11**	**0.18**	**0.062**	**0.16**	NR	**0.46**	**0.012**	**3.5**	**0.48**	**0.065**	**0.33**	**2.9**	**2.1**
SD-103-B	SD-103-B. _2004(	6/1/2004	0	0.33	P	NR	**0.034**	**0.025**	**0.011**	**0.065**	**0.087**	**0.074**	**0.09**	**0.066**	**0.08**	NR	**0.13**	**0.0091**	**0.26**	**0.039**	**0.059**	**0.07**	**0.17**	**0.21**
SD-103-C	SD-103-C _20040	6/1/2004	0	0.33	P	NR	**0.11**	**0.069**	**0.02**	**0.2**	**0.25**	**0.17**	**0.25**	**0.096**	**0.2**	NR	**0.47**	**0.02**	**0.6**	**0.11**	**0.11**	**0.23**	**0.42**	**0.43**
SD-104	SD-104_2003120	12/1/2003	0	0.33	P	NR	**0.14**	**0.092**	**0.017**	**0.21**	**0.25**	**0.17**	**0.23**	**0.11**	**0.16**	NR	**0.3**	**0.022**	**0.99**	**0.098**	**0.16**	**0.22**	**0.55**	**0.76**
SD-104-A	SD-104-A _20040	6/1/2004	0	0.33	P	NR	**0.0093**	**0.0075**	0.0064 U	**0.026**	**0.043**	**0.042**	**0.051**	**0.038**	**0.043**	NR	**0.081**	0.0064 U	**0.1**	**0.011**	**0.034**	**0.02**	**0.056**	**0.09**
SD-104-B	SD-104-B _20040	6/1/2004	0	0.33	P	NR	**0.01**	**0.0087**	0.0067 U	**0.026**	**0.044**	**0.036**	**0.05**	**0.031**	**0.037**	NR	**0.072**	0.0067 U	**0.14**	**0.012**	**0.026**	**0.022**	**0.058**	**0.11**
SD-104-C	SD-104-C _20040	6/1/2004	0	0.33	P	NR	**0.0095**	**0.0078**	0.0066 U	**0.03**	**0.044**	**0.037**	**0.049**	**0.033**	**0.037**	NR	**0.087**	0.0066 U	**0.11**	**0.012**	**0.028**	**0.02**	**0.058**	**0.099**
SD-105	SD-105_2003120	12/1/2003	0	0.33	P	NR	**0.07**	**0.083**	**0.01**	**0.11**	**0.14**	**0.12**	**0.13**	**0.089**	**0.098**	NR	**0.19**	**0.014**	**0.39**	**0.084**	**0.11**	**0.17**	**0.31**	**0.29**
SD-105-A	SD-105-A _20040	6/1/2004	0	0.33	P	NR	**0.024**	**0.02**	**0.0097**	**0.06**	**0.075**	**0.054**	**0.077**	**0.044**	**0.058**	NR	**0.13**	0.0067 U	**0.22**	**0.03**	**0.038**	**0.061**	**0.12**	**0.17**
SD-105-B	SD-105-B _20040	6/1/2004	0	0.33	P	NR	**0.02**	**0.93**	**0.022**	**0.29**	**0.052**	**0.036**	**0.05**	**0.026**	**0.045**	NR	**0.097**	0.0065 U	**0.38**	**0.74**	**0.025**	**0.041**	**1.1**	**0.22**
SD-105-C	SD-105-C _20040	6/1/2004	0	0.33	P	NR	**0.01**	**0.011**	0.0066 U	**0.027**	**0.035**	**0.027**	**0.038**	**0.022**	**0.031**	NR	**0.058**	0.0064 U	**0.12**	**0.014**	**0.021**	**0.022**	**0.067**	**0.09**
SD-106	SD-106 _2003120	12/1/2003	0	0.33	P	NR	**0.032**	**0.027**	**0.0085**	**0.085**	**0.16**	**0.16**	**0.17**	**0.099**	**0.13**	NR	**0.28**	**0.016**	**0.33**	**0.037**	**0.13**	**0.067**	**0.16**	**0.28**
SD-108	SD-108 _2003120	12/1/2003	0	0.33	P	NR	**0.7**	**0.78**	**0.038**	**1.1**	**0.85**	**0.51**	**0.64**	**0.24**	**0.45**	NR	**1.2**	**0.05**	**3.5**	**1.1**	**0.35**	**1.3**	**3.3**	**2.4**
SD-110	SD-110_2003120	12/1/2003	0	0.33	P	NR	**0.22**	**0.56**	**0.029**	**0.52**	**0.75**	**0.56**	**0.73**	**0.22**	**0.5**	NR	**1.1**	**0.055**	**2.5**	**0.59**	**0.34**	**0.36**	**1.7**	**1.7**
SD-112	SD-112 _2003120	12/1/2003	0	0.33	P	NR	**0.11**	**0.15**	**0.017**	**0.23**	**0.27**	**0.26**	**0.31**	**0.16**	**0.21**	NR	**0.42**	**0.028**	**0.87**	**0.2**	**0.22**	**0.2**	**0.76**	**0.68**
SD-112-A	SD-112-A _20040	6/1/2004	0	0.33	P	NR	**0.069**	**0.063**	**0.025**	**0.19**	**0.15**	**0.26**	**0.32**	**0.17**	**0.24**	NR	**0.38**	**0.034**	**0.69**	**0.092**	**0.2**	**0.16**	**0.47**	**0.49**
SD-112-B	SD-112-B _20040	6/1/2004	0	0.33	P	NR	**0.19**	**0.18**	**0.065**	**0.45**	**0.86**	**0.89**	**1.2**	**0.42**	**1**	NR	**1.5**	**0.11**	**2.2**	**0.28**	**0.54**	**0.3**	**0.85**	**0.97**
SD-112-C	SD-112-C _20040	6/1/2004	0	0.33	P	NR	**0.069**	**0.1**	**0.049**	**0.31**	**0.61**	**0.63**	**0.83**	**0.36**	**0.62**	NR	**0.91**	**0.083**	**1.8**	**0.16**	**0.43**	**0.12**	**0.83**	**0.96**

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	TPH			VPH								
						Diesel Range Organics	Residual Range Hydrocarbons	TPH	$C_{>5}$-C_6 Aliphatics	$C_{>6}$-C_8 Aliphatics	$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{13} Aromatics	PID: 2,5-Dibromotoluene	FID: 2,5-Dibromotoluene
						Concentrations in mg/kg											
SCAPPOOSE BAY																	
SB01	SB01-0-0.3	7/14/2011	0	0.3	P	48.6 U	97.2 U	72.9	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB02	SB02-0.0.3	7/14/2011	0	0.3	P	41.4 U	82.9 U	62.2	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB03	SB03_0-0.3	7/14/2011	0	0.3	P	54.9 U	110 U	82.5	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB04	SB04-0-0.3	7/14/2011	0	0.3	P	43.9 U	87.9 U	65.9	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB06	SB06-0-0.3	7/14/2011	0	0.3	P	43.8 U	87.6 U	65.7	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB07	SB07-0-0.3	7/13/2011	0	0.3	P	30.6 U	61.1 U	45.9	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB08	SB08-0-0.3	7/13/2011	0	0.3	P	50.7 U	101 U	75.9	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB09	SB09-0-0.3	7/14/2011	0	0.3	P	86.0 U	**208**	**251**	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB12	SB12-0-0.3	7/14/2011	0	0.3	P	111 U	221 U	166	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB13	SB13-0-0.3	7/14/2011	0	0.3	P	49.3 U	98.5 U	73.9	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB17	SB17-0-0.3	7/15/2011	0	0.3	P	**39.7 N**	**135**	**175**	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB19	SB19-0-0.3	7/15/2011	0	0.3	P	49.0 U	97.9 U	73.5	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB20	SB20-0-0.3	7/15/2011	0	0.3	P	47.9 U	**144**	**168**	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB21	SB21-0-0.3	7/15/2011	0	0.3	P	39.9 U	79.8 U	59.9	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB24	SB24-0-0.3	7/16/2011	0	0.3	P	**164 N**	**226**	**390**	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB26	SB26-0-0.3	7/16/2011	0	0.3	P	46.6 U	93.1 U	69.9	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB27	SB27-0-0.3	7/16/2011	0	0.3	P	**93.6 N**	**216**	**310**	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB28	SB28-0-0.3	7/16/2011	0	0.3	P	**253 N**	**289 N**	**542**	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-100	SD-100_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-101	SD-101 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-102	SD-102 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-103	SD-103 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-103-A	SD-103-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-103-B	SD-103-B. _2004(	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-103-C	SD-103-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-104	SD-104_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-104-A	SD-104-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-104-B	SD-104-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-104-C	SD-104-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-105	SD-105_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-105-A	SD-105-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-105-B	SD-105-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-105-C	SD-105-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-106	SD-106 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-108	SD-108 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-110	SD-110_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-112	SD-112 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-112-A	SD-112-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-112-B	SD-112-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-112-C	SD-112-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	EPH									
						$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>12}$-C_{16} Aliphatics	$C_{>16}$-C_{21} Aliphatics	$C_{>21}$-C_{34} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{16} Aromatics	$C_{>16}$-C_{21} Aromatics	$C_{>21}$-C_{34} Aromatics
						Concentrations in mg/kg									
SCAPPOOSE BAY															
SB01	SB01-0-0.3	7/14/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB02	SB02-0.0.3	7/14/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB03	SB03_0-0.3	7/14/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB04	SB04-0-0.3	7/14/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB06	SB06-0-0.3	7/14/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB07	SB07-0-0.3	7/13/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB08	SB08-0-0.3	7/13/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB09	SB09-0-0.3	7/14/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB12	SB12-0-0.3	7/14/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB13	SB13-0-0.3	7/14/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB17	SB17-0-0.3	7/15/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB19	SB19-0-0.3	7/15/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB20	SB20-0-0.3	7/15/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB21	SB21-0-0.3	7/15/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB24	SB24-0-0.3	7/16/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB26	SB26-0-0.3	7/16/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB27	SB27-0-0.3	7/16/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SB28	SB28-0-0.3	7/16/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-100	SD-100_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-101	SD-101 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-102	SD-102 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-103	SD-103 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-103-A	SD-103-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-103-B	SD-103-B. _2004(	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-103-C	SD-103-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-104	SD-104_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-104-A	SD-104-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-104-B	SD-104-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-104-C	SD-104-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-105	SD-105_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-105-A	SD-105-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-105-B	SD-105-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-105-C	SD-105-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-106	SD-106 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-108	SD-108 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-110	SD-110_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-112	SD-112 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-112-A	SD-112-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-112-B	SD-112-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-112-C	SD-112-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	PAHs										PAHs							
						1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
						Concentrations in mg/kg																		
SCAPPOOSE BAY																							
SD-113	SD-113 _2003120	12/1/2003	0	0.33	P	NR	0.005 U	0.005 U	0.005 U	0.005 U	**0.015**	**0.018**	**0.012**	**0.012**	**0.012**	NR	**0.019**	0.005 U	**0.02**	0.005 U	**0.015**	0.005 U	0.005 U	**0.022**
SD-114	SD-114 _2003120	12/1/2003	0	0.33	P	NR	**0.006**	**0.0063**	0.0059 U	**0.022**	**0.039**	**0.058**	**0.049**	**0.045**	**0.04**	NR	**0.072**	0.0059 U	**0.081**	**0.0085**	**0.05**	**0.016**	**0.039**	**0.091**
SD-115	SD-115_2003120	12/1/2003	0	0.33	P	NR	0.006 U	0.008 U	0.007 U	0.005 U	**0.009**	**0.012**	**0.011**	**0.0091**	**0.0088**	NR	**0.013**	0.005 U	**0.023**	0.01 U	**0.011**	0.005 U	**0.0086**	**0.024**
SD-116	SD-116 _2003120	12/1/2003	0	0.33	P	NR	0.0049 U	**0.0053**	0.0049 U	**0.0079**	**0.031**	**0.059**	**0.039**	**0.052**	**0.033**	NR	**0.041**	**0.0061**	**0.057**	**0.0062**	**0.056**	**0.012**	**0.033**	**0.07**
SD-117	SD-117 _2003120	12/1/2003	0	0.33	P	NR	**0.035**	**0.034**	**0.014**	**0.078**	**0.2**	**0.25**	**0.18**	**0.18**	**0.15**	NR	**0.36**	**0.023**	**0.31**	**0.046**	**0.22**	**0.085**	**0.2**	**0.3**
SD-117-A	SD-117-A _20040	6/1/2004	0	0.33	P	NR	0.005 U	0.005 U	0.005 U	0.005 U	**0.0082**	**0.009**	**0.0087**	**0.0071**	**0.0083**	NR	**0.0092**	0.005 U	**0.018**	0.005 U	**0.0062**	0.005 U	0.005 U	**0.015**
SD-117-B	SD-117-B _20040	6/1/2004	0	0.33	P	NR	**0.0068**	**0.0082**	0.0037 U	**0.0064**	**0.0063**	**0.0077**	**0.0091**	**0.0071**	**0.006**	NR	**0.01**	0.0037 U	**0.019**	**0.0094**	**0.0068**	**0.013**	**0.029**	**0.016**
SD-117-C	SD-117-C _20040	6/1/2004	0	0.33	P	NR	**0.02**	**0.015**	**0.0073**	**0.029**	**0.055**	**0.07**	**0.079**	**0.054**	**0.066**	NR	**0.14**	**0.0076**	**0.12**	**0.021**	**0.051**	**0.065**	**0.1**	**0.1**
SD-119	SD-119_2003120	12/1/2003	0	0.33	P	NR	**0.019**	**0.017**	**0.0096**	**0.029**	**0.088**	**0.15**	**0.12**	**0.11**	**0.099**	NR	**0.14**	**0.013**	**0.15**	**0.022**	**0.12**	**0.049**	**0.095**	**0.17**
SD-119-A	SD-119-A _20040	6/1/2004	0	0.33	P	NR	**0.054**	**0.27**	**0.0076**	**0.096**	**0.083**	**0.038**	**0.046**	**0.021**	**0.035**	NR	**0.099**	**0.0044**	**0.51**	**0.14**	**0.022**	**0.14**	**0.46**	**0.35**
SD-119-B	SD-119-B _20040	6/1/2004	0	0.33	P	NR	**0.094**	**0.089**	**0.017**	**0.064**	**0.084**	**0.079**	**0.066**	**0.057**	**0.059**	NR	**0.12**	**0.0099**	**0.28**	**0.093**	**0.056**	**0.28**	**0.27**	**0.23**
SD-119-C	SD-119-C _20040	6/1/2004	0	0.33	P	NR	**0.1**	**0.12**	**0.023**	**0.087**	**0.05**	**0.031**	**0.029**	**0.028**	**0.026**	NR	**0.068**	0.005 U	**0.34**	**0.15**	**0.022**	**0.27**	**0.44**	**0.26**
SD-120	SD-120 _2003120	12/1/2003	0	0.33	P	NR	0.005 U	0.005 U	0.005 U	0.005 U	**0.0094**	**0.015**	**0.0091**	**0.013**	**0.0096**	NR	**0.013**	0.005 U	**0.0089**	0.005 U	**0.013**	0.005 U	0.005 U	**0.016**
SD-121	SD-121 _2004060	6/1/2004	0	0.33	P	NR	**0.014**	**0.01**	**0.005**	**0.022**	**0.052**	**0.062**	**0.061**	**0.041**	**0.05**	NR	**0.056**	**0.0066**	**0.11**	**0.017**	**0.04**	**0.027**	**0.091**	**0.088**
SD-122	SD-122 _2004060	6/1/2004	0	0.33	P	NR	**0.077**	**0.1**	**0.0099**	**0.15**	**0.16**	**0.096**	**0.11**	**0.058**	**0.099**	NR	**0.29**	**0.0099**	**0.71**	**0.15**	**0.059**	**0.12**	**0.56**	**0.46**
SD-123	SD-123 _2004060	6/1/2004	0	0.33	P	NR	**0.026**	**0.04**	**0.013**	**0.12**	**0.31**	**0.22**	**0.21**	**0.11**	**0.23**	NR	**0.61**	**0.028**	**0.32**	**0.07**	**0.11**	**0.049**	**0.29**	**0.24**
SD-124	SD-124 _2004060	6/1/2004	0	0.33	P	NR	0.0049 U	0.0049 U	0.0049 U	**0.012**	**0.05**	**0.039**	**0.043**	**0.025**	**0.038**	NR	**0.076**	0.0049 U	**0.11**	**0.0057**	**0.023**	**0.0068**	**0.034**	**0.09**
SD-125	SD-125 _2005040	4/1/2005	0	0.33	P	NR	**0.13**	**0.36**	**0.03**	**0.39**	**0.42**	**0.17**	**0.29**	**0.07**	**0.11**	NR	**0.47**	**0.07**	**1.9**	**0.45**	**0.078**	**0.32**	**1.6**	**1.4**
SD-126	SD-126_2005040	4/1/2005	0	0.33	P	NR	**0.05**	**0.3**	**0.06**	**0.35**	**0.62**	**0.33**	**0.55**	**0.15**	**0.2**	NR	**0.71**	**0.04**	**1.9**	**0.4**	**0.16**	**0.11**	**1.4**	**1.6**
SD-127	SD-127 _2005040	4/1/2005	0	0.33	P	NR	**0.26**	**0.93**	**0.068**	**0.92**	**0.83**	**0.31**	**0.59**	**0.13**	**0.18**	NR	**0.94**	**0.04**	**3.9**	**1.2**	**0.15**	**0.42**	**4.6**	**2.6**
SD-128	SD-128 _2005040	4/1/2005	0	0.33	P	NR	**0.28**	**1.1**	**0.03**	**0.54**	**0.32**	**0.11**	**0.2**	**0.054**	**0.068**	NR	**0.36**	0.022 U	**2.1**	**1.4**	**0.057**	**0.35**	**4.2**	**1.5**
SD-130	SD-130 _2005040	4/1/2005	0	0.33	P	NR	**0.072**	**0.1**	**0.04**	**0.2**	**0.27**	**0.17**	**0.37**	**0.11**	**0.11**	NR	**0.44**	**0.03**	**0.87**	**0.13**	**0.12**	**0.15**	**0.51**	**0.64**
SD-131	SD-131 _2005040	4/1/2005	0	0.33	P	NR	**0.20**	**0.69**	**0.32**	**3.5**	**7**	**3.6**	**6.3**	**1.5**	**2.3**	NR	**11**	**0.45**	**20**	**0.78**	**1.7**	**0.44**	**5.1**	**15**
SD-132	SD-132 _2005040	4/1/2005	0	0.33	P	NR	**0.066**	**0.24**	**0.078**	**0.29**	**0.39**	**0.25**	**0.58**	**0.16**	**0.2**	NR	**0.8**	**0.04**	**3.7**	**0.24**	**0.17**	**0.14**	**1.9**	**2.2**
SD-133	SD-133 _2005040	4/1/2005	0	0.33	P	NR	**0.01**	**0.012**	**0.02**	**0.039**	**0.1**	**0.12**	**0.21**	**0.086**	**0.073**	NR	**0.21**	**0.017**	**0.39**	**0.016**	**0.087**	**0.017**	**0.14**	**0.38**
SD-134	SD-134_2005040	4/1/2005	0	0.33	P	NR	**0.02**	**0.1**	**0.05**	**0.51**	**0.42**	**0.26**	**0.56**	**0.12**	**0.2**	NR	**0.63**	**0.034**	**1.3**	**0.13**	**0.14**	**0.035**	**0.59**	**0.98**
SD-135	SD-135_2005040	4/1/2005	0	0.33	P	NR	**0.16**	**0.32**	**0.31**	**1.4**	**2.3**	**1.9**	**5.2**	**1.3**	**1.5**	NR	**5.2**	**0.31**	**12**	**0.5**	**1.5**	**0.36**	**5.5**	**7.9**
SD-135	SD-135_DUP_200	4/1/2005	0	0.33	FD	NR	**0.11**	**0.24**	**0.25**	**0.74**	**2.3**	**1.8**	**4.2**	**1.1**	**1.4**	NR	**4.5**	**0.27**	**7.1**	**0.33**	**1.3**	**0.25**	**2.2**	**5.9**
SD-136	SD-136 _2005040	4/1/2005	0	0.33	P	NR	**0.02**	**0.054**	**0.07**	**0.25**	**1.2**	**1.1**	**2.2**	**0.48**	**0.67**	NR	**2.3**	**0.14**	**1.6**	**0.13**	**0.56**	**0.025**	**0.51**	**1.3**
SD-137	SD-137 _2005040	4/1/2005	0	0.33	P	NR	0.0022 U	0.0018 U	**0.00**	**0.01**	**0.012**	**0.026**	**0.039**	**0.02**	**0.01**	NR	**0.018**	**0.00**	**0.018**	0.003 U	**0.021**	**0.00**	**0.01**	**0.02**
SD-139	SD-139 _2005040	4/1/2005	0	0.33	P	NR	**0.017**	**0.12**	**0.018**	**0.052**	**0.051**	**0.07**	**0.1**	**0.052**	**0.035**	NR	**0.11**	**0.012**	**0.15**	**0.084**	**0.056**	**0.027**	**0.15**	**0.14**
SD-140	SD-140_2005040	4/1/2005	0	0.33	P	NR	**0.00**	**0.01**	**0.013**	**0.03**	**0.091**	**0.078**	**0.12**	**0.057**	**0.038**	NR	**0.13**	**0.012**	**0.24**	**0.01**	**0.054**	**0.01**	**0.048**	**0.23**
SD-141	SD-141_2005040	4/1/2005	0	0.33	P	NR	0.0023 U	**0.00**	**0.00**	**0.012**	**0.024**	**0.026**	**0.038**	**0.017**	**0.017**	NR	**0.064**	0.0041 U	**0.023**	**0.00**	**0.018**	**0.00**	**0.015**	**0.026**
SHID1	SHID1_19961001	10/1/1996	0	0.3	P	NR	0.02 U	0.02 U	0.02 U	**0.025**	**0.13**	**0.23**	**0.29**	NR	**0.14**	NR	**0.24**	NR	**0.33**	0.02 U	**0.16**	0.02 U	**0.073**	**0.29**
SHID2	SHID2 _19961001	10/1/1996	0	0.3	P	NR	0.019 U	0.019 U	0.019 U	0.019 U	0.019 U	**0.019**	0.019 U	NR	0.019 U	NR	0.019 U	NR	**0.022**	0.019 U	0.019 U	0.019 U	0.019 U	**0.026**
SHID6	SHI6D_19961101	11/1/1996	0	0.3	P	NR	0.019 U	**0.028**	**0.022**	**0.13**	**0.14**	**0.1**	**0.27**	NR	**0.069**	NR	**0.2**	NR	**0.36**	**0.038**	**0.085**	**0.028**	**0.19**	**0.34**

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	TPH			VPH								
						Diesel Range Organics	Residual Range Hydrocarbons	TPH	$C_{>5}$-C_6 Aliphatics	$C_{>6}$-C_8 Aliphatics	$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{13} Aromatics	PID: 2,5-Dibromotoluene	FID: 2,5-Dibromotoluene
						Concentrations in mg/kg											
SCAPPOOSE BAY																	
SD-113	SD-113 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-114	SD-114 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-115	SD-115_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-116	SD-116 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-117	SD-117 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-117-A	SD-117-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-117-B	SD-117-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-117-C	SD-117-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-119	SD-119_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-119-A	SD-119-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-119-B	SD-119-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-119-C	SD-119-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-120	SD-120 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-121	SD-121 _2004060	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-122	SD-122 _2004060	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-123	SD-123 _2004060	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-124	SD-124 _2004060	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-125	SD-125 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-126	SD-126_2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-127	SD-127 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-128	SD-128 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-130	SD-130 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-131	SD-131 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-132	SD-132 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-133	SD-133 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-134	SD-134_2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-135	SD-135 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-135	SD-135_DUP_200	4/1/2005	0	0.33	FD	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-136	SD-136 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-137	SD-137 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-139	SD-139 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-140	SD-140_2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-141	SD-141_2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SHID1	SHID1_19961001	10/1/1996	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SHID2	SHID2 _19961001	10/1/1996	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SHID6	SHI6D_19961101	11/1/1996	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	EPH									
						$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>12}$-C_{16} Aliphatics	$C_{>16}$-C_{21} Aliphatics	$C_{>21}$-C_{34} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{16} Aromatics	$C_{>16}$-C_{21} Aromatics	$C_{>21}$-C_{34} Aromatics
						Concentrations in mg/kg									
SCAPPOOSE BAY															
SD-113	SD-113 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-114	SD-114 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-115	SD-115_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-116	SD-116 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-117	SD-117 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-117-A	SD-117-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-117-B	SD-117-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-117-C	SD-117-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-119	SD-119_2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-119-A	SD-119-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-119-B	SD-119-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-119-C	SD-119-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-120	SD-120 _2003120	12/1/2003	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-121	SD-121 _2004060	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-122	SD-122 _2004060	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-123	SD-123 _2004060	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-124	SD-124 _2004060	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-125	SD-125 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-126	SD-126_2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-127	SD-127 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-128	SD-128 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-130	SD-130 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-131	SD-131 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-132	SD-132 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-133	SD-133 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-134	SD-134_2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-135	SD-135 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-135	SD-135_DUP_200	4/1/2005	0	0.33	FD	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-136	SD-136 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-137	SD-137 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-139	SD-139 _2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-140	SD-140_2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-141	SD-141_2005040	4/1/2005	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SHID1	SHID1_19961001	10/1/1996	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SHID2	SHID2 _19961001	10/1/1996	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SHID6	SHI6D_19961101	11/1/1996	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	PAHs											PAHs							
						1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
						Concentrations in mg/kg																		
MILTON CREEK																								
MC03	MCO3-0-0.3	7/12/2011	0	0.3	P	NR	NR	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	NR	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U
MC04	MC04-0-0.3	7/12/2011	0	0.3	P	NR	NR	**0.268**	0.0135 U	**0.0303**	0.0135 U	0.0135 U	0.0135 U	0.0135 U	0.0135 U	NR	0.0135 U	0.0135 U	**0.0236**	**0.168**	0.0135 U	**0.0866**	**0.235**	**0.0177**
PWS-17	PWS-17_4-7	10/10/2012	0.33	0.58	P	**0.0803**	**0.0458**	**0.149**	**0.00891**	**0.0238**	**0.0263**	**0.0203**	**0.0471**	**0.019**	**0.0137**	**0.0587**	**0.0403**	0.00553 U	**0.0825**	**0.0625**	**0.0172**	**0.195**	**0.124**	**0.0568**
PWS-27	PWS-27_8-11	10/9/2012	0.66	0.92	P	0.00689 U	**0.00972**	**0.0104**	**0.00934**	**0.0264**	**0.0645**	**0.0646**	**0.095**	**0.0491**	**0.0339**	**0.123**	**0.0923**	**0.0103**	**0.186**	**0.0141**	**0.0436**	**0.0228**	**0.103**	**0.186**
PWS-27	PWS-27_8-11_SE	7/13/2012	0.66	0.92	P	0.00805 U	**0.018**	**0.00987**	0.00805 U	**0.0179**	**0.0698**	**0.102**	**0.135**	0.0805 U	**0.0458**	NR	**0.084**	0.0805 U	**0.129**	**0.0129**	0.0805 U	**0.0665**	**0.0652**	**0.135**
PWS-30	PWS-30_8-11	10/12/2012	0.66	0.92	P	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.0171 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U
SD-MC-A	SD-MC-A _20040(	6/1/2004	0	0.33	P	NR	0.026 U	0.026 U	**0.086**	**0.15**	**0.48**	**0.9**	**0.58**	**0.91**	**0.54**	NR	**0.71**	**0.05**	**1.2**	**0.056**	**0.7**	0.026 U	**1**	**1.2**
SD-MC-B	SD-MC-B _20040(	6/1/2004	0	0.33	P	NR	**0.012**	**0.012**	0.005 U	0.005 U	**0.0052**	**0.0095**	**0.0096**	**0.014**	**0.0063**	NR	**0.0081**	0.005 U	**0.02**	**0.011**	**0.012**	**0.051**	**0.023**	**0.017**
SD-MC-C	SD-MC-C _20040(	6/1/2004	0	0.33	P	NR	**0.015**	**0.052**	**0.011**	**0.035**	**0.049**	**0.066**	**0.053**	**0.082**	**0.036**	NR	**0.073**	**0.007**	**0.17**	**0.049**	**0.064**	**0.013**	**0.19**	**0.16**
SD-MC-D	SD-MC-D _20040(	6/1/2004	0	0.33	P	NR	**0.0075**	**0.016**	0.0055 U	**0.015**	**0.033**	**0.026**	**0.025**	**0.02**	**0.019**	NR	**0.05**	0.0055 U	**0.073**	**0.019**	**0.016**	**0.014**	**0.077**	**0.085**
SD-MC-E	SD-MC-E _20040(	6/1/2004	0	0.33	P	NR	**0.02**	**0.041**	**0.037**	**0.27**	**0.15**	**0.31**	**0.3**	**0.2**	**0.17**	NR	**0.26**	**0.037**	**0.36**	**0.055**	**0.23**	**0.056**	**0.17**	**0.31**

Please see notes at end of table.
Notes:

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	TPH			VPH								
						Diesel Range Organics	Residual Range Hydrocarbons	TPH	C_5-C_6 Aliphatics	$C_{>6}$-C_8 Aliphatics	$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{13} Aromatics	PID: 2,5-Dibromotoluene	FID: 2,5-Dibromotoluene
						Concentrations in mg/kg											
MILTON CREEK																	
MC03	MCO3-0-0.3	7/12/2011	0	0.3	P	71.1 U	142 U	107	NT	NT	NT	NT	NT	NT	NT	NT	NT
MC04	MC04-0-0.3	7/12/2011	0	0.3	P	77.1 U	154 U	116	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-17	PWS-17_4-7	10/10/2012	0.33	0.58	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-27	PWS-27_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-27	PWS-27_8-11_SE	7/13/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-30	PWS-30_8-11	10/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-A	SD-MC-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-B	SD-MC-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-C	SD-MC-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-D	SD-MC-D _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-E	SD-MC-E _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

Please see notes at end of table.

TABLE F-A4
Bulk Sediment Analytical Results Summary - PAHs and TPH

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Sample Type	EPH									
						$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>12}$-C_{16} Aliphatics	$C_{>16}$-C_{21} Aliphatics	$C_{>21}$-C_{34} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{16} Aromatics	$C_{>16}$-C_{21} Aromatics	$C_{>21}$-C_{34} Aromatics
						Concentrations in mg/kg									
MILTON CREEK															
MC03	MCO3-0-0.3	7/12/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
MC04	MC04-0-0.3	7/12/2011	0	0.3	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-17	PWS-17_4-7	10/10/2012	0.33	0.58	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-27	PWS-27_8-11	10/9/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-27	PWS-27_8-11_SE	7/13/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PWS-30	PWS-30_8-11	10/12/2012	0.66	0.92	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-A	SD-MC-A _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-B	SD-MC-B _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-C	SD-MC-C _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-D	SD-MC-D _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
SD-MC-E	SD-MC-E _20040	6/1/2004	0	0.33	P	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

Notes:

BOLD = indicates analyte was detected at or above the method detection limit

2011 and 2013 data reported to the reporting limit; 2012 data reported to the method detection limit

PAHs were analyzed using EPA Methods 8270, 8270D and 8270D-SIM

TPH were analyzed using method NWTPH-Dx

TPH calculated as the sum of diesel- and residual- range hydrocarbons using 1/2 the detection limit (DL) for non-detects

VPH - Volatile Petroleum Hydrocarbons using the Washington Ecology method where volatile aliphatic and aromatic hydrocarbons are collectively quantified within the following ranges by gas chromatography (GC) using a photo-ionization detector (PID) and flame ionization detector (FID) in series.

EPH - Extractable Petroleum Hydrocarbons using the Washington Ecology method where extractable aliphatic and aromatic hydrocarbons are collectively quantified within the following ranges by GC using a FID.

-- = Due to an error by the laboratory, EPH was not performed on approximately 1/3 of the 2017 bulk sediment samples (PWS-01, PWS-12, PWS-13, and PWS-15)

Acronyms/Abbreviations

EPA = United States Environmental Protection Agency

FD = field duplicate

ft bgs = feet below ground surface

J = estimated result

mg/kg = milligrams per kilogram

N = presumptively identified result

NJ = presumptively identified and estimated result

NR = not reported

NT = not tested

P = primary sample

PAHs = polycyclic aromatic hydrocarbons

TPH = total petroleum hydrocarbons

U = not detected at or above the stated level

UJ = not detected at or above the stated level, which is an approximate value

H = Sample was analyzed outside of the recommended 14-day holding time.

TABLE F-A5
Bulk Sediment Analytical Results Summary - Dioxins and Furans

Sample	Date	Depth (ft)	2,3,7,8-TCDD	1,2,3,7,8-PeCDD	1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD	1,2,3,7,8,9-HxCDD	1,2,3,4,6,7,8-HpCDD	OCDD	2,3,7,8-TCDF	1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDF	2,3,4,6,7,8-HxCDF	1,2,3,7,8,9-HxCDF	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF	OCDF
			Concentrations in pg/g																
SD-131	4/26/05	0.5	0.044 U	**0.117**	**0.254**	**2.323**	**0.695**	**76.6**	**771**	0.551 U	**0.122**	**0.118**	**0.553**	**0.235**	**0.383**	**0.173**	**11.6**	**0.623**	**63.9**
SD-143	4/26/05	0.5	0.0230 U	0.021 U	0.016 U	**0.130**	0.018 U	**2.35**	**22.9**	0.222 U	0.018 U	0.018 U	0.092	0.018 U	0.018 U	0.013 U	**0.54**	0.020 U	**1.66**
SD-144	4/26/05	0.5	0.0380 U	0.040 U	0.050 U	**0.355**	0.055 U	**10.3**	**116**	0.287 U	0.034 U	0.037 U	0.224	0.035 U	0.033 U	0.033 U	**1.67**	**0.149**	**8.71**

Notes:

Only samples from outside the inferred extent of NAPL (shown on Figure F-1) are presented.

Bold = analyte detection**.**

U = analyte not detected above the stated detection limit.

pg/g = picograms per gram.

TABLE F-A6
Surface Water Analytical Results Summary - 34 PAHs

					Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [2]																	
Sample ID	Passive Sampler Location [1]	No. of Detected Analytes	Total PAHs	Fl/Py Ratio	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/ Anthracenes	C-2 Phenanthrenes/ Anthracenes	C-3 Phenanthrenes/ Anthracenes	C-4 Phenanthrenes/ Anthracenes	Fluoranthene	Pyrene
			µg/L		µg/L																		
Surface Water Site 2	PWS-2	29	0.0518	0.80	**0.0107** B	**0.0396** B	**0.132** B	**0.46** B	**0.996** B	**0.000401**	**0.00952**	**0.00412**	**0.0109** B	**0.0359** B	**0.0321**	**0.0055**	**0.000581**	**0.00599** B	**0.0135**	**0.0191**	0.000276 U	**0.00363**	**0.00451**
Surface Water Site 3	PWS-3	30	0.0192	0.72	**0.00223** B	**0.00758** B	**0.043** B	**0.454** B	**1.94** B	**0.000298**	**0.00267**	**0.00196**	**0.00726** B	**0.047** B	**0.0474**	**0.00135**	**0.00052**	**0.00483** B	**0.0207**	**0.0309**	**0.00951** B	**0.0025**	**0.00347**
Surface Water Site 4	PWS-4	30	0.0260	0.68	**0.0034** B	**0.0102** B	**0.0618** B	**0.515** B	**2.62** B	**0.000292**	**0.00351**	**0.0022**	**0.00868** B	**0.0707** B	**0.08**	**0.00169**	**0.000558**	**0.00562** B	**0.0294**	**0.0424**	**0.00924** B	**0.00335**	**0.00494**
Surface Water Site 9	PWS-9	32	0.0634	0.80	**0.00426** B	**0.0194** B	**0.105** B	**0.832** B	**3.25** B	**0.000849**	**0.0159**	**0.00683**	**0.0198** B	**0.112** B	**0.102**	**0.00627**	**0.00202**	**0.0126** B	**0.0466**	**0.0625**	**0.0244** B	**0.00694**	**0.00871**
Surface Water Site 10-1	PWS-10	32	0.0797	0.75	**0.0108** B	**0.0318** B	**0.12** B	**0.815** B	**3.33** B	**0.000833**	**0.022**	**0.00805**	**0.0178** B	**0.0998** B	**0.0945**	**0.00671**	**0.00174**	**0.012** B	**0.0452**	**0.0576**	**0.0173** B	**0.00642**	**0.00856**
Surface Water Site 10-3	PWS-10	30	0.0657	0.73	**0.00861** B	**0.0264** B	**0.106** B	**0.712** B	**3.23** B	**0.000883**	**0.0173**	**0.00683**	**0.0158** B	**0.0916** B	**0.0906**	**0.00556**	**0.00144**	**0.0102** B	**0.0388**	**0.0501**	0.000276 U	**0.00553**	**0.00758**
Surface Water Site 12	PWS-12	31	0.0709	0.72	**0.00586** B	**0.0201** B	**0.0854** B	**0.586** B	**3.24** B	**0.000936**	**0.0128**	**0.00552**	**0.0114** B	**0.0887** B	**0.096**	**0.00563**	**0.00172**	**0.0111** B	**0.0455**	**0.0614**	**0.0236** B	**0.00665**	**0.00922**
Surface Water Site 13	PWS-13	31	0.0793	0.76	**0.00942** B	**0.0277** B	**0.0968** B	**0.672** B	**3.03** B	**0.00138**	**0.0157**	**0.00669**	**0.0155** B	**0.092** B	**0.0916**	**0.00576**	**0.00268**	**0.0126** B	**0.053**	**0.0826**	**0.0393** B	**0.0102**	**0.0134**
Surface Water Site 14	PWS-14	31	0.0327	0.72	**0.00475** B	**0.0093** B	**0.044** B	**0.38** B	**1.43** B	**0.000468**	**0.0093**	**0.00388**	**0.01** B	**0.0467** B	**0.0428**	**0.00241**	**0.00087**	**0.00456** B	**0.0175**	**0.0252**	**0.00987** B	**0.00259**	**0.00361**
Screening Level Value (SLV) [8]			--	--	620 [3]	--	--	--	--	4,840[4]	74[3]	3.9[5]	--	--	--	6.3[5]	0.09[3]	--	--	--	--	30[3]	0.3[4]

Notes:

[1] The term "passive sampler" refers to the sampling hardware (surface water cages) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU SOPs to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These in situ passive samplers are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in surface water.

[2] SOP 427.00 = Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.

[3] LCV Fish Surface Water Screening Benchmark.

[4] EPA Region 5 ESL Surface Water Screening Benchmark.

[5] OSWER Ambient Water Quality Criteria.

[6] EPA Region 6 FW Surface Water Screening Benchmark.

[7] Tier II SCV Surface Water Screening Benchmark.

[8] SLVs based on the Oak Ridge National Laboratory Risk Assessment Information System database (ORNL, 2014).

Passive samplers PWS-3, PWS-4, PWS-5, PWS-6, PWS-7, PWS-8, PWS-9, PWS-10, PWS-11, PWS-14 were deployed on September 5, 2017.

Passive samplers PWS-1, PWS-2, PWS-12, PWS-13, and PWS-15 were deployed on September 6, 2017.

All passive samplers were removed on September 26, 2017.

Total PAHs represent sum of all 63 freely dissolved concentrations (Cfree ∑63) measured on the passive sampler's media.

Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS)

PAHs = polycyclic aromatic hydrocarbons

µg/L = micrograms per liter

J = estimated value.

U = The analyte was not detected above the applicable reporting or detection limit.

B = Sample was background corrected.

OSU FSES = Oregon State University Food Safety and Environmental Stewardship Program

SOP = Standard Operating Procedure

µg/L = micrograms per liter

Fl/Py = fluoranthene/pyrene

LDPE = low density polyethylene

TABLE F-A6
Surface Water Analytical Results Summary - 34 PAHs

				Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [2]														
Sample ID	**Passive Sampler Location [1]**	**No. of Detected Analytes**	**Total PAHs**	**C-1 Fluoranthrenes/ Pyrenes**	**Benzo(a)anthracene**	**Chrysene**	**C-1 Benz(a)anth/ Chrysenes**	**C-2 Benz(a)anth/ Chrysenes**	**C-3 Benz(a)anth/ Chrysenes**	**C-4 Benz(a)anth/ Chrysenes**	**Benzo(b)fluoranthene**	**Benzo(k)fluoranthene**	**Benzo(e)pyrene**	**Benzo(a)pyrene**	**Perylene**	**Indeno(1,2,3-cd)pyrene**	**Dibenzo(a,h)anthracene**	**Benzo(g,h,i)perylene**
			µg/L	µg/L														
Surface Water Site 2	PWS-2	29	0.0518	**0.00146**	**0.000162**	**0.000168**	**0.000152**	**0.00000542**	0.000000252 U	0.000000252 U	**0.0000447**	**0.00002**	**0.0000408**	**0.0000161**	**0.0000425**	0.000000089 U	0.000000358 U	**0.00000534**
Surface Water Site 3	PWS-3	30	0.0192	**0.00345**	**0.000118**	**0.000137**	**0.000429**	**0.0000239**	0.000000899 U	0.000000899 U	**0.0000493**	**0.0000191**	**0.0000608**	**0.0000226**	**0.000129**	0.000000081 U	0.000000326 U	**0.0000106**
Surface Water Site 4	PWS-4	30	0.0260	**0.00208**	**0.00018**	**0.000207**	**0.000144**	**0.00000802**	0.000000246 U	0.000000246 U	**0.0000651**	**0.0000276**	**0.0000802**	**0.0000298**	**0.00015**	0.000000086 U	0.000000348 U	**0.0000123**
Surface Water Site 9	PWS-9	32	0.0634	**0.00382**	**0.000307**	**0.000315**	**0.000219**	**0.00001**	0.000000185 U	0.000000185 U	**0.000111**	**0.0000363**	**0.000119**	**0.0000549**	**0.000139**	**0.000013**	**0.00000346**	**0.0000166**
Surface Water Site 10-1	PWS-10	32	0.0797	**0.00357**	**0.000293**	**0.000288**	**0.000192**	**0.00000827**	0.00000018 U	0.00000018 U	**0.0000928**	**0.0000394**	**0.0000965**	**0.0000478**	**0.000104**	**0.0000104**	**0.00000277**	**0.0000135**
Surface Water Site 10-3	PWS-10	30	0.0657	**0.00315**	**0.000225**	**0.000247**	**0.000158**	**0.00000831**	0.000000171 U	0.000000171 U	**0.0000729**	**0.0000298**	**0.0000765**	**0.0000408**	**0.000102**	**0.00000881**	0.000000229 U	**0.0000111**
Surface Water Site 12	PWS-12	31	0.0709	**0.00447**	**0.000353**	**0.000328**	**0.000222**	**0.0000104**	0.00000017 U	0.00000017 U	**0.000118**	**0.0000491**	**0.000116**	**0.0000664**	**0.0000969**	**0.0000116**	0.000000228 U	**0.0000156**
Surface Water Site 13	PWS-13	31	0.0793	**0.00689**	**0.000619**	**0.000566**	**0.000372**	**0.0000155**	0.00000019 U	0.00000019 U	**0.000208**	**0.0000908**	**0.000204**	**0.000123**	**0.000126**	**0.000017**	0.000000259 U	**0.0000232**
Surface Water Site 14	PWS-14	31	0.0327	**0.0012**	**0.0000801**	**0.0000956**	**0.0000734**	**0.00000412**	0.000000155 U	0.000000155 U	**0.0000337**	**0.0000129**	**0.000037**	**0.0000192**	**0.0000634**	**0.00000472**	0.000000205 U	**0.00000738**
Screening Level Value (SLV) [8]			--	--	0.027[7]	7[6]	--	--	--	--	9.07[4]	9.07[4]	--	0.014[7]	--	4.31[4]	5.0[6]	7.64[4]

Notes:

[1] The term "passive sampler" refers to the sampling hardware (surface water cages) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU SOPs to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These in situ passive samplers are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in surfacewater.

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Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS)

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J = estimated value.

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B = Sample was background corrected.

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SOP = Standard Operating Procedure

µg/L = micrograms per liter

Fl/Py = fluoranthene/pyrene

LDPE = low density polyethylene

ATTACHMENT B

RBC TABLES (RME AND CTE)

PRINTED TO SHOW ALL VALUES

Risk-Based Concentrations

Note: CTE Data were used for these RBCs.

Contaminated Medium →			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)					
Exposure Pathway →			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}					
Receptor Scenario →			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note
83-32-9	Acenaphthene	nc, v	9,400	>Csat	28,000	>Csat	140,000	>Csat	140,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	1,500		2,000		2,700	
107-13-1	Acrylonitrile	c, v	1.9		6.9		25		200		5,500		3.8		8.6		24		0.23		0.51		4.3		0.0010		0.0045		0.0079		0.15		0.66		1.1	
309-00-2	Aldrin	c, v	0.074		0.25		1.3		6.8	>Csat	190	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.066		0.29		0.45		0.0027		0.012		0.018	
120-12-7	Anthracene	nc, v	47,000	>Csat	140,000	>Csat	700,000	>Csat	700,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-38-2	Arsenic	c, nv	0.91		3.1		17		99		2,700		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.15		0.63		1.8	
7440-39-3	Barium	nc, nv	30,000		90,000		400,000		430,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		8,900		12,000		45,000	
56-55-3	Benz[a]anthracene	c, v	1.1		2.5		220	>Csat	1,100	>Csat	30,000	>Csat	-	>Csat	-	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Max	1.6		6.0		-	>Csat	0.030		0.11		1.6	
71-43-2	Benzene	c, v	18		66		230		1,900	>Csat	52,000	>Csat	33		75		210		0.46		1.0		8.7		0.067		0.28		0.47		1.3		5.7		9.3	
92-87-5	Benzidine	c, nv	0.00052		0.0012		0.10		0.53		15		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.000038		0.00012		0.0040		0.00011		0.00034		0.011	
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	0.11		0.25		23	>Csat	110	>Csat	3,100	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	4.4		-	>Csat	-	>Csat	0.025		0.080		-	>S
205-99-2	Benzo[b]fluoranthene	c, nv	1.1		2.5		230	>Csat	1,100	>Csat	31,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.25		0.80		-	>S
207-08-9	Benzo[k]fluoranthene	c, nv	11	>Csat	25	>Csat	2,300	>Csat	11,000	>Csat	310,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-41-7	Beryllium	c, nv	4,500		20,000		28,000		340,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	92		310	>Csat	1,700	>Csat	8,600	>Csat	240,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	17		67		190	
75-27-4	Bromodichloromethane	c, v	8.6		34		73		750		21,000	>Csat	7.0		16		44		0.12		0.26		2.2		0.0057		0.025		0.037		0.39		1.7		2.6	
75-25-2	Bromoform	c, v	130		460		1,600	>Csat	13,000	>Csat	360,000	>Csat	240		530		1,500		24		53		450		0.14		0.58		0.98		9.7		41		70	
74-83-9	Bromomethane	nc, v	59		180		980		1,500		21,000	>Csat	170		170		700		1.3		1.3		17		0.098		0.13		0.42		8.9		12		38	
7440-43-9	Cadmium	nc, nv	150		460		2,200		2,300		32,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		45		59		230	
56-23-5	Carbon tetrachloride	c, v	16		57		230		1,700	>Csat	48,000	>Csat	43		97		270		0.35		0.78		6.6		0.038		0.15		0.26		1.4		5.5		9.5	
108-90-7	Chlorobenzene	nc, v	640	>Csat	1,900	>Csat	11,000	>Csat	17,000	>Csat	240,000	>Csat	-	>Csat	-	>Csat	-	>Csat	77		77		-	>Csat	6.9		9.2		28		91		120		370	
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	8.9		34		88		830		23,000	>Csat	9.6		22		60		0.65		1.5		12		0.0069		0.030		0.047		0.49		2.1		3.3	
75-00-3	Chloroethane (ethyl chloride)	nc, v	160,000	>Csat	480,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	310		410		1,300		21,000		28,000		88,000	
67-66-3	Chloroform	c, v	15		61		120		1,300	>Csat	36,000	>Csat	11		25		71		0.091		0.20		1.7		0.0097		0.043		0.063		0.64		2.8		4.2	
74-87-3	Chloromethane	nc, v	1,400	>Csat	4,300	>Csat	25,000	>Csat	50,000	>Csat	700,000	>Csat	-	>Csat	-	>Csat	-	>Csat	24		24		300		2.2		2.9		9.1		190		250		790	
12789-03-6	Chlordane	c, v	4.6		15		66	>Csat	390	>Csat	11,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	2.6		12		18		0.13		0.57		0.90	
16065-83-1	Chromium (III)	nc, nv	230,000		700,000		-	>Max	-	>Max	-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		67,000		89,000		340,000	
18540-29-9	Chromium (VI)	c, nv	0.30		0.67		51		320		8,800		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.050		0.16		5.2	
218-01-9	Chrysene	c, nv	110	>Csat	250	>Csat	23,000	>Csat	110,000	>Csat	-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-50-8	Copper	nc, nv	6,300		19,000		93,000		93,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		1,800		2,400		9,100	
74-90-8	Cyanide (hydrogen cyanide) ^A	nc, v	17		50		190		340		4,700		98		98		1,200		98		98		1,200		0.94		1.3		4.0		1.6		2.1		6.7	
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	7.1		22		110		620	>Csat	17,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	4.0		8.7		11		0.11		0.25		0.31	
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	4.8		15		71		420		12,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	5.2		23		33		0.15		0.65		0.93	
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	5.0		16		77		430	>Csat	12,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	65		230		-	>Csat	1.3		4.6		-	>S
53-70-3	Dibenz[a,h]anthracene	c, nv	0.11		0.25		23	>Csat	110	>Csat	3,100	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.025		0.080		-	>S
95-50-1	1,2-Dichlorobenzene	nc, v	2,600	>Csat	7,800	>Csat	44,000	>Csat	73,000	>Csat	1,000,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	44		58		170		360		490		1,400	
106-46-7	1,4-Dichlorobenzene	c, v	41		180		280	>Csat	3,200	>Csat	88,000	>Csat	24		53		150		2.9		6.5		54		0.17		0.74		1.0		1.4		6.3		8.8	
91-94-1	3,3-Dichlorobenzidine	c, nv	3.5		11		53	>Csat	270	>Csat	7,500	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.94		3.3		5.8		0.98		3.5		6.1	
75-34-3	1,1-Dichloroethane	c, v	160		580		1,400	>Csat	13,000	>Csat	370,000	>Csat	160		360		1,000		1.3		2.9		25		0.14		0.61		0.87		8.9		38		55	
75-35-4	1,1-Dichloroethene	nc, v	2,300	>Csat	6,800	>Csat	38,000	>Csat	57,000	>Csat	790,000	>Csat	-	>Csat	-	>Csat	-	>Csat	54		54		680		8.2		11		34		350		460		1,400	
156-59-2	cis-1,2-Dichloroethene	nc, v	310		940		4,700	>Csat	4,700	>Csat	65,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	1.5		2.0		5.8		83		110		330	
156-60-5	trans-1,2-Dichloroethene	nc, v	3,100	>Csat	9,400	>Csat	47,000	>Csat	47,000	>Csat	650,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	16		22		65		830		1,100		3,300	
111-44-4	Dichloroethylether	c, v	0.79		2.9		7.1		66		1,800		1.5		3.4		29		1.5		3.4		29		0.00061		0.0026		0.0038		0.044		0.19		0.27	
75-09-2	Dichloromethane	c, v	76		170		13,000	>Csat	80,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	26		51		-	>Csat	0.14		0.44		13		11		37		1,100	
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	1,400	>Csat	4,300	>Csat	20,000	>Csat	17,000	>Csat	240,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5.3		7.1		21		410		540		1,600	
60-57-1	Dieldrin	c, nv	0.099		0.31		1.5		7.6		210	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.042		0.10		0.13		0.0070		0.017		0.022	
606-20-2	2,6-Dinitrotoluene	c, nv	1.1		3.3		16		81		2,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.048		0.16		0.27		0.27		0.90		1.5	
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	0.23		0.71		3.4		17		480		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.0052		0.018		0.031		0.060		0.21		0.35	
123-91-1	1,4-Dioxane	c, v	15		48		190		1,200		35,000		81		180		1,500		81		180		1,500		0.0094		0.038		0.058		1.9		7.5		12	
86-30-6	Diphenylnitrosamine	c, nv	320	>Csat	1,000	>Csat	4,900	>Csat	25,000	>Csat	690,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	51		150		-	>Csat	64		190		290	
106-93-4	EDB (1,2-dibromoethane)	c, v	0.43		1.6		3.9		36		1,000	>Csat	0.43		0.97		2.7		0.035		0.078		0.65		0.00039		0.0017		0.0024		0.024		0.10		0.15	
107-06-2	EDC (1,2-dichloroethane)	c, v	9.8		36		88		820		23,000	>Csat	10.0		22		63		0.22		0.50		4.2		0.0091		0.039		0.056		0.55		2.4		3.4	
115-29-7	Endosulfan (alpha-beta)	nc, v	860	>Csat	2,600	>Csat	12,000	>Csat	10,000	>Csat	140,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	230		320		-	>S
72-20-8	Endrin	nc, nv	43	>Csat	130	>Csat	610	>Csat	520	>Csat	7,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	5.6		7.8		9.0	
100-41-4	Ethylbenzene	c, v	90		320		850	>Csat	7,600	>Csat	210,000	>Csat	100		230		-	>Csat	3.7		8.4		70		0.71		2.8		3.9		5.1		20		28	
206-44-0	Fluoranthene	nc, nv	5,600	>Csat	17,000	>Csat	79,000	>Csat	64,000	>Csat	890,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
86-73-7	Fluorene	nc, v	6,300	>Csat	19,000	>Csat	93,000	>Csat	93,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	820		1,100		1,400	
50-00-0	Formaldehyde	c, v	42		190		270		3,200		89,000	>Csat	140		310		2,600		140		310		2,600		0.0057		0.025		0.036		1.2		5.6		7.9	
76-44-8	Heptachlor	c, v	0.31		1.0		4.0		24		660		51		120		970		51		120		970		0.058		0.16		0.20		0.0047		0.013		0.016	
1024-57-3	Heptachlor Epoxide	c, v	0.16		0.52		2.2		12		340	>Csat	81		-	>Csat	-	>Csat	81		-	>Csat	-	>Csat	0.014		0.050		0.069		0.0045		0.016		0.023	
118-74-1	Hexachlorobenzene	c, v	0.55		2.0		5.0		46		1,300		2.9		6.6		55		2.9		6.6		55		0.058		0.25		0.37		0.031		0.14		0.20	
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	0.25		0.79		3.8		19	>Csat	530	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.029		0.077		0.11		0.034		0.091		0.13	
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	1.4		4.5		22		110	>Csat	3,100	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.17		0.44		0.62		0.20		0.52		0.73	
67-72-1	Hexachloroethane	c, v	22		79		200		1,600	>Csat	45,000	>Csat	24		53		150		1.7		3.8		32		0.072		0.27		0.38		1.1		4.2		5.8	
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	1.1	>Csat	2.5	>Csat	230	>Csat	1,100	>Csat	31,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7439-92-1	Lead	NA, nv	400	L	400	L	800	L	800	L	800		L	NV	-	NV	-	NV	-	NV	-	NV	-	NV	30	L	30	L	30	L	15	L	15	L	15	L

Risk-Based Concentrations

Contaminated Medium →			GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
Exposure Pathway →			Volatilization to Outdoor Air RBC_{wo}						Vapor Intrusion into Buildings RBC_{wi}						GW in Excavation RBC_{we}		Vapor Intrusion into Buildings RBC_{sv}						Inhalation RBC_{air}					
Receptor Scenario →			Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			IVW		IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
83-32-9	Acenaphthene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
107-13-1	Acrylonitrile	c, v	6,500		15,000		41,000		2,000		4,600		38,000		490		24		54		750		0.12		0.27		0.75	
309-00-2	Aldrin	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	7.0		0.33		0.74		10		0.0017		0.0037		0.010	
120-12-7	Anthracene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
7440-38-2	Arsenic	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	13,000		-	NV	-	NV	-	NV	0.0019		0.0042		0.012	
7440-39-3	Barium	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.7E+07		-	NV	-	NV	-	NV	0.52		0.52		2.2	
56-55-3	Benz[a]anthracene	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	0.017		0.033		0.85	
71-43-2	Benzene	c, v	9,100		20,000		57,000		620		1,400		12,000		3,500		210		470		6,600		1.0		2.3		6.6	
92-87-5	Benzidine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	35		-	NV	-	NV	-	NV	0.000015		0.000029		0.00076	
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0017		0.0033		-	>Pv
205-99-2	Benzo[b]fluoranthene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.017		0.033		0.85	
207-08-9	Benzo[k]fluoranthene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7440-41-7	Beryllium	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0034		0.0076		0.021	
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
75-27-4	Bromodichloromethane	c, v	4,000		8,900		25,000		510		1,200		9,700		900		44		99		1,400		0.22		0.49		1.4	
75-25-2	Bromoform	c, v	360,000		820,000		2,300,000		100,000		230,000		2,000,000		28,000		1,500		3,300		46,000		7.4		17		46	
74-83-9	Bromomethane	nc, v	32,000		32,000		130,000		2,100		2,100		27,000		1,200		1,000		1,000		22,000		5.2		5.2		22	
7440-43-9	Cadmium	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	130,000		-	NV	-	NV	-	NV	0.010		0.010		0.044	
56-23-5	Carbon tetrachloride	c, v	5,100		11,000		32,000		260		600		5,000		3,500		270		610		8,500		1.4		3.0		8.5	
108-90-7	Chlorobenzene	nc, v	-	>S	-	>S	-	>S	67,000		67,000		-	>S	10,000		10,000		10,000		220,000		52		52		220	
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	11,000		25,000		71,000		2,800		6,400		53,000		1,200		60		140		1,900		0.30		0.68		1.9	
75-00-3	Chloroethane (ethyl chloride)	nc, v	-	>S	-	>S	-	>S	2,800,000		2,800,000		-	>S	2,400,000		2,100,000		2,100,000		4.4E+07		10,000		10,000		44,000	
67-66-3	Chloroform	c, v	4,200		9,400		26,000		360		810		6,800		1,400		71		160		2,200		0.35		0.79		2.2	
74-87-3	Chloromethane	nc, v	440,000		440,000		1,800,000		26,000		26,000		330,000		22,000		19,000		19,000		390,000		94		94		390	
12789-03-6	Chlordane	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	16		37		-	>Pv	0.081		0.18		0.51	
16065-83-1	Chromium (III)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.0E+15		1.0E+15		4.4E+15	
18540-29-9	Chromium (VI)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	19,000		-	NV	-	NV	-	NV	0.000012		0.000023		0.00061	
218-01-9	Chrysene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.7		3.3		-	>Pv
7440-50-8	Copper	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5,400,000		-	NV	-	NV	-	NV	1.0E+15		1.0E+15		4.4E+15	
74-90-8	Cyanide (hydrogen cyanide) ^	nc, v	32,000		32,000		140,000		10,000		10,000		130,000		190		170		170		3,500		0.83		0.83		3.5	
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	63		-	NV	-	NV	-	NV	0.12		0.26		0.74	
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	17		38		-	>Pv	0.084		0.19		0.53	
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.084		0.19		0.53	
53-70-3	Dibenz[a,h]anthracene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
95-50-1	1,2-Dichlorobenzene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	37,000		42,000		42,000		880,000		210		210		880	
106-46-7	1,4-Dichlorobenzene	c, v	14,000		32,000		-	>S	1,600		3,500		30,000		2,900		150		330		4,600		0.74		1.7		4.6	
91-94-1	3,3-Dichlorobenzidine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.024		0.054		0.15	
75-34-3	1,1-Dichloroethane	c, v	45,000		100,000		290,000		3,200		7,200		60,000		20,000		1,000		2,300		32,000		5.1		11		32	
75-35-4	1,1-Dichloroethene	nc, v	570,000		570,000		2,400,000		29,000		29,000		360,000		44,000		42,000		42,000		880,000		210		210		880	
156-59-2	cis-1,2-Dichloroethene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	18,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
156-60-5	trans-1,2-Dichloroethene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	180,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
111-44-4	Dichloroethylether	c, v	16,000		37,000		130,000		6,700		15,000		130,000		100		4.9		11		150		0.025		0.055		0.15	
75-09-2	Dichloromethane	c, v	1,000,000		2,000,000		-	>S	90,000		170,000		-	>S	1,300,000		20,000		39,000		5,100,000		100		200		5,100	
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	77,000		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
60-57-1	Dieldrin	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	4.9		-	NV	-	NV	-	NV	0.0018		0.0040		0.011	
606-20-2	2,6-Dinitrotoluene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,700		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	740		-	NV	-	NV	-	NV	0.0041		0.0091		0.026	
123-91-1	1,4-Dioxane	c, v	2,400,000		5,400,000		1.9E+07		980,000		2,200,000		1.9E+07		6,700		320		730		10,000		1.6		3.7		10	
86-30-6	Diphenylnitrosamine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	3.1		7.0		20	
106-93-4	EDB (1,2-dibromoethane)	c, v	520		1,200		3,300		130		290		2,500		55		2.7		6.1		85		0.014		0.030		0.085	
107-06-2	EDC (1,2-dichloroethane)	c, v	6,000		13,000		38,000		850		1,900		16,000		1,300		62		140		2,000		0.31		0.70		2.0	
115-29-7	Endosulfan (alpha-beta)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
72-20-8	Endrin	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	170		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
100-41-4	Ethylbenzene	c, v	29,000		65,000		-	>S	1,800		4,100		34,000		9,000		650		1,500		20,000		3.2		7.3		20	
206-44-0	Fluoranthene	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
86-73-7	Fluorene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
50-00-0	Formaldehyde	c, v	4,500,000		1.0E+07		3.5E+07		1,900,000		4,200,000		3.5E+07		2,600		120		280		3,900		0.62		1.4		3.9	
76-44-8	Heptachlor	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.6		1.2		2.8		39		0.0062		0.014		0.039	
1024-57-3	Heptachlor Epoxide	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	6.4		0.62		1.4		20		0.0031		0.0070		0.020	
118-74-1	Hexachlorobenzene	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.5		7.9		110		0.018		0.040		0.11	
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	35		-	NV	-	NV	-	NV	0.0045		0.010		0.028	
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	200		-	NV	-	NV	-	NV	0.026		0.059		0.16	
67-72-1	Hexachloroethane	c, v	14,000		32,000		-	>S	1,700		3,700		31,000		1,700		150		330		4,600		0.74		1.7		4.6	
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7439-92-1	Lead	NA, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv

Risk-Based Concentrations

Note: CTE Data were used for these RBCs.

Contaminated Medium			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)					
Exposure Pathway			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}					
Receptor Scenario			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note
7439-96-5	Manganese	nc, nv	3,600		11,000		47,000		51,000		710,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		1,100		1,400		5,500	
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	71		210	>Csat	1,000	>Csat	860	>Csat	12,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.24		0.32		0.73		18		25		56	
7439-97-6	Mercury	nc, nv	47		140		700		700		9,700		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		13		18		-	>S
1634-04-4	MTBE (methyl t-butyl ether)	c, v	650		2,300		6,900	>Csat	57,000	>Csat	-	>Max	1,000		2,200		6,300		25		55		460		0.39		1.7		2.4		49		210		310	
91-20-3	Naphthalene	c, v	15		69		96		1,200	>Csat	32,000	>Csat	18		41		-	>Csat	18		41		-	>Csat	0.22		1.0		1.4		0.48		2.1		3.0	
7440-02-0	Nickel	c, nv	41,000		190,000		260,000		-	>Max	-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S
87-86-5	Pentachlorophenol	c, nv	3.5		11		50		220		6,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.26		0.58		0.74		0.17		0.39		0.50	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	nc, v	0.77		0.93		1.6	>Csat	31	>Csat	430	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	0.036		0.048		0.19	
98-82-8	iso-Propylbenzene (cumene)	nc, v	4,500	>Csat	14,000	>Csat	76,000	>Csat	110,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	140		180		-	>Csat	630		850		2,100	
129-00-0	Pyrene	nc, v	4,200	>Csat	13,000	>Csat	59,000	>Csat	48,000	>Csat	670,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-22-4	Silver	nc, nv	780		2,300		12,000		12,000		160,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		220		300		1,100	
100-42-5	Styrene	nc, v	11,000	>Csat	32,000	>Csat	170,000	>Csat	250,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	220		300		840		1,600		2,200		6,000	
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	0.000013		0.000040		0.00014		0.0011		0.030		0.030		0.067		-	>Csat	0.030		0.067		-	>Csat	0.000022		0.000095		0.00014		2.9E-07		1.3E-06		1.8E-06	
127-18-4	Tetrachloroethene (PCE)	c, v	590	>Csat	2,000	>Csat	6,400	>Csat	51,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	8.0		18		150		1.6		6.0		8.5		41		150		210	
108-88-3	Toluene	nc, v	11,000	>Csat	32,000	>Csat	160,000	>Csat	180,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	180		240		-	>Csat	2,300		3,100		7,300	
8001-35-2	Toxaphene	c, nv	1.4		4.5		22		110		3,100	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.4		3.1		4.0		0.059		0.13		0.17	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	430,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	59,000		79,000		-	>S
71-55-6	1,1,1-Trichloroethane	nc, v	64,000	>Csat	190,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	220		290		910		9,200		12,000		38,000	
79-00-5	1,1,2-Trichloroethane	c, v	16		58		140		1,300		37,000	>Csat	16		36		100		0.92		2.1		17		0.020		0.087		0.12		0.89		3.8		5.5	
79-01-6	Trichloroethene	NA, v	6.7		17		51		130		3,700	>Csat	15		33		96		0.12		0.26		2.3		0.013		0.053		0.087		0.49		2.0		3.3	
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	9,000	>Csat	27,000	>Csat	150,000	>Csat	250,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	190		190		-	>Csat	70		93		290		1,300		1,700		5,400	
88-06-2	2,4,6-Trichlorophenol	c, nv	140		450		2,200		11,000	>Csat	310,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	11		30		41		21		55		77	
95-63-6	1,2,4-Trimethylbenzene	nc, v	590		1,800	>Csat	9,800	>Csat	14,000	>Csat	190,000	>Csat	-	>Csat	-	>Csat	-	>Csat	140		140		-	>Csat	16		22		51		85		110		260	
108-67-8	1,3,5-Trimethylbenzene	nc, v	590	>Csat	1,800	>Csat	9,800	>Csat	14,000	>Csat	190,000	>Csat	-	>Csat	-	>Csat	-	>Csat	98		98		-	>Csat	17		22		56		88		120		300	
75-01-4	Vinyl chloride	c, v	0.70		1.5		36		220		6,200	>Csat	5.3		6.5		370		0.043		0.053		9.0		0.0016		0.0037		0.055		0.074		0.18		2.6	
1330-20-7	Xylenes	nc, v	1,500	>Csat	4,600	>Csat	26,000	>Csat	50,000	>Csat	690,000	>Csat	-	>Csat	-	>Csat	-	>Csat	160		160		-	>Csat	24		33		100		200		270		830	

For a complete explanation of notes, please see "Notes to Accompany Risk-Based Concentrations for Individual Chemicals."

Ψ WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.

Risk-Based Concentrations

Contaminated Medium →			GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m^3						AIR µg/m^3					
Exposure Pathway →			Volatilization to Outdoor Air RBC_{wo}						Vapor Intrusion into Buildings RBC_{wi}						GW in Excavation RBC_{we}		Vapor Intrusion into Buildings RBC_{sv}						Inhalation RBC_{air}					
Receptor Scenario →			Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			IVW		IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
7439-96-5	Manganese	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	3,200,000		-	NV	-	NV	-	NV	0.052		0.052		0.22	
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,700		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7439-97-6	Mercury	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.31		0.31		1.3	
1634-04-4	MTBE (methyl t-butyl ether)	c, v	1,000,000		2,300,000		6,400,000		190,000		430,000		3,600,000		130,000		6,200		14,000		200,000		31		70		200	
91-20-3	Naphthalene	c, v	10,000		23,000		-	>S	2,400		5,500		-	>S	1,000		48		110		1,500		0.24		0.54		1.5	
7440-02-0	Nickel	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.031		0.070		0.20	
87-86-5	Pentachlorophenol	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	110		-	NV	-	NV	-	NV	1.6		3.6		10	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
98-82-8	iso-Propylbenzene (cumene)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	51,000		83,000		83,000		1,800,000		420		420		1,800	
129-00-0	Pyrene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
7440-22-4	Silver	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,100,000		-	NV	-	NV	-	NV	1.0E+15		1.0E+15		4.4E+15	
100-42-5	Styrene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	170,000		210,000		210,000		4,400,000		1,000		1,000		4,400	
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	0.063		0.14		-	>S	0.024		0.054		-	>S	0.00090		0.000043		0.000096		0.0013		1.6E-07		3.7E-07		1.0E-06	
127-18-4	Tetrachloroethene (PCE)	c, v	190,000		-	>S	-	>S	11,000		24,000		200,000		69,000		6,200		14,000		200,000		31		70		200	
108-88-3	Toluene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	220,000		1,000,000		1,000,000		2.2E+07		5,200		5,200		22,000	
8001-35-2	Toxaphene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	36		-	NV	-	NV	-	NV	0.025		0.057		0.16	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	6,300,000		6,300,000		1.3E+08		31,000		31,000		130,000	
71-55-6	1,1,1-Trichloroethane	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1,100,000		1,000,000		1,000,000		2.2E+07		5,200		5,200		22,000	
79-00-5	1,1,2-Trichloroethane	c, v	14,000		31,000		86,000		2,500		5,700		47,000		2,000		100		230		3,200		0.51		1.1		3.2	
79-01-6	Trichloroethene	NA, v	3,300		6,900		20,000		200		430		3,700		430		95		200		2,900		0.47		1.0		2.9	
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	780,000		780,000		-	>S	36,000		36,000		460,000		160,000		150,000		150,000		3,100,000		730		730		3,100	
88-06-2	2,4,6-Trichlorophenol	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	22,000		-	NV	-	NV	-	NV	2.6		5.9		16	
95-63-6	1,2,4-Trimethylbenzene	nc, v	-	>S	-	>S	-	>S	50,000		50,000		-	>S	6,300		13,000		13,000		260,000		63		63		260	
108-67-8	1,3,5-Trimethylbenzene	nc, v	-	>S	-	>S	-	>S	36,000		36,000		-	>S	7,500		13,000		13,000		260,000		63		63		260	
75-01-4	Vinyl chloride	c, v	350		430		25,000		17		21		3,700		1,900		33		41		12,000		0.17		0.20		12	
1330-20-7	Xylenes	nc, v	-	>S	-	>S	-	>S	86,000		86,000		-	>S	23,000		21,000		21,000		440,000		100		100		440	

Ψ **WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.**

Risk-Based Concentrations

Contaminated Medium			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)					
Exposure Pathway			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}					
Receptor Scenario			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note
83-32-9	Acenaphthene	nc, v	4,700	>Csat	9,400	>Csat	70,000	>Csat	21,000	>Csat	590,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	510		2,400		2,500	
107-13-1	Acrylonitrile	c, v	0.86		2.5		4.0		40		1,100		1.3		3.1		5.8		0.079		0.19		1.0		0.00036		0.0016		0.0017		0.052		0.23		0.25	
309-00-2	Aldrin	c, v	0.031		0.078		0.13		1.1		30	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.023		0.10		0.10		0.00092		0.0042		0.0042	
120-12-7	Anthracene	nc, v	23,000	>Csat	47,000	>Csat	350,000	>Csat	110,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-38-2	Arsenic	c, nv	0.43		1.0		1.9		15		420		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.052		0.21		0.31	
7440-39-3	Barium	nc, nv	15,000		31,000		220,000		69,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		4,000		15,000		33,000	
56-55-3	Benz[a]anthracene	c, v	1.1		2.5		21	>Csat	170	>Csat	4,800	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	1.6		6.0		-	>Csat	0.030		0.11		0.38	
71-43-2	Benzene	c, v	8.2		24		37		380		11,000	>Csat	11		27		50		0.16		0.38		2.1		0.023		0.10		0.10		0.46		2.0		2.1	
92-87-5	Benzidine	c, nv	0.00052		0.0012		0.0100		0.082		2.3		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.000038		0.00012		0.00070		0.00011		0.00034		0.0019	
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	0.11		0.25		2.1		17	>Csat	490	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	4.4		-	>Csat	-	>Csat	0.025		0.080		0.47	
205-99-2	Benzo[b]fluoranthene	c, nv	1.1		2.5		21	>Csat	170	>Csat	4,900	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.25		0.80		-	>S
207-08-9	Benzo[k]fluoranthene	c, nv	11	>Csat	25	>Csat	210	>Csat	1,700	>Csat	49,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-41-7	Beryllium	c, nv	1,500		7,300		6,700		170,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	39		97		160	>Csat	1,300	>Csat	37,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	5.6		22		33	
75-27-4	Bromodichloromethane	c, v	3.4		12		15		230		6,300	>Csat	2.4		5.7		11		0.041		0.096		0.53		0.0020		0.0091		0.0088		0.13		0.62		0.60	
75-25-2	Bromoform	c, v	57		170		260		2,700	>Csat	74,000	>Csat	81		190		360		8.2		19		110		0.046		0.20		0.22		3.3		15		16	
74-83-9	Bromomethane	nc, v	46		92		750		370		10,000	>Csat	170		170		700		1.3		1.3		17		0.083		0.30		0.40		7.5		28		36	
7440-43-9	Cadmium	nc, nv	78		160		1,100		350		9,700		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		20		73		160	
56-23-5	Carbon tetrachloride	c, v	7.5		21		34		320		8,900	>Csat	15		35		65		0.12		0.28		1.6		0.013		0.055		0.058		0.46		2.0		2.1	
108-90-7	Chlorobenzene	nc, v	530		1,100	>Csat	8,700	>Csat	4,700	>Csat	130,000	>Csat	-	>Csat	-	>Csat	-	>Csat	77		77		-	>Csat	5.8		22		27		77		290		350	
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	3.7		12		17		210		5,800	>Csat	3.3		7.8		14		0.22		0.53		2.9		0.0024		0.011		0.011		0.17		0.77		0.77	
75-00-3	Chloroethane (ethyl chloride)	nc, v	160,000	>Csat	320,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	310		1,100		1,300		21,000		76,000		88,000	
67-66-3	Chloroform	c, v	5.8		22		26		410		11,000	>Csat	3.9		9.2		17		0.031		0.074		0.41		0.0034		0.016		0.015		0.22		1.0		0.98	
74-87-3	Chloromethane	nc, v	1,400	>Csat	2,900	>Csat	25,000	>Csat	25,000	>Csat	700,000	>Csat	-	>Csat	-	>Csat	-	>Csat	24		24		300		2.2		7.9		9.1		190		690		790	
12789-03-6	Chlordane	c, v	1.7		4.3		7.6		62	>Csat	1,700	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.91		4.1		4.2		0.045		0.20		0.21	
16065-83-1	Chromium (III)	nc, nv	120,000		230,000		-	>Max	530,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		30,000		110,000		250,000	
18540-29-9	Chromium (VI)	c, nv	0.30		0.67		6.3		49		1,400		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.050		0.16		0.90	
218-01-9	Chrysene	c, nv	110	>Csat	250	>Csat	2,100	>Csat	17,000	>Csat	490,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-50-8	Copper	nc, nv	3,100		6,200		47,000		14,000		390,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		800		2,900		6,500	
74-90-8	Cyanide (hydrogen cyanide) ^A^	nc, v	14		28		170		110		3,000		98		98		1,200		98		98		1,200		0.88		3.2		3.9		1.5		5.4		6.5	
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	2.7		6.6		12		94		2,600	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.1		3.7		2.6		0.031		0.10		0.074	
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	1.8		4.5		8.2		66		1,800		-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	1.6		7.4		7.5		0.046		0.21		0.21	
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	1.9		4.6		8.5		66		1,800	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	12		46		70		0.23		0.92		1.4	
53-70-3	Dibenz[a,h]anthracene	c, nv	0.11		0.25		2.1		17	>Csat	490	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.025		0.080		0.47	
95-50-1	1,2-Dichlorobenzene	nc, v	2,200	>Csat	4,400	>Csat	36,000	>Csat	20,000	>Csat	560,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	36		140		160		300		1,200		1,400	
106-46-7	1,4-Dichlorobenzene	c, v	14		62		64		1,300	>Csat	36,000	>Csat	8.1		19		36		0.99		2.3		13		0.057		0.27		0.25		0.48		2.3		2.1	
91-94-1	3,3-Dichlorobenzidine	c, nv	1.2		3.0		5.1		42	>Csat	1,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.17		0.67		1.00		0.17		0.69		1.0	
75-34-3	1,1-Dichloroethane	c, v	58		190		260		3,200	>Csat	89,000	>Csat	56		130		240		0.45		1.1		5.9		0.044		0.20		0.20		2.8		13		13	
75-35-4	1,1-Dichloroethene	nc, v	1,800	>Csat	3,500	>Csat	29,000	>Csat	13,000	>Csat	370,000	>Csat	-	>Csat	-	>Csat	-	>Csat	54		54		680		6.7		25		32		280		1,100		1,400	
156-59-2	cis-1,2-Dichloroethene	nc, v	160		310		2,300	>Csat	710		20,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	0.63		2.4		4.5		36		140		260	
156-60-5	trans-1,2-Dichloroethene	nc, v	1,600		3,100	>Csat	23,000	>Csat	7,100	>Csat	200,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	7.0		27		51		360		1,400		2,600	
111-44-4	Dichloroethylether	c, v	0.29		0.96		1.3		16		450		0.53		1.2		6.9		0.53		1.2		6.9		0.00019		0.00087		0.00087		0.014		0.062		0.063	
75-09-2	Dichloromethane	c, v	76		170		1,600		12,000	>Csat	340,000	>Csat	-	>Csat	-	>Csat	-	>Csat	26		51		950		0.14		0.44		2.4		11		37		200	
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	630	>Csat	1,300	>Csat	8,200	>Csat	2,700	>Csat	74,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.3		8.8		16		170		670		1,200	
60-57-1	Dieldrin	c, nv	0.034		0.085		0.14		1.2		33	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.010		0.037		0.030		0.0017		0.0061		0.0050	
606-20-2	2,6-Dinitrotoluene	c, nv	0.36		0.90		1.5		13		350		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.0089		0.035		0.049		0.049		0.19		0.27	
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	0.078		0.19		0.33		2.7		74		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.00094		0.0038		0.0054		0.011		0.043		0.062	
123-91-1	1,4-Dioxane	c, v	5.4		14		24		210		5,900		28		67		370		28		67		370		0.0023		0.0099		0.012		0.46		2.0		2.4	
86-30-6	Diphenylnitrosamine	c, nv	110		280	>Csat	470	>Csat	3,800	>Csat	110,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	10		39		45		13		49		57	
106-93-4	EDB (1,2-dibromoethane)	c, v	0.16		0.53		0.73		9.0		250		0.15		0.35		0.65		0.012		0.028		0.16		0.00012		0.00056		0.00056		0.0075		0.034		0.034	
107-06-2	EDC (1,2-dichloroethane)	c, v	3.6		12		16		200		5,600	>Csat	3.4		8.1		15		0.077		0.18		1.0		0.0028		0.013		0.013		0.17		0.78		0.78	
115-29-7	Endosulfan (alpha-beta)	nc, v	380	>Csat	760	>Csat	4,900	>Csat	1,600	>Csat	45,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	98		-	>S	-	>S
72-20-8	Endrin	nc, nv	19	>Csat	38	>Csat	250	>Csat	80	>Csat	2,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	11		-	>Csat	-	>Csat	1.9		9.5		8.6	
100-41-4	Ethylbenzene	c, v	34		110		150		1,700	>Csat	49,000	>Csat	36		85		160		1.3		3.0		17		0.22		0.94		0.90		1.5		6.7		6.4	
206-44-0	Fluoranthene	nc, nv	2,400	>Csat	4,800	>Csat	30,000	>Csat	10,000	>Csat	280,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
86-73-7	Fluorene	nc, v	3,100	>Csat	6,300	>Csat	47,000	>Csat	14,000	>Csat	390,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	280		1,400		1,300	
50-00-0	Formaldehyde	c, v	15		69		64		1,600		44,000	>Csat	48		110		630		48		110		630		0.0020		0.0093		0.0086		0.43		2.0		1.9	
76-44-8	Heptachlor	c, v	0.11		0.28		0.45		4.0		110		18		42		230		18		42		230		0.017		0.063		0.048		0.0014		0.0051		0.0039	
1024-57-3	Heptachlor Epoxide	c, v	0.055		0.14		0.24		2.0		56		28		66		-	>Csat	28		66		-	>Csat	0.0042		0.018		0.016		0.0014		0.0059		0.0053	
118-74-1	Hexachlorobenzene	c, v	0.21		0.67		0.93		11		320		1.0		2.4		13		1.0		2.4		13		0.018		0.083		0.084		0.0098		0.045		0.045	
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	0.086		0.21		0.36		3.0		83	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.0063		0.024		0.023		0.0075		0.028		0.027	
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	0.49		1.2		2.1		17		470	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.036		0.13		0.13		0.043		0.16		0.16	
67-72-1	Hexachloroethane	c, v	7.4		24		32		370		10,000	>Csat	8.1		19		36		0.58		1.4		7.6		0.022		0.095		0.087		0.34		1.5		1.3	
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	1.1	>Csat	2.5	>Csat	21	>Csat	170	>Csat	4,900	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7439-92-1	Lead	NA, nv	400	L	400	L	800	L	800	L	800		L	NV	-	NV	-	NV	-	NV	-	NV	-	NV	30	L	30	L	30	L	15	L	15	L	15	L

Risk-Based Concentrations

Contaminated Medium →			GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
Exposure Pathway →			Volatilization to Outdoor Air RBC_{wo}						Vapor Intrusion into Buildings RBC_{wi}						GW in Excavation RBC_{we}		Vapor Intrusion into Buildings RBC_{sv}						Inhalation RBC_{air}					
Receptor Scenario →			Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			IVW		IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
83-32-9	Acenaphthene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
107-13-1	Acrylonitrile	c, v	2,200		5,300		9,800		700		1,700		9,200		250		8.3		20		180		0.041		0.098		0.18	
309-00-2	Aldrin	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.5		0.11		0.27		2.5		0.00057		0.0014		0.0025	
120-12-7	Anthracene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
7440-38-2	Arsenic	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	6,300		-	NV	-	NV	-	NV	0.00065		0.0015		0.0029	
7440-39-3	Barium	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.7E+07		-	NV	-	NV	-	NV	0.52		0.52		2.2	
56-55-3	Benz[a]anthracene	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	0.017		0.033		0.20	
71-43-2	Benzene	c, v	3,100		7,400		14,000		210		510		2,800		1,800		72		170		1,600		0.36		0.85		1.6	
92-87-5	Benzidine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	17		-	NV	-	NV	-	NV	0.000015		0.000029		0.00018	
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0017		0.0033		0.020	
205-99-2	Benzo[b]fluoranthene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.017		0.033		0.20	
207-08-9	Benzo[k]fluoranthene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7440-41-7	Beryllium	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0012		0.0028		0.0051	
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
75-27-4	Bromodichloromethane	c, v	1,400		3,200		6,000		180		420		2,300		450		15		36		330		0.076		0.18		0.33	
75-25-2	Bromoform	c, v	130,000		300,000		550,000		36,000		85,000		470,000		14,000		510		1,200		11,000		2.6		6.0		11	
74-83-9	Bromomethane	nc, v	32,000		32,000		130,000		2,100		2,100		27,000		1,200		1,000		1,000		22,000		5.2		5.2		22	
7440-43-9	Cadmium	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	130,000		-	NV	-	NV	-	NV	0.010		0.010		0.044	
56-23-5	Carbon tetrachloride	c, v	1,800		4,200		7,700		92		220		1,200		1,800		94		220		2,000		0.47		1.1		2.0	
108-90-7	Chlorobenzene	nc, v	-	>S	-	>S	-	>S	67,000		67,000		-	>S	10,000		10,000		10,000		220,000		52		52		220	
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	3,900		9,300		17,000		980		2,300		13,000		610		21		49		450		0.10		0.25		0.45	
75-00-3	Chloroethane (ethyl chloride)	nc, v	-	>S	-	>S	-	>S	2,800,000		2,800,000		-	>S	2,400,000		2,100,000		2,100,000		4.4E+07		10,000		10,000		44,000	
67-66-3	Chloroform	c, v	1,400		3,400		6,300		120		290		1,600		720		24		58		530		0.12		0.29		0.53	
74-87-3	Chloromethane	nc, v	440,000		440,000		1,800,000		26,000		26,000		330,000		22,000		19,000		19,000		390,000		94		94		390	
12789-03-6	Chlordane	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	5.6		13		-	>Pv	0.028		0.066		0.12	
16065-83-1	Chromium (III)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.0E+15		1.0E+15		4.4E+15	
18540-29-9	Chromium (VI)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	9,400		-	NV	-	NV	-	NV	0.000012		0.000023		0.00015	
218-01-9	Chrysene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.7		3.3		-	>Pv
7440-50-8	Copper	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5,400,000		-	NV	-	NV	-	NV	1.0E+15		1.0E+15		4.4E+15	
74-90-8	Cyanide (hydrogen cyanide) ^	nc, v	32,000		32,000		140,000		10,000		10,000		130,000		190		170		170		3,500		0.83		0.83		3.5	
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	31		-	NV	-	NV	-	NV	0.041		0.096		0.18	
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	5.8		14		-	>Pv	0.029		0.068		0.13	
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.029		0.068		0.13	
53-70-3	Dibenz[a,h]anthracene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
95-50-1	1,2-Dichlorobenzene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	37,000		42,000		42,000		880,000		210		210		880	
106-46-7	1,4-Dichlorobenzene	c, v	4,900		12,000		21,000		540		1,300		7,100		1,500		51		120		1,100		0.26		0.60		1.1	
91-94-1	3,3-Dichlorobenzidine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.0083		0.020		0.036	
75-34-3	1,1-Dichloroethane	c, v	16,000		37,000		68,000		1,100		2,600		14,000		10,000		350		830		7,700		1.8		4.1		7.7	
75-35-4	1,1-Dichloroethene	nc, v	570,000		570,000		2,400,000		29,000		29,000		360,000		44,000		42,000		42,000		880,000		210		210		880	
156-59-2	cis-1,2-Dichloroethene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	18,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
156-60-5	trans-1,2-Dichloroethene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	180,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
111-44-4	Dichloroethylether	c, v	5,700		13,000		30,000		2,300		5,500		30,000		51		1.7		4.0		37		0.0085		0.020		0.037	
75-09-2	Dichloromethane	c, v	1,000,000		2,000,000		1.3E+07		90,000		170,000		3,300,000		640,000		20,000		39,000		1,200,000		100		200		1,200	
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	77,000		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
60-57-1	Dieldrin	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.4		-	NV	-	NV	-	NV	0.00061		0.0014		0.0027	
606-20-2	2,6-Dinitrotoluene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	830		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	370		-	NV	-	NV	-	NV	0.0014		0.0033		0.0061	
123-91-1	1,4-Dioxane	c, v	820,000		1,900,000		4,500,000		340,000		810,000		4,500,000		3,400		110		270		2,500		0.56		1.3		2.5	
86-30-6	Diphenylnitrosamine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.1		2.6		4.7	
106-93-4	EDB (1,2-dibromoethane)	c, v	180		430		790		45		110		590		27		0.94		2.2		20		0.0047		0.011		0.020	
107-06-2	EDC (1,2-dichloroethane)	c, v	2,100		4,900		9,000		300		700		3,900		630		22		51		470		0.11		0.26		0.47	
115-29-7	Endosulfan (alpha-beta)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
72-20-8	Endrin	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	170		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
100-41-4	Ethylbenzene	c, v	9,900		23,000		43,000		620		1,500		8,200		4,500		220		530		4,900		1.1		2.7		4.9	
206-44-0	Fluoranthene	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
86-73-7	Fluorene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
50-00-0	Formaldehyde	c, v	1,500,000		3,700,000		8,500,000		650,000		1,500,000		8,500,000		1,300		43		100		940		0.22		0.51		0.94	
76-44-8	Heptachlor	c, v	-	>S	-	>S	-	>S	88		-	>S	-	>S	1.8		0.43		1.0		9.4		0.0022		0.0051		0.0094	
1024-57-3	Heptachlor Epoxide	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.2		0.22		0.51		4.7		0.0011		0.0026		0.0047	
118-74-1	Hexachlorobenzene	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1.2		2.9		27		0.0061		0.014		0.027	
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	18		-	NV	-	NV	-	NV	0.0016		0.0037		0.0068	
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	100		-	NV	-	NV	-	NV	0.0091		0.021		0.040	
67-72-1	Hexachloroethane	c, v	5,000		12,000		22,000		570		1,400		7,500		860		51		120		1,100		0.26		0.60		1.1	
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7439-92-1	Lead	NA, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv

Risk-Based Concentrations

Contaminated Medium →			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)					
Exposure Pathway →			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}					
Receptor Scenario →			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes) →			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW	
CASn	Chemical	Note		Note		Note		Note		Note				Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note
7439-96-5	Manganese	nc, nv	1,800		3,600		25,000		8,200		230,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		480		1,800		3,900	
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	32		63		410	>Csat	130		3,700	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.097		0.40		0.61		7.4		30		47	
7439-97-6	Mercury	nc, nv	23		47		350		110		2,900		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		6.0		22		49	
1634-04-4	MTBE (methyl t-butyl ether)	c, v	250		730		1,100		12,000	>Csat	320,000	>Csat	340		810		1,500		8.5		20		110		0.11		0.50		0.54		14		64		68	
91-20-3	Naphthalene	c, v	5.3		25		23		580	>Csat	16,000	>Csat	6.4		15		83		6.4		15		83		0.077		0.37		0.34		0.17		0.78		0.72	
7440-02-0	Nickel	c, nv	14,000		67,000		62,000		-	>Max	-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S
87-86-5	Pentachlorophenol	c, nv	1.0		2.6		4.0		34		960		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.066		0.23		0.17		0.044		0.15		0.12	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	nc, v	0.33		0.33		0.59		4.9	>Csat	140	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	0.63		-	>Csat	-	>Csat	0.016		0.059		0.13	
98-82-8	iso-Propylbenzene (cumene)	nc, v	3,500	>Csat	7,000	>Csat	57,000	>Csat	27,000	>Csat	750,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	96		-	>Csat	-	>Csat	440		1,800		2,000	
129-00-0	Pyrene	nc, v	1,800	>Csat	3,600	>Csat	23,000	>Csat	7,500	>Csat	210,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	110		-	>S	-	>S
7440-22-4	Silver	nc, nv	390		780		5,800		1,800		49,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		100		370		820	
100-42-5	Styrene	nc, v	7,900	>Csat	16,000	>Csat	130,000	>Csat	56,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	170		640		800		1,200		4,600		5,700	
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	4.7E-06		0.000012		0.000016		0.00017		0.0048		0.010		0.024		0.13		0.010		0.024		0.13		6.8E-06		0.000031		0.000031		9.1E-08		4.2E-07		4.2E-07	
127-18-4	Tetrachloroethene (PCE)	c, v	220	>Csat	650	>Csat	1,000	>Csat	10,000	>Csat	280,000	>Csat	-	>Csat	-	>Csat	-	>Csat	2.8		6.6		36		0.46		1.9		1.9		12		49		48	
108-88-3	Toluene	nc, v	5,800	>Csat	12,000	>Csat	88,000	>Csat	28,000	>Csat	770,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	83		340		490		1,100		4,400		6,300	
8001-35-2	Toxaphene	c, nv	0.49		1.2		2.1		17		470		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.36		1.2		0.93		0.015		0.053		0.040	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	400,000	>Csat	800,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	55,000		-	>S	-	>S
71-55-6	1,1,1-Trichloroethane	nc, v	53,000	>Csat	110,000	>Csat	870,000	>Csat	470,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	190		710		880		8,000		30,000		37,000	
79-00-5	1,1,2-Trichloroethane	c, v	5.8		19		26		320		8,900	>Csat	5.6		13		24		0.32		0.75		4.2		0.0063		0.029		0.029		0.28		1.3		1.3	
79-01-6	Trichloroethene	NA, v	6.7		17		51		130		3,700	>Csat	15		33		96		0.12		0.26		2.3		0.013		0.053		0.087		0.49		2.0		3.3	
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	7,600	>Csat	15,000	>Csat	130,000	>Csat	69,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	190		190		-	>Csat	61		230		280		1,100		4,200		5,200	
88-06-2	2,4,6-Trichlorophenol	c, nv	49		120		210		1,700		47,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.4		8.9		8.9		4.4		17		16	
95-63-6	1,2,4-Trimethylbenzene	nc, v	430		860		6,900	>Csat	2,900	>Csat	81,000	>Csat	-	>Csat	-	>Csat	-	>Csat	140		140		-	>Csat	10		43		48		54		230		250	
108-67-8	1,3,5-Trimethylbenzene	nc, v	430	>Csat	860	>Csat	6,900	>Csat	2,900	>Csat	81,000	>Csat	-	>Csat	-	>Csat	-	>Csat	98		98		-	>Csat	11		45		53		59		240		280	
75-01-4	Vinyl chloride	c, v	0.36		0.80		4.4		34		950	>Csat	5.3		6.5		89		0.043		0.053		2.2		0.00057		0.0014		0.010		0.027		0.066		0.49	
1330-20-7	Xylenes	nc, v	1,400	>Csat	2,900	>Csat	25,000	>Csat	20,000	>Csat	560,000	>Csat	-	>Csat	-	>Csat	-	>Csat	160		160		-	>Csat	23		87		100		190		710		830	

For a complete explanation of notes, please see "Notes to Accompany Risk-Based Concentrations for Individual Chemicals."

Ψ WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.

Risk-Based Concentrations

Contaminated Medium →			GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
Exposure Pathway →			Volatilization to Outdoor Air RBC_{wo}						Vapor Intrusion into Buildings RBC_{wi}						GW in Excavation RBC_{we}		Vapor Intrusion into Buildings RBC_{sv}						Inhalation RBC_{air}					
Receptor Scenario →			Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			IVW		IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
7439-96-5	Manganese	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	3,200,000		-	NV	-	NV	-	NV	0.052		0.052		0.22	
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,700		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7439-97-6	Mercury	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.31		0.31		1.3	
1634-04-4	MTBE (methyl t-butyl ether)	c, v	350,000		830,000		1,500,000		67,000		160,000		870,000		63,000		2,200		5,100		47,000		11		26		47	
91-20-3	Naphthalene	c, v	3,600		8,500		16,000		840		2,000		11,000		500		17		39		360		0.083		0.20		0.36	
7440-02-0	Nickel	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.011		0.026		0.047	
87-86-5	Pentachlorophenol	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	53		-	NV	-	NV	-	NV	0.55		1.3		2.4	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
98-82-8	iso-Propylbenzene (cumene)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	51,000		83,000		83,000		1,800,000		420		420		1,800	
129-00-0	Pyrene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
7440-22-4	Silver	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,100,000		-	NV	-	NV	-	NV	1.0E+15		1.0E+15		4.4E+15	
100-42-5	Styrene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	170,000		210,000		210,000		4,400,000		1,000		1,000		4,400	
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	0.022		0.052		0.11		0.0083		0.020		0.11		0.00045		0.000015		0.000035		0.00032		5.7E-08		1.3E-07		2.5E-07	
127-18-4	Tetrachloroethene (PCE)	c, v	64,000		150,000		-	>S	3,700		8,700		48,000		34,000		2,200		5,100		47,000		11		26		47	
108-88-3	Toluene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	220,000		1,000,000		1,000,000		2.2E+07		5,200		5,200		22,000	
8001-35-2	Toxaphene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	18		-	NV	-	NV	-	NV	0.0088		0.021		0.038	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	6,300,000		6,300,000		1.3E+08		31,000		31,000		130,000	
71-55-6	1,1,1-Trichloroethane	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1,100,000		1,000,000		1,000,000		2.2E+07		5,200		5,200		22,000	
79-00-5	1,1,2-Trichloroethane	c, v	4,700		11,000		21,000		870		2,100		11,000		1,000		35		83		770		0.18		0.41		0.77	
79-01-6	Trichloroethene	NA, v	3,300		6,900		20,000		200		430		3,700		430		95		200		2,900		0.47		1.0		2.9	
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	780,000		780,000		-	>S	36,000		36,000		460,000		160,000		150,000		150,000		3,100,000		730		730		3,100	
88-06-2	2,4,6-Trichlorophenol	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	11,000		-	NV	-	NV	-	NV	0.91		2.1		4.0	
95-63-6	1,2,4-Trimethylbenzene	nc, v	-	>S	-	>S	-	>S	50,000		50,000		-	>S	6,300		13,000		13,000		260,000		63		63		260	
108-67-8	1,3,5-Trimethylbenzene	nc, v	-	>S	-	>S	-	>S	36,000		36,000		-	>S	7,500		13,000		13,000		260,000		63		63		260	
75-01-4	Vinyl chloride	c, v	350		430		5,900		17		21		880		960		33		41		2,800		0.17		0.20		2.8	
1330-20-7	Xylenes	nc, v	-	>S	-	>S	-	>S	86,000		86,000		-	>S	23,000		21,000		21,000		440,000		100		100		440	

Ψ **WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.**

ATTACHMENT C

DEVELOPMENT OF SITE-SPECIFIC RBCs FOR
THE OLDER CHILD RECREATIONAL TRESPASSER

Risk-Based Concentrations

Note: CTE Data were used for these RBCs.

Contaminated Medium →			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)					
Exposure Pathway →			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}					
Receptor Scenario →			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note
83-32-9	Acenaphthene	nc, v	200,000	>Csat	66,000	>Csat	140,000	>Csat	140,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	2,700	
107-13-1	Acrylonitrile	c, v	59		14		25		200		5,500		160		79		24		9.4		4.7		4.3		0.046		0.0063		0.0079		6.7		0.92		1.1	
309-00-2	Aldrin	c, v	2.0		0.63		1.3		6.8	>Csat	190	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	2.8		0.34		0.45		0.11		0.014		0.018	
120-12-7	Anthracene	nc, v	1,000,000	>Csat	330,000	>Csat	700,000	>Csat	700,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-38-2	Arsenic	c, nv	25		8.2		17		99		2,700		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		7.4		2.4		1.8	
7440-39-3	Barium	nc, nv	650,000		200,000		400,000		430,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		190,000		28,000		45,000	
56-55-3	Benz[a]anthracene	c, v	100	>Csat	2.5		220	>Csat	1,100	>Csat	30,000	>Csat	-	>Max	-	>Csat	-	>Max	-	>Max	-	>Csat	-	>Max	-	>Csat	6.0		-	>Csat	2.2		0.11		1.6	
71-43-2	Benzene	c, v	570		130		230		1,900	>Csat	52,000	>Csat	-	>Csat	690		210		19		9.5		8.7		2.9		0.40		0.47		58		7.9		9.3	
92-87-5	Benzidine	c, nv	0.047		0.0012		0.10		0.53		15		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.00080		0.00012		0.0040		0.0022		0.00034		0.011	
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	10	>Csat	0.25		23	>Csat	110	>Csat	3,100	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.52		0.080		-	>S
205-99-2	Benzo[b]fluoranthene	c, nv	100	>Csat	2.5		230	>Csat	1,100	>Csat	31,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	0.80		-	>S
207-08-9	Benzo[k]fluoranthene	c, nv	1,000	>Csat	25	>Csat	2,300	>Csat	11,000	>Csat	310,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-41-7	Beryllium	c, nv	180,000		20,000		28,000		340,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	2,500	>Csat	820	>Csat	1,700	>Csat	8,600	>Csat	240,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	260		190	
75-27-4	Bromodichloromethane	c, v	300		48		73		750		21,000	>Csat	290		140		44		4.9		2.4		2.2		0.24		0.028		0.037		16		1.9		2.6	
75-25-2	Bromoform	c, v	4,000	>Csat	920		1,600	>Csat	13,000	>Csat	360,000	>Csat	-	>Csat	-	>Csat	1,500		980		490		450		5.8		0.80		0.98		420		57		70	
74-83-9	Bromomethane	nc, v	1,500		210		980		1,500		21,000	>Csat	-	>Csat	1,500		700		56		12		17		2.6		0.14		0.42		240		13		38	
7440-43-9	Cadmium	nc, nv	3,300		1,100		2,200		2,300		32,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		960		140		230	
56-23-5	Carbon tetrachloride	c, v	480		120		230		1,700	>Csat	48,000	>Csat	-	>Csat	890		270		14		7.2		6.6		1.6		0.25		0.26		59		8.9		9.5	
108-90-7	Chlorobenzene	nc, v	17,000	>Csat	2,200	>Csat	11,000	>Csat	17,000	>Csat	240,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	190		10.0		28		2,500		130		370	
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	290		55		88		830		23,000	>Csat	400		200		60		27		13		12		0.29		0.036		0.047		21		2.5		3.3	
75-00-3	Chloroethane (ethyl chloride)	nc, v	-	>Max	480,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	410		1,300		580,000		28,000		88,000	
67-66-3	Chloroform	c, v	540		81		120		1,300	>Csat	36,000	>Csat	470		230		71		3.8		1.9		1.7		0.41		0.047		0.063		27		3.1		4.2	
74-87-3	Chloromethane	nc, v	40,000	>Csat	4,300	>Csat	25,000	>Csat	50,000	>Csat	700,000	>Csat	-	>Csat	-	>Csat	-	>Csat	1,000		220		300		60		2.9		9.1		5,200		250		790	
12789-03-6	Chlordane	c, v	100	>Csat	33		66	>Csat	390	>Csat	11,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	14		18		5.6		0.68		0.90	
16065-83-1	Chromium (III)	nc, nv	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		1,400,000		210,000		340,000	
18540-29-9	Chromium (VI)	c, nv	26		0.67		51		320		8,800		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		1.0		0.16		5.2	
218-01-9	Chrysene	c, nv	10,000	>Csat	250	>Csat	23,000	>Csat	110,000	>Csat	-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-50-8	Copper	nc, nv	130,000		44,000		93,000		93,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		38,000		5,600		9,100	
74-90-8	Cyanide (hydrogen cyanide) ^A	nc, v	430		55		190		340		4,700		4,100		900		1,200		4,100		900		1,200		26		1.3		4.0		43		2.2		6.7	
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	160		51		110		620	>Csat	17,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	120		20		11		3.5		0.58		0.31	
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	110		34		71		420		12,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	200		25		33		5.7		0.70		0.93	
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	110		36		77		430	>Csat	12,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
53-70-3	Dibenz[a,h]anthracene	c, nv	10	>Csat	0.25		23	>Csat	110	>Csat	3,100	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.52		0.080		-	>S
95-50-1	1,2-Dichlorobenzene	nc, v	68,000	>Csat	8,700	>Csat	44,000	>Csat	73,000	>Csat	1,000,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	63		170		10,000		530		1,400	
106-46-7	1,4-Dichlorobenzene	c, v	1,500	>Csat	190		280	>Csat	3,200	>Csat	88,000	>Csat	-	>Csat	-	>Csat	150		120		59		54		6.8		0.76		1.0		58		6.5		8.8	
91-94-1	3,3-Dichlorobenzidine	c, nv	78	>Csat	25	>Csat	53	>Csat	270	>Csat	7,500	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	7.8		5.8		25		8.1		6.1	
75-34-3	1,1-Dichloroethane	c, v	4,500	>Csat	880		1,400	>Csat	13,000	>Csat	370,000	>Csat	-	>Csat	-	>Csat	1,000		54		27		25		5.4		0.67		0.87		340		42		55	
75-35-4	1,1-Dichloroethene	nc, v	58,000	>Csat	8,200	>Csat	38,000	>Csat	57,000	>Csat	790,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	490		680		220		12		34		9,300		510		1,400	
156-59-2	cis-1,2-Dichloroethene	nc, v	6,700	>Csat	2,200	>Csat	4,700	>Csat	4,700	>Csat	65,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	33		4.8		5.8		1,900		270		330	
156-60-5	trans-1,2-Dichloroethene	nc, v	67,000	>Csat	22,000	>Csat	47,000	>Csat	47,000	>Csat	650,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	370		53		65		19,000		2,700		3,300	
111-44-4	Dichloroethylether	c, v	23		4.4		7.1		66		1,800		63		32		29		63		32		29		0.024		0.0029		0.0038		1.7		0.21		0.27	
75-09-2	Dichloromethane	c, v	6,500	>Csat	170		13,000	>Csat	80,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	470		-	>Csat	3.0		0.44		13		250		37		1,100	
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	30,000	>Csat	9,800	>Csat	20,000	>Csat	17,000	>Csat	240,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	120		18		21		9,300		1,300		1,600	
60-57-1	Dieldrin	c, nv	2.2		0.71		1.5		7.6		210	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.3		0.23		0.13		0.21		0.039		0.022	
606-20-2	2,6-Dinitrotoluene	c, nv	23		7.6		16		81		2,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.3		0.38		0.27		7.0		2.1		1.5	
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	5.0		1.6		3.4		17		480		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.13		0.042		0.031		1.5		0.49		0.35	
123-91-1	1,4-Dioxane	c, v	350		98		190		1,200		35,000		3,400		1,700		1,500		3,400		1,700		1,500		0.31		0.052		0.058		61		10		12	
86-30-6	Diphenylnitrosamine	c, nv	7,200	>Csat	2,300	>Csat	4,900	>Csat	25,000	>Csat	690,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	1,700		450		290	
106-93-4	EDB (1,2-dibromoethane)	c, v	13		2.4		3.9		36		1,000	>Csat	18		8.9		2.7		1.4		0.72		0.65		0.015		0.0019		0.0024		0.92		0.11		0.15	
107-06-2	EDC (1,2-dichloroethane)	c, v	280		55		88		820		23,000	>Csat	410		210		63		9.3		4.6		4.2		0.35		0.043		0.056		21		2.6		3.4	
115-29-7	Endosulfan (alpha-beta)	nc, v	18,000	>Csat	5,900	>Csat	12,000	>Csat	10,000	>Csat	140,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
72-20-8	Endrin	nc, nv	900	>Csat	290	>Csat	610	>Csat	520	>Csat	7,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	210		27		9.0	
100-41-4	Ethylbenzene	c, v	2,500	>Csat	520	>Csat	850	>Csat	7,600	>Csat	210,000	>Csat	-	>Csat	-	>Csat	-	>Csat	150		77		70		27		3.4		3.9		190		24		28	
206-44-0	Fluoranthene	nc, nv	120,000	>Csat	38,000	>Csat	79,000	>Csat	64,000	>Csat	890,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
86-73-7	Fluorene	nc, v	130,000	>Csat	44,000	>Csat	93,000	>Csat	93,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	1,400	
50-00-0	Formaldehyde	c, v	1,800		190		270		3,200		89,000	>Csat	5,800		2,900		2,600		5,800		2,900		2,600		0.23		0.025		0.036		52		5.6		7.9	
76-44-8	Heptachlor	c, v	7.3		2.1		4.0		24		660		-	>Csat	1,100		970		-	>Csat	1,100		970		2.0		0.28		0.20		0.16		0.023		0.016	
1024-57-3	Heptachlor Epoxide	c, v	3.7		1.1		2.2		12		340	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.51		0.066		0.069		0.17		0.022		0.023	
118-74-1	Hexachlorobenzene	c, v	16		3.1		5.0		46		1,300		120		61		55		120		61		55		2.3		0.28		0.37		1.2		0.15		0.20	
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	5.6		1.8		3.8		19	>Csat	530	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.82		0.18		0.11		0.97		0.21		0.13	
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	32		10		22		110	>Csat	3,100	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	4.7		1.0		0.62		5.6		1.2		0.73	
67-72-1	Hexachloroethane	c, v	610	>Csat	120		200		1,600	>Csat	45,000	>Csat	-	>Csat	-	>Csat	150		69		35		32		2.7		0.34		0.38		41		5.3		5.8	
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	100	>Csat	2.5	>Csat	230	>Csat	1,100	>Csat	31,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7439-92-1	Lead	NA, nv	400	L	400	L	800	L	800	L	800		L	NV	-	NV	-	NV	-	NV	-	NV	-	NV	30	L	30	L	30	L	15	L	15	L	15	L

Risk-Based Concentrations

Contaminated Medium →			GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
Exposure Pathway →			Volatilization to Outdoor Air RBC_{wo}						Vapor Intrusion into Buildings RBC_{wi}						GW in Excavation RBC_{we}		Vapor Intrusion into Buildings RBC_{sv}						Inhalation RBC_{air}					
Receptor Scenario →			Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			IVW		IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
83-32-9	Acenaphthene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
107-13-1	Acrylonitrile	c, v	270,000		130,000		41,000		84,000		42,000		38,000		490		990		490		750		4.9		2.5		0.75	
309-00-2	Aldrin	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	7.0		14		6.9		10		0.069		0.034		0.010	
120-12-7	Anthracene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
7440-38-2	Arsenic	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	13,000		-	NV	-	NV	-	NV	0.078		0.039		0.012	
7440-39-3	Barium	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.7E+07		-	NV	-	NV	-	NV	22		4.8		2.2	
56-55-3	Benz[a]anthracene	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	0.30		0.85	
71-43-2	Benzene	c, v	380,000		190,000		57,000		26,000		13,000		12,000		3,500		8,600		4,300		6,600		43		22		6.6	
92-87-5	Benzidine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	35		-	NV	-	NV	-	NV	0.0017		0.00027		0.00076	
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	0.030		-	>Pv
205-99-2	Benzo[b]fluoranthene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.9		0.30		0.85	
207-08-9	Benzo[k]fluoranthene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7440-41-7	Beryllium	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.14		0.070		0.021	
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
75-27-4	Bromodichloromethane	c, v	160,000		82,000		25,000		21,000		11,000		9,700		900		1,800		910		1,400		9.1		4.5		1.4	
75-25-2	Bromoform	c, v	-	>S	-	>S	2,300,000		-	>S	2,100,000		2,000,000		28,000		61,000		31,000		46,000		310		150		46	
74-83-9	Bromomethane	nc, v	1,300,000		290,000		130,000		87,000		19,000		27,000		1,200		43,000		9,600		22,000		220		48		22	
7440-43-9	Cadmium	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	130,000		-	NV	-	NV	-	NV	0.43		0.096		0.044	
56-23-5	Carbon tetrachloride	c, v	210,000		110,000		32,000		11,000		5,500		5,000		3,500		11,000		5,600		8,500		56		28		8.5	
108-90-7	Chlorobenzene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	10,000		430,000		96,000		220,000		2,200		480		220	
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	470,000		230,000		71,000		120,000		59,000		53,000		1,200		2,500		1,200		1,900		12		6.2		1.9	
75-00-3	Chloroethane (ethyl chloride)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	2,400,000		8.6E+07		1.9E+07		4.4E+07		430,000		96,000		44,000	
67-66-3	Chloroform	c, v	170,000		86,000		26,000		15,000		7,500		6,800		1,400		2,900		1,500		2,200		15		7.3		2.2	
74-87-3	Chloromethane	nc, v	-	>S	4,000,000		1,800,000		1,100,000		240,000		330,000		22,000		780,000		170,000		390,000		3,900		860		390	
12789-03-6	Chlordane	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	3.4		1.7		0.51	
16065-83-1	Chromium (III)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	4.3E+16		9.6E+15		4.4E+15	
18540-29-9	Chromium (VI)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	19,000		-	NV	-	NV	-	NV	0.0013		0.00022		0.00061	
218-01-9	Chrysene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7440-50-8	Copper	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5,400,000		-	NV	-	NV	-	NV	4.3E+16		9.6E+15		4.4E+15	
74-90-8	Cyanide (hydrogen cyanide) ^	nc, v	1,300,000		300,000		140,000		410,000		92,000		130,000		190		6,900		1,500		3,500		35		7.7		3.5	
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	63		-	NV	-	NV	-	NV	4.9		2.4		0.74	
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	3.5		1.7		0.53	
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	3.5		1.7		0.53	
53-70-3	Dibenz[a,h]anthracene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
95-50-1	1,2-Dichlorobenzene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	37,000		1,700,000		380,000		880,000		8,600		1,900		880	
106-46-7	1,4-Dichlorobenzene	c, v	-	>S	-	>S	-	>S	65,000		32,000		30,000		2,900		6,100		3,100		4,600		31		15		4.6	
91-94-1	3,3-Dichlorobenzidine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	0.49		0.15	
75-34-3	1,1-Dichloroethane	c, v	1,900,000		940,000		290,000		130,000		66,000		60,000		20,000		42,000		21,000		32,000		210		110		32	
75-35-4	1,1-Dichloroethene	nc, v	-	>S	-	>S	2,400,000		1,200,000		270,000		360,000		44,000		1,700,000		380,000		880,000		8,600		1,900		880	
156-59-2	cis-1,2-Dichloroethene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	18,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
156-60-5	trans-1,2-Dichloroethene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	180,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
111-44-4	Dichloroethylether	c, v	680,000		340,000		130,000		280,000		140,000		130,000		100		200		100		150		1.0		0.51		0.15	
75-09-2	Dichloromethane	c, v	-	>S	-	>S	-	>S	9,900,000		1,600,000		-	>S	1,300,000		2,200,000		360,000		5,100,000		11,000		1,800		5,100	
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	77,000		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
60-57-1	Dieldrin	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	4.9		-	NV	-	NV	-	NV	0.073		0.037		0.011	
606-20-2	2,6-Dinitrotoluene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,700		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	740		-	NV	-	NV	-	NV	0.17		0.084		0.026	
123-91-1	1,4-Dioxane	c, v	9.9E+07		4.9E+07		1.9E+07		4.1E+07		2.0E+07		1.9E+07		6,700		13,000		6,700		10,000		67		34		10	
86-30-6	Diphenylnitrosamine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	130		65		20	
106-93-4	EDB (1,2-dibromoethane)	c, v	22,000		11,000		3,300		5,400		2,700		2,500		55		110		56		85		0.56		0.28		0.085	
107-06-2	EDC (1,2-dichloroethane)	c, v	250,000		120,000		38,000		35,000		18,000		16,000		1,300		2,600		1,300		2,000		13		6.5		2.0	
115-29-7	Endosulfan (alpha-beta)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
72-20-8	Endrin	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	170		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
100-41-4	Ethylbenzene	c, v	-	>S	-	>S	-	>S	75,000		37,000		34,000		9,000		27,000		13,000		20,000		130		67		20	
206-44-0	Fluoranthene	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
86-73-7	Fluorene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
50-00-0	Formaldehyde	c, v	1.9E+08		9.3E+07		3.5E+07		7.8E+07		3.9E+07		3.5E+07		2,600		5,200		2,600		3,900		26		13		3.9	
76-44-8	Heptachlor	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.6		52		26		39		0.26		0.13		0.039	
1024-57-3	Heptachlor Epoxide	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	6.4		26		13		20		0.13		0.065		0.020	
118-74-1	Hexachlorobenzene	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	150		73		110		0.73		0.37		0.11	
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	35		-	NV	-	NV	-	NV	0.19		0.093		0.028	
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	200		-	NV	-	NV	-	NV	1.1		0.54		0.16	
67-72-1	Hexachloroethane	c, v	-	>S	-	>S	-	>S	-	>S	34,000		31,000		1,700		6,100		3,100		4,600		31		15		4.6	
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7439-92-1	Lead	NA, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv

Risk-Based Concentrations

Note: CTE Data were used for these RBCs.

Contaminated Medium			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)					
Exposure Pathway			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}					
Receptor Scenario			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note
7439-96-5	Manganese	nc, nv	77,000		23,000		47,000		51,000		710,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		23,000		3,300		5,500	
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	1,500	>Csat	490	>Csat	1,000	>Csat	860	>Csat	12,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5.9		0.84		0.73		450		64		56	
7439-97-6	Mercury	nc, nv	1,000		330		700		700		9,700		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	42		-	>S
1634-04-4	MTBE (methyl t-butyl ether)	c, v	17,000	>Csat	4,000		6,900	>Csat	57,000	>Csat	-	>Max	-	>Csat	-	>Csat	6,300		1,000		510		460		14		1.9		2.4		1,800		250		310	
91-20-3	Naphthalene	c, v	630	>Csat	69		96		1,200	>Csat	32,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	9.2		1.0		1.4		20		2.1		3.0	
7440-02-0	Nickel	c, nv	-	>Max	190,000		260,000		-	>Max	-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S
87-86-5	Pentachlorophenol	c, nv	76		25		50		220		6,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	7.8		1.4		0.74		5.2		0.91		0.50	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	c, v	16	>Csat	16	>Csat	7.4	>Csat	51	>Csat	1,400	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.75		0.75		0.12	
98-82-8	iso-Propylbenzene (cumene)	nc, v	120,000	>Csat	16,000	>Csat	76,000	>Csat	110,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	220		-	>Csat	18,000		1,000		2,100	
129-00-0	Pyrene	nc, v	87,000	>Csat	28,000	>Csat	59,000	>Csat	48,000	>Csat	670,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-22-4	Silver	nc, nv	17,000		5,500		12,000		12,000		160,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		4,800		690		1,100	
100-42-5	Styrene	nc, v	270,000	>Csat	39,000	>Csat	170,000	>Csat	250,000	>Csat	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	350		840		44,000		2,500		6,000	
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	0.00029		0.00029		0.00014		0.0011		0.030		-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.00084		0.00084		0.00014		0.000011		0.000011		1.8E-06	
127-18-4	Tetrachloroethene (PCE)	c, v	15,000	>Csat	3,600	>Csat	6,400	>Csat	51,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	170		150		57		8.1		8.5		1,500		210		210	
108-88-3	Toluene	nc, v	240,000	>Csat	64,000	>Csat	160,000	>Csat	180,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	450		-	>Csat	58,000		5,900		7,300	
8001-35-2	Toxaphene	c, nv	32		10		22		110		3,100	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	42		7.3		4.0		1.8		0.31		0.17	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>S	82,000		-	>S
71-55-6	1,1,1-Trichloroethane	nc, v	-	>Max	220,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	320		910		250,000		13,000		38,000	
79-00-5	1,1,2-Trichloroethane	c, v	450		88		140		1,300		37,000	>Csat	670		340		100		38		19		17		0.78		0.096		0.12		34		4.2		5.5	
79-01-6	Trichloroethene	NA, v	6.7		17		51		130		3,700	>Csat	15		33		96		0.12		0.26		2.3		0.013		0.053		0.087		0.49		2.0		3.3	
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	240,000	>Csat	30,000	>Csat	150,000	>Csat	250,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	100		290		35,000		1,900		5,400	
88-06-2	2,4,6-Trichlorophenol	c, nv	3,200		1,000		2,200		11,000	>Csat	310,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	310		69		41		580		130		77	
95-63-6	1,2,4-Trimethylbenzene	nc, v	15,000	>Csat	2,300	>Csat	9,800	>Csat	14,000	>Csat	190,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	460		28		51		2,400		140		260	
108-67-8	1,3,5-Trimethylbenzene	nc, v	15,000	>Csat	2,300	>Csat	9,800	>Csat	14,000	>Csat	190,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	27		56		2,500		150		300	
75-01-4	Vinyl chloride	c, v	6.3		2.4		36		220		6,200	>Csat	150		60		370		1.2		0.49		9.0		0.020		0.0044		0.055		0.94		0.21		2.6	
1330-20-7	Xylenes	nc, v	41,000	>Csat	4,700	>Csat	26,000	>Csat	50,000	>Csat	690,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	33		100		5,600		270		830	

For a complete explanation of notes, please see "Notes to Accompany Risk-Based Concentrations for Individual Chemicals."

Ψ WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.

Risk-Based Concentrations

Contaminated Medium →			GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
Exposure Pathway →			Volatilization to Outdoor Air RBC$_{wo}$						Vapor Intrusion into Buildings RBC$_{wi}$						GW in Excavation RBC$_{we}$		Vapor Intrusion into Buildings RBC$_{sv}$						Inhalation RBC$_{air}$					
Receptor Scenario →			Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			IVW		IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
7439-96-5	Manganese	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	3,200,000		-	NV	-	NV	-	NV	2.2		0.48		0.22	
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,700		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7439-97-6	Mercury	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	13		2.9		1.3	
1634-04-4	MTBE (methyl t-butyl ether)	c, v	4.2E+07		2.1E+07		6,400,000		8,000,000		4,000,000		3,600,000		130,000		260,000		130,000		200,000		1,300		650		200	
91-20-3	Naphthalene	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1,000		2,000		990		1,500		9.9		4.9		1.5	
7440-02-0	Nickel	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.3		0.65		0.20	
87-86-5	Pentachlorophenol	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	110		-	NV	-	NV	-	NV	66		33		10	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	0.45		0.45		0.069	
98-82-8	iso-Propylbenzene (cumene)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	51,000		3,500,000		770,000		1,800,000		17,000		3,800		1,800	
129-00-0	Pyrene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
7440-22-4	Silver	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,100,000		-	NV	-	NV	-	NV	4.3E+16		9.6E+15		4.4E+15	
100-42-5	Styrene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	170,000		8,600,000		1,900,000		4,400,000		43,000		9,600		4,400	
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	0.00090		0.0018		0.00088		0.0013		6.8E-06		6.8E-06		1.0E-06	
127-18-4	Tetrachloroethene (PCE)	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	200,000		69,000		260,000		130,000		200,000		1,300		650		200	
108-88-3	Toluene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	220,000		4.3E+07		9,600,000		2.2E+07		220,000		48,000		22,000	
8001-35-2	Toxaphene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	36		-	NV	-	NV	-	NV	1.1		0.53		0.16	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	2.6E+08		5.8E+07		1.3E+08		1,300,000		290,000		130,000	
71-55-6	1,1,1-Trichloroethane	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1,100,000		4.3E+07		9,600,000		2.2E+07		220,000		48,000		22,000	
79-00-5	1,1,2-Trichloroethane	c, v	570,000		280,000		86,000		100,000		52,000		47,000		2,000		4,200		2,100		3,200		21		11		3.2	
79-01-6	Trichloroethene	NA, v	3,300		6,900		20,000		200		430		3,700		430		95		200		2,900		0.47		1.0		2.9	
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	-	>S	-	>S	-	>S	-	>S	340,000		460,000		160,000		6,100,000		1,300,000		3,100,000		30,000		6,700		3,100	
88-06-2	2,4,6-Trichlorophenol	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	22,000		-	NV	-	NV	-	NV	110		54		16	
95-63-6	1,2,4-Trimethylbenzene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	6,300		520,000		120,000		260,000		2,600		580		260	
108-67-8	1,3,5-Trimethylbenzene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	7,500		520,000		120,000		260,000		2,600		580		260	
75-01-4	Vinyl chloride	c, v	9,700		4,000		25,000		480		200		3,700		1,900		920		380		12,000		4.6		1.9		12	
1330-20-7	Xylenes	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	23,000		860,000		190,000		440,000		4,300		960		440	

Ψ **WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.**

Exposure Factors: Central Tendency Exposure

Parameter (unit)	Symbol	Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker	
			Note		Note		Note		Note		Note
ACCEPTABLE RISK LEVELS											
Acceptable Risk Level - Carcinogens	ARLc	1.00E-06	1	=		=		=		=	
Acceptable Risk Level - Noncarcinogens	ARLn	1	1	=		=		=		=	
EXPOSURE PARAMETERS											
Averaging Time - Carcinogen (yr)	ATc	70	2	=		=		=		=	
Averaging Time - Noncarcinogen (yr)	ATn	9	2	4	2	6	2	1	2	0.5	2
Averaging Time - Noncarcinogen, Child (yr)	ATnc	6	2	4	2	NA		NA		NA	
Body Weight - Adult (kg)	BWa	80	3	=		=		=		=	
Body Weight - Child (kg)	BWc	35	3	=		NA		NA		NA	
Exposure Duration - Adult (yr)	ED	6	3	4	4	6	3	1	21	0.5	6
Exposure Duration - Child (yr)	EDc	6	3	4	4	NA		NA		NA	
Exposure Frequency (day/yr)	EF	38	3	175	3a	250	6	125	6	9	6
Exposure Time (hr/day)	ET	8		24		8		8		8	
Event Frequency - Groundwater (events/day)	EvF	1	24	1	24	2	24	2	6	=	
Event Time - Groundwater (hr/event) (age adjusted)	t_{event}	0.67	xx	0.62	25	2	24	2	6	=	
Soil Ingestion Rate - Adult (mg/day)	IRS	100	6	50	6	50	6	100	21	100	21
Soil Ingestion Rate - Child (mg/day)	IRSc	100	4	100	4	NA		NA		NA	
Water Ingestion Rate - Adult (L/day)	IRW	0.7	2	0.7	2	0.5	4a	NA		NA	
Water Ingestion Rate - Child (L/day)	IRWc	0.35	24(a)	=		NA		NA		NA	
Skin Surface Area - Adult to Soil (cm^2)	SA	6032	4	6032	4	3527	4	3527	4	3527	4
Skin Surface Area - Child to Soil (cm^2)	SAc	2938	4	=		NA		NA		NA	
Skin Surface Area - Adult to Groundwater (cm^2)	SAw	20900	3	20900	3	3527	3	6032	4	6032	4
Skin Surface Area - Child to Groundwater (cm^2)	SAwc	6378	3	6378	3	NA		NA		NA	
Soil to Skin Adherence Factor - Adult (mg/cm^2-day)	AF	0.01	5a	0.01	5a	0.02	5b	0.10	5c	0.10	5c
Soil to Skin Adherence Factor - Child (mg/cm^2-day)	AFc	0.04	5d	=		NA		NA		NA	
AGE-ADJUSTED EXPOSURE FACTORS											
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	17	7	11	7a	NA		NA		NA	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0.06	7	0.04	7a	NA		NA		NA	
Surface Area Tapwater-age adjusted (cm2-yr/kg)	SAwadj	504	7	729	7	NA		NA		NA	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	20	7	13	7a	NA		NA		NA	

SITE PARAMETERS											
Soil Bulk Density (g/cm^3)	ρ_b	1.70	8	=		=		=		=	
Soil Particle Density (g/cm^3)	ρ_s	2.74	9	=		=		=		=	
Soil Porosity	n	0.38	8	=		=		=		=	
Air Content - Vadose Zone Soils	n_a	0.26	10	=		=		=		=	
Air Content - Cap. Fringe Soils	n_{acap}	0.038	10	=		=		=		=	
Air Content - Foundation Cracks	n_{acrk}	0.26	10	=		=		=		=	
Water Content - Vadose Zone Soils	n_w	0.12	8	=		=		=		=	
Water Content - Cap. Fringe Soils	n_{wcap}	0.342	8	=		=		=		=	
Water Content - Foundation Cracks	n_{wcrk}	0.12	11	=		=		=		=	
Vadose Zone Thickness (cm)	L_v	295	12	=		=		=		=	
Capillary Fringe Thickness (cm)	L_{cap}	5.00	8	=		=		=		=	
Fraction Organic Carbon (shallow soil)	f_{oc}	0.005	8a	=		=		=		=	
Depth to Groundwater (cm)	L_w	300	8	=		=		=		=	
Groundwater Dilution-Attenuation Factor	DAF	60	19	=		=		=		=	
SOIL CONTAMINATION PARAMETERS											
Thickness of Contaminated Surface Soils (cm)	L_{ss}	100	8	=		=		=		=	
Fraction of Site with Surface Soil Contamination	f_{ss}	0.50	16	=		=		=		=	
Thickness of Clean Surface Soils (cm)	L_c	100	8	=		=		=		=	
Thickness of Subsurface Contamination (cm)	L_s	200	8	=		=		=		=	
Soil Gas Attenuation Factor for Chlorinated Hydrocarbons	AF_{ch}	200	23	200	23	1000	23	NA		NA	
Soil Gas Attenuation Factor for Petroleum Hydrocarbons	AF_{ph}	200	23	200	23	1000	23	NA		NA	
Fraction of Site with Subsurface Vol. To Outdoor Air	f_{so}	0.50	17	=		=		=		=	
Thickness of Clean Soils Under Building (cm)	L_{cb}	100	8	=		=		=		=	
Thickness of Contaminated Soils Under Building (cm)	L_{sb}	200	8	=		=		=		=	
Fraction of Contaminated Soils Under Building	f_{sb}	0.50	18	=		=		=		=	
Particulate Emission Factor for Soils (kg/m^3)	PEF	7.58E-10	13	=		=		=		=	
BUILDING PARAMETERS											
Building Air Exchange Rate (1/day)	ER	24	14	=		48	14	NA		NA	
Building Height (indoor air mixing zone) (cm)	L_B	200	8	=		300	8	NA		NA	
Foundation Wall Thickness (cm)	L_{crk}	15	8	=		=		NA		NA	
Foundation Crack Fraction	f_{crk}	0.0010	15	=		=		NA		NA	
VOLATILIZATION FACTORS											
Averaging time for Volatilization -Adults (yr)	t_{vol}	25	16	=		=		=		=	
Averaging time for Volatilization -Children (yr)	t_{volc}	6	16	=		NA		NA		NA	
Max. Soil to Building Vol. Factor (kg/m^3)	$VF_{si}max$	3.88E-03	18	3.88E-03	18	1.29E-03	18	NA		NA	
Max. Surface Soil Vol. Factor - Adult (kg/m^3)	$VF_{ss}max$	1.57E-05	16	1.57E-05	16	1.57E-05	16	1.57E-05	16	1.57E-05	16
Max. Surface Soil Vol. Factor - Child (kg/m^3)	$VF_{ss}max$	6.53E-05	16	=		NA		NA		NA	
Max. Soil to Outdoor Air Vol. Factor - Adult (kg/m^3)	$VF_{so}max$	3.13E-05	17	3.13E-05	17	3.13E-05	17	NA		NA	
Volatile Organics Dispersion Term (g/m^2-s per kg/m^3)	Q/C	6.88E+01	13	=		=		=		=	
MISCELLANEOUS PARAMETERS											
Ideal Gas Law Constant (m^3-atm/K-mol)	R	8.21E-05	20	=		=		=		=	
Absolute Temperature (K)	T	2.93E+02	20	=		=		=		=	

Additional Information for Early Life-Stage Factor Calculations

Early Life-Stage Factors - Residential	Symbol	0 - 2 Years		3 - 6 Years		7 - 16 Years		17 - 26 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	0		0		6		0		6	
Body Weight (kg)	BW	15		15		35		80		NA	
Soil Ingestion Rate (mg/day)	IRs	200		200		100		100		NA	
Air Inhalation Rate (m^3/day)	IRa	10		10		20		20		NA	
Water Ingestion Rate (L/day) -adults	IRw	0.78		0.78		2.5		2.5		NA	
Age-dependent Adjustment Factor	ADAF	10		3		3		1		NA	
Soil to Skin Adherence Factor (mg/cm^2)	AF	0.2		0.2		0.07		0.07		NA	
Skin Surface Area - Adult to Soil (cm^2)	SA	2690		2690		2938		6032		NA	
Skin Surface Area - to tapwater (cm2)	SAtw	6378		6378		20900		20900		NA	
Adjusted Exposure Duration (yr)	EDadj	0		0		18		0		18	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	0		0		51		0		51	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0		0		1		0		1	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	0		0		106		0		106	
Surface Area Tapwater-age adjusted (cm2-yr/kg)	Sawr_adj	0		0		10749		0		10749	

Early Life-Stage Factors - Urban Residential	Symbol	0 - 2 Years		3 - 6 Years		7 - 16 Years		17 - 26 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	2		4		0		5		11	
Adjusted Exposure Duration (yr)	EDadj	20		12		0		5		37	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	267		160		0		6		433	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	1.04		0.624		0		0.16		2	
Surface Area Tapwater-age adjusted (cm2-yr/kg)	Sawu_adj	8504		5102		0		1306		14913	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	717		430		0		26		1174	

Early Life-Stage Factors - Vinyl Chloride Residential	Symbol	0 - 6 Years		0 - 6 Years		7 - 30 Years		7 - 70 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	6		6		24		64		100	
Adjusted Exposure Duration (yr)	EDadj	6		6		24		64		100	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	17		17		30		80		144	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0.1		0.1		0.2		0.6		0.9	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	20		20		18		48		107	

Early Life-Stage Factors - Vinyl Chloride Urban Residential	Symbol	0 - 6 Years		0 - 6 Years		7 - 11 Years		7 - 70 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	6		6		5		64		81	
Adjusted Exposure Duration (yr)	EDadj	6		6		5		64		81	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	17		17		3.1		40		77	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0.1		0.1		0.0		0.6		0.7	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	20		20		4		48		92	

For explanation of notes, please see "Notes to Accompany Risk-Based Concentrations for Individual Chemicals."

Risk-Based Concentrations

Contaminated Medium			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)					
Exposure Pathway			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}					
Receptor Scenario			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note
83-32-9	Acenaphthene	nc, v	41,000	>Csat	22,000	>Csat	70,000	>Csat	21,000	>Csat	590,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	2,500	
107-13-1	Acrylonitrile	c, v	8.0		4.3		4.0		40		1,100		64		12		5.8		3.8		0.69		1.0		0.0039		0.0019		0.0017		0.57		0.27		0.25	
309-00-2	Aldrin	c, v	0.22		0.15		0.13		1.1		30	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.38		0.11		0.10		0.015		0.0046		0.0042	
120-12-7	Anthracene	nc, v	200,000	>Csat	110,000	>Csat	350,000	>Csat	110,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-38-2	Arsenic	c, nv	2.9		2.2		1.9		15		420		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.24		0.33		0.31	
7440-39-3	Barium	nc, nv	130,000		69,000		220,000		69,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		35,000		34,000		33,000	
56-55-3	Benz[a]anthracene	c, v	40	>Csat	2.5		21	>Csat	170	>Csat	4,800	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	6.0		-	>Csat	0.88		0.11		0.38	
71-43-2	Benzene	c, v	78		41		37		380		11,000	>Csat	560		100		50		7.7		1.4		2.1		0.27		0.12		0.10		5.4		2.4		2.1	
92-87-5	Benzidine	c, nv	0.019		0.0012		0.0100		0.082		2.3		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.00032		0.00012		0.00070		0.00090		0.00034		0.0019	
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	4.0		0.25		2.1		17	>Csat	490	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.21		0.080		0.47	
205-99-2	Benzo[b]fluoranthene	c, nv	40	>Csat	2.5		21	>Csat	170	>Csat	4,900	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	0.80		-	>S
207-08-9	Benzo[k]fluoranthene	c, nv	400	>Csat	25	>Csat	210	>Csat	1,700	>Csat	49,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-41-7	Beryllium	c, nv	75,000		7,300		6,700		170,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	270	>Csat	190	>Csat	160	>Csat	1,300	>Csat	37,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	26		36		33	
75-27-4	Bromodichloromethane	c, v	56		16		15		230		6,300	>Csat	120		21		11		2.0		0.36		0.53		0.047		0.0096		0.0088		3.2		0.66		0.60	
75-25-2	Bromoform	c, v	540		290		260		2,700	>Csat	74,000	>Csat	-	>Csat	720		360		400		72		110		0.53		0.24		0.22		38		17		16	
74-83-9	Bromomethane	nc, v	460		120		750		370		10,000	>Csat	-	>Csat	620		700		65		5.0		17		0.86		0.36		0.40		79		33		36	
7440-43-9	Cadmium	nc, nv	670		360		1,100		350		9,700		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		170		170		160	
56-23-5	Carbon tetrachloride	c, v	63		38		34		320		8,900	>Csat	720		130		65		5.8		1.1		1.6		0.12		0.069		0.058		4.5		2.5		2.1	
108-90-7	Chlorobenzene	nc, v	5,400	>Csat	1,300	>Csat	8,700	>Csat	4,700	>Csat	130,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	290		-	>Csat	65		26		27		870		340		350	
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	47		18		17		210		5,800	>Csat	160		29		14		11		2.0		2.9		0.042		0.012		0.011		3.0		0.84		0.77	
75-00-3	Chloroethane (ethyl chloride)	nc, v	-	>Max	320,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	1,100		1,300		230,000		76,000		88,000	
67-66-3	Chloroform	c, v	110		28		26		410		11,000	>Csat	190		34		17		1.5		0.28		0.41		0.088		0.016		0.015		5.8		1.1		0.98	
74-87-3	Chloromethane	nc, v	16,000	>Csat	2,900	>Csat	25,000	>Csat	25,000	>Csat	700,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	90		300		24		7.9		9.1		2,100		690		790	
12789-03-6	Chlordane	c, v	20		8.6		7.6		62	>Csat	1,700	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	15		4.5		4.2		0.74		0.22		0.21	
16065-83-1	Chromium (III)	nc, nv	1,000,000		550,000		-	>Max	530,000		-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		260,000		260,000		250,000	
18540-29-9	Chromium (VI)	c, nv	10		0.67		6.3		49		1,400		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		0.42		0.16		0.90	
218-01-9	Chrysene	c, nv	4,000	>Csat	250	>Csat	2,100	>Csat	17,000	>Csat	490,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-50-8	Copper	nc, nv	27,000		15,000		47,000		14,000		390,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		7,000		6,900		6,500	
74-90-8	Cyanide (hydrogen cyanide) ^A	nc, v	140		34		170		110		3,000		4,700		360		1,200		4,700		360		1,200		9.5		3.5		3.9		16		5.8		6.5	
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	30		14		12		94		2,600	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	41		5.9		2.6		1.2		0.17		0.074	
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	21		9.2		8.2		66		1,800	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	67		8.1		7.5		1.9		0.23		0.21	
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	21		9.6		8.5		66		1,800	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	300		75		70		-	>S	1.5		1.4	
53-70-3	Dibenz[a,h]anthracene	c, nv	4.0		0.25		2.1		17	>Csat	490	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	0.21		0.080		0.47	
95-50-1	1,2-Dichlorobenzene	nc, v	23,000	>Csat	5,300	>Csat	36,000	>Csat	20,000	>Csat	560,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	420		160		160		3,500		1,400		1,400	
106-46-7	1,4-Dichlorobenzene	c, v	510	>Csat	69		64		1,300	>Csat	36,000	>Csat	-	>Csat	72		36		48		8.7		13		2.7		0.27		0.25		23		2.3		2.1	
91-94-1	3,3-Dichlorobenzidine	c, nv	13	>Csat	5.9		5.1		42	>Csat	1,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	4.3		1.1		1.00		4.5		1.1		1.0	
75-34-3	1,1-Dichloroethane	c, v	1,100		290		260		3,200	>Csat	89,000	>Csat	-	>Csat	490		240		22		4.0		5.9		1.8		0.22		0.20		110		14		13	
75-35-4	1,1-Dichloroethene	nc, v	17,000	>Csat	4,700	>Csat	29,000	>Csat	13,000	>Csat	370,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	200		680		71		30		32		3,000		1,300		1,400	
156-59-2	cis-1,2-Dichloroethene	nc, v	1,400	>Csat	730		2,300	>Csat	710		20,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	6.1		5.8		4.5		340		330		260	
156-60-5	trans-1,2-Dichloroethene	nc, v	14,000	>Csat	7,300	>Csat	23,000	>Csat	7,100	>Csat	200,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	68		65		51		3,400		3,300		2,600	
111-44-4	Dichloroethylether	c, v	5.7		1.4		1.3		16		450		26		4.7		6.9		26		4.7		6.9		0.0079		0.00095		0.00087		0.57		0.068		0.063	
75-09-2	Dichloromethane	c, v	2,600	>Csat	170		1,600		12,000	>Csat	340,000	>Csat	-	>Csat	-	>Csat	-	>Csat	1,200		190		950		1.2		0.44		2.4		100		37		200	
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	5,100	>Csat	2,700	>Csat	8,200	>Csat	2,700	>Csat	74,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	23		21		16		1,700		1,600		1,200	
60-57-1	Dieldrin	c, nv	0.37		0.17		0.14		1.2		33	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.35		0.059		0.030		0.057		0.0098		0.0050	
606-20-2	2,6-Dinitrotoluene	c, nv	3.9		1.8		1.5		13		350		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.24		0.057		0.049		1.3		0.31		0.27	
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	0.85		0.38		0.33		2.7		74		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.025		0.0061		0.0054		0.29		0.070		0.062	
123-91-1	1,4-Dioxane	c, v	69		27		24		210		5,900		1,400		250		370		1,400		250		370		0.074		0.013		0.012		15		2.6		2.4	
86-30-6	Diphenylnitrosamine	c, nv	1,200	>Csat	540	>Csat	470	>Csat	3,800	>Csat	110,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	63		45		360		79		57	
106-93-4	EDB (1,2-dibromoethane)	c, v	3.1		0.79		0.73		9.0		250		7.2		1.3		0.65		0.58		0.11		0.16		0.0051		0.00061		0.00056		0.31		0.037		0.034	
107-06-2	EDC (1,2-dichloroethane)	c, v	69		18		16		200		5,600	>Csat	170		30		15		3.7		0.68		1.0		0.12		0.014		0.013		7.1		0.86		0.78	
115-29-7	Endosulfan (alpha-beta)	nc, v	3,000	>Csat	1,600	>Csat	4,900	>Csat	1,600	>Csat	45,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
72-20-8	Endrin	nc, nv	150	>Csat	82	>Csat	250	>Csat	80	>Csat	2,200	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	43		28		8.6	
100-41-4	Ethylbenzene	c, v	600	>Csat	170		150		1,700	>Csat	49,000	>Csat	-	>Csat	320		160		62		11		17		8.7		1.1		0.90		61		7.8		6.4	
206-44-0	Fluoranthene	nc, nv	19,000	>Csat	10,000	>Csat	30,000	>Csat	10,000	>Csat	280,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
86-73-7	Fluorene	nc, v	27,000	>Csat	15,000	>Csat	47,000	>Csat	14,000	>Csat	390,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	1,300	
50-00-0	Formaldehyde	c, v	710		69		64		1,600		44,000	>Csat	2,300		430		630		2,300		430		630		0.095		0.0093		0.0086		21		2.0		1.9	
76-44-8	Heptachlor	c, v	1.3		0.52		0.45		4.0		110		860		160		230		860		160		230		0.68		0.088		0.048		0.055		0.0071		0.0039	
1024-57-3	Heptachlor Epoxide	c, v	0.64		0.27		0.24		2.0		56		-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	0.17		0.021		0.016		0.056		0.0070		0.0053	
118-74-1	Hexachlorobenzene	c, v	3.9		1.0		0.93		11		320		49		8.9		13		49		8.9		13		0.75		0.091		0.084		0.40		0.049		0.045	
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	0.94		0.42		0.36		3.0		83	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	0.19		0.038		0.023		0.23		0.045		0.027	
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	5.4		2.4		2.1		17		470	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.1		0.22		0.13		1.3		0.26		0.16	
67-72-1	Hexachloroethane	c, v	120		36		32		370		10,000	>Csat	390		72		36		28		5.1		7.6		0.90		0.11		0.087		14		1.7		1.3	
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	40	>Csat	2.5	>Csat	21	>Csat	170	>Csat	4,900	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7439-92-1	Lead	NA, nv	400	L	400	L	800	L	800	L	800		L	NV	-	NV	-	NV	-	NV	-	NV	-	NV	30	L	30	L	30	L	15	L	15	L	15	L

Risk-Based Concentrations

Contaminated Medium →		GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
Exposure Pathway →		Volatilization to Outdoor Air RBC$_{wo}$						Vapor Intrusion into Buildings RBC$_{wi}$						GW in Excavation RBC$_{we}$		Vapor Intrusion into Buildings RBC$_{sv}$						Inhalation RBC$_{air}$					
Receptor Scenario →		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)		IVW		IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		1	Note	1	Note	1	Note		Note		Note		Note
83-32-9	Acenaphthene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
107-13-1	Acrylonitrile	c, v	110,000		20,000		9,800		34,000		6,200		9,200		250		400		73		180		2.0		0.36		0.18	
309-00-2	Aldrin	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.5		5.5		1.0		2.5		0.028		0.0050		0.0025	
120-12-7	Anthracene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
7440-38-2	Arsenic	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	6,300		-	NV	-	NV	-	NV	0.032		0.0057		0.0029	
7440-39-3	Barium	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.7E+07		-	NV	-	NV	-	NV	25		1.9		2.2	
56-55-3	Benz[a]anthracene	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	0.76		0.12		0.20	
71-43-2	Benzene	c, v	150,000		28,000		14,000		10,000		1,900		2,800		1,800		3,500		630		1,600		17		3.2		1.6	
92-87-5	Benzidine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	17		-	NV	-	NV	-	NV	0.00068		0.00011		0.00018	
50-32-8	Benzo[a]pyrene (BaP equivalents)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.076		0.012		0.020	
205-99-2	Benzo[b]fluoranthene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.76		0.12		0.20	
207-08-9	Benzo[k]fluoranthene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7440-41-7	Beryllium	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.057		0.010		0.0051	
117-81-7	Bis(2-ethylhexyl)phthalate	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
75-27-4	Bromodichloromethane	c, v	66,000		12,000		6,000		8,600		1,600		2,300		450		730		130		330		3.7		0.67		0.33	
75-25-2	Bromoform	c, v	-	>S	1,100,000		550,000		1,700,000		320,000		470,000		14,000		25,000		4,500		11,000		120		22		11	
74-83-9	Bromomethane	nc, v	1,500,000		120,000		130,000		100,000		7,800		27,000		1,200		50,000		3,900		22,000		250		19		22	
7440-43-9	Cadmium	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	130,000		-	NV	-	NV	-	NV	0.50		0.039		0.044	
56-23-5	Carbon tetrachloride	c, v	85,000		16,000		7,700		4,400		810		1,200		1,800		4,500		820		2,000		23		4.1		2.0	
108-90-7	Chlorobenzene	nc, v	-	>S	-	>S	-	>S	-	>S	250,000		-	>S	10,000		500,000		39,000		220,000		2,500		190		220	
124-48-1	Chlorodibromomethane (dibromochloromethane)	c, v	190,000		35,000		17,000		47,000		8,600		13,000		610		1,000		180		450		5.0		0.92		0.45	
75-00-3	Chloroethane (ethyl chloride)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	2,400,000		1.0E+08		7,800,000		4.4E+07		500,000		39,000		44,000	
67-66-3	Chloroform	c, v	70,000		13,000		6,300		6,000		1,100		1,600		720		1,200		210		530		5.9		1.1		0.53	
74-87-3	Chloromethane	nc, v	-	>S	1,600,000		1,800,000		1,300,000		97,000		330,000		22,000		910,000		70,000		390,000		4,500		350		390	
12789-03-6	Chlordane	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	49		-	>Pv	1.4		0.25		0.12	
16065-83-1	Chromium (III)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	5.0E+16		3.9E+15		4.4E+15	
18540-29-9	Chromium (VI)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	9,400		-	NV	-	NV	-	NV	0.00054		0.000087		0.00015	
218-01-9	Chrysene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7440-50-8	Copper	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	5,400,000		-	NV	-	NV	-	NV	5.0E+16		3.9E+15		4.4E+15	
74-90-8	Cyanide (hydrogen cyanide) ^	nc, v	1,600,000		120,000		140,000		480,000		37,000		130,000		190		8,100		620		3,500		40		3.1		3.5	
72-54-8	DDD (4,4'-Dichlorodiphenyldichloroethane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	31		-	NV	-	NV	-	NV	2.0		0.36		0.18	
72-55-9	DDE (4,4'-Dichlorodiphenyldichloroethene)	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	51		-	>Pv	1.4		0.25		0.13	
50-29-3	DDT (4,4'-Dichlorodiphenyltrichloroethane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	1.4		0.25		0.13	
53-70-3	Dibenz[a,h]anthracene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
95-50-1	1,2-Dichlorobenzene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	37,000		2,000,000		160,000		880,000		10,000		780		880	
106-46-7	1,4-Dichlorobenzene	c, v	-	>S	43,000		21,000		26,000		4,800		7,100		1,500		2,500		450		1,100		12		2.2		1.1	
91-94-1	3,3-Dichlorobenzidine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.40		0.073		0.036	
75-34-3	1,1-Dichloroethane	c, v	760,000		140,000		68,000		53,000		9,700		14,000		10,000		17,000		3,100		7,700		85		15		7.7	
75-35-4	1,1-Dichloroethene	nc, v	-	>S	2,100,000		2,400,000		1,400,000		110,000		360,000		44,000		2,000,000		160,000		880,000		10,000		780		880	
156-59-2	cis-1,2-Dichloroethene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	18,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
156-60-5	trans-1,2-Dichloroethene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	180,000		-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
111-44-4	Dichloroethylether	c, v	280,000		50,000		30,000		110,000		20,000		30,000		51		82		15		37		0.41		0.075		0.037	
75-09-2	Dichloromethane	c, v	-	>S	7,500,000		1.3E+07		4,000,000		650,000		3,300,000		640,000		910,000		150,000		1,200,000		4,500		730		1,200	
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	77,000		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
60-57-1	Dieldrin	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.4		-	NV	-	NV	-	NV	0.030		0.0054		0.0027	
606-20-2	2,6-Dinitrotoluene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	830		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
621-64-7	Di-N-propylnitrosamine (N-nitroso-di-N-propylamine)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	370		-	NV	-	NV	-	NV	0.068		0.012		0.0061	
123-91-1	1,4-Dioxane	c, v	4.0E+07		7,200,000		4,500,000		1.6E+07		3,000,000		4,500,000		3,400		5,400		990		2,500		27		4.9		2.5	
86-30-6	Diphenylnitrosamine	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	52		9.5		4.7	
106-93-4	EDB (1,2-dibromoethane)	c, v	8,700		1,600		790		2,200		400		590		27		45		8.2		20		0.23		0.041		0.020	
107-06-2	EDC (1,2-dichloroethane)	c, v	100,000		18,000		9,000		14,000		2,600		3,900		630		1,000		190		470		5.2		0.95		0.47	
115-29-7	Endosulfan (alpha-beta)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
72-20-8	Endrin	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	170		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
100-41-4	Ethylbenzene	c, v	-	>S	87,000		43,000		30,000		5,500		8,200		4,500		11,000		2,000		4,900		54		9.9		4.9	
206-44-0	Fluoranthene	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
86-73-7	Fluorene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
50-00-0	Formaldehyde	c, v	7.5E+07		1.4E+07		8,500,000		3.1E+07		5,700,000		8,500,000		1,300		2,100		380		940		10		1.9		0.94	
76-44-8	Heptachlor	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1.8		21		3.8		9.4		0.10		0.019		0.0094	
1024-57-3	Heptachlor Epoxide	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.2		10		1.9		4.7		0.052		0.0095		0.0047	
118-74-1	Hexachlorobenzene	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	59		11		27		0.30		0.054		0.027	
319-84-6	alpha-Hexachlorocyclohexane (alpha-HCH)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	18		-	NV	-	NV	-	NV	0.076		0.014		0.0068	
58-89-9	gamma-Hexachlorocyclohexane (Lindane)	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	100		-	NV	-	NV	-	NV	0.44		0.080		0.040	
67-72-1	Hexachloroethane	c, v	-	>S	44,000		22,000		28,000		5,100		7,500		860		2,500		450		1,100		12		2.2		1.1	
193-39-5	Indeno[1,2,3-cd]pyrene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7439-92-1	Lead	NA, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv

Risk-Based Concentrations

Contaminated Medium →			SOIL mg/Kg (ppm)										SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						SOIL mg/Kg (ppm)						GROUNDWATER µg/L (ppb)					
Exposure Pathway →			Soil Ingestion, Dermal Contact, and Inhalation RBC_{ss}										Volatilization to Outdoor Air RBC_{so}						Vapor Intrusion into Buildings RBC_{si}						Leaching to Groundwater RBC_{sw}						Ingestion, Dermal & Inhalation from Tapwater RBC_{tw}					
Receptor Scenario →			Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			DCS		DCS		DCS		DCS		DCS		IVS		IVS		IVS		IVS		IVS		IVS		ILS		ILS		ILS		DCW		DCW		DCW	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note		Note
7439-96-5	Manganese	nc, nv	16,000		8,200		25,000		8,200		230,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		4,200		4,100		3,900	
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	250	>Csat	140	>Csat	410	>Csat	130		3,700	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1.1		0.99		0.61		84		76		47	
7439-97-6	Mercury	nc, nv	200		110		350		110		2,900		-	NV	-	NV	-	NV	*		*		*		*		*		*		52		51		49	
1634-04-4	MTBE (methyl t-butyl ether)	c, v	3,900		1,200		1,100		12,000	>Csat	320,000	>Csat	-	>Csat	3,000		1,500		410		75		110		4.3		0.59		0.54		540		74		68	
91-20-3	Naphthalene	c, v	260		25		23		580	>Csat	16,000	>Csat	310		56		83		310		56		83		3.7		0.37		0.34		8.0		0.78		0.72	
7440-02-0	Nickel	c, nv	690,000		67,000		62,000		-	>Max	-	>Max	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		-	>S	-	>S	-	>S
87-86-5	Pentachlorophenol	c, nv	11		4.8		4.0		34		960		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	2.3		0.37		0.17		1.6		0.25		0.12	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	c, v	2.6	>Csat	2.6	>Csat	0.74		8.4	>Csat	230	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	1.1		0.25		0.25		0.028	
98-82-8	iso-Propylbenzene (cumene)	nc, v	35,000	>Csat	9,500	>Csat	57,000	>Csat	27,000	>Csat	750,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	5,900		2,400		2,000	
129-00-0	Pyrene	nc, v	14,000	>Csat	7,600	>Csat	23,000	>Csat	7,500	>Csat	210,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
7440-22-4	Silver	nc, nv	3,400		1,800		5,800		1,800		49,000		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	*		*		*		870		860		820	
100-42-5	Styrene	nc, v	77,000	>Csat	22,000	>Csat	130,000	>Csat	56,000	>Csat	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	850		800		14,000		6,100		5,700	
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	0.000055		0.000055		0.000016		0.00017		0.0048		-	>Csat	0.090		0.13		-	>Csat	0.090		0.13		0.00028		0.00028		0.000031		3.8E-06		3.8E-06		4.2E-07	
127-18-4	Tetrachloroethene (PCE)	c, v	3,400	>Csat	1,100	>Csat	1,000	>Csat	10,000	>Csat	280,000	>Csat	-	>Csat	-	>Csat	-	>Csat	130		24		36		17		2.4		1.9		430		61		48	
108-88-3	Toluene	nc, v	51,000	>Csat	25,000	>Csat	88,000	>Csat	28,000	>Csat	770,000	>Csat	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	490		12,000		9,300		6,300	
8001-35-2	Toxaphene	c, nv	5.4		2.4		2.1		17		470		-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	13		2.0		0.93		0.55		0.086		0.040	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	-	>Max	880,000	>Csat	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>S	-	>S	-	>S
71-55-6	1,1,1-Trichloroethane	nc, v	540,000	>Csat	130,000	>Csat	870,000	>Csat	470,000	>Csat	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	820		880		87,000		34,000		37,000	
79-00-5	1,1,2-Trichloroethane	c, v	110		29		26		320		8,900	>Csat	270		49		24		15		2.8		4.2		0.26		0.031		0.029		11		1.4		1.3	
79-01-6	Trichloroethene	NA, v	6.7		17		51		130		3,700	>Csat	15		33		96		0.12		0.26		2.3		0.013		0.053		0.087		0.49		2.0		3.3	
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	77,000	>Csat	19,000	>Csat	130,000	>Csat	69,000	>Csat	-	>Max	-	>Max	-	>Csat	-	>Csat	-	>Csat	700		-	>Csat	670		260		280		12,000		4,800		5,200	
88-06-2	2,4,6-Trichlorophenol	c, nv	540		240		210		1,700		47,000	>Csat	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	71		14		8.9		130		27		16	
95-63-6	1,2,4-Trimethylbenzene	nc, v	4,200	>Csat	1,300	>Csat	6,900	>Csat	2,900	>Csat	81,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	520		-	>Csat	140		64		48		740		330		250	
108-67-8	1,3,5-Trimethylbenzene	nc, v	4,200	>Csat	1,300	>Csat	6,900	>Csat	2,900	>Csat	81,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	140		64		53		750		340		280	
75-01-4	Vinyl chloride	c, v	2.1		1.2		4.4		34		950	>Csat	59		24		89		0.48		0.20		2.2		0.0026		0.0016		0.010		0.12		0.075		0.49	
1330-20-7	Xylenes	nc, v	16,000	>Csat	3,100	>Csat	25,000	>Csat	20,000	>Csat	560,000	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	-	>Csat	260		90		100		2,200		740		830	

For a complete explanation of notes, please see "Notes to Accompany Risk-Based Concentrations for Individual Chemicals."

Ψ WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.

Risk-Based Concentrations

Contaminated Medium →			GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)						GROUNDWATER µg/L (ppb)		SOIL GAS µg/m³						AIR µg/m³					
Exposure Pathway →			Volatilization to Outdoor Air RBC$_{wo}$						Vapor Intrusion into Buildings RBC$_{wi}$						GW in Excavation RBC$_{we}$		Vapor Intrusion into Buildings RBC$_{sv}$						Inhalation RBC$_{air}$					
Receptor Scenario →			Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational		Construction & Excavation Worker		Residential		Urban Residential		Occupational		Residential		Urban Residential		Occupational	
Direct or Indirect Pathway (see notes)			IVW		IVW		IVW		IVW		IVW		IVW		DCW		ICA		ICA		ICA		DCA		DCA		DCA	
CASn	Chemical	Note		Note		Note		Note		Note		Note		Note		Note	1	Note	1	Note	1	Note		Note		Note		Note
7439-96-5	Manganese	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	3,200,000		-	NV	-	NV	-	NV	2.5		0.19		0.22	
94-74-6	MCPA ((4-chloro-2-methylphenoxy)acetic acid)	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,700		-	NV	-	NV	-	NV	-	>Pv	-	>Pv	-	>Pv
7439-97-6	Mercury	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	15		1.2		1.3	
1634-04-4	MTBE (methyl t-butyl ether)	c, v	1.7E+07		3,100,000		1,500,000		3,200,000		590,000		870,000		63,000		100,000		19,000		47,000		520		95		47	
91-20-3	Naphthalene	c, v	-	>S	31,000		16,000		-	>S	7,400		11,000		500		800		150		360		4.0		0.73		0.36	
7440-02-0	Nickel	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	-	>S	-	NV	-	NV	-	NV	0.52		0.095		0.047	
87-86-5	Pentachlorophenol	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	53		-	NV	-	NV	-	NV	27		4.8		2.4	
11097-69-1	Polychlorinated biphenyls (Total PCBs)	c, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	30		-	>Pv	8.7		22		0.18		0.18		0.017	
98-82-8	iso-Propylbenzene (cumene)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	51,000		4,000,000		310,000		1,800,000		20,000		1,600		1,800	
129-00-0	Pyrene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv	-	>Pv
7440-22-4	Silver	nc, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	1,100,000		-	NV	-	NV	-	NV	5.0E+16		3.9E+15		4.4E+15	
100-42-5	Styrene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	170,000		1.0E+07		780,000		4,400,000		50,000		3,900		4,400	
1746-01-6	2,3,7,8-TCDD (dioxin) equivalents	c, v	-	>S	0.19		0.11		-	>S	0.073		0.11		0.00045		0.00072		0.00013		0.00032		2.8E-06		2.8E-06		2.5E-07	
127-18-4	Tetrachloroethene (PCE)	c, v	-	>S	-	>S	-	>S	180,000		32,000		48,000		34,000		100,000		19,000		47,000		520		95		47	
108-88-3	Toluene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	220,000		5.0E+07		3,900,000		2.2E+07		250,000		19,000		22,000	
8001-35-2	Toxaphene	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	18		-	NV	-	NV	-	NV	0.42		0.077		0.038	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	3.0E+08		2.3E+07		1.3E+08		1,500,000		120,000		130,000	
71-55-6	1,1,1-Trichloroethane	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	1,100,000		5.0E+07		3,900,000		2.2E+07		250,000		19,000		22,000	
79-00-5	1,1,2-Trichloroethane	c, v	230,000		42,000		21,000		42,000		7,700		11,000		1,000		1,700		310		770		8.5		1.5		0.77	
79-01-6	Trichloroethene	NA, v	3,300		6,900		20,000		200		430		3,700		430		95		200		2,900		0.47		1.0		2.9	
75-69-4	Trichlorofluoromethane (Freon 11)	nc, v	-	>S	-	>S	-	>S	-	>S	140,000		460,000		160,000		7,100,000		540,000		3,100,000		35,000		2,700		3,100	
88-06-2	2,4,6-Trichlorophenol	c, nv	-	NV	-	NV	-	NV	-	NV	-	NV	-	NV	11,000		-	NV	-	NV	-	NV	44		8.0		4.0	
95-63-6	1,2,4-Trimethylbenzene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	6,300		610,000		47,000		260,000		3,000		230		260	
108-67-8	1,3,5-Trimethylbenzene	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	7,500		610,000		47,000		260,000		3,000		230		260	
75-01-4	Vinyl chloride	c, v	3,900		1,600		5,900		190		80		880		960		370		150		2,800		1.9		0.76		2.8	
1330-20-7	Xylenes	nc, v	-	>S	-	>S	-	>S	-	>S	-	>S	-	>S	23,000		1,000,000		78,000		440,000		5,000		390		440	

Ψ **WARNING: Both non-cancer and cancer endpoints must be calculated for these substances to show all the lowest RBCs.**

Exposure Factors: Reasonable Maximum Exposure

Parameter (unit)	Symbol	Residential		Urban Residential		Occupational		Construction Worker		Excavation Worker	
			Note		Note		Note		Note		Note
ACCEPTABLE RISK LEVELS											
Acceptable Risk Level - Carcinogens	ARLc	1.00E-06	1	=		=		=		=	
Acceptable Risk Level - Noncarcinogens	ARLn	1	1	=		=		=		=	
EXPOSURE PARAMETERS											
Averaging Time - Carcinogen (yr)	ATc	70	3	=		=		=		=	
Averaging Time - Noncarcinogen (yr)	ATn	26	3	11	2	25	3	1	3	1	3
Averaging Time - Noncarcinogen, Child (yr)	ATnc	6	3	6	3	NA		NA		NA	
Body Weight - Adult (kg)	BWa	80	3	=		=		=		=	
Body Weight - Child (kg)	BWc	35	3	=		NA		NA		NA	
Exposure Duration - Adult (yr)	ED	6	3	11	4	25	3	1	21	1	6
Exposure Duration - Child (yr)	EDc	6	3	6	4	NA		NA		NA	
Exposure Frequency (day/yr)	EF	94	3	175	3c	250	6	250	6	9	6
Exposure Time (hr/day)	ET	8		24		8		8		8	
Event Frequency - Groundwater (events/day)	EvF	1	24	1	24	2	24	2	6	=	
Event Time - Groundwater (hr/event) (age adjusted)	t_{event}	0.67	25	0.62	25	2	24	2	6	=	
Soil Ingestion Rate - Adult (mg/day)	IRS	100	6	100	6	100	6	330	21	330	21
Soil Ingestion Rate - Child (mg/day)	IRSc	200	4	200	4	NA		NA		NA	
Water Ingestion Rate - Adult (L/day)	IRW	2.5	3a	2.5	3a	0.7	4a	NA		NA	
Water Ingestion Rate - Child (L/day)	IRWc	0.78	3b	=		NA		NA		NA	
Skin Surface Area - Adult to Soil (cm^2)	SA	6032	4	6032	4	3527	4	3527	4	3527	4
Skin Surface Area - Child to Soil (cm^2)	SAc	3395	3	=		NA		NA		NA	
Skin Surface Area - Adult to Groundwater (cm^2)	SAw	20900	3	20900	3	3527	3	6032	4	6032	4
Skin Surface Area - Child to Groundwater (cm^2)	SAwc	6378	3	6378	3	NA		NA		NA	
Soil to Skin Adherence Factor - Adult (mg/cm^2-day)	AF	0.07	5a	0.07	5a	0.12	5b	0.30	5c	0.30	5c
Soil to Skin Adherence Factor - Child (mg/cm^2-day)	AFc	0.20	5d	=		NA		NA		NA	
AGE-ADJUSTED EXPOSURE FACTORS											
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	34	7	41	7a	NA		NA		NA	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0.13	7	0.29	7a	NA		NA		NA	
Surface Area Tapwater-age adjusted (cm2-yr/kg)	SAwadj	582	7	2400	7	NA		NA		NA	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	116	7	143	7a	NA		NA		NA	

SITE PARAMETERS											
Soil Bulk Density (g/cm^3)	ρ_b	1.70	8	=		=		=		=	
Soil Particle Density (g/cm^3)	ρ_s	2.74	9	=		=		=		=	
Soil Porosity	n	0.38	8	=		=		=		=	
Air Content - Vadose Zone Soils	n_a	0.26	10	=		=		=		=	
Air Content - Cap. Fringe Soils	n_{acap}	0.038	10	=		=		=		=	
Air Content - Foundation Cracks	n_{acrk}	0.26	10	=		=		=		=	
Water Content - Vadose Zone Soils	n_w	0.12	8	=		=		=		=	
Water Content - Cap. Fringe Soils	n_{wcap}	0.342	8	=		=		=		=	
Water Content - Foundation Cracks	n_{wcrk}	0.12	11	=		=		=		=	
Vadose Zone Thickness (cm)	L_v	295	12	=		=		=		=	
Capillary Fringe Thickness (cm)	L_{cap}	5.00	8	=		=		=		=	
Fraction Organic Carbon (shallow soil)	f_{oc}	0.005	8a	=		=		=		=	
Depth to Groundwater (cm)	L_w	300	8	=		=		=		=	
Groundwater Dilution-Attenuation Factor	DAF	60	19	=		=		=		=	
SOIL CONTAMINATION PARAMETERS											
Thickness of Contaminated Surface Soils (cm)	L_{ss}	100	8	=		=		=		=	
Fraction of Site with Surface Soil Contamination	f_{ss}	0.50	16	=		=		=		=	
Thickness of Clean Surface Soils (cm)	L_c	100	8	=		=		=		=	
Thickness of Subsurface Contamination (cm)	L_s	200	8	=		=		=		=	
Soil Gas Attenuation Factor for Chlorinated Hydrocarbons	AF_{ch}	200	23	200	23	1000	23	NA		NA	
Soil Gas Attenuation Factor for Petroleum Hydrocarbons	AF_{ph}	200	23	200	23	1000	23	NA		NA	
Fraction of Site with Subsurface Vol. To Outdoor Air	f_{so}	0.50	17	=		=		=		=	
Thickness of Clean Soils Under Building (cm)	L_{cb}	100	8	=		=		=		=	
Thickness of Contaminated Soils Under Building (cm)	L_{sb}	200	8	=		=		=		=	
Fraction of Contaminated Soils Under Building	f_{sb}	0.50	18	=		=		=		=	
Particulate Emission Factor for Soils (kg/m^3)	PEF	7.58E-10	13	=		=		=		=	
BUILDING PARAMETERS											
Building Air Exchange Rate (1/day)	ER	24	14	=		48	14	NA		NA	
Building Height (indoor air mixing zone) (cm)	L_B	200	8	=		300	8	NA		NA	
Foundation Wall Thickness (cm)	L_{crk}	15	8	=		=		NA		NA	
Foundation Crack Fraction	f_{crk}	0.0010	15	=		=		NA		NA	
VOLATILIZATION FACTORS											
Averaging time for Volatilization -Adults (yr)	t_{vol}	25	16	=		=		=		=	
Averaging time for Volatilization -Children (yr)	t_{volc}	6	16	=		NA		NA		NA	
Max. Soil to Building Vol. Factor (kg/m^3)	$VF_{si}max$	3.88E-03	18	3.88E-03	18	1.29E-03	18	NA		NA	
Max. Surface Soil Vol. Factor - Adult (kg/m^3)	$VF_{ss}max$	1.57E-05	16	1.57E-05	16	1.57E-05	16	1.57E-05	16	1.57E-05	16
Max. Surface Soil Vol. Factor - Child (kg/m^3)	$VF_{ss}max$	6.53E-05	16	=		NA		NA		NA	
Max. Soil to Outdoor Air Vol. Factor - Adult (kg/m^3)	$VF_{so}max$	3.13E-05	17	3.13E-05	17	3.13E-05	17	NA		NA	
Volatile Organics Dispersion Term (g/m^2-s per kg/m^3)	Q/C	6.88E+01	13	=		=		=		=	
MISCELLANEOUS PARAMETERS											
Ideal Gas Law Constant (m^3-atm/K-mol)	R	8.21E-05	20	=		=		=		=	
Absolute Temperature (K)	T	2.93E+02	20	=		=		=		=	

Additional Information for Early Life-Stage Factor Calculations

Early Life-Stage Factors - Residential	Symbol	0 - 2 Years		3 - 6 Years		7 - 16 Years		17 - 26 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	0		0		6		0		6	
Body Weight (kg)	BW	15		15		35		80		NA	
Soil Ingestion Rate (mg/day)	IRs	200		200		100		100		NA	
Air Inhalation Rate (m^3/day)	IRa	10		10		20		20		NA	
Water Ingestion Rate (L/day) -adults	IRw	0.78		0.78		2.5		2.5		NA	
Age-dependent Adjustment Factor	ADAF	10		3		3		1		NA	
Soil to Skin Adherence Factor (mg/cm^2)	AF	0.2		0.2		0.07		0.07		NA	
Skin Surface Area - Adult to Soil (cm^2)	SA	2690		2690		3395		6032		NA	
Skin Surface Area - to tapwater (cm2)	SAtw	6378		6378		20900		20900		NA	
Adjusted Exposure Duration (yr)	EDadj	0		0		18		0		18	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	0		0		51		0		51	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0		0		1		0		1	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	0		0		122		0		122	
Surface Area Tapwater-age adjusted (cm2-yr/kg)	Sawr_adj	0		0		10749		0		10749	

Early Life-Stage Factors - Urban Residential	Symbol	0 - 2 Years		3 - 6 Years		7 - 16 Years		17 - 26 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	2		4		0		5		11	
Adjusted Exposure Duration (yr)	EDadj	20		12		0		5		37	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	267		160		0		6		433	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	1.04		0.624		0		0.16		2	
Surface Area Tapwater-age adjusted (cm2-yr/kg)	Sawu_adj	8504		5102		0		1306		14913	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	717		430		0		26		1174	

Early Life-Stage Factors - Vinyl Chloride Residential	Symbol	0 - 6 Years		0 - 6 Years		7 - 30 Years		7 - 70 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	6		6		24		64		100	
Adjusted Exposure Duration (yr)	EDadj	6		6		24		64		100	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	34		34		30		80		179	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0.1		0.1		0.8		2.0		3.0	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	116		116		127		338		697	

Early Life-Stage Factors - Vinyl Chloride Urban Residential	Symbol	0 - 6 Years		0 - 6 Years		7 - 11 Years		7 - 70 Years		Total	
(See Note 22)			Note		Note		Note		Note		Note
Exposure Duration (yr)	ED	6		6		5		64		81	
Adjusted Exposure Duration (yr)	EDadj	6		6		5		64		81	
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	34		34		6.3		80		155	
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	0.1		0.1		0.2		2.0		2.4	
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	116		116		26		338		597	

For explanation of notes, please see "Notes to Accompany Risk-Based Concentrations for Individual Chemicals."

ATTACHMENT D

ProUCL OUTPUT

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

User Selected Options	
Date/Time of Computation	4/11/2014 12:17:13 PM
From File	Groundwater_EPCs_20140410.xls
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

Acenaphthene

General Statistics

Total Number of Observations	102	Number of Distinct Observations	96
Number of Detects	94	Number of Non-Detects	8
Number of Distinct Detects	91	Number of Distinct Non-Detects	5
Minimum Detect	0.0478	Minimum Non-Detect	0.013
Maximum Detect	972	Maximum Non-Detect	0.187
Variance Detects	30729	Percent Non-Detects	7.843%
Mean Detects	132.8	SD Detects	175.3
Median Detects	89.7	CV Detects	1.32
Skewness Detects	2.666	Kurtosis Detects	8.577
Mean of Logged Detects	3.315	SD of Logged Detects	2.726

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.706	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.224	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0914	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	122.4	Standard Error of Mean	17.04
SD	171.2	90% KM (BCA) UCL	142.2
90% KM (t) UCL	144.4	90% KM (Percentile Bootstrap) UCL	145.8
90% KM (z) UCL	144.3	90% KM Bootstrap t UCL	149.2
90% KM Chebyshev UCL	173.5	95% KM Chebyshev UCL	196.7
97.5% KM Chebyshev UCL	228.8	99% KM Chebyshev UCL	291.9

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.588	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.839	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.175	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0987	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.415	k star (bias corrected MLE)	0.409
Theta hat (MLE)	319.8	Theta star (bias corrected MLE)	324.6
nu hat (MLE)	78.1	nu star (bias corrected)	76.94
MLE Mean (bias corrected)	132.8	MLE Sd (bias corrected)	207.6

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.512	nu hat (KM)	104.4
Approximate Chi Square Value (104.37, α)	86.33	Adjusted Chi Square Value (104.37, β)	86.14
90% Gamma Approximate KM-UCL (use when n>=50)	148	90% Gamma Adjusted KM-UCL (use when n<50)	148.3

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Acenaphthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0478	Mean	123
Maximum	972	Median	86.25
SD	171.6	CV	1.396
k hat (MLE)	0.408	k star (bias corrected MLE)	0.403
Theta hat (MLE)	301.1	Theta star (bias corrected MLE)	305.2
nu hat (MLE)	83.32	nu star (bias corrected)	82.2
MLE Mean (bias corrected)	123	MLE Sd (bias corrected)	193.7
		Adjusted Level of Significance (β)	0.0974
Approximate Chi Square Value (82.20, α)	66.26	Adjusted Chi Square Value (82.20, β)	66.09
90% Gamma Approximate UCL (use when n>=50)	152.5	90% Gamma Adjusted UCL (use when n<50)	152.9

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.242	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0914	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	122.4	Mean in Log Scale	2.884
SD in Original Scale	172	SD in Log Scale	3.012
90% t UCL (assumes normality of ROS data)	144.4	90% Percentile Bootstrap UCL	145.3
90% BCA Bootstrap UCL	146.7	90% Bootstrap t UCL	149.4
90% H-UCL (Log ROS)	4738		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	122.4	Mean in Log Scale	2.748
SD in Original Scale	172	SD in Log Scale	3.269
90% t UCL (Assumes normality)	144.4	90% H-Stat UCL	10992

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Anthracene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	92
Number of Detects	84	Number of Non-Detects	18
Number of Distinct Detects	80	Number of Distinct Non-Detects	12
Minimum Detect	0.014	Minimum Non-Detect	0.012
Maximum Detect	276	Maximum Non-Detect	75.5
Variance Detects	2077	Percent Non-Detects	17.65%
Mean Detects	15.66	SD Detects	45.57
Median Detects	5.75	CV Detects	2.91
Skewness Detects	4.366	Kurtosis Detects	19.22
Mean of Logged Detects	0.748	SD of Logged Detects	2.273

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.348	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.454	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0967	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	13.3	Standard Error of Mean	4.132
SD	41.46	90% KM (BCA) UCL	18.9
90% KM (t) UCL	18.63	90% KM (Percentile Bootstrap) UCL	18.81
90% KM (z) UCL	18.6	90% KM Bootstrap t UCL	21.09
90% KM Chebyshev UCL	25.7	95% KM Chebyshev UCL	31.31
97.5% KM Chebyshev UCL	39.11	99% KM Chebyshev UCL	54.41

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	4.676	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.857	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.247	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.105	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.338	k star (bias corrected MLE)	0.333
Theta hat (MLE)	46.39	Theta star (bias corrected MLE)	46.97
nu hat (MLE)	56.72	nu star (bias corrected)	56.03
MLE Mean (bias corrected)	15.66	MLE Sd (bias corrected)	27.12

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.103	nu hat (KM)	21.01
Approximate Chi Square Value (21.01, α)	13.25	Adjusted Chi Square Value (21.01, β)	13.18
90% Gamma Approximate KM-UCL (use when n>=50)	21.1	90% Gamma Adjusted KM-UCL (use when n<50)	21.21

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	13.19
Maximum	276	Median	3.345
SD	41.71	CV	3.162
k hat (MLE)	0.275	k star (bias corrected MLE)	0.273
Theta hat (MLE)	48.03	Theta star (bias corrected MLE)	48.3
nu hat (MLE)	56.02	nu star (bias corrected)	55.71
MLE Mean (bias corrected)	13.19	MLE Sd (bias corrected)	25.24
		Adjusted Level of Significance (β)	0.0974
Approximate Chi Square Value (55.71, α)	42.68	Adjusted Chi Square Value (55.71, β)	42.55
90% Gamma Approximate UCL (use when n>=50)	17.22	90% Gamma Adjusted UCL (use when n<50)	17.27

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0967	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	13.11	Mean in Log Scale	0.434
SD in Original Scale	41.69	SD in Log Scale	2.293
90% t UCL (assumes normality of ROS data)	18.44	90% Percentile Bootstrap UCL	18.82
90% BCA Bootstrap UCL	20.31	90% Bootstrap t UCL	21.6
90% H-UCL (Log ROS)	40.31		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	14.98	Mean in Log Scale	0.734
SD in Original Scale	41.68	SD in Log Scale	2.359
90% t UCL (Assumes normality)	20.3	90% H-Stat UCL	65.61

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(a)Anthracene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	65
Number of Detects	34	Number of Non-Detects	68
Number of Distinct Detects	34	Number of Distinct Non-Detects	32
Minimum Detect	0.0454	Minimum Non-Detect	0.015
Maximum Detect	118	Maximum Non-Detect	75.5
Variance Detects	893.7	Percent Non-Detects	66.67%
Mean Detects	12.45	SD Detects	29.89
Median Detects	0.437	CV Detects	2.401
Skewness Detects	2.489	Kurtosis Detects	5.297
Mean of Logged Detects	-0.219	SD of Logged Detects	2.193

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.477	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.452	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	4.266	Standard Error of Mean	1.813
SD	18	90% KM (BCA) UCL	6.653
90% KM (t) UCL	6.605	90% KM (Percentile Bootstrap) UCL	6.738
90% KM (z) UCL	6.59	90% KM Bootstrap t UCL	7.527
90% KM Chebyshev UCL	9.706	95% KM Chebyshev UCL	12.17
97.5% KM Chebyshev UCL	15.59	99% KM Chebyshev UCL	22.31

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	5.04	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.877	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.349	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.165	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.258	k star (bias corrected MLE)	0.255
Theta hat (MLE)	48.28	Theta star (bias corrected MLE)	48.88
nu hat (MLE)	17.54	nu star (bias corrected)	17.32
MLE Mean (bias corrected)	12.45	MLE Sd (bias corrected)	24.67

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0562	nu hat (KM)	11.46
Approximate Chi Square Value (11.46, α)	5.909	Adjusted Chi Square Value (11.46, β)	5.863
90% Gamma Approximate KM-UCL (use when n>=50)	8.272	90% Gamma Adjusted KM-UCL (use when n<50)	8.336
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(a)Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	4.184
Maximum	118	Median	0.01
SD	18.07	CV	4.319
k hat (MLE)	0.168	k star (bias corrected MLE)	0.17
Theta hat (MLE)	24.84	Theta star (bias corrected MLE)	24.61
nu hat (MLE)	34.36	nu star (bias corrected)	34.68
MLE Mean (bias corrected)	4.184	MLE Sd (bias corrected)	10.15
		Adjusted Level of Significance (β)	0.0974
Approximate Chi Square Value (34.68, α)	24.53	Adjusted Chi Square Value (34.68, β)	24.43
90% Gamma Approximate UCL (use when n>=50)	5.916	90% Gamma Adjusted UCL (use when n<50)	5.94

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.822	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.229	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.186	Mean in Log Scale	-2.816
SD in Original Scale	18.07	SD in Log Scale	2.591
90% t UCL (assumes normality of ROS data)	6.494	90% Percentile Bootstrap UCL	6.674
90% BCA Bootstrap UCL	7.102	90% Bootstrap t UCL	7.587
90% H-UCL (Log ROS)	3.777		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	6.641	Mean in Log Scale	-0.864
SD in Original Scale	18.82	SD in Log Scale	2.482
90% t UCL (Assumes normality)	9.045	90% H-Stat UCL	19.02

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(a)Pyrene

General Statistics			
Total Number of Observations	91	Number of Distinct Observations	50
Number of Detects	15	Number of Non-Detects	76
Number of Distinct Detects	15	Number of Distinct Non-Detects	35
Minimum Detect	0.0379	Minimum Non-Detect	0.01
Maximum Detect	32.4	Maximum Non-Detect	19.5
Variance Detects	78.02	Percent Non-Detects	83.52%
Mean Detects	3.332	SD Detects	8.833
Median Detects	0.15	CV Detects	2.651
Skewness Detects	3.053	Kurtosis Detects	9.413
Mean of Logged Detects	-1.228	SD of Logged Detects	1.988

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.435	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.469	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.229	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.579	Standard Error of Mean	0.4
SD	3.679	90% KM (BCA) UCL	1.075
90% KM (t) UCL	1.095	90% KM (Percentile Bootstrap) UCL	1.096
90% KM (z) UCL	1.091	90% KM Bootstrap t UCL	8.936
90% KM Chebyshev UCL	1.778	95% KM Chebyshev UCL	2.321
97.5% KM Chebyshev UCL	3.075	99% KM Chebyshev UCL	4.555

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	2.308	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.842	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.366	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.241	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.286	k star (bias corrected MLE)	0.273
Theta hat (MLE)	11.66	Theta star (bias corrected MLE)	12.2
nu hat (MLE)	8.575	nu star (bias corrected)	8.194
MLE Mean (bias corrected)	3.332	MLE Sd (bias corrected)	6.376

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0247	nu hat (KM)	4.504
Approximate Chi Square Value (4.50, α)	1.336	Adjusted Chi Square Value (4.50, β)	1.315
90% Gamma Approximate KM-UCL (use when n>=50)	1.951	90% Gamma Adjusted KM-UCL (use when n<50)	1.983
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(a)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.558
Maximum	32.4	Median	0.01
SD	3.698	CV	6.631
k hat (MLE)	0.211	k star (bias corrected MLE)	0.211
Theta hat (MLE)	2.646	Theta star (bias corrected MLE)	2.642
nu hat (MLE)	38.35	nu star (bias corrected)	38.42
MLE Mean (bias corrected)	0.558	MLE Sd (bias corrected)	1.214
		Adjusted Level of Significance (β)	0.0971
Approximate Chi Square Value (38.42, α)	27.7	Adjusted Chi Square Value (38.42, β)	27.58
90% Gamma Approximate UCL (use when n>=50)	0.773	90% Gamma Adjusted UCL (use when n<50)	0.777

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.836	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.216	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.229	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.554	Mean in Log Scale	-5.597
SD in Original Scale	3.698	SD in Log Scale	2.609
90% t UCL (assumes normality of ROS data)	1.054	90% Percentile Bootstrap UCL	1.073
90% BCA Bootstrap UCL	1.449	90% Bootstrap t UCL	12.12
90% H-UCL (Log ROS)	0.266		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.757	90% H-UCL (KM -Log)	0.122
KM SD (logged)	1.6	90% Critical H Value (KM-Log)	2.194
KM Standard Error of Mean (logged)	0.208		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.115	Mean in Log Scale	-2.016
SD in Original Scale	3.845	SD in Log Scale	2.07
90% t UCL (Assumes normality)	1.635	90% H-Stat UCL	2.015

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzofluoranthenes

General Statistics			
Total Number of Observations	21	Number of Distinct Observations	19
Number of Detects	14	Number of Non-Detects	7
Number of Distinct Detects	14	Number of Distinct Non-Detects	6
Minimum Detect	0.0819	Minimum Non-Detect	0.0748
Maximum Detect	72.2	Maximum Non-Detect	0.377
Variance Detects	499.6	Percent Non-Detects	33.33%
Mean Detects	11	SD Detects	22.35
Median Detects	0.605	CV Detects	2.033
Skewness Detects	2.112	Kurtosis Detects	3.812
Mean of Logged Detects	-0.056	SD of Logged Detects	2.314

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.568	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.443	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	7.361	Standard Error of Mean	4.149
SD	18.32	90% KM (BCA) UCL	12.41
90% KM (t) UCL	12.86	90% KM (Percentile Bootstrap) UCL	12.77
90% KM (z) UCL	12.68	90% KM Bootstrap t UCL	16.99
90% KM Chebyshev UCL	19.81	95% KM Chebyshev UCL	25.45
97.5% KM Chebyshev UCL	33.27	99% KM Chebyshev UCL	48.65

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	1.659	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.84	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.323	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.249	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.284	k star (bias corrected MLE)	0.27
Theta hat (MLE)	38.77	Theta star (bias corrected MLE)	40.66
nu hat (MLE)	7.941	nu star (bias corrected)	7.573
MLE Mean (bias corrected)	11	MLE Sd (bias corrected)	21.15

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.161	nu hat (KM)	6.779
Approximate Chi Square Value (6.78, α)	2.693	Adjusted Chi Square Value (6.78, β)	2.543
90% Gamma Approximate KM-UCL (use when n>=50)	18.53	90% Gamma Adjusted KM-UCL (use when n<50)	19.62

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzofluoranthenes (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	7.335
Maximum	72.2	Median	0.208
SD	18.79	CV	2.561
k hat (MLE)	0.206	k star (bias corrected MLE)	0.208
Theta hat (MLE)	35.68	Theta star (bias corrected MLE)	35.28
nu hat (MLE)	8.633	nu star (bias corrected)	8.733
MLE Mean (bias corrected)	7.335	MLE Sd (bias corrected)	16.09
		Adjusted Level of Significance (β)	0.0869
Approximate Chi Square Value (8.73, α)	3.986	Adjusted Chi Square Value (8.73, β)	3.798
90% Gamma Approximate UCL (use when n>=50)	16.07	90% Gamma Adjusted UCL (use when n<50)	16.87

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.853	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	7.338	Mean in Log Scale	-1.571
SD in Original Scale	18.78	SD in Log Scale	2.944
90% t UCL (assumes normality of ROS data)	12.77	90% Percentile Bootstrap UCL	12.84
90% BCA Bootstrap UCL	14.93	90% Bootstrap t UCL	17.01
90% H-UCL (Log ROS)	250.5		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.863	90% H-UCL (KM -Log)	20.11
KM SD (logged)	2.156	90% Critical H Value (KM-Log)	3.196
KM Standard Error of Mean (logged)	0.49		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	7.359	Mean in Log Scale	-0.958
SD in Original Scale	18.78	SD in Log Scale	2.314
90% t UCL (Assumes normality)	12.79	90% H-Stat UCL	32.33

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Chrysene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	66
Number of Detects	32	Number of Non-Detects	70
Number of Distinct Detects	32	Number of Distinct Non-Detects	34
Minimum Detect	0.0068	Minimum Non-Detect	0.0065
Maximum Detect	102	Maximum Non-Detect	75.5
Variance Detects	663.7	Percent Non-Detects	68.63%
Mean Detects	10.7	SD Detects	25.76
Median Detects	0.388	CV Detects	2.408
Skewness Detects	2.495	Kurtosis Detects	5.449
Mean of Logged Detects	-0.527	SD of Logged Detects	2.312

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.477	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.471	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.157	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	3.47	Standard Error of Mean	1.529
SD	15.11	90% KM (BCA) UCL	5.551
90% KM (t) UCL	5.443	90% KM (Percentile Bootstrap) UCL	5.541
90% KM (z) UCL	5.43	90% KM Bootstrap t UCL	6.389
90% KM Chebyshev UCL	8.058	95% KM Chebyshev UCL	10.14
97.5% KM Chebyshev UCL	13.02	99% KM Chebyshev UCL	18.69

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	4.773	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.882	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.347	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.171	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.246	k star (bias corrected MLE)	0.244
Theta hat (MLE)	43.51	Theta star (bias corrected MLE)	43.91
nu hat (MLE)	15.73	nu star (bias corrected)	15.59
MLE Mean (bias corrected)	10.7	MLE Sd (bias corrected)	21.67

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0527	nu hat (KM)	10.76
Approximate Chi Square Value (10.76, α)	5.406	Adjusted Chi Square Value (10.76, β)	5.363
90% Gamma Approximate KM-UCL (use when n>=50)	6.908	90% Gamma Adjusted KM-UCL (use when n<50)	6.963
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Chrysene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0068	Mean	3.394
Maximum	102	Median	0.01
SD	15.11	CV	4.453
k hat (MLE)	0.168	k star (bias corrected MLE)	0.17
Theta hat (MLE)	20.17	Theta star (bias corrected MLE)	19.98
nu hat (MLE)	34.32	nu star (bias corrected)	34.65
MLE Mean (bias corrected)	3.394	MLE Sd (bias corrected)	8.236
		Adjusted Level of Significance (β)	0.0974
Approximate Chi Square Value (34.65, α)	24.5	Adjusted Chi Square Value (34.65, β)	24.4
90% Gamma Approximate UCL (use when n>=50)	4.8	90% Gamma Adjusted UCL (use when n<50)	4.819

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.849	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.157	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.382	Mean in Log Scale	-3.283
SD in Original Scale	15.11	SD in Log Scale	2.659
90% t UCL (assumes normality of ROS data)	5.313	90% Percentile Bootstrap UCL	5.385
90% BCA Bootstrap UCL	6.061	90% Bootstrap t UCL	6.228
90% H-UCL (Log ROS)	2.948		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	5.882	Mean in Log Scale	-0.984
SD in Original Scale	16.11	SD in Log Scale	2.495
90% t UCL (Assumes normality)	7.94	90% H-Stat UCL	17.59

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Dibenzo(a,h)anthracene

General Statistics

Total Number of Observations	81	Number of Distinct Observations	31
Number of Detects	3	Number of Non-Detects	78
Number of Distinct Detects	3	Number of Distinct Non-Detects	28
Minimum Detect	0.0932	Minimum Non-Detect	0.011
Maximum Detect	2.96	Maximum Non-Detect	2.4
Variance Detects	2.104	Percent Non-Detects	96.3%
Mean Detects	1.398	SD Detects	1.451
Median Detects	1.14	CV Detects	1.038
Skewness Detects	0.774	Kurtosis Detects	N/A
Mean of Logged Detects	-0.386	SD of Logged Detects	1.786

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0664	Standard Error of Mean	0.0487
SD	0.352	90% KM (BCA) UCL	N/A
90% KM (t) UCL	0.129	90% KM (Percentile Bootstrap) UCL	N/A
90% KM (z) UCL	0.129	90% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.213	95% KM Chebyshev UCL	0.279
97.5% KM Chebyshev UCL	0.371	99% KM Chebyshev UCL	0.551

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.821	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.702	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	4.926	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0356	nu hat (KM)	5.765
		Adjusted Level of Significance (β)	0.0967
Approximate Chi Square Value (5.77, α)	2.063	Adjusted Chi Square Value (5.77, β)	2.032
90% Gamma Approximate KM-UCL (use when n>=50)	0.185	90% Gamma Adjusted KM-UCL (use when n<50)	0.188

Gamma (KM) may not be used when k hat (KM) is < 0.1

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.28	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Dibenzo(a,h)anthracene (cont.)

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0523	Mean in Log Scale	-9.734
SD in Original Scale	0.351	SD in Log Scale	3.202
90% t UCL (assumes normality of ROS data)	0.103	90% Percentile Bootstrap UCL	0.104
90% BCA Bootstrap UCL	0.151	90% Bootstrap t UCL	1.246
90% H-UCL (Log ROS)	0.038		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-4.323	90% H-UCL (KM -Log)	0.023
KM SD (logged)	0.883	90% Critical H Value (KM-Log)	1.624
KM Standard Error of Mean (logged)	0.131		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.279	Mean in Log Scale	-2.707
SD in Original Scale	0.48	SD in Log Scale	1.737
90% t UCL (Assumes normality)	0.348	90% H-Stat UCL	0.472

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Fluoranthene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	82
Number of Detects	73	Number of Non-Detects	29
Number of Distinct Detects	67	Number of Distinct Non-Detects	15
Minimum Detect	0.04	Minimum Non-Detect	0.0078
Maximum Detect	820	Maximum Non-Detect	75.5
Variance Detects	20717	Percent Non-Detects	28.43%
Mean Detects	45.94	SD Detects	143.9
Median Detects	7.74	CV Detects	3.133
Skewness Detects	4.014	Kurtosis Detects	16.1
Mean of Logged Detects	1.707	SD of Logged Detects	2.07

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.344	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.461	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	33.39	Standard Error of Mean	12.22
SD	122.6	90% KM (BCA) UCL	50.16
90% KM (t) UCL	49.16	90% KM (Percentile Bootstrap) UCL	49.76
90% KM (z) UCL	49.06	90% KM Bootstrap t UCL	56.35
90% KM Chebyshev UCL	70.06	95% KM Chebyshev UCL	86.67
97.5% KM Chebyshev UCL	109.7	99% KM Chebyshev UCL	155

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	7.8	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.86	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.314	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.113	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.322	k star (bias corrected MLE)	0.317
Theta hat (MLE)	142.9	Theta star (bias corrected MLE)	144.7
nu hat (MLE)	46.95	nu star (bias corrected)	46.35
MLE Mean (bias corrected)	45.94	MLE Sd (bias corrected)	81.54

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0742	nu hat (KM)	15.14
Approximate Chi Square Value (15.14, α)	8.653	Adjusted Chi Square Value (15.14, β)	8.597
90% Gamma Approximate KM-UCL (use when n>=50)	58.42	90% Gamma Adjusted KM-UCL (use when n<50)	58.8
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	33.25
Maximum	820	Median	5.05
SD	123.3	CV	3.707
k hat (MLE)	0.208	k star (bias corrected MLE)	0.209
Theta hat (MLE)	159.6	Theta star (bias corrected MLE)	159.3
nu hat (MLE)	42.49	nu star (bias corrected)	42.57
MLE Mean (bias corrected)	33.25	MLE Sd (bias corrected)	72.78
		Adjusted Level of Significance (β)	0.0974
Approximate Chi Square Value (42.57, α)	31.26	Adjusted Chi Square Value (42.57, β)	31.15
90% Gamma Approximate UCL (use when n>=50)	45.28	90% Gamma Adjusted UCL (use when n<50)	45.44

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.181	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	33.16	Mean in Log Scale	0.807
SD in Original Scale	123.2	SD in Log Scale	2.416
90% t UCL (assumes normality of ROS data)	48.9	90% Percentile Bootstrap UCL	49.18
90% BCA Bootstrap UCL	54.5	90% Bootstrap t UCL	55.09
90% H-UCL (Log ROS)	83.17		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	34.78	Mean in Log Scale	0.861
SD in Original Scale	122.9	SD in Log Scale	2.797
90% t UCL (Assumes normality)	50.48	90% H-Stat UCL	293.1

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Fluorene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	92
Number of Detects	88	Number of Non-Detects	14
Number of Distinct Detects	86	Number of Distinct Non-Detects	6
Minimum Detect	0.045	Minimum Non-Detect	0.028
Maximum Detect	799	Maximum Non-Detect	0.777
Variance Detects	17910	Percent Non-Detects	13.73%
Mean Detects	87.47	SD Detects	133.8
Median Detects	60.05	CV Detects	1.53
Skewness Detects	3.476	Kurtosis Detects	13.57
Mean of Logged Detects	3.099	SD of Logged Detects	2.403

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.59	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.257	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0944	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	75.47	Standard Error of Mean	12.67
SD	127.2	90% KM (BCA) UCL	90.97
90% KM (t) UCL	91.81	90% KM (Percentile Bootstrap) UCL	91.38
90% KM (z) UCL	91.7	90% KM Bootstrap t UCL	96.2
90% KM Chebyshev UCL	113.5	95% KM Chebyshev UCL	130.7
97.5% KM Chebyshev UCL	154.6	99% KM Chebyshev UCL	201.5

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.465	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.826	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.161	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.101	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.468	k star (bias corrected MLE)	0.459
Theta hat (MLE)	187	Theta star (bias corrected MLE)	190.4
nu hat (MLE)	82.33	nu star (bias corrected)	80.86
MLE Mean (bias corrected)	87.47	MLE Sd (bias corrected)	129

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.352	nu hat (KM)	71.8
Approximate Chi Square Value (71.80, α)	56.93	Adjusted Chi Square Value (71.80, β)	56.78
90% Gamma Approximate KM-UCL (use when n>=50)	95.17	90% Gamma Adjusted KM-UCL (use when n<50)	95.43

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Fluorene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	75.46
Maximum	799	Median	51.05
SD	127.8	CV	1.694
k hat (MLE)	0.302	k star (bias corrected MLE)	0.3
Theta hat (MLE)	250	Theta star (bias corrected MLE)	251.9
nu hat (MLE)	61.58	nu star (bias corrected)	61.11
MLE Mean (bias corrected)	75.46	MLE Sd (bias corrected)	137.9
		Adjusted Level of Significance (β)	0.0974
Approximate Chi Square Value (61.11, α)	47.44	Adjusted Chi Square Value (61.11, β)	47.3
90% Gamma Approximate UCL (use when n>=50)	97.21	90% Gamma Adjusted UCL (use when n<50)	97.5

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.24	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0944	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	75.5	Mean in Log Scale	2.459
SD in Original Scale	127.8	SD in Log Scale	2.764
90% t UCL (assumes normality of ROS data)	91.82	90% Percentile Bootstrap UCL	93.03
90% BCA Bootstrap UCL	96.81	90% Bootstrap t UCL	96.51
90% H-UCL (Log ROS)	1299		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	75.47	Mean in Log Scale	2.168
SD in Original Scale	127.8	SD in Log Scale	3.254
90% t UCL (Assumes normality)	91.8	90% H-Stat UCL	5797

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Indeno(1,2,3_cd)Pyrene

General Statistics

Total Number of Observations	90	Number of Distinct Observations	41
Number of Detects	7	Number of Non-Detects	83
Number of Distinct Detects	7	Number of Distinct Non-Detects	34
Minimum Detect	0.08	Minimum Non-Detect	0.014
Maximum Detect	9.55	Maximum Non-Detect	7.84
Variance Detects	13	Percent Non-Detects	92.22%
Mean Detects	2.039	SD Detects	3.606
Median Detects	0.119	CV Detects	1.769
Skewness Detects	1.976	Kurtosis Detects	3.601
Mean of Logged Detects	-0.928	SD of Logged Detects	1.941

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.646	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.397	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.179	Standard Error of Mean	0.124
SD	1.081	90% KM (BCA) UCL	0.323
90% KM (t) UCL	0.339	90% KM (Percentile Bootstrap) UCL	0.335
90% KM (z) UCL	0.338	90% KM Bootstrap t UCL	1.77
90% KM Chebyshev UCL	0.55	95% KM Chebyshev UCL	0.718
97.5% KM Chebyshev UCL	0.951	99% KM Chebyshev UCL	1.409

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.964	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.768	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.347	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.331	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.401	k star (bias corrected MLE)	0.324
Theta hat (MLE)	5.084	Theta star (bias corrected MLE)	6.285
nu hat (MLE)	5.613	nu star (bias corrected)	4.541
MLE Mean (bias corrected)	2.039	MLE Sd (bias corrected)	3.579

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0275	nu hat (KM)	4.951
Approximate Chi Square Value (4.95, α)	1.585	Adjusted Chi Square Value (4.95, β)	1.561
90% Gamma Approximate KM-UCL (use when n>=50)	0.56	90% Gamma Adjusted KM-UCL (use when n<50)	0.568

Gamma (KM) may not be used when k hat (KM) is < 0.1

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Indeno(1,2,3_cd)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.168
Maximum	9.55	Median	0.01
SD	1.084	CV	6.461
k hat (MLE)	0.276	k star (bias corrected MLE)	0.274
Theta hat (MLE)	0.608	Theta star (bias corrected MLE)	0.612
nu hat (MLE)	49.66	nu star (bias corrected)	49.33
MLE Mean (bias corrected)	0.168	MLE Sd (bias corrected)	0.32
		Adjusted Level of Significance (β)	0.0971
Approximate Chi Square Value (49.33, α)	37.11	Adjusted Chi Square Value (49.33, β)	36.97
90% Gamma Approximate UCL (use when n>=50)	0.223	90% Gamma Adjusted UCL (use when n<50)	0.224

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.782	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.303	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.16	Mean in Log Scale	-7.709
SD in Original Scale	1.085	SD in Log Scale	2.892
90% t UCL (assumes normality of ROS data)	0.308	90% Percentile Bootstrap UCL	0.326
90% BCA Bootstrap UCL	0.458	90% Bootstrap t UCL	3.361
90% H-UCL (Log ROS)	0.0845		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.906	90% H-UCL (KM -Log)	0.0459
KM SD (logged)	1.109	90% Critical H Value (KM-Log)	1.788
KM Standard Error of Mean (logged)	0.145		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.627	Mean in Log Scale	-2.233
SD in Original Scale	1.348	SD in Log Scale	1.971
90% t UCL (Assumes normality)	0.811	90% H-Stat UCL	1.269

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Naphthalene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	96
Number of Detects	89	Number of Non-Detects	13
Number of Distinct Detects	88	Number of Distinct Non-Detects	8
Minimum Detect	0.0773	Minimum Non-Detect	0.048
Maximum Detect	22800	Maximum Non-Detect	3.74
Variance Detects	23461020	Percent Non-Detects	12.75%
Mean Detects	2396	SD Detects	4844
Median Detects	53.3	CV Detects	2.021
Skewness Detects	2.404	Kurtosis Detects	5.743
Mean of Logged Detects	3.936	SD of Logged Detects	3.763

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.573	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.354	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0939	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	2091	Standard Error of Mean	455
SD	4569	90% KM (BCA) UCL	2664
90% KM (t) UCL	2678	90% KM (Percentile Bootstrap) UCL	2691
90% KM (z) UCL	2674	90% KM Bootstrap t UCL	2770
90% KM Chebyshev UCL	3456	95% KM Chebyshev UCL	4074
97.5% KM Chebyshev UCL	4932	99% KM Chebyshev UCL	6618

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	3.421	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.923	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.155	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.105	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.192	k star (bias corrected MLE)	0.193
Theta hat (MLE)	12449	Theta star (bias corrected MLE)	12384
nu hat (MLE)	34.26	nu star (bias corrected)	34.44
MLE Mean (bias corrected)	2396	MLE Sd (bias corrected)	5448

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.209	nu hat (KM)	42.71
Approximate Chi Square Value (42.71, α)	31.38	Adjusted Chi Square Value (42.71, β)	31.27
90% Gamma Approximate KM-UCL (use when n>=50)	2846	90% Gamma Adjusted KM-UCL (use when n<50)	2856

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Naphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2091
Maximum	22800	Median	20.6
SD	4592	CV	2.196
k hat (MLE)	0.159	k star (bias corrected MLE)	0.161
Theta hat (MLE)	13163	Theta star (bias corrected MLE)	13010
nu hat (MLE)	32.4	nu star (bias corrected)	32.78
MLE Mean (bias corrected)	2091	MLE Sd (bias corrected)	5216
		Adjusted Level of Significance (β)	0.0974
Approximate Chi Square Value (32.78, α)	22.93	Adjusted Chi Square Value (32.78, β)	22.83
90% Gamma Approximate UCL (use when n>=50)	2990	90% Gamma Adjusted UCL (use when n<50)	3002

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0975	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0939	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2091	Mean in Log Scale	2.97
SD in Original Scale	4592	SD in Log Scale	4.374
90% t UCL (assumes normality of ROS data)	2677	90% Percentile Bootstrap UCL	2665
90% BCA Bootstrap UCL	2755	90% Bootstrap t UCL	2794
90% H-UCL (Log ROS)	2312269		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2091	Mean in Log Scale	3.134
SD in Original Scale	4592	SD in Log Scale	4.132
90% t UCL (Assumes normality)	2677	90% H-Stat UCL	780117

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Phenanthrene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	85
Number of Detects	85	Number of Non-Detects	17
Number of Distinct Detects	78	Number of Distinct Non-Detects	7
Minimum Detect	0.0379	Minimum Non-Detect	0.032
Maximum Detect	1990	Maximum Non-Detect	0.374
Variance Detects	103368	Percent Non-Detects	16.67%
Mean Detects	134	SD Detects	321.5
Median Detects	54.7	CV Detects	2.4
Skewness Detects	4.236	Kurtosis Detects	18.66
Mean of Logged Detects	3.021	SD of Logged Detects	2.64

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.415	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.371	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0961	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	111.7	Standard Error of Mean	29.48
SD	296	90% KM (BCA) UCL	151.2
90% KM (t) UCL	149.7	90% KM (Percentile Bootstrap) UCL	149.7
90% KM (z) UCL	149.4	90% KM Bootstrap t UCL	168.2
90% KM Chebyshev UCL	200.1	95% KM Chebyshev UCL	240.2
97.5% KM Chebyshev UCL	295.8	99% KM Chebyshev UCL	405

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	2.241	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.853	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.158	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.105	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.357	k star (bias corrected MLE)	0.352
Theta hat (MLE)	375.1	Theta star (bias corrected MLE)	380.2
nu hat (MLE)	60.72	nu star (bias corrected)	59.91
MLE Mean (bias corrected)	134	MLE Sd (bias corrected)	225.7

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.142	nu hat (KM)	29.03
Approximate Chi Square Value (29.03, α)	19.79	Adjusted Chi Square Value (29.03, β)	19.7
90% Gamma Approximate KM-UCL (use when n>=50)	163.8	90% Gamma Adjusted KM-UCL (use when n<50)	164.5

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Phenanthrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	111.7
Maximum	1990	Median	29.7
SD	297.5	CV	2.664
k hat (MLE)	0.241	k star (bias corrected MLE)	0.24
Theta hat (MLE)	463.4	Theta star (bias corrected MLE)	464.4
nu hat (MLE)	49.16	nu star (bias corrected)	49.04
MLE Mean (bias corrected)	111.7	MLE Sd (bias corrected)	227.7
		Adjusted Level of Significance (β)	0.0974
Approximate Chi Square Value (49.04, α)	36.86	Adjusted Chi Square Value (49.04, β)	36.73
90% Gamma Approximate UCL (use when n>=50)	148.6	90% Gamma Adjusted UCL (use when n<50)	149.1

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0961	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	111.7	Mean in Log Scale	2.149
SD in Original Scale	297.5	SD in Log Scale	3.124
90% t UCL (assumes normality of ROS data)	149.7	90% Percentile Bootstrap UCL	153.2
90% BCA Bootstrap UCL	162.6	90% Bootstrap t UCL	167.9
90% H-UCL (Log ROS)	3442		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	111.7	Mean in Log Scale	1.914
SD in Original Scale	297.5	SD in Log Scale	3.479
90% t UCL (Assumes normality)	149.7	90% H-Stat UCL	11271

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Pyrene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	81
Number of Detects	67	Number of Non-Detects	35
Number of Distinct Detects	65	Number of Distinct Non-Detects	18
Minimum Detect	0.013	Minimum Non-Detect	0.013
Maximum Detect	490	Maximum Non-Detect	75.5
Variance Detects	7632	Percent Non-Detects	34.31%
Mean Detects	27.54	SD Detects	87.36
Median Detects	3.55	CV Detects	3.172
Skewness Detects	3.945	Kurtosis Detects	15.66
Mean of Logged Detects	1.088	SD of Logged Detects	2.047

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.344	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.465	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.108	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	18.47	Standard Error of Mean	7.125
SD	71.4	90% KM (BCA) UCL	26.93
90% KM (t) UCL	27.66	90% KM (Percentile Bootstrap) UCL	27.38
90% KM (z) UCL	27.6	90% KM Bootstrap t UCL	33.1
90% KM Chebyshev UCL	39.84	95% KM Chebyshev UCL	49.53
97.5% KM Chebyshev UCL	62.96	99% KM Chebyshev UCL	89.36

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	7.915	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.863	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.32	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.118	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.308	k star (bias corrected MLE)	0.304
Theta hat (MLE)	89.36	Theta star (bias corrected MLE)	90.49
nu hat (MLE)	41.3	nu star (bias corrected)	40.79
MLE Mean (bias corrected)	27.54	MLE Sd (bias corrected)	49.93

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0669	nu hat (KM)	13.65
Approximate Chi Square Value (13.65, α)	7.526	Adjusted Chi Square Value (13.65, β)	7.474
90% Gamma Approximate KM-UCL (use when n>=50)	33.49	90% Gamma Adjusted KM-UCL (use when n<50)	33.73
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	18.31
Maximum	490	Median	1.86
SD	71.81	CV	3.921
k hat (MLE)	0.199	k star (bias corrected MLE)	0.2
Theta hat (MLE)	91.94	Theta star (bias corrected MLE)	91.63
nu hat (MLE)	40.63	nu star (bias corrected)	40.77
MLE Mean (bias corrected)	18.31	MLE Sd (bias corrected)	40.96
		Adjusted Level of Significance (β)	0.0974
Approximate Chi Square Value (40.77, α)	29.71	Adjusted Chi Square Value (40.77, β)	29.6
90% Gamma Approximate UCL (use when n>=50)	25.13	90% Gamma Adjusted UCL (use when n<50)	25.22

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.179	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.108	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	18.28	Mean in Log Scale	0.0965
SD in Original Scale	71.79	SD in Log Scale	2.334
90% t UCL (assumes normality of ROS data)	27.45	90% Percentile Bootstrap UCL	27.23
90% BCA Bootstrap UCL	30.64	90% Bootstrap t UCL	31.72
90% H-UCL (Log ROS)	32.31		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	20.3	Mean in Log Scale	0.41
SD in Original Scale	71.61	SD in Log Scale	2.585
90% t UCL (Assumes normality)	29.45	90% H-Stat UCL	93.51

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Gasoline Range Hydrocarbons

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	6
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	789	Minimum Non-Detect	100
Maximum Detect	28500	Maximum Non-Detect	100
Variance Detects	1.341E+8	Percent Non-Detects	54.55%
Mean Detects	7964	SD Detects	11580
Median Detects	3640	CV Detects	1.454
Skewness Detects	2.141	Kurtosis Detects	4.663
Mean of Logged Detects	8.25	SD of Logged Detects	1.317

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.678	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.408	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	3674	Standard Error of Mean	2699
SD	8006	90% KM (BCA) UCL	6480
90% KM (t) UCL	7378	90% KM (Percentile Bootstrap) UCL	6578
90% KM (z) UCL	7133	90% KM Bootstrap t UCL	16493
90% KM Chebyshev UCL	11771	95% KM Chebyshev UCL	15438
97.5% KM Chebyshev UCL	20528	99% KM Chebyshev UCL	30527

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.442	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.314	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.366	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.809	k star (bias corrected MLE)	0.457
Theta hat (MLE)	9840	Theta star (bias corrected MLE)	17424
nu hat (MLE)	8.093	nu star (bias corrected)	4.571
MLE Mean (bias corrected)	7964	MLE Sd (bias corrected)	11780

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.211	nu hat (KM)	4.634
Approximate Chi Square Value (4.63, α)	1.408	Adjusted Chi Square Value (4.63, β)	1.201
90% Gamma Approximate KM-UCL (use when n>=50)	12098	90% Gamma Adjusted KM-UCL (use when n<50)	14182

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Gasoline Range Hydrocarbons (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	3620
Maximum	28500	Median	0.01
SD	8422	CV	2.327
k hat (MLE)	0.115	k star (bias corrected MLE)	0.144
Theta hat (MLE)	31560	Theta star (bias corrected MLE)	25134
nu hat (MLE)	2.523	nu star (bias corrected)	3.169
MLE Mean (bias corrected)	3620	MLE Sd (bias corrected)	9539
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (3.17, α)	0.668	Adjusted Chi Square Value (3.17, β)	0.544
90% Gamma Approximate UCL (use when n>=50)	17177	90% Gamma Adjusted UCL (use when n<50)	21079

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3675	Mean in Log Scale	5.903
SD in Original Scale	8397	SD in Log Scale	2.603
90% t UCL (assumes normality of ROS data)	7149	90% Percentile Bootstrap UCL	6755
90% BCA Bootstrap UCL	8942	90% Bootstrap t UCL	20110
90% H-UCL (Log ROS)	446186		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	6.262	90% H-UCL (KM -Log)	34178
KM SD (logged)	1.981	90% Critical H Value (KM-Log)	3.535
KM Standard Error of Mean (logged)	0.668		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3647	Mean in Log Scale	5.884
SD in Original Scale	8409	SD in Log Scale	2.414
90% t UCL (Assumes normality)	7126	90% H-Stat UCL	165241

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Diesel Range Organics

General Statistics			
Total Number of Observations	84	Number of Distinct Observations	70
Number of Detects	63	Number of Non-Detects	21
Number of Distinct Detects	63	Number of Distinct Non-Detects	8
Minimum Detect	191	Minimum Non-Detect	187
Maximum Detect	374000	Maximum Non-Detect	239
Variance Detects	2.774E+9	Percent Non-Detects	25%
Mean Detects	21224	SD Detects	52672
Median Detects	4110	CV Detects	2.482
Skewness Detects	5.249	Kurtosis Detects	33.07
Mean of Logged Detects	8.443	SD of Logged Detects	1.747

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.433	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.359	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.112	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	15965	Standard Error of Mean	5077
SD	46160	90% KM (BCA) UCL	22736
90% KM (t) UCL	22523	90% KM (Percentile Bootstrap) UCL	22766
90% KM (z) UCL	22471	90% KM Bootstrap t UCL	29355
90% KM Chebyshev UCL	31196	95% KM Chebyshev UCL	38095
97.5% KM Chebyshev UCL	47670	99% KM Chebyshev UCL	66479

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	3.061	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.833	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.212	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.12	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.428	k star (bias corrected MLE)	0.418
Theta hat (MLE)	49557	Theta star (bias corrected MLE)	50719
nu hat (MLE)	53.96	nu star (bias corrected)	52.73
MLE Mean (bias corrected)	21224	MLE Sd (bias corrected)	32809

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.12	nu hat (KM)	20.1
Approximate Chi Square Value (20.10, α)	12.52	Adjusted Chi Square Value (20.10, β)	12.44
90% Gamma Approximate KM-UCL (use when n>=50)	25627	90% Gamma Adjusted KM-UCL (use when n<50)	25799

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Diesel Range Organics (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	15918
Maximum	374000	Median	1705
SD	46453	CV	2.918
k hat (MLE)	0.168	k star (bias corrected MLE)	0.17
Theta hat (MLE)	94662	Theta star (bias corrected MLE)	93587
nu hat (MLE)	28.25	nu star (bias corrected)	28.57
MLE Mean (bias corrected)	15918	MLE Sd (bias corrected)	38597
		Adjusted Level of Significance (β)	0.0969
Approximate Chi Square Value (28.57, α)	19.42	Adjusted Chi Square Value (28.57, β)	19.31
90% Gamma Approximate UCL (use when n>=50)	23428	90% Gamma Adjusted UCL (use when n<50)	23556

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.079	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.112	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	15945	Mean in Log Scale	7.455
SD in Original Scale	46444	SD in Log Scale	2.317
90% t UCL (assumes normality of ROS data)	22492	90% Percentile Bootstrap UCL	22732
90% BCA Bootstrap UCL	25302	90% Bootstrap t UCL	28152
90% H-UCL (Log ROS)	52244		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	7.641	90% H-UCL (KM -Log)	30152
KM SD (logged)	2.045	90% Critical H Value (KM-Log)	2.592
KM Standard Error of Mean (logged)	0.225		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	15945	Mean in Log Scale	7.496
SD in Original Scale	46444	SD in Log Scale	2.237
90% t UCL (Assumes normality)	22491	90% H-Stat UCL	43472

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Residual Range Hydrocarbons

General Statistics

Total Number of Observations	84	Number of Distinct Observations	44
Number of Detects	16	Number of Non-Detects	68
Number of Distinct Detects	16	Number of Distinct Non-Detects	28
Minimum Detect	391	Minimum Non-Detect	374
Maximum Detect	103000	Maximum Non-Detect	15000
Variance Detects	6.513E+8	Percent Non-Detects	80.95%
Mean Detects	7373	SD Detects	25521
Median Detects	613.5	CV Detects	3.461
Skewness Detects	3.989	Kurtosis Detects	15.94
Mean of Logged Detects	6.916	SD of Logged Detects	1.403

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.297	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.493	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.222	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1728	Standard Error of Mean	1254
SD	11128	90% KM (BCA) UCL	3015
90% KM (t) UCL	3348	90% KM (Percentile Bootstrap) UCL	3036
90% KM (z) UCL	3335	90% KM Bootstrap t UCL	37955
90% KM Chebyshev UCL	5491	95% KM Chebyshev UCL	7195
97.5% KM Chebyshev UCL	9560	99% KM Chebyshev UCL	14206

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.899	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.83	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.435	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.232	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.34	k star (bias corrected MLE)	0.318
Theta hat (MLE)	21708	Theta star (bias corrected MLE)	23213
nu hat (MLE)	10.87	nu star (bias corrected)	10.16
MLE Mean (bias corrected)	7373	MLE Sd (bias corrected)	13082

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0241	nu hat (KM)	4.052
Approximate Chi Square Value (4.05, α)	1.096	Adjusted Chi Square Value (4.05, β)	1.075
90% Gamma Approximate KM-UCL (use when n>=50)	6393	90% Gamma Adjusted KM-UCL (use when n<50)	6513

Gamma (KM) may not be used when k hat (KM) is < 0.1

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Residual Range Hydrocarbons (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1404
Maximum	103000	Median	0.01
SD	11233	CV	7.999
k hat (MLE)	0.0857	k star (bias corrected MLE)	0.0906
Theta hat (MLE)	16390	Theta star (bias corrected MLE)	15508
nu hat (MLE)	14.4	nu star (bias corrected)	15.21
MLE Mean (bias corrected)	1404	MLE Sd (bias corrected)	4667
		Adjusted Level of Significance (β)	0.0969
Approximate Chi Square Value (15.21, α)	8.71	Adjusted Chi Square Value (15.21, β)	8.642
90% Gamma Approximate UCL (use when n>=50)	2453	90% Gamma Adjusted UCL (use when n<50)	2472

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.638	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.343	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.222	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1441	Mean in Log Scale	3.976
SD in Original Scale	11229	SD in Log Scale	1.87
90% t UCL (assumes normality of ROS data)	3024	90% Percentile Bootstrap UCL	2734
90% BCA Bootstrap UCL	5030	90% Bootstrap t UCL	34501
90% H-UCL (Log ROS)	503.9		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2054	Mean in Log Scale	6.132
SD in Original Scale	11229	SD in Log Scale	1.154
90% t UCL (Assumes normality)	3637	90% H-Stat UCL	1128

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

User Selected Options	
Date/Time of Computation	4/11/2014 12:12:19 PM
From File	Groundwater_EPCs_20140410.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Acenaphthene

General Statistics

Total Number of Observations	102	Number of Distinct Observations	96
Number of Detects	94	Number of Non-Detects	8
Number of Distinct Detects	91	Number of Distinct Non-Detects	5
Minimum Detect	0.0478	Minimum Non-Detect	0.013
Maximum Detect	972	Maximum Non-Detect	0.187
Variance Detects	30729	Percent Non-Detects	7.843%
Mean Detects	132.8	SD Detects	175.3
Median Detects	89.7	CV Detects	1.32
Skewness Detects	2.666	Kurtosis Detects	8.577
Mean of Logged Detects	3.315	SD of Logged Detects	2.726

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.706	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.224	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0914	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	122.4	Standard Error of Mean	17.04
SD	171.2	95% KM (BCA) UCL	150.7
95% KM (t) UCL	150.7	95% KM (Percentile Bootstrap) UCL	151.7
95% KM (z) UCL	150.4	95% KM Bootstrap t UCL	158.7
90% KM Chebyshev UCL	173.5	95% KM Chebyshev UCL	196.7
97.5% KM Chebyshev UCL	228.8	99% KM Chebyshev UCL	291.9

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.588	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.839	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.175	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0987	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.415	k star (bias corrected MLE)	0.409
Theta hat (MLE)	319.8	Theta star (bias corrected MLE)	324.6
nu hat (MLE)	78.1	nu star (bias corrected)	76.94
MLE Mean (bias corrected)	132.8	MLE Sd (bias corrected)	207.6

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.512	nu hat (KM)	104.4
Approximate Chi Square Value (104.37, α)	81.79	Adjusted Chi Square Value (104.37, β)	81.51
95% Gamma Approximate KM-UCL (use when n>=50)	156.2	95% Gamma Adjusted KM-UCL (use when n<50)	156.8

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Acenaphthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0478	Mean	123
Maximum	972	Median	86.25
SD	171.6	CV	1.396
k hat (MLE)	0.408	k star (bias corrected MLE)	0.403
Theta hat (MLE)	301.1	Theta star (bias corrected MLE)	305.2
nu hat (MLE)	83.32	nu star (bias corrected)	82.2
MLE Mean (bias corrected)	123	MLE Sd (bias corrected)	193.7
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (82.20, α)	62.31	Adjusted Chi Square Value (82.20, β)	62.06
95% Gamma Approximate UCL (use when n>=50)	162.2	95% Gamma Adjusted UCL (use when n<50)	162.9

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.242	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0914	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	122.4	Mean in Log Scale	2.884
SD in Original Scale	172	SD in Log Scale	3.012
95% t UCL (assumes normality of ROS data)	150.7	95% Percentile Bootstrap UCL	152
95% BCA Bootstrap UCL	155	95% Bootstrap t UCL	155.7
95% H-UCL (Log ROS)	6610		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	122.4	Mean in Log Scale	2.748
SD in Original Scale	172	SD in Log Scale	3.269
95% t UCL (Assumes normality)	150.7	95% H-Stat UCL	16210

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	228.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Anthracene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	92
Number of Detects	84	Number of Non-Detects	18
Number of Distinct Detects	80	Number of Distinct Non-Detects	12
Minimum Detect	0.014	Minimum Non-Detect	0.012
Maximum Detect	276	Maximum Non-Detect	75.5
Variance Detects	2077	Percent Non-Detects	17.65%
Mean Detects	15.66	SD Detects	45.57
Median Detects	5.75	CV Detects	2.91
Skewness Detects	4.366	Kurtosis Detects	19.22
Mean of Logged Detects	0.748	SD of Logged Detects	2.273

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.348	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.454	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0967	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	13.3	Standard Error of Mean	4.132
SD	41.46	95% KM (BCA) UCL	21.42
95% KM (t) UCL	20.16	95% KM (Percentile Bootstrap) UCL	20.52
95% KM (z) UCL	20.1	95% KM Bootstrap t UCL	24.22
90% KM Chebyshev UCL	25.7	95% KM Chebyshev UCL	31.31
97.5% KM Chebyshev UCL	39.11	99% KM Chebyshev UCL	54.41

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	4.676	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.857	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.247	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.105	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.338	k star (bias corrected MLE)	0.333
Theta hat (MLE)	46.39	Theta star (bias corrected MLE)	46.97
nu hat (MLE)	56.72	nu star (bias corrected)	56.03
MLE Mean (bias corrected)	15.66	MLE Sd (bias corrected)	27.12

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.103	nu hat (KM)	21.01
Approximate Chi Square Value (21.01, α)	11.6	Adjusted Chi Square Value (21.01, β)	11.5
95% Gamma Approximate KM-UCL (use when n>=50)	24.1	95% Gamma Adjusted KM-UCL (use when n<50)	24.31

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	13.19
Maximum	276	Median	3.345
SD	41.71	CV	3.162
k hat (MLE)	0.275	k star (bias corrected MLE)	0.273
Theta hat (MLE)	48.03	Theta star (bias corrected MLE)	48.3
nu hat (MLE)	56.02	nu star (bias corrected)	55.71
MLE Mean (bias corrected)	13.19	MLE Sd (bias corrected)	25.24
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (55.71, α)	39.56	Adjusted Chi Square Value (55.71, β)	39.36
95% Gamma Approximate UCL (use when n>=50)	18.58	95% Gamma Adjusted UCL (use when n<50)	18.67

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0967	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	13.11	Mean in Log Scale	0.434
SD in Original Scale	41.69	SD in Log Scale	2.293
95% t UCL (assumes normality of ROS data)	19.96	95% Percentile Bootstrap UCL	20.21
95% BCA Bootstrap UCL	23.14	95% Bootstrap t UCL	24.26
95% H-UCL (Log ROS)	49.3		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	14.98	Mean in Log Scale	0.734
SD in Original Scale	41.68	SD in Log Scale	2.359
95% t UCL (Assumes normality)	21.83	95% H-Stat UCL	81.1

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	39.11

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(a)Anthracene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	65
Number of Detects	34	Number of Non-Detects	68
Number of Distinct Detects	34	Number of Distinct Non-Detects	32
Minimum Detect	0.0454	Minimum Non-Detect	0.015
Maximum Detect	118	Maximum Non-Detect	75.5
Variance Detects	893.7	Percent Non-Detects	66.67%
Mean Detects	12.45	SD Detects	29.89
Median Detects	0.437	CV Detects	2.401
Skewness Detects	2.489	Kurtosis Detects	5.297
Mean of Logged Detects	-0.219	SD of Logged Detects	2.193

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.477	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.452	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.152	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	4.266	Standard Error of Mean	1.813
SD	18	95% KM (BCA) UCL	7.674
95% KM (t) UCL	7.276	95% KM (Percentile Bootstrap) UCL	7.371
95% KM (z) UCL	7.249	95% KM Bootstrap t UCL	9.105
90% KM Chebyshev UCL	9.706	95% KM Chebyshev UCL	12.17
97.5% KM Chebyshev UCL	15.59	99% KM Chebyshev UCL	22.31

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	5.04	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.877	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.349	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.165	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.258	k star (bias corrected MLE)	0.255
Theta hat (MLE)	48.28	Theta star (bias corrected MLE)	48.88
nu hat (MLE)	17.54	nu star (bias corrected)	17.32
MLE Mean (bias corrected)	12.45	MLE Sd (bias corrected)	24.67

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0562	nu hat (KM)	11.46
Approximate Chi Square Value (11.46, α)	4.872	Adjusted Chi Square Value (11.46, β)	4.81
95% Gamma Approximate KM-UCL (use when n>=50)	10.03	95% Gamma Adjusted KM-UCL (use when n<50)	10.16
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Benzo(a)Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	4.184
Maximum	118	Median	0.01
SD	18.07	CV	4.319
k hat (MLE)	0.168	k star (bias corrected MLE)	0.17
Theta hat (MLE)	24.84	Theta star (bias corrected MLE)	24.61
nu hat (MLE)	34.36	nu star (bias corrected)	34.68
MLE Mean (bias corrected)	4.184	MLE Sd (bias corrected)	10.15
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (34.68, α)	22.21	Adjusted Chi Square Value (34.68, β)	22.07
95% Gamma Approximate UCL (use when n>=50)	6.533	95% Gamma Adjusted UCL (use when n<50)	6.576

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.822	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.229	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.186	Mean in Log Scale	-2.816
SD in Original Scale	18.07	SD in Log Scale	2.591
95% t UCL (assumes normality of ROS data)	7.156	95% Percentile Bootstrap UCL	7.41
95% BCA Bootstrap UCL	8.584	95% Bootstrap t UCL	9.14
95% H-UCL (Log ROS)	4.856		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	6.641	Mean in Log Scale	-0.864
SD in Original Scale	18.82	SD in Log Scale	2.482
95% t UCL (Assumes normality)	9.734	95% H-Stat UCL	24

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	15.59

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(a)Pyrene

General Statistics			
Total Number of Observations	91	Number of Distinct Observations	50
Number of Detects	15	Number of Non-Detects	76
Number of Distinct Detects	15	Number of Distinct Non-Detects	35
Minimum Detect	0.0379	Minimum Non-Detect	0.01
Maximum Detect	32.4	Maximum Non-Detect	19.5
Variance Detects	78.02	Percent Non-Detects	83.52%
Mean Detects	3.332	SD Detects	8.833
Median Detects	0.15	CV Detects	2.651
Skewness Detects	3.053	Kurtosis Detects	9.413
Mean of Logged Detects	-1.228	SD of Logged Detects	1.988

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.435	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.469	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.229	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.579	Standard Error of Mean	0.4
SD	3.679	95% KM (BCA) UCL	1.281
95% KM (t) UCL	1.243	95% KM (Percentile Bootstrap) UCL	1.284
95% KM (z) UCL	1.236	95% KM Bootstrap t UCL	12.03
90% KM Chebyshev UCL	1.778	95% KM Chebyshev UCL	2.321
97.5% KM Chebyshev UCL	3.075	99% KM Chebyshev UCL	4.555

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.308	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.842	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.366	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.241	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.286	k star (bias corrected MLE)	0.273
Theta hat (MLE)	11.66	Theta star (bias corrected MLE)	12.2
nu hat (MLE)	8.575	nu star (bias corrected)	8.194
MLE Mean (bias corrected)	3.332	MLE Sd (bias corrected)	6.376

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0247	nu hat (KM)	4.504
Approximate Chi Square Value (4.50, α)	0.93	Adjusted Chi Square Value (4.50, β)	0.905
95% Gamma Approximate KM-UCL (use when n>=50)	2.802	95% Gamma Adjusted KM-UCL (use when n<50)	2.879
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(a)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.558
Maximum	32.4	Median	0.01
SD	3.698	CV	6.631
k hat (MLE)	0.211	k star (bias corrected MLE)	0.211
Theta hat (MLE)	2.646	Theta star (bias corrected MLE)	2.642
nu hat (MLE)	38.35	nu star (bias corrected)	38.42
MLE Mean (bias corrected)	0.558	MLE Sd (bias corrected)	1.214
		Adjusted Level of Significance (β)	0.0474
Approximate Chi Square Value (38.42, α)	25.22	Adjusted Chi Square Value (38.42, β)	25.05
95% Gamma Approximate UCL (use when n>=50)	0.849	95% Gamma Adjusted UCL (use when n<50)	0.855

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.836	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.216	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.229	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.554	Mean in Log Scale	-5.597
SD in Original Scale	3.698	SD in Log Scale	2.609
95% t UCL (assumes normality of ROS data)	1.198	95% Percentile Bootstrap UCL	1.263
95% BCA Bootstrap UCL	1.628	95% Bootstrap t UCL	16.45
95% H-UCL (Log ROS)	0.353		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.757	95% H-UCL (KM -Log)	0.137
KM SD (logged)	1.6	95% Critical H Value (KM-Log)	2.898
KM Standard Error of Mean (logged)	0.208		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.115	Mean in Log Scale	-2.016
SD in Original Scale	3.845	SD in Log Scale	2.07
95% t UCL (Assumes normality)	1.785	95% H-Stat UCL	2.425

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	2.321

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzofluoranthenes

General Statistics			
Total Number of Observations	21	Number of Distinct Observations	19
Number of Detects	14	Number of Non-Detects	7
Number of Distinct Detects	14	Number of Distinct Non-Detects	6
Minimum Detect	0.0819	Minimum Non-Detect	0.0748
Maximum Detect	72.2	Maximum Non-Detect	0.377
Variance Detects	499.6	Percent Non-Detects	33.33%
Mean Detects	11	SD Detects	22.35
Median Detects	0.605	CV Detects	2.033
Skewness Detects	2.112	Kurtosis Detects	3.812
Mean of Logged Detects	-0.056	SD of Logged Detects	2.314

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.568	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.443	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.237	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	7.361	Standard Error of Mean	4.149
SD	18.32	95% KM (BCA) UCL	15.59
95% KM (t) UCL	14.52	95% KM (Percentile Bootstrap) UCL	14.82
95% KM (z) UCL	14.19	95% KM Bootstrap t UCL	22.82
90% KM Chebyshev UCL	19.81	95% KM Chebyshev UCL	25.45
97.5% KM Chebyshev UCL	33.27	99% KM Chebyshev UCL	48.65

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.659	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.84	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.323	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.249	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.284	k star (bias corrected MLE)	0.27
Theta hat (MLE)	38.77	Theta star (bias corrected MLE)	40.66
nu hat (MLE)	7.941	nu star (bias corrected)	7.573
MLE Mean (bias corrected)	11	MLE Sd (bias corrected)	21.15

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.161	nu hat (KM)	6.779
Approximate Chi Square Value (6.78, α)	2.05	Adjusted Chi Square Value (6.78, β)	1.857
95% Gamma Approximate KM-UCL (use when n>=50)	24.34	95% Gamma Adjusted KM-UCL (use when n<50)	26.88

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzofluoranthenes (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	7.335
Maximum	72.2	Median	0.208
SD	18.79	CV	2.561
k hat (MLE)	0.206	k star (bias corrected MLE)	0.208
Theta hat (MLE)	35.68	Theta star (bias corrected MLE)	35.28
nu hat (MLE)	8.633	nu star (bias corrected)	8.733
MLE Mean (bias corrected)	7.335	MLE Sd (bias corrected)	16.09
		Adjusted Level of Significance (β)	0.0383
Approximate Chi Square Value (8.73, α)	3.167	Adjusted Chi Square Value (8.73, β)	2.914
95% Gamma Approximate UCL (use when n>=50)	20.23	95% Gamma Adjusted UCL (use when n<50)	21.98

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.853	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	7.338	Mean in Log Scale	-1.571
SD in Original Scale	18.78	SD in Log Scale	2.944
95% t UCL (assumes normality of ROS data)	14.41	95% Percentile Bootstrap UCL	14.31
95% BCA Bootstrap UCL	17.64	95% Bootstrap t UCL	22.91
95% H-UCL (Log ROS)	722		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.863	95% H-UCL (KM -Log)	36.07
KM SD (logged)	2.156	95% Critical H Value (KM-Log)	4.409
KM Standard Error of Mean (logged)	0.49		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	7.359	Mean in Log Scale	-0.958
SD in Original Scale	18.78	SD in Log Scale	2.314
95% t UCL (Assumes normality)	14.43	95% H-Stat UCL	63.06

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL	48.65

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Chrysene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	66
Number of Detects	32	Number of Non-Detects	70
Number of Distinct Detects	32	Number of Distinct Non-Detects	34
Minimum Detect	0.0068	Minimum Non-Detect	0.0065
Maximum Detect	102	Maximum Non-Detect	75.5
Variance Detects	663.7	Percent Non-Detects	68.63%
Mean Detects	10.7	SD Detects	25.76
Median Detects	0.388	CV Detects	2.408
Skewness Detects	2.495	Kurtosis Detects	5.449
Mean of Logged Detects	-0.527	SD of Logged Detects	2.312

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.477	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.471	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.157	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	3.47	Standard Error of Mean	1.529
SD	15.11	95% KM (BCA) UCL	6.189
95% KM (t) UCL	6.009	95% KM (Percentile Bootstrap) UCL	6.185
95% KM (z) UCL	5.986	95% KM Bootstrap t UCL	7.58
90% KM Chebyshev UCL	8.058	95% KM Chebyshev UCL	10.14
97.5% KM Chebyshev UCL	13.02	99% KM Chebyshev UCL	18.69

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	4.773	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.882	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.347	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.171	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.246	k star (bias corrected MLE)	0.244
Theta hat (MLE)	43.51	Theta star (bias corrected MLE)	43.91
nu hat (MLE)	15.73	nu star (bias corrected)	15.59
MLE Mean (bias corrected)	10.7	MLE Sd (bias corrected)	21.67

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0527	nu hat (KM)	10.76
Approximate Chi Square Value (10.76, α)	4.422	Adjusted Chi Square Value (10.76, β)	4.364
95% Gamma Approximate KM-UCL (use when n>=50)	8.444	95% Gamma Adjusted KM-UCL (use when n<50)	8.557
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Chrysene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0068	Mean	3.394
Maximum	102	Median	0.01
SD	15.11	CV	4.453
k hat (MLE)	0.168	k star (bias corrected MLE)	0.17
Theta hat (MLE)	20.17	Theta star (bias corrected MLE)	19.98
nu hat (MLE)	34.32	nu star (bias corrected)	34.65
MLE Mean (bias corrected)	3.394	MLE Sd (bias corrected)	8.236
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (34.65, α)	22.18	Adjusted Chi Square Value (34.65, β)	22.04
95% Gamma Approximate UCL (use when n>=50)	5.301	95% Gamma Adjusted UCL (use when n<50)	5.336

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.849	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.157	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.382	Mean in Log Scale	-3.283
SD in Original Scale	15.11	SD in Log Scale	2.659
95% t UCL (assumes normality of ROS data)	5.867	95% Percentile Bootstrap UCL	5.908
95% BCA Bootstrap UCL	7.018	95% Bootstrap t UCL	7.564
95% H-UCL (Log ROS)	3.839		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	5.882	Mean in Log Scale	-0.984
SD in Original Scale	16.11	SD in Log Scale	2.495
95% t UCL (Assumes normality)	8.53	95% H-Stat UCL	22.24

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	13.02

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Dibenzo(a,h)anthracene

General Statistics			
Total Number of Observations	81	Number of Distinct Observations	31
Number of Detects	3	Number of Non-Detects	78
Number of Distinct Detects	3	Number of Distinct Non-Detects	28
Minimum Detect	0.0932	Minimum Non-Detect	0.011
Maximum Detect	2.96	Maximum Non-Detect	2.4
Variance Detects	2.104	Percent Non-Detects	96.3%
Mean Detects	1.398	SD Detects	1.451
Median Detects	1.14	CV Detects	1.038
Skewness Detects	0.774	Kurtosis Detects	N/A
Mean of Logged Detects	-0.386	SD of Logged Detects	1.786

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0664	Standard Error of Mean	0.0487
SD	0.352	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.147	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.147	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.213	95% KM Chebyshev UCL	0.279
97.5% KM Chebyshev UCL	0.371	99% KM Chebyshev UCL	0.551

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.821	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.702	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	4.926	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0356	nu hat (KM)	5.765
		Adjusted Level of Significance (β)	0.047
Approximate Chi Square Value (5.77, α)	1.521	Adjusted Chi Square Value (5.77, β)	1.482
95% Gamma Approximate KM-UCL (use when n>=50)	0.252	95% Gamma Adjusted KM-UCL (use when n<50)	0.258

Gamma (KM) may not be used when k hat (KM) is < 0.1

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.28	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Dibenzo(a,h)anthracene (cont.)

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0523	Mean in Log Scale	-9.734
SD in Original Scale	0.351	SD in Log Scale	3.202
95% t UCL (assumes normality of ROS data)	0.117	95% Percentile Bootstrap UCL	0.125
95% BCA Bootstrap UCL	0.186	95% Bootstrap t UCL	1.772
95% H-UCL (Log ROS)	0.0587		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-4.323	95% H-UCL (KM -Log)	0.0242
KM SD (logged)	0.883	95% Critical H Value (KM-Log)	2.125
KM Standard Error of Mean (logged)	0.131		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.279	Mean in Log Scale	-2.707
SD in Original Scale	0.48	SD in Log Scale	1.737
95% t UCL (Assumes normality)	0.368	95% H-Stat UCL	0.544

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.147	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Fluoranthene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	82
Number of Detects	73	Number of Non-Detects	29
Number of Distinct Detects	67	Number of Distinct Non-Detects	15
Minimum Detect	0.04	Minimum Non-Detect	0.0078
Maximum Detect	820	Maximum Non-Detect	75.5
Variance Detects	20717	Percent Non-Detects	28.43%
Mean Detects	45.94	SD Detects	143.9
Median Detects	7.74	CV Detects	3.133
Skewness Detects	4.014	Kurtosis Detects	16.1
Mean of Logged Detects	1.707	SD of Logged Detects	2.07

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.344	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.461	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.104	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	33.39	Standard Error of Mean	12.22
SD	122.6	95% KM (BCA) UCL	56.08
95% KM (t) UCL	53.68	95% KM (Percentile Bootstrap) UCL	55.12
95% KM (z) UCL	53.5	95% KM Bootstrap t UCL	70.08
90% KM Chebyshev UCL	70.06	95% KM Chebyshev UCL	86.67
97.5% KM Chebyshev UCL	109.7	99% KM Chebyshev UCL	155

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	7.8	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.86	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.314	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.113	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.322	k star (bias corrected MLE)	0.317
Theta hat (MLE)	142.9	Theta star (bias corrected MLE)	144.7
nu hat (MLE)	46.95	nu star (bias corrected)	46.35
MLE Mean (bias corrected)	45.94	MLE Sd (bias corrected)	81.54

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0742	nu hat (KM)	15.14
Approximate Chi Square Value (15.14, α)	7.358	Adjusted Chi Square Value (15.14, β)	7.28
95% Gamma Approximate KM-UCL (use when n>=50)	68.7	95% Gamma Adjusted KM-UCL (use when n<50)	69.44
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	33.25
Maximum	820	Median	5.05
SD	123.3	CV	3.707
k hat (MLE)	0.208	k star (bias corrected MLE)	0.209
Theta hat (MLE)	159.6	Theta star (bias corrected MLE)	159.3
nu hat (MLE)	42.49	nu star (bias corrected)	42.57
MLE Mean (bias corrected)	33.25	MLE Sd (bias corrected)	72.78
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (42.57, α)	28.61	Adjusted Chi Square Value (42.57, β)	28.45
95% Gamma Approximate UCL (use when n>=50)	49.47	95% Gamma Adjusted UCL (use when n<50)	49.75

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.181	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	33.16	Mean in Log Scale	0.807
SD in Original Scale	123.2	SD in Log Scale	2.416
95% t UCL (assumes normality of ROS data)	53.42	95% Percentile Bootstrap UCL	55.03
95% BCA Bootstrap UCL	59.26	95% Bootstrap t UCL	66.92
95% H-UCL (Log ROS)	103.8		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	34.78	Mean in Log Scale	0.861
SD in Original Scale	122.9	SD in Log Scale	2.797
95% t UCL (Assumes normality)	54.99	95% H-Stat UCL	391.7

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	109.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Fluorene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	92
Number of Detects	88	Number of Non-Detects	14
Number of Distinct Detects	86	Number of Distinct Non-Detects	6
Minimum Detect	0.045	Minimum Non-Detect	0.028
Maximum Detect	799	Maximum Non-Detect	0.777
Variance Detects	17910	Percent Non-Detects	13.73%
Mean Detects	87.47	SD Detects	133.8
Median Detects	60.05	CV Detects	1.53
Skewness Detects	3.476	Kurtosis Detects	13.57
Mean of Logged Detects	3.099	SD of Logged Detects	2.403

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.59	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.257	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0944	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	75.47	Standard Error of Mean	12.67
SD	127.2	95% KM (BCA) UCL	99.39
95% KM (t) UCL	96.5	95% KM (Percentile Bootstrap) UCL	96.6
95% KM (z) UCL	96.3	95% KM Bootstrap t UCL	105.1
90% KM Chebyshev UCL	113.5	95% KM Chebyshev UCL	130.7
97.5% KM Chebyshev UCL	154.6	99% KM Chebyshev UCL	201.5

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.465	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.826	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.161	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.101	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.468	k star (bias corrected MLE)	0.459
Theta hat (MLE)	187	Theta star (bias corrected MLE)	190.4
nu hat (MLE)	82.33	nu star (bias corrected)	80.86
MLE Mean (bias corrected)	87.47	MLE Sd (bias corrected)	129

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.352	nu hat (KM)	71.8
Approximate Chi Square Value (71.80, α)	53.29	Adjusted Chi Square Value (71.80, β)	53.06
95% Gamma Approximate KM-UCL (use when n>=50)	101.7	95% Gamma Adjusted KM-UCL (use when n<50)	102.1

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Fluorene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	75.46
Maximum	799	Median	51.05
SD	127.8	CV	1.694
k hat (MLE)	0.302	k star (bias corrected MLE)	0.3
Theta hat (MLE)	250	Theta star (bias corrected MLE)	251.9
nu hat (MLE)	61.58	nu star (bias corrected)	61.11
MLE Mean (bias corrected)	75.46	MLE Sd (bias corrected)	137.9
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (61.11, α)	44.13	Adjusted Chi Square Value (61.11, β)	43.92
95% Gamma Approximate UCL (use when n>=50)	104.5	95% Gamma Adjusted UCL (use when n<50)	105

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.24	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0944	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	75.5	Mean in Log Scale	2.459
SD in Original Scale	127.8	SD in Log Scale	2.764
95% t UCL (assumes normality of ROS data)	96.51	95% Percentile Bootstrap UCL	97.14
95% BCA Bootstrap UCL	104.8	95% Bootstrap t UCL	105.3
95% H-UCL (Log ROS)	1725		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	75.47	Mean in Log Scale	2.168
SD in Original Scale	127.8	SD in Log Scale	3.254
95% t UCL (Assumes normality)	96.48	95% H-Stat UCL	8520

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	154.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Indeno(1,2,3_cd)Pyrene

General Statistics

Total Number of Observations	90	Number of Distinct Observations	41
Number of Detects	7	Number of Non-Detects	83
Number of Distinct Detects	7	Number of Distinct Non-Detects	34
Minimum Detect	0.08	Minimum Non-Detect	0.014
Maximum Detect	9.55	Maximum Non-Detect	7.84
Variance Detects	13	Percent Non-Detects	92.22%
Mean Detects	2.039	SD Detects	3.606
Median Detects	0.119	CV Detects	1.769
Skewness Detects	1.976	Kurtosis Detects	3.601
Mean of Logged Detects	-0.928	SD of Logged Detects	1.941

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.646	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.397	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.179	Standard Error of Mean	0.124
SD	1.081	95% KM (BCA) UCL	0.396
95% KM (t) UCL	0.385	95% KM (Percentile Bootstrap) UCL	0.395
95% KM (z) UCL	0.382	95% KM Bootstrap t UCL	2.765
90% KM Chebyshev UCL	0.55	95% KM Chebyshev UCL	0.718
97.5% KM Chebyshev UCL	0.951	99% KM Chebyshev UCL	1.409

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.964	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.768	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.347	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.331	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.401	k star (bias corrected MLE)	0.324
Theta hat (MLE)	5.084	Theta star (bias corrected MLE)	6.285
nu hat (MLE)	5.613	nu star (bias corrected)	4.541
MLE Mean (bias corrected)	2.039	MLE Sd (bias corrected)	3.579

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0275	nu hat (KM)	4.951
Approximate Chi Square Value (4.95, α)	1.13	Adjusted Chi Square Value (4.95, β)	1.101
95% Gamma Approximate KM-UCL (use when n>=50)	0.785	95% Gamma Adjusted KM-UCL (use when n<50)	0.806

Gamma (KM) may not be used when k hat (KM) is < 0.1

Indeno(1,2,3_cd)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.168
Maximum	9.55	Median	0.01
SD	1.084	CV	6.461
k hat (MLE)	0.276	k star (bias corrected MLE)	0.274
Theta hat (MLE)	0.608	Theta star (bias corrected MLE)	0.612
nu hat (MLE)	49.66	nu star (bias corrected)	49.33
MLE Mean (bias corrected)	0.168	MLE Sd (bias corrected)	0.32
		Adjusted Level of Significance (β)	0.0473
Approximate Chi Square Value (49.33, α)	34.21	Adjusted Chi Square Value (49.33, β)	34
95% Gamma Approximate UCL (use when n>=50)	0.242	95% Gamma Adjusted UCL (use when n<50)	0.243

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.782	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.303	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.16	Mean in Log Scale	-7.709
SD in Original Scale	1.085	SD in Log Scale	2.892
95% t UCL (assumes normality of ROS data)	0.35	95% Percentile Bootstrap UCL	0.368
95% BCA Bootstrap UCL	0.517	95% Bootstrap t UCL	4.656
95% H-UCL (Log ROS)	0.119		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.906	95% H-UCL (KM -Log)	0.049
KM SD (logged)	1.109	95% Critical H Value (KM-Log)	2.351
KM Standard Error of Mean (logged)	0.145		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.627	Mean in Log Scale	-2.233
SD in Original Scale	1.348	SD in Log Scale	1.971
95% t UCL (Assumes normality)	0.863	95% H-Stat UCL	1.505

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.718

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Naphthalene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	96
Number of Detects	89	Number of Non-Detects	13
Number of Distinct Detects	88	Number of Distinct Non-Detects	8
Minimum Detect	0.0773	Minimum Non-Detect	0.048
Maximum Detect	22800	Maximum Non-Detect	3.74
Variance Detects	23461020	Percent Non-Detects	12.75%
Mean Detects	2396	SD Detects	4844
Median Detects	53.3	CV Detects	2.021
Skewness Detects	2.404	Kurtosis Detects	5.743
Mean of Logged Detects	3.936	SD of Logged Detects	3.763

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.573	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.354	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0939	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	2091	Standard Error of Mean	455
SD	4569	95% KM (BCA) UCL	2942
95% KM (t) UCL	2846	95% KM (Percentile Bootstrap) UCL	2844
95% KM (z) UCL	2839	95% KM Bootstrap t UCL	2991
90% KM Chebyshev UCL	3456	95% KM Chebyshev UCL	4074
97.5% KM Chebyshev UCL	4932	99% KM Chebyshev UCL	6618

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.421	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.923	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.155	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.105	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.192	k star (bias corrected MLE)	0.193
Theta hat (MLE)	12449	Theta star (bias corrected MLE)	12384
nu hat (MLE)	34.26	nu star (bias corrected)	34.44
MLE Mean (bias corrected)	2396	MLE Sd (bias corrected)	5448

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.209	nu hat (KM)	42.71
Approximate Chi Square Value (42.71, α)	28.73	Adjusted Chi Square Value (42.71, β)	28.56
95% Gamma Approximate KM-UCL (use when n>=50)	3109	95% Gamma Adjusted KM-UCL (use when n<50)	3126

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Naphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	2091
Maximum	22800	Median	20.6
SD	4592	CV	2.196
k hat (MLE)	0.159	k star (bias corrected MLE)	0.161
Theta hat (MLE)	13163	Theta star (bias corrected MLE)	13010
nu hat (MLE)	32.4	nu star (bias corrected)	32.78
MLE Mean (bias corrected)	2091	MLE Sd (bias corrected)	5216
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (32.78, α)	20.69	Adjusted Chi Square Value (32.78, β)	20.56
95% Gamma Approximate UCL (use when n>=50)	3312	95% Gamma Adjusted UCL (use when n<50)	3334

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0975	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0939	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2091	Mean in Log Scale	2.97
SD in Original Scale	4592	SD in Log Scale	4.374
95% t UCL (assumes normality of ROS data)	2846	95% Percentile Bootstrap UCL	2857
95% BCA Bootstrap UCL	2959	95% Bootstrap t UCL	3028
95% H-UCL (Log ROS)	4561582		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2091	Mean in Log Scale	3.134
SD in Original Scale	4592	SD in Log Scale	4.132
95% t UCL (Assumes normality)	2846	95% H-Stat UCL	1433578

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	4932

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Phenanthrene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	85
Number of Detects	85	Number of Non-Detects	17
Number of Distinct Detects	78	Number of Distinct Non-Detects	7
Minimum Detect	0.0379	Minimum Non-Detect	0.032
Maximum Detect	1990	Maximum Non-Detect	0.374
Variance Detects	103368	Percent Non-Detects	16.67%
Mean Detects	134	SD Detects	321.5
Median Detects	54.7	CV Detects	2.4
Skewness Detects	4.236	Kurtosis Detects	18.66
Mean of Logged Detects	3.021	SD of Logged Detects	2.64

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.415	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.371	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0961	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	111.7	Standard Error of Mean	29.48
SD	296	95% KM (BCA) UCL	162.8
95% KM (t) UCL	160.6	95% KM (Percentile Bootstrap) UCL	164
95% KM (z) UCL	160.2	95% KM Bootstrap t UCL	192.3
90% KM Chebyshev UCL	200.1	95% KM Chebyshev UCL	240.2
97.5% KM Chebyshev UCL	295.8	99% KM Chebyshev UCL	405

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.241	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.853	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.158	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.105	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.357	k star (bias corrected MLE)	0.352
Theta hat (MLE)	375.1	Theta star (bias corrected MLE)	380.2
nu hat (MLE)	60.72	nu star (bias corrected)	59.91
MLE Mean (bias corrected)	134	MLE Sd (bias corrected)	225.7

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.142	nu hat (KM)	29.03
Approximate Chi Square Value (29.03, α)	17.73	Adjusted Chi Square Value (29.03, β)	17.61
95% Gamma Approximate KM-UCL (use when n>=50)	182.8	95% Gamma Adjusted KM-UCL (use when n<50)	184.1

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Phenanthrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	111.7
Maximum	1990	Median	29.7
SD	297.5	CV	2.664
k hat (MLE)	0.241	k star (bias corrected MLE)	0.24
Theta hat (MLE)	463.4	Theta star (bias corrected MLE)	464.4
nu hat (MLE)	49.16	nu star (bias corrected)	49.04
MLE Mean (bias corrected)	111.7	MLE Sd (bias corrected)	227.7
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (49.04, α)	33.97	Adjusted Chi Square Value (49.04, β)	33.79
95% Gamma Approximate UCL (use when n>=50)	161.2	95% Gamma Adjusted UCL (use when n<50)	162.1

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.187	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0961	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	111.7	Mean in Log Scale	2.149
SD in Original Scale	297.5	SD in Log Scale	3.124
95% t UCL (assumes normality of ROS data)	160.6	95% Percentile Bootstrap UCL	162.6
95% BCA Bootstrap UCL	180.4	95% Bootstrap t UCL	190.4
95% H-UCL (Log ROS)	4917		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	111.7	Mean in Log Scale	1.914
SD in Original Scale	297.5	SD in Log Scale	3.479
95% t UCL (Assumes normality)	160.6	95% H-Stat UCL	17448

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	295.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Pyrene

General Statistics			
Total Number of Observations	102	Number of Distinct Observations	81
Number of Detects	67	Number of Non-Detects	35
Number of Distinct Detects	65	Number of Distinct Non-Detects	18
Minimum Detect	0.013	Minimum Non-Detect	0.013
Maximum Detect	490	Maximum Non-Detect	75.5
Variance Detects	7632	Percent Non-Detects	34.31%
Mean Detects	27.54	SD Detects	87.36
Median Detects	3.55	CV Detects	3.172
Skewness Detects	3.945	Kurtosis Detects	15.66
Mean of Logged Detects	1.088	SD of Logged Detects	2.047

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.344	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.465	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.108	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	18.47	Standard Error of Mean	7.125
SD	71.4	95% KM (BCA) UCL	30.89
95% KM (t) UCL	30.3	95% KM (Percentile Bootstrap) UCL	31.11
95% KM (z) UCL	30.19	95% KM Bootstrap t UCL	38.12
90% KM Chebyshev UCL	39.84	95% KM Chebyshev UCL	49.53
97.5% KM Chebyshev UCL	62.96	99% KM Chebyshev UCL	89.36

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	7.915	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.863	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.32	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.118	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.308	k star (bias corrected MLE)	0.304
Theta hat (MLE)	89.36	Theta star (bias corrected MLE)	90.49
nu hat (MLE)	41.3	nu star (bias corrected)	40.79
MLE Mean (bias corrected)	27.54	MLE Sd (bias corrected)	49.93

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0669	nu hat (KM)	13.65
Approximate Chi Square Value (13.65, α)	6.332	Adjusted Chi Square Value (13.65, β)	6.26
95% Gamma Approximate KM-UCL (use when n>=50)	39.81	95% Gamma Adjusted KM-UCL (use when n<50)	40.27
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	18.31
Maximum	490	Median	1.86
SD	71.81	CV	3.921
k hat (MLE)	0.199	k star (bias corrected MLE)	0.2
Theta hat (MLE)	91.94	Theta star (bias corrected MLE)	91.63
nu hat (MLE)	40.63	nu star (bias corrected)	40.77
MLE Mean (bias corrected)	18.31	MLE Sd (bias corrected)	40.96
		Adjusted Level of Significance (β)	0.0476
Approximate Chi Square Value (40.77, α)	27.14	Adjusted Chi Square Value (40.77, β)	26.98
95% Gamma Approximate UCL (use when n>=50)	27.51	95% Gamma Adjusted UCL (use when n<50)	27.67

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.179	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.108	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	18.28	Mean in Log Scale	0.0965
SD in Original Scale	71.79	SD in Log Scale	2.334
95% t UCL (assumes normality of ROS data)	30.08	95% Percentile Bootstrap UCL	30.09
95% BCA Bootstrap UCL	34.59	95% Bootstrap t UCL	37.67
95% H-UCL (Log ROS)	39.78		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	20.3	Mean in Log Scale	0.41
SD in Original Scale	71.61	SD in Log Scale	2.585
95% t UCL (Assumes normality)	32.07	95% H-Stat UCL	120.1

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	62.96

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Gasoline Range Hydrocarbons

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	6
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	789	Minimum Non-Detect	100
Maximum Detect	28500	Maximum Non-Detect	100
Variance Detects	1.341E+8	Percent Non-Detects	54.55%
Mean Detects	7964	SD Detects	11580
Median Detects	3640	CV Detects	1.454
Skewness Detects	2.141	Kurtosis Detects	4.663
Mean of Logged Detects	8.25	SD of Logged Detects	1.317

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.678	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.408	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	3674	Standard Error of Mean	2699
SD	8006	95% KM (BCA) UCL	8454
95% KM (t) UCL	8566	95% KM (Percentile Bootstrap) UCL	8349
95% KM (z) UCL	8114	95% KM Bootstrap t UCL	18821
90% KM Chebyshev UCL	11771	95% KM Chebyshev UCL	15438
97.5% KM Chebyshev UCL	20528	99% KM Chebyshev UCL	30527

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.442	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.314	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.366	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.809	k star (bias corrected MLE)	0.457
Theta hat (MLE)	9840	Theta star (bias corrected MLE)	17424
nu hat (MLE)	8.093	nu star (bias corrected)	4.571
MLE Mean (bias corrected)	7964	MLE Sd (bias corrected)	11780

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.211	nu hat (KM)	4.634
Approximate Chi Square Value (4.63, α)	0.987	Adjusted Chi Square Value (4.63, β)	0.746
95% Gamma Approximate KM-UCL (use when n>=50)	17250	95% Gamma Adjusted KM-UCL (use when n<50)	22840

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Gasoline Range Hydrocarbons (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	3620
Maximum	28500	Median	0.01
SD	8422	CV	2.327
k hat (MLE)	0.115	k star (bias corrected MLE)	0.144
Theta hat (MLE)	31560	Theta star (bias corrected MLE)	25134
nu hat (MLE)	2.523	nu star (bias corrected)	3.169
MLE Mean (bias corrected)	3620	MLE Sd (bias corrected)	9539
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (3.17, α)	0.424	Adjusted Chi Square Value (3.17, β)	0.299
95% Gamma Approximate UCL (use when n>=50)	27049	95% Gamma Adjusted UCL (use when n<50)	38329

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.962	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3675	Mean in Log Scale	5.903
SD in Original Scale	8397	SD in Log Scale	2.603
95% t UCL (assumes normality of ROS data)	8263	95% Percentile Bootstrap UCL	8481
95% BCA Bootstrap UCL	11214	95% Bootstrap t UCL	25458
95% H-UCL (Log ROS)	2382820		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	6.262	95% H-UCL (KM -Log)	91751
KM SD (logged)	1.981	95% Critical H Value (KM-Log)	5.111
KM Standard Error of Mean (logged)	0.668		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	3647	Mean in Log Scale	5.884
SD in Original Scale	8409	SD in Log Scale	2.414
95% t UCL (Assumes normality)	8243	95% H-Stat UCL	702110

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	8566	95% GROS Adjusted Gamma UCL	38329
95% Adjusted Gamma KM-UCL	22840		

Warning: Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Diesel Range Organics

General Statistics			
Total Number of Observations	84	Number of Distinct Observations	70
Number of Detects	63	Number of Non-Detects	21
Number of Distinct Detects	63	Number of Distinct Non-Detects	8
Minimum Detect	191	Minimum Non-Detect	187
Maximum Detect	374000	Maximum Non-Detect	239
Variance Detects	2.774E+9	Percent Non-Detects	25%
Mean Detects	21224	SD Detects	52672
Median Detects	4110	CV Detects	2.482
Skewness Detects	5.249	Kurtosis Detects	33.07
Mean of Logged Detects	8.443	SD of Logged Detects	1.747

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.433	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.359	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.112	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	15965	Standard Error of Mean	5077
SD	46160	95% KM (BCA) UCL	24908
95% KM (t) UCL	24410	95% KM (Percentile Bootstrap) UCL	25585
95% KM (z) UCL	24316	95% KM Bootstrap t UCL	33655
90% KM Chebyshev UCL	31196	95% KM Chebyshev UCL	38095
97.5% KM Chebyshev UCL	47670	99% KM Chebyshev UCL	66479

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.061	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.833	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.212	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.12	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.428	k star (bias corrected MLE)	0.418
Theta hat (MLE)	49557	Theta star (bias corrected MLE)	50719
nu hat (MLE)	53.96	nu star (bias corrected)	52.73
MLE Mean (bias corrected)	21224	MLE Sd (bias corrected)	32809

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.12	nu hat (KM)	20.1
Approximate Chi Square Value (20.10, α)	10.92	Adjusted Chi Square Value (20.10, β)	10.8
95% Gamma Approximate KM-UCL (use when n>=50)	29375	95% Gamma Adjusted KM-UCL (use when n<50)	29696

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Diesel Range Organics (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	15918
Maximum	374000	Median	1705
SD	46453	CV	2.918
k hat (MLE)	0.168	k star (bias corrected MLE)	0.17
Theta hat (MLE)	94662	Theta star (bias corrected MLE)	93587
nu hat (MLE)	28.25	nu star (bias corrected)	28.57
MLE Mean (bias corrected)	15918	MLE Sd (bias corrected)	38597
		Adjusted Level of Significance (β)	0.0471
Approximate Chi Square Value (28.57, α)	17.38	Adjusted Chi Square Value (28.57, β)	17.22
95% Gamma Approximate UCL (use when n>=50)	26177	95% Gamma Adjusted UCL (use when n<50)	26409

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.079	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.112	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	15945	Mean in Log Scale	7.455
SD in Original Scale	46444	SD in Log Scale	2.317
95% t UCL (assumes normality of ROS data)	24375	95% Percentile Bootstrap UCL	25199
95% BCA Bootstrap UCL	29151	95% Bootstrap t UCL	33215
95% H-UCL (Log ROS)	66044		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	7.641	95% H-UCL (KM -Log)	36359
KM SD (logged)	2.045	95% Critical H Value (KM-Log)	3.425
KM Standard Error of Mean (logged)	0.225		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	15945	Mean in Log Scale	7.496
SD in Original Scale	46444	SD in Log Scale	2.237
95% t UCL (Assumes normality)	24374	95% H-Stat UCL	54165

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	47670

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Residual Range Hydrocarbons

General Statistics			
Total Number of Observations	84	Number of Distinct Observations	44
Number of Detects	16	Number of Non-Detects	68
Number of Distinct Detects	16	Number of Distinct Non-Detects	28
Minimum Detect	391	Minimum Non-Detect	374
Maximum Detect	103000	Maximum Non-Detect	15000
Variance Detects	6.513E+8	Percent Non-Detects	80.95%
Mean Detects	7373	SD Detects	25521
Median Detects	613.5	CV Detects	3.461
Skewness Detects	3.989	Kurtosis Detects	15.94
Mean of Logged Detects	6.916	SD of Logged Detects	1.403

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.297	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.493	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.222	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1728	Standard Error of Mean	1254
SD	11128	95% KM (BCA) UCL	4154
95% KM (t) UCL	3814	95% KM (Percentile Bootstrap) UCL	4151
95% KM (z) UCL	3791	95% KM Bootstrap t UCL	41967
90% KM Chebyshev UCL	5491	95% KM Chebyshev UCL	7195
97.5% KM Chebyshev UCL	9560	99% KM Chebyshev UCL	14206

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.899	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.83	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.435	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.232	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.34	k star (bias corrected MLE)	0.318
Theta hat (MLE)	21708	Theta star (bias corrected MLE)	23213
nu hat (MLE)	10.87	nu star (bias corrected)	10.16
MLE Mean (bias corrected)	7373	MLE Sd (bias corrected)	13082

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0241	nu hat (KM)	4.052
Approximate Chi Square Value (4.05, α)	0.743	Adjusted Chi Square Value (4.05, β)	0.719
95% Gamma Approximate KM-UCL (use when n>=50)	9432	95% Gamma Adjusted KM-UCL (use when n<50)	9735
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helens' Groundwater Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Residual Range Hydrocarbons (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1404
Maximum	103000	Median	0.01
SD	11233	CV	7.999
k hat (MLE)	0.0857	k star (bias corrected MLE)	0.0906
Theta hat (MLE)	16390	Theta star (bias corrected MLE)	15508
nu hat (MLE)	14.4	nu star (bias corrected)	15.21
MLE Mean (bias corrected)	1404	MLE Sd (bias corrected)	4667
		Adjusted Level of Significance (β)	0.0471
Approximate Chi Square Value (15.21, α)	7.411	Adjusted Chi Square Value (15.21, β)	7.316
95% Gamma Approximate UCL (use when n>=50)	2883	95% Gamma Adjusted UCL (use when n<50)	2921

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.638	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.343	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.222	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1441	Mean in Log Scale	3.976
SD in Original Scale	11229	SD in Log Scale	1.87
95% t UCL (assumes normality of ROS data)	3479	95% Percentile Bootstrap UCL	3871
95% BCA Bootstrap UCL	5202	95% Bootstrap t UCL	39519
95% H-UCL (Log ROS)	591.2		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2054	Mean in Log Scale	6.132
SD in Original Scale	11229	SD in Log Scale	1.154
95% t UCL (Assumes normality)	4092	95% H-Stat UCL	1213

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	4154

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

User Selected Options	
Date/Time of Computation	3/25/2014 10:31:18 AM
From File	SedSB_EPCs_20140325.xls
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

1_Methylnaphthalene

General Statistics

Total Number of Observations	37	Number of Distinct Observations	36
Number of Detects	34	Number of Non-Detects	3
Number of Distinct Detects	33	Number of Distinct Non-Detects	3
Minimum Detect	0.00614	Minimum Non-Detect	0.00625
Maximum Detect	2.11	Maximum Non-Detect	0.00804
Variance Detects	0.154	Percent Non-Detects	8.108%
Mean Detects	0.239	SD Detects	0.392
Median Detects	0.116	CV Detects	1.64
Skewness Detects	3.634	Kurtosis Detects	15.88
Mean of Logged Detects	-2.347	SD of Logged Detects	1.446

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.587	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.276	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.22	Standard Error of Mean	0.0628
SD	0.376	90% KM (BCA) UCL	0.299
90% KM (t) UCL	0.302	90% KM (Percentile Bootstrap) UCL	0.302
90% KM (z) UCL	0.301	90% KM Bootstrap t UCL	0.373
90% KM Chebyshev UCL	0.409	95% KM Chebyshev UCL	0.494
97.5% KM Chebyshev UCL	0.612	99% KM Chebyshev UCL	0.845

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.549	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.796	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.115	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.158	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.664	k star (bias corrected MLE)	0.625
Theta hat (MLE)	0.361	Theta star (bias corrected MLE)	0.383
nu hat (MLE)	45.13	nu star (bias corrected)	42.48
MLE Mean (bias corrected)	0.239	MLE Sd (bias corrected)	0.303

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.344	nu hat (KM)	25.43
Approximate Chi Square Value (25.43, α)	16.82	Adjusted Chi Square Value (25.43, β)	16.58
90% Gamma Approximate KM-UCL (use when n>=50)	0.333	90% Gamma Adjusted KM-UCL (use when n<50)	0.338

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

1_Methylnaphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.00614	Mean	0.221
Maximum	2.11	Median	0.0992
SD	0.381	CV	1.726
k hat (MLE)	0.605	k star (bias corrected MLE)	0.574
Theta hat (MLE)	0.365	Theta star (bias corrected MLE)	0.384
nu hat (MLE)	44.79	nu star (bias corrected)	42.49
MLE Mean (bias corrected)	0.221	MLE Sd (bias corrected)	0.291
		Adjusted Level of Significance (β)	0.0924
Approximate Chi Square Value (42.49, α)	31.19	Adjusted Chi Square Value (42.49, β)	30.85
90% Gamma Approximate UCL (use when n>=50)	0.301	90% Gamma Adjusted UCL (use when n<50)	0.304

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0925	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.22	Mean in Log Scale	-2.587
SD in Original Scale	0.381	SD in Log Scale	1.608
90% t UCL (assumes normality of ROS data)	0.302	90% Percentile Bootstrap UCL	0.305
90% BCA Bootstrap UCL	0.327	90% Bootstrap t UCL	0.373
90% H-UCL (Log ROS)	0.516		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.568	90% H-UCL (KM -Log)	0.467
KM SD (logged)	1.555	90% Critical H Value (KM-Log)	2.303
KM Standard Error of Mean (logged)	0.26		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.22	Mean in Log Scale	-2.616
SD in Original Scale	0.381	SD in Log Scale	1.661
90% t UCL (Assumes normality)	0.302	90% H-Stat UCL	0.566

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

2_Methylnaphthalene

General Statistics			
Total Number of Observations	94	Number of Distinct Observations	81
Number of Detects	81	Number of Non-Detects	13
Number of Distinct Detects	75	Number of Distinct Non-Detects	9
Minimum Detect	0.0039	Minimum Non-Detect	0.0022
Maximum Detect	4.89	Maximum Non-Detect	0.02
Variance Detects	0.432	Percent Non-Detects	13.83%
Mean Detects	0.291	SD Detects	0.657
Median Detects	0.072	CV Detects	2.259
Skewness Detects	5.026	Kurtosis Detects	30.96
Mean of Logged Detects	-2.503	SD of Logged Detects	1.591

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.465	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.331	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0984	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.251	Standard Error of Mean	0.0638
SD	0.614	90% KM (BCA) UCL	0.345
90% KM (t) UCL	0.334	90% KM (Percentile Bootstrap) UCL	0.333
90% KM (z) UCL	0.333	90% KM Bootstrap t UCL	0.382
90% KM Chebyshev UCL	0.443	95% KM Chebyshev UCL	0.529
97.5% KM Chebyshev UCL	0.649	99% KM Chebyshev UCL	0.886

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.931	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.819	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.156	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.105	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.501	k star (bias corrected MLE)	0.49
Theta hat (MLE)	0.581	Theta star (bias corrected MLE)	0.593
nu hat (MLE)	81.09	nu star (bias corrected)	79.42
MLE Mean (bias corrected)	0.291	MLE Sd (bias corrected)	0.415

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.167	nu hat (KM)	31.43
Approximate Chi Square Value (31.43, α)	21.8	Adjusted Chi Square Value (31.43, β)	21.7
90% Gamma Approximate KM-UCL (use when n>=50)	0.362	90% Gamma Adjusted KM-UCL (use when n<50)	0.364

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

2_Methylnaphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0039	Mean	0.252
Maximum	4.89	Median	0.0545
SD	0.617	CV	2.449
k hat (MLE)	0.455	k star (bias corrected MLE)	0.448
Theta hat (MLE)	0.554	Theta star (bias corrected MLE)	0.563
nu hat (MLE)	85.58	nu star (bias corrected)	84.18
MLE Mean (bias corrected)	0.252	MLE Sd (bias corrected)	0.377
		Adjusted Level of Significance (β)	0.0972
Approximate Chi Square Value (84.18, α)	68.04	Adjusted Chi Square Value (84.18, β)	67.86
90% Gamma Approximate UCL (use when n>=50)	0.312	90% Gamma Adjusted UCL (use when n<50)	0.313

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.059	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0984	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.251	Mean in Log Scale	-2.962
SD in Original Scale	0.618	SD in Log Scale	1.884
90% t UCL (assumes normality of ROS data)	0.333	90% Percentile Bootstrap UCL	0.333
90% BCA Bootstrap UCL	0.357	90% Bootstrap t UCL	0.405
90% H-UCL (Log ROS)	0.493		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.952	90% H-UCL (KM -Log)	0.469
KM SD (logged)	1.857	90% Critical H Value (KM-Log)	2.434
KM Standard Error of Mean (logged)	0.194		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.251	Mean in Log Scale	-2.951
SD in Original Scale	0.618	SD in Log Scale	1.872
90% t UCL (Assumes normality)	0.333	90% H-Stat UCL	0.485

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Acenaphthene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	100
Number of Detects	93	Number of Non-Detects	19
Number of Distinct Detects	85	Number of Distinct Non-Detects	17
Minimum Detect	0.0034	Minimum Non-Detect	0.0018
Maximum Detect	16.2	Maximum Non-Detect	0.586
Variance Detects	3.849	Percent Non-Detects	16.96%
Mean Detects	0.65	SD Detects	1.962
Median Detects	0.102	CV Detects	3.016
Skewness Detects	6.276	Kurtosis Detects	45.24
Mean of Logged Detects	-2.054	SD of Logged Detects	1.808

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.348	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.371	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0919	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.544	Standard Error of Mean	0.17
SD	1.794	90% KM (BCA) UCL	0.789
90% KM (t) UCL	0.764	90% KM (Percentile Bootstrap) UCL	0.771
90% KM (z) UCL	0.762	90% KM Bootstrap t UCL	0.963
90% KM Chebyshev UCL	1.055	95% KM Chebyshev UCL	1.287
97.5% KM Chebyshev UCL	1.608	99% KM Chebyshev UCL	2.24

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.902	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.842	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.154	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0994	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.405	k star (bias corrected MLE)	0.399
Theta hat (MLE)	1.608	Theta star (bias corrected MLE)	1.632
nu hat (MLE)	75.25	nu star (bias corrected)	74.16
MLE Mean (bias corrected)	0.65	MLE Sd (bias corrected)	1.03

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.092	nu hat (KM)	20.6
Approximate Chi Square Value (20.60, α)	12.92	Adjusted Chi Square Value (20.60, β)	12.86
90% Gamma Approximate KM-UCL (use when n>=50)	0.867	90% Gamma Adjusted KM-UCL (use when n<50)	0.872
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Acenaphthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0034	Mean	0.542
Maximum	16.2	Median	0.0824
SD	1.802	CV	3.327
k hat (MLE)	0.358	k star (bias corrected MLE)	0.354
Theta hat (MLE)	1.515	Theta star (bias corrected MLE)	1.531
nu hat (MLE)	80.11	nu star (bias corrected)	79.3
MLE Mean (bias corrected)	0.542	MLE Sd (bias corrected)	0.911
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (79.30, α)	63.65	Adjusted Chi Square Value (79.30, β)	63.5
90% Gamma Approximate UCL (use when n>=50)	0.675	90% Gamma Adjusted UCL (use when n<50)	0.677

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0558	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0919	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.542	Mean in Log Scale	-2.555
SD in Original Scale	1.802	SD in Log Scale	2.044
90% t UCL (assumes normality of ROS data)	0.762	90% Percentile Bootstrap UCL	0.756
90% BCA Bootstrap UCL	0.87	90% Bootstrap t UCL	0.983
90% H-UCL (Log ROS)	1.032		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.561	90% H-UCL (KM -Log)	1.065
KM SD (logged)	2.059	90% Critical H Value (KM-Log)	2.573
KM Standard Error of Mean (logged)	0.2		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.549	Mean in Log Scale	-2.463
SD in Original Scale	1.801	SD in Log Scale	2.006
90% t UCL (Assumes normality)	0.768	90% H-Stat UCL	1.03

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Acenaphthylene

General Statistics			
Total Number of Observations	108	Number of Distinct Observations	95
Number of Detects	73	Number of Non-Detects	35
Number of Distinct Detects	67	Number of Distinct Non-Detects	30
Minimum Detect	0.0036	Minimum Non-Detect	0.0037
Maximum Detect	0.49	Maximum Non-Detect	0.414
Variance Detects	0.00896	Percent Non-Detects	32.41%
Mean Detects	0.0664	SD Detects	0.0947
Median Detects	0.033	CV Detects	1.426
Skewness Detects	2.692	Kurtosis Detects	7.428
Mean of Logged Detects	-3.369	SD of Logged Detects	1.111

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.626	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.298	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.104	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0485	Standard Error of Mean	0.00808
SD	0.0826	90% KM (BCA) UCL	0.059
90% KM (t) UCL	0.0589	90% KM (Percentile Bootstrap) UCL	0.0591
90% KM (z) UCL	0.0588	90% KM Bootstrap t UCL	0.0613
90% KM Chebyshev UCL	0.0727	95% KM Chebyshev UCL	0.0837
97.5% KM Chebyshev UCL	0.0989	99% KM Chebyshev UCL	0.129

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.616	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.786	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.151	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.108	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.891	k star (bias corrected MLE)	0.864
Theta hat (MLE)	0.0745	Theta star (bias corrected MLE)	0.0769
nu hat (MLE)	130.1	nu star (bias corrected)	126.1
MLE Mean (bias corrected)	0.0664	MLE Sd (bias corrected)	0.0715

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.344	nu hat (KM)	74.35
Approximate Chi Square Value (74.35, α)	59.22	Adjusted Chi Square Value (74.35, β)	59.07
90% Gamma Approximate KM-UCL (use when n>=50)	0.0608	90% Gamma Adjusted KM-UCL (use when n<50)	0.061

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Acenaphthylene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0036	Mean	0.0481
Maximum	0.49	Median	0.017
SD	0.0821	CV	1.705
k hat (MLE)	0.806	k star (bias corrected MLE)	0.79
Theta hat (MLE)	0.0597	Theta star (bias corrected MLE)	0.0609
nu hat (MLE)	174.1	nu star (bias corrected)	170.6
MLE Mean (bias corrected)	0.0481	MLE Sd (bias corrected)	0.0541
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (170.60, α)	147.4	Adjusted Chi Square Value (170.60, β)	147.2
90% Gamma Approximate UCL (use when n>=50)	0.0557	90% Gamma Adjusted UCL (use when n<50)	0.0558

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0776	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0473	Mean in Log Scale	-3.94
SD in Original Scale	0.0825	SD in Log Scale	1.286
90% t UCL (assumes normality of ROS data)	0.0575	90% Percentile Bootstrap UCL	0.0581
90% BCA Bootstrap UCL	0.06	90% Bootstrap t UCL	0.0594
90% H-UCL (Log ROS)	0.0563		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.92	90% H-UCL (KM -Log)	0.0583
KM SD (logged)	1.296	90% Critical H Value (KM-Log)	1.906
KM Standard Error of Mean (logged)	0.132		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0542	Mean in Log Scale	-3.819
SD in Original Scale	0.0851	SD in Log Scale	1.382
90% t UCL (Assumes normality)	0.0648	90% H-Stat UCL	0.0743

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Anthracene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	98
Number of Detects	101	Number of Non-Detects	11
Number of Distinct Detects	91	Number of Distinct Non-Detects	8
Minimum Detect	0.0059	Minimum Non-Detect	0.005
Maximum Detect	4.95	Maximum Non-Detect	1.73
Variance Detects	0.741	Percent Non-Detects	9.821%
Mean Detects	0.485	SD Detects	0.861
Median Detects	0.15	CV Detects	1.775
Skewness Detects	3.129	Kurtosis Detects	10.57
Mean of Logged Detects	-1.857	SD of Logged Detects	1.584

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.578	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.289	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0882	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.443	Standard Error of Mean	0.0784
SD	0.825	90% KM (BCA) UCL	0.561
90% KM (t) UCL	0.544	90% KM (Percentile Bootstrap) UCL	0.544
90% KM (z) UCL	0.543	90% KM Bootstrap t UCL	0.568
90% KM Chebyshev UCL	0.678	95% KM Chebyshev UCL	0.785
97.5% KM Chebyshev UCL	0.933	99% KM Chebyshev UCL	1.223

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.403	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.814	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.117	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.094	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.552	k star (bias corrected MLE)	0.542
Theta hat (MLE)	0.879	Theta star (bias corrected MLE)	0.895
nu hat (MLE)	111.5	nu star (bias corrected)	109.5
MLE Mean (bias corrected)	0.485	MLE Sd (bias corrected)	0.659

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.289	nu hat (KM)	64.67
Approximate Chi Square Value (64.67, α)	50.59	Adjusted Chi Square Value (64.67, β)	50.46
90% Gamma Approximate KM-UCL (use when n>=50)	0.566	90% Gamma Adjusted KM-UCL (use when n<50)	0.568

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0059	Mean	0.439
Maximum	4.95	Median	0.117
SD	0.829	CV	1.888
k hat (MLE)	0.496	k star (bias corrected MLE)	0.489
Theta hat (MLE)	0.885	Theta star (bias corrected MLE)	0.899
nu hat (MLE)	111.1	nu star (bias corrected)	109.4
MLE Mean (bias corrected)	0.439	MLE Sd (bias corrected)	0.628
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (109.43, α)	90.95	Adjusted Chi Square Value (109.43, β)	90.78
90% Gamma Approximate UCL (use when n>=50)	0.528	90% Gamma Adjusted UCL (use when n<50)	0.529

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0529	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0882	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.44	Mean in Log Scale	-2.103
SD in Original Scale	0.828	SD in Log Scale	1.735
90% t UCL (assumes normality of ROS data)	0.541	90% Percentile Bootstrap UCL	0.544
90% BCA Bootstrap UCL	0.561	90% Bootstrap t UCL	0.57
90% H-UCL (Log ROS)	0.801		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.096	90% H-UCL (KM -Log)	0.787
KM SD (logged)	1.723	90% Critical H Value (KM-Log)	2.269
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.451	Mean in Log Scale	-2.07
SD in Original Scale	0.827	SD in Log Scale	1.773
90% t UCL (Assumes normality)	0.552	90% H-Stat UCL	0.897

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(a)Anthracene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	102
Number of Detects	109	Number of Non-Detects	3
Number of Distinct Detects	99	Number of Distinct Non-Detects	3
Minimum Detect	0.0063	Minimum Non-Detect	0.0129
Maximum Detect	7	Maximum Non-Detect	0.383
Variance Detects	0.984	Percent Non-Detects	2.679%
Mean Detects	0.553	SD Detects	0.992
Median Detects	0.221	CV Detects	1.794
Skewness Detects	4.181	Kurtosis Detects	21.66
Mean of Logged Detects	-1.608	SD of Logged Detects	1.507

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.551	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.291	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0849	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.539	Standard Error of Mean	0.0928
SD	0.978	90% KM (BCA) UCL	0.672
90% KM (t) UCL	0.659	90% KM (Percentile Bootstrap) UCL	0.666
90% KM (z) UCL	0.658	90% KM Bootstrap t UCL	0.698
90% KM Chebyshev UCL	0.818	95% KM Chebyshev UCL	0.944
97.5% KM Chebyshev UCL	1.119	99% KM Chebyshev UCL	1.463

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.915	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.809	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.106	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0915	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.607	k star (bias corrected MLE)	0.596
Theta hat (MLE)	0.911	Theta star (bias corrected MLE)	0.927
nu hat (MLE)	132.3	nu star (bias corrected)	130
MLE Mean (bias corrected)	0.553	MLE Sd (bias corrected)	0.716

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.304	nu hat (KM)	68.18
Approximate Chi Square Value (68.18, α)	53.71	Adjusted Chi Square Value (68.18, β)	53.58
90% Gamma Approximate KM-UCL (use when n>=50)	0.685	90% Gamma Adjusted KM-UCL (use when n<50)	0.687

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(a)Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0063	Mean	0.538
Maximum	7	Median	0.196
SD	0.983	CV	1.825
k hat (MLE)	0.58	k star (bias corrected MLE)	0.571
Theta hat (MLE)	0.928	Theta star (bias corrected MLE)	0.943
nu hat (MLE)	130	nu star (bias corrected)	127.9
MLE Mean (bias corrected)	0.538	MLE Sd (bias corrected)	0.713
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (127.88, α)	107.9	Adjusted Chi Square Value (127.88, β)	107.7
90% Gamma Approximate UCL (use when n>=50)	0.638	90% Gamma Adjusted UCL (use when n<50)	0.64

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0574	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0849	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.539	Mean in Log Scale	-1.668
SD in Original Scale	0.982	SD in Log Scale	1.538
90% t UCL (assumes normality of ROS data)	0.659	90% Percentile Bootstrap UCL	0.656
90% BCA Bootstrap UCL	0.683	90% Bootstrap t UCL	0.695
90% H-UCL (Log ROS)	0.838		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.672	90% H-UCL (KM -Log)	0.838
KM SD (logged)	1.54	90% Critical H Value (KM-Log)	2.111
KM Standard Error of Mean (logged)	0.147		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.54	Mean in Log Scale	-1.667
SD in Original Scale	0.982	SD in Log Scale	1.548
90% t UCL (Assumes normality)	0.66	90% H-Stat UCL	0.855

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(a)Pyrene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	98
Number of Detects	104	Number of Non-Detects	8
Number of Distinct Detects	90	Number of Distinct Non-Detects	8
Minimum Detect	0.0077	Minimum Non-Detect	0.0129
Maximum Detect	3.6	Maximum Non-Detect	1.73
Variance Detects	0.372	Percent Non-Detects	7.143%
Mean Detects	0.368	SD Detects	0.61
Median Detects	0.155	CV Detects	1.66
Skewness Detects	3.391	Kurtosis Detects	13.59
Mean of Logged Detects	-1.905	SD of Logged Detects	1.371

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.584	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0869	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.351	Standard Error of Mean	0.0562
SD	0.59	90% KM (BCA) UCL	0.415
90% KM (t) UCL	0.424	90% KM (Percentile Bootstrap) UCL	0.424
90% KM (z) UCL	0.423	90% KM Bootstrap t UCL	0.44
90% KM Chebyshev UCL	0.52	95% KM Chebyshev UCL	0.596
97.5% KM Chebyshev UCL	0.702	99% KM Chebyshev UCL	0.91

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.563	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.802	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.125	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0924	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.672	k star (bias corrected MLE)	0.659
Theta hat (MLE)	0.547	Theta star (bias corrected MLE)	0.558
nu hat (MLE)	139.8	nu star (bias corrected)	137.1
MLE Mean (bias corrected)	0.368	MLE Sd (bias corrected)	0.453

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.354	nu hat (KM)	79.29
Approximate Chi Square Value (79.29, α)	63.64	Adjusted Chi Square Value (79.29, β)	63.49
90% Gamma Approximate KM-UCL (use when n>=50)	0.437	90% Gamma Adjusted KM-UCL (use when n<50)	0.438

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(a)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0077	Mean	0.346
Maximum	3.6	Median	0.122
SD	0.593	CV	1.716
k hat (MLE)	0.657	k star (bias corrected MLE)	0.646
Theta hat (MLE)	0.526	Theta star (bias corrected MLE)	0.536
nu hat (MLE)	147.2	nu star (bias corrected)	144.6
MLE Mean (bias corrected)	0.346	MLE Sd (bias corrected)	0.43
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (144.61, α)	123.3	Adjusted Chi Square Value (144.61, β)	123.1
90% Gamma Approximate UCL (use when n>=50)	0.406	90% Gamma Adjusted UCL (use when n<50)	0.406

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0642	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0869	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.348	Mean in Log Scale	-1.954
SD in Original Scale	0.592	SD in Log Scale	1.351
90% t UCL (assumes normality of ROS data)	0.42	90% Percentile Bootstrap UCL	0.421
90% BCA Bootstrap UCL	0.432	90% Bootstrap t UCL	0.439
90% H-UCL (Log ROS)	0.454		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.961	90% H-UCL (KM -Log)	0.467
KM SD (logged)	1.372	90% Critical H Value (KM-Log)	1.971
KM Standard Error of Mean (logged)	0.133		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.363	Mean in Log Scale	-1.893
SD in Original Scale	0.592	SD in Log Scale	1.373
90% t UCL (Assumes normality)	0.435	90% H-Stat UCL	0.5

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(b)Fluoranthene

General Statistics			
Total Number of Observations	97	Number of Distinct Observations	85
Number of Detects	94	Number of Non-Detects	3
Number of Distinct Detects	82	Number of Distinct Non-Detects	3
Minimum Detect	0.0087	Minimum Non-Detect	0.0129
Maximum Detect	7.6	Maximum Non-Detect	0.383
Variance Detects	1.686	Percent Non-Detects	3.093%
Mean Detects	0.715	SD Detects	1.298
Median Detects	0.23	CV Detects	1.815
Skewness Detects	3.349	Kurtosis Detects	12.58
Mean of Logged Detects	-1.473	SD of Logged Detects	1.583

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.567	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.293	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0914	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.695	Standard Error of Mean	0.13
SD	1.277	90% KM (BCA) UCL	0.858
90% KM (t) UCL	0.863	90% KM (Percentile Bootstrap) UCL	0.862
90% KM (z) UCL	0.862	90% KM Bootstrap t UCL	0.915
90% KM Chebyshev UCL	1.086	95% KM Chebyshev UCL	1.263
97.5% KM Chebyshev UCL	1.509	99% KM Chebyshev UCL	1.991

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.32	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.814	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.111	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0973	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.55	k star (bias corrected MLE)	0.54
Theta hat (MLE)	1.3	Theta star (bias corrected MLE)	1.326
nu hat (MLE)	103.4	nu star (bias corrected)	101.4
MLE Mean (bias corrected)	0.715	MLE Sd (bias corrected)	0.974

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.296	nu hat (KM)	57.43
Approximate Chi Square Value (57.43, α)	44.19	Adjusted Chi Square Value (57.43, β)	44.05
90% Gamma Approximate KM-UCL (use when n>=50)	0.903	90% Gamma Adjusted KM-UCL (use when n<50)	0.906

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(b)Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0087	Mean	0.693
Maximum	7.6	Median	0.21
SD	1.284	CV	1.851
k hat (MLE)	0.524	k star (bias corrected MLE)	0.514
Theta hat (MLE)	1.324	Theta star (bias corrected MLE)	1.348
nu hat (MLE)	101.6	nu star (bias corrected)	99.81
MLE Mean (bias corrected)	0.693	MLE Sd (bias corrected)	0.967
		Adjusted Level of Significance (β)	0.0973
Approximate Chi Square Value (99.81, α)	82.19	Adjusted Chi Square Value (99.81, β)	81.99
90% Gamma Approximate UCL (use when n>=50)	0.842	90% Gamma Adjusted UCL (use when n<50)	0.844

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0522	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0914	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.694	Mean in Log Scale	-1.545
SD in Original Scale	1.283	SD in Log Scale	1.621
90% t UCL (assumes normality of ROS data)	0.862	90% Percentile Bootstrap UCL	0.866
90% BCA Bootstrap UCL	0.901	90% Bootstrap t UCL	0.913
90% H-UCL (Log ROS)	1.145		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.549	90% H-UCL (KM -Log)	1.139
KM SD (logged)	1.62	90% Critical H Value (KM-Log)	2.221
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.695	Mean in Log Scale	-1.545
SD in Original Scale	1.283	SD in Log Scale	1.631
90% t UCL (Assumes normality)	0.863	90% H-Stat UCL	1.171

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(b+k)fluoranthene(s)

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	0.301	Mean	0.301
Maximum	0.301	Median	0.301

Warning: This data set only has 1 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable Benzo(b+k)fluoranthene(s) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(g,h,i)Perylene

General Statistics			
Total Number of Observations	109	Number of Distinct Observations	96
Number of Detects	99	Number of Non-Detects	10
Number of Distinct Detects	86	Number of Distinct Non-Detects	10
Minimum Detect	0.0071	Minimum Non-Detect	0.00759
Maximum Detect	1.75	Maximum Non-Detect	1.73
Variance Detects	0.0845	Percent Non-Detects	9.174%
Mean Detects	0.19	SD Detects	0.291
Median Detects	0.097	CV Detects	1.526
Skewness Detects	3.408	Kurtosis Detects	13.34
Mean of Logged Detects	-2.365	SD of Logged Detects	1.187

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.591	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.278	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.089	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.182	Standard Error of Mean	0.0271
SD	0.28	90% KM (BCA) UCL	0.217
90% KM (t) UCL	0.217	90% KM (Percentile Bootstrap) UCL	0.216
90% KM (z) UCL	0.216	90% KM Bootstrap t UCL	0.226
90% KM Chebyshev UCL	0.263	95% KM Chebyshev UCL	0.3
97.5% KM Chebyshev UCL	0.351	99% KM Chebyshev UCL	0.452

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.354	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.791	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.137	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0932	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.835	k star (bias corrected MLE)	0.816
Theta hat (MLE)	0.228	Theta star (bias corrected MLE)	0.233
nu hat (MLE)	165.3	nu star (bias corrected)	161.6
MLE Mean (bias corrected)	0.19	MLE Sd (bias corrected)	0.211

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.422	nu hat (KM)	91.9
Approximate Chi Square Value (91.90, α)	75.01	Adjusted Chi Square Value (91.90, β)	74.85
90% Gamma Approximate KM-UCL (use when n>=50)	0.222	90% Gamma Adjusted KM-UCL (use when n<50)	0.223

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(g,h,i)Perylene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0071	Mean	0.178
Maximum	1.75	Median	0.086
SD	0.28	CV	1.57
k hat (MLE)	0.835	k star (bias corrected MLE)	0.818
Theta hat (MLE)	0.213	Theta star (bias corrected MLE)	0.218
nu hat (MLE)	182	nu star (bias corrected)	178.3
MLE Mean (bias corrected)	0.178	MLE Sd (bias corrected)	0.197
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (178.31, α)	154.6	Adjusted Chi Square Value (178.31, β)	154.3
90% Gamma Approximate UCL (use when n>=50)	0.206	90% Gamma Adjusted UCL (use when n<50)	0.206

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0547	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.089	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.179	Mean in Log Scale	-2.427
SD in Original Scale	0.279	SD in Log Scale	1.18
90% t UCL (assumes normality of ROS data)	0.213	90% Percentile Bootstrap UCL	0.216
90% BCA Bootstrap UCL	0.219	90% Bootstrap t UCL	0.22
90% H-UCL (Log ROS)	0.218		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.433	90% H-UCL (KM -Log)	0.226
KM SD (logged)	1.209	90% Critical H Value (KM-Log)	1.841
KM Standard Error of Mean (logged)	0.12		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.197	Mean in Log Scale	-2.345
SD in Original Scale	0.287	SD in Log Scale	1.244
90% t UCL (Assumes normality)	0.232	90% H-Stat UCL	0.26

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(k)Fluoranthene

General Statistics			
Total Number of Observations	97	Number of Distinct Observations	86
Number of Detects	94	Number of Non-Detects	3
Number of Distinct Detects	83	Number of Distinct Non-Detects	3
Minimum Detect	0.006	Minimum Non-Detect	0.0129
Maximum Detect	2.65	Maximum Non-Detect	0.383
Variance Detects	0.193	Percent Non-Detects	3.093%
Mean Detects	0.269	SD Detects	0.439
Median Detects	0.11	CV Detects	1.634
Skewness Detects	3.412	Kurtosis Detects	13.71
Mean of Logged Detects	-2.201	SD of Logged Detects	1.374

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.591	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0914	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.262	Standard Error of Mean	0.0441
SD	0.432	90% KM (BCA) UCL	0.321
90% KM (t) UCL	0.319	90% KM (Percentile Bootstrap) UCL	0.323
90% KM (z) UCL	0.318	90% KM Bootstrap t UCL	0.335
90% KM Chebyshev UCL	0.394	95% KM Chebyshev UCL	0.454
97.5% KM Chebyshev UCL	0.537	99% KM Chebyshev UCL	0.7

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.025	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.801	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.124	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0964	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.684	k star (bias corrected MLE)	0.669
Theta hat (MLE)	0.393	Theta star (bias corrected MLE)	0.401
nu hat (MLE)	128.6	nu star (bias corrected)	125.8
MLE Mean (bias corrected)	0.269	MLE Sd (bias corrected)	0.328

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.367	nu hat (KM)	71.21
Approximate Chi Square Value (71.21, α)	56.41	Adjusted Chi Square Value (71.21, β)	56.25
90% Gamma Approximate KM-UCL (use when n>=50)	0.33	90% Gamma Adjusted KM-UCL (use when n<50)	0.331

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzo(k)Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.006	Mean	0.261
Maximum	2.65	Median	0.107
SD	0.434	CV	1.663
k hat (MLE)	0.664	k star (bias corrected MLE)	0.651
Theta hat (MLE)	0.393	Theta star (bias corrected MLE)	0.401
nu hat (MLE)	128.9	nu star (bias corrected)	126.2
MLE Mean (bias corrected)	0.261	MLE Sd (bias corrected)	0.324
		Adjusted Level of Significance (β)	0.0973
Approximate Chi Square Value (126.24, α)	106.4	Adjusted Chi Square Value (126.24, β)	106.1
90% Gamma Approximate UCL (use when n>=50)	0.31	90% Gamma Adjusted UCL (use when n<50)	0.311

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0472	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0914	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.261	Mean in Log Scale	-2.252
SD in Original Scale	0.434	SD in Log Scale	1.392
90% t UCL (assumes normality of ROS data)	0.318	90% Percentile Bootstrap UCL	0.319
90% BCA Bootstrap UCL	0.332	90% Bootstrap t UCL	0.334
90% H-UCL (Log ROS)	0.369		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.256	90% H-UCL (KM -Log)	0.37
KM SD (logged)	1.395	90% Critical H Value (KM-Log)	2.025
KM Standard Error of Mean (logged)	0.143		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.263	Mean in Log Scale	-2.25
SD in Original Scale	0.434	SD in Log Scale	1.406
90% t UCL (Assumes normality)	0.319	90% H-Stat UCL	0.379

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzofluoranthenes

General Statistics			
Total Number of Observations	34	Number of Distinct Observations	33
Number of Detects	29	Number of Non-Detects	5
Number of Distinct Detects	29	Number of Distinct Non-Detects	5
Minimum Detect	0.0276	Minimum Non-Detect	0.383
Maximum Detect	5.6	Maximum Non-Detect	3.47
Variance Detects	1.506	Percent Non-Detects	14.71%
Mean Detects	0.892	SD Detects	1.227
Median Detects	0.35	CV Detects	1.376
Skewness Detects	2.509	Kurtosis Detects	7.297
Mean of Logged Detects	-0.94	SD of Logged Detects	1.39

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.696	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.926	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.241	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.165	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.817	Standard Error of Mean	0.202
SD	1.143	90% KM (BCA) UCL	1.058
90% KM (t) UCL	1.081	90% KM (Percentile Bootstrap) UCL	1.098
90% KM (z) UCL	1.076	90% KM Bootstrap t UCL	1.195
90% KM Chebyshev UCL	1.422	95% KM Chebyshev UCL	1.697
97.5% KM Chebyshev UCL	2.078	99% KM Chebyshev UCL	2.825

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.518	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.786	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.138	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.169	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.728	k star (bias corrected MLE)	0.676
Theta hat (MLE)	1.226	Theta star (bias corrected MLE)	1.321
nu hat (MLE)	42.22	nu star (bias corrected)	39.19
MLE Mean (bias corrected)	0.892	MLE Sd (bias corrected)	1.086

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.511	nu hat (KM)	34.72
Approximate Chi Square Value (34.72, α)	24.56	Adjusted Chi Square Value (34.72, β)	24.23
90% Gamma Approximate KM-UCL (use when n>=50)	1.155	90% Gamma Adjusted KM-UCL (use when n<50)	1.171

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Benzofluoranthenes (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0276	Mean	0.792
Maximum	5.6	Median	0.277
SD	1.158	CV	1.463
k hat (MLE)	0.712	k star (bias corrected MLE)	0.669
Theta hat (MLE)	1.111	Theta star (bias corrected MLE)	1.183
nu hat (MLE)	48.44	nu star (bias corrected)	45.5
MLE Mean (bias corrected)	0.792	MLE Sd (bias corrected)	0.968
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (45.50, α)	33.78	Adjusted Chi Square Value (45.50, β)	33.39
90% Gamma Approximate UCL (use when n>=50)	1.066	90% Gamma Adjusted UCL (use when n<50)	1.079

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.165	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.796	Mean in Log Scale	-1.017
SD in Original Scale	1.155	SD in Log Scale	1.299
90% t UCL (assumes normality of ROS data)	1.055	90% Percentile Bootstrap UCL	1.05
90% BCA Bootstrap UCL	1.119	90% Bootstrap t UCL	1.163
90% H-UCL (Log ROS)	1.354		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.031	90% H-UCL (KM -Log)	1.465
KM SD (logged)	1.348	90% Critical H Value (KM-Log)	2.15
KM Standard Error of Mean (logged)	0.247		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.876	Mean in Log Scale	-0.874
SD in Original Scale	1.15	SD in Log Scale	1.323
90% t UCL (Assumes normality)	1.134	90% H-Stat UCL	1.633

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Chrysene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	100
Number of Detects	108	Number of Non-Detects	4
Number of Distinct Detects	97	Number of Distinct Non-Detects	4
Minimum Detect	0.0092	Minimum Non-Detect	0.0129
Maximum Detect	11	Maximum Non-Detect	0.826
Variance Detects	2.82	Percent Non-Detects	3.571%
Mean Detects	0.863	SD Detects	1.679
Median Detects	0.313	CV Detects	1.946
Skewness Detects	4.165	Kurtosis Detects	19.84
Mean of Logged Detects	-1.207	SD of Logged Detects	1.513

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.508	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.306	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0853	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.836	Standard Error of Mean	0.156
SD	1.648	90% KM (BCA) UCL	1.029
90% KM (t) UCL	1.037	90% KM (Percentile Bootstrap) UCL	1.045
90% KM (z) UCL	1.036	90% KM Bootstrap t UCL	1.115
90% KM Chebyshev UCL	1.305	95% KM Chebyshev UCL	1.518
97.5% KM Chebyshev UCL	1.813	99% KM Chebyshev UCL	2.392

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.401	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.811	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.117	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0919	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.585	k star (bias corrected MLE)	0.575
Theta hat (MLE)	1.474	Theta star (bias corrected MLE)	1.5
nu hat (MLE)	126.4	nu star (bias corrected)	124.2
MLE Mean (bias corrected)	0.863	MLE Sd (bias corrected)	1.138

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.257	nu hat (KM)	57.64
Approximate Chi Square Value (57.64, α)	44.38	Adjusted Chi Square Value (57.64, β)	44.25
90% Gamma Approximate KM-UCL (use when n>=50)	1.086	90% Gamma Adjusted KM-UCL (use when n<50)	1.089

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Chrysene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0092	Mean	0.832
Maximum	11	Median	0.295
SD	1.656	CV	1.99
k hat (MLE)	0.547	k star (bias corrected MLE)	0.538
Theta hat (MLE)	1.521	Theta star (bias corrected MLE)	1.546
nu hat (MLE)	122.6	nu star (bias corrected)	120.6
MLE Mean (bias corrected)	0.832	MLE Sd (bias corrected)	1.134
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (120.61, α)	101.2	Adjusted Chi Square Value (120.61, β)	101
90% Gamma Approximate UCL (use when n>=50)	0.992	90% Gamma Adjusted UCL (use when n<50)	0.994

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0353	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0853	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.835	Mean in Log Scale	-1.279
SD in Original Scale	1.655	SD in Log Scale	1.55
90% t UCL (assumes normality of ROS data)	1.036	90% Percentile Bootstrap UCL	1.055
90% BCA Bootstrap UCL	1.092	90% Bootstrap t UCL	1.122
90% H-UCL (Log ROS)	1.264		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.283	90% H-UCL (KM -Log)	1.27
KM SD (logged)	1.555	90% Critical H Value (KM-Log)	2.123
KM Standard Error of Mean (logged)	0.148		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.838	Mean in Log Scale	-1.273
SD in Original Scale	1.654	SD in Log Scale	1.563
90% t UCL (Assumes normality)	1.039	90% H-Stat UCL	1.303

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Dibenzo(A,H)anthracene

General Statistics			
Total Number of Observations	105	Number of Distinct Observations	85
Number of Detects	68	Number of Non-Detects	37
Number of Distinct Detects	59	Number of Distinct Non-Detects	30
Minimum Detect	0.0041	Minimum Non-Detect	0.0037
Maximum Detect	0.45	Maximum Non-Detect	0.414
Variance Detects	0.0088	Percent Non-Detects	35.24%
Mean Detects	0.067	SD Detects	0.0938
Median Detects	0.0299	CV Detects	1.4
Skewness Detects	2.6	Kurtosis Detects	7.192
Mean of Logged Detects	-3.404	SD of Logged Detects	1.175

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.652	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.27	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.107	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0475	Standard Error of Mean	0.00801
SD	0.0806	90% KM (BCA) UCL	0.0587
90% KM (t) UCL	0.0579	90% KM (Percentile Bootstrap) UCL	0.0572
90% KM (z) UCL	0.0578	90% KM Bootstrap t UCL	0.0596
90% KM Chebyshev UCL	0.0716	95% KM Chebyshev UCL	0.0824
97.5% KM Chebyshev UCL	0.0976	99% KM Chebyshev UCL	0.127

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.938	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.788	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.14	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.112	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.84	k star (bias corrected MLE)	0.813
Theta hat (MLE)	0.0797	Theta star (bias corrected MLE)	0.0824
nu hat (MLE)	114.3	nu star (bias corrected)	110.6
MLE Mean (bias corrected)	0.067	MLE Sd (bias corrected)	0.0743

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.348	nu hat (KM)	72.99
Approximate Chi Square Value (72.99, α)	58	Adjusted Chi Square Value (72.99, β)	57.85
90% Gamma Approximate KM-UCL (use when n>=50)	0.0598	90% Gamma Adjusted KM-UCL (use when n<50)	0.06

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Dibenzo(A,H)anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0041	Mean	0.0469
Maximum	0.45	Median	0.012
SD	0.0801	CV	1.707
k hat (MLE)	0.776	k star (bias corrected MLE)	0.76
Theta hat (MLE)	0.0605	Theta star (bias corrected MLE)	0.0618
nu hat (MLE)	162.9	nu star (bias corrected)	159.6
MLE Mean (bias corrected)	0.0469	MLE Sd (bias corrected)	0.0538
		Adjusted Level of Significance (β)	0.0975
Approximate Chi Square Value (159.56, α)	137.1	Adjusted Chi Square Value (159.56, β)	136.9
90% Gamma Approximate UCL (use when n>=50)	0.0546	90% Gamma Adjusted UCL (use when n<50)	0.0547

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.057	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0458	Mean in Log Scale	-4.058
SD in Original Scale	0.0807	SD in Log Scale	1.375
90% t UCL (assumes normality of ROS data)	0.056	90% Percentile Bootstrap UCL	0.0564
90% BCA Bootstrap UCL	0.0579	90% Bootstrap t UCL	0.0589
90% H-UCL (Log ROS)	0.058		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.976	90% H-UCL (KM -Log)	0.0573
KM SD (logged)	1.317	90% Critical H Value (KM-Log)	1.921
KM Standard Error of Mean (logged)	0.136		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0541	Mean in Log Scale	-3.843
SD in Original Scale	0.0831	SD in Log Scale	1.416
90% t UCL (Assumes normality)	0.0646	90% H-Stat UCL	0.0771

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Fluoranthene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	95
Number of Detects	111	Number of Non-Detects	1
Number of Distinct Detects	94	Number of Distinct Non-Detects	1
Minimum Detect	0.0089	Minimum Non-Detect	0.0129
Maximum Detect	20	Maximum Non-Detect	0.0129
Variance Detects	15	Percent Non-Detects	0.893%
Mean Detects	2.053	SD Detects	3.873
Median Detects	0.465	CV Detects	1.886
Skewness Detects	3.181	Kurtosis Detects	10.2
Mean of Logged Detects	-0.554	SD of Logged Detects	1.72

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.543	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0841	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	2.035	Standard Error of Mean	0.365
SD	3.843	90% KM (BCA) UCL	2.553
90% KM (t) UCL	2.505	90% KM (Percentile Bootstrap) UCL	2.488
90% KM (z) UCL	2.503	90% KM Bootstrap t UCL	2.581
90% KM Chebyshev UCL	3.129	95% KM Chebyshev UCL	3.625
97.5% KM Chebyshev UCL	4.313	99% KM Chebyshev UCL	5.665

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.737	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.819	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.141	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0916	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.499	k star (bias corrected MLE)	0.492
Theta hat (MLE)	4.114	Theta star (bias corrected MLE)	4.177
nu hat (MLE)	110.8	nu star (bias corrected)	109.1
MLE Mean (bias corrected)	2.053	MLE Sd (bias corrected)	2.929

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.28	nu hat (KM)	62.8
Approximate Chi Square Value (62.80, α)	48.94	Adjusted Chi Square Value (62.80, β)	48.81
90% Gamma Approximate KM-UCL (use when n>=50)	2.612	90% Gamma Adjusted KM-UCL (use when n<50)	2.619

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0089	Mean	2.035
Maximum	20	Median	0.449
SD	3.861	CV	1.897
k hat (MLE)	0.49	k star (bias corrected MLE)	0.483
Theta hat (MLE)	4.153	Theta star (bias corrected MLE)	4.215
nu hat (MLE)	109.8	nu star (bias corrected)	108.1
MLE Mean (bias corrected)	2.035	MLE Sd (bias corrected)	2.929
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (108.15, α)	89.78	Adjusted Chi Square Value (108.15, β)	89.6
90% Gamma Approximate UCL (use when n>=50)	2.451	90% Gamma Adjusted UCL (use when n<50)	2.456

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0609	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0841	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.035	Mean in Log Scale	-0.592
SD in Original Scale	3.861	SD in Log Scale	1.76
90% t UCL (assumes normality of ROS data)	2.505	90% Percentile Bootstrap UCL	2.528
90% BCA Bootstrap UCL	2.584	90% Bootstrap t UCL	2.602
90% H-UCL (Log ROS)	3.822		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.591	90% H-UCL (KM -Log)	3.741
KM SD (logged)	1.749	90% Critical H Value (KM-Log)	2.292
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.035	Mean in Log Scale	-0.594
SD in Original Scale	3.861	SD in Log Scale	1.764
90% t UCL (Assumes normality)	2.505	90% H-Stat UCL	3.851

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Fluorene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	103
Number of Detects	95	Number of Non-Detects	17
Number of Distinct Detects	89	Number of Distinct Non-Detects	15
Minimum Detect	0.0045	Minimum Non-Detect	0.003
Maximum Detect	12.2	Maximum Non-Detect	0.586
Variance Detects	2.719	Percent Non-Detects	15.18%
Mean Detects	0.647	SD Detects	1.649
Median Detects	0.13	CV Detects	2.547
Skewness Detects	5.077	Kurtosis Detects	29.6
Mean of Logged Detects	-1.965	SD of Logged Detects	1.8

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.418	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.348	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0909	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.553	Standard Error of Mean	0.145
SD	1.527	90% KM (BCA) UCL	0.725
90% KM (t) UCL	0.74	90% KM (Percentile Bootstrap) UCL	0.743
90% KM (z) UCL	0.739	90% KM Bootstrap t UCL	0.845
90% KM Chebyshev UCL	0.988	95% KM Chebyshev UCL	1.185
97.5% KM Chebyshev UCL	1.459	99% KM Chebyshev UCL	1.996

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.265	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.837	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.149	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0981	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.426	k star (bias corrected MLE)	0.419
Theta hat (MLE)	1.52	Theta star (bias corrected MLE)	1.544
nu hat (MLE)	80.89	nu star (bias corrected)	79.67
MLE Mean (bias corrected)	0.647	MLE Sd (bias corrected)	1

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.131	nu hat (KM)	29.38
Approximate Chi Square Value (29.38, α)	20.08	Adjusted Chi Square Value (29.38, β)	20
90% Gamma Approximate KM-UCL (use when n>=50)	0.809	90% Gamma Adjusted KM-UCL (use when n<50)	0.812

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Fluorene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0045	Mean	0.551
Maximum	12.2	Median	0.0925
SD	1.535	CV	2.788
k hat (MLE)	0.376	k star (bias corrected MLE)	0.372
Theta hat (MLE)	1.465	Theta star (bias corrected MLE)	1.481
nu hat (MLE)	84.17	nu star (bias corrected)	83.24
MLE Mean (bias corrected)	0.551	MLE Sd (bias corrected)	0.903
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (83.24, α)	67.2	Adjusted Chi Square Value (83.24, β)	67.04
90% Gamma Approximate UCL (use when n>=50)	0.682	90% Gamma Adjusted UCL (use when n<50)	0.684

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0482	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0909	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.551	Mean in Log Scale	-2.392
SD in Original Scale	1.534	SD in Log Scale	1.997
90% t UCL (assumes normality of ROS data)	0.738	90% Percentile Bootstrap UCL	0.736
90% BCA Bootstrap UCL	0.792	90% Bootstrap t UCL	0.836
90% H-UCL (Log ROS)	1.081		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.376	90% H-UCL (KM -Log)	1.03
KM SD (logged)	1.97	90% Critical H Value (KM-Log)	2.49
KM Standard Error of Mean (logged)	0.19		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.557	Mean in Log Scale	-2.312
SD in Original Scale	1.533	SD in Log Scale	1.959
90% t UCL (Assumes normality)	0.744	90% H-Stat UCL	1.071

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Indeno(1,2,3_cd)Pyrene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	96
Number of Detects	103	Number of Non-Detects	9
Number of Distinct Detects	89	Number of Distinct Non-Detects	9
Minimum Detect	0.0062	Minimum Non-Detect	0.0129
Maximum Detect	1.92	Maximum Non-Detect	1.73
Variance Detects	0.11	Percent Non-Detects	8.036%
Mean Detects	0.216	SD Detects	0.331
Median Detects	0.11	CV Detects	1.535
Skewness Detects	3.222	Kurtosis Detects	11.73
Mean of Logged Detects	-2.299	SD of Logged Detects	1.257

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.602	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.285	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0873	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.207	Standard Error of Mean	0.0306
SD	0.32	90% KM (BCA) UCL	0.244
90% KM (t) UCL	0.246	90% KM (Percentile Bootstrap) UCL	0.246
90% KM (z) UCL	0.246	90% KM Bootstrap t UCL	0.257
90% KM Chebyshev UCL	0.298	95% KM Chebyshev UCL	0.34
97.5% KM Chebyshev UCL	0.398	99% KM Chebyshev UCL	0.511

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.206	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.794	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.133	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0921	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.778	k star (bias corrected MLE)	0.761
Theta hat (MLE)	0.278	Theta star (bias corrected MLE)	0.283
nu hat (MLE)	160.2	nu star (bias corrected)	156.8
MLE Mean (bias corrected)	0.216	MLE Sd (bias corrected)	0.247

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.416	nu hat (KM)	93.18
Approximate Chi Square Value (93.18, α)	76.17	Adjusted Chi Square Value (93.18, β)	76.01
90% Gamma Approximate KM-UCL (use when n>=50)	0.253	90% Gamma Adjusted KM-UCL (use when n<50)	0.253

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Indeno(1,2,3_cd)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0062	Mean	0.203
Maximum	1.92	Median	0.0873
SD	0.321	CV	1.578
k hat (MLE)	0.773	k star (bias corrected MLE)	0.758
Theta hat (MLE)	0.263	Theta star (bias corrected MLE)	0.268
nu hat (MLE)	173.1	nu star (bias corrected)	169.8
MLE Mean (bias corrected)	0.203	MLE Sd (bias corrected)	0.233
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (169.81, α)	146.7	Adjusted Chi Square Value (169.81, β)	146.4
90% Gamma Approximate UCL (use when n>=50)	0.235	90% Gamma Adjusted UCL (use when n<50)	0.236

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.057	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0873	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.204	Mean in Log Scale	-2.356
SD in Original Scale	0.32	SD in Log Scale	1.245
90% t UCL (assumes normality of ROS data)	0.243	90% Percentile Bootstrap UCL	0.243
90% BCA Bootstrap UCL	0.251	90% Bootstrap t UCL	0.252
90% H-UCL (Log ROS)	0.257		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.362	90% H-UCL (KM -Log)	0.266
KM SD (logged)	1.273	90% Critical H Value (KM-Log)	1.892
KM Standard Error of Mean (logged)	0.124		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.22	Mean in Log Scale	-2.28
SD in Original Scale	0.326	SD in Log Scale	1.29
90% t UCL (Assumes normality)	0.26	90% H-Stat UCL	0.297

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Naphthalene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	98
Number of Detects	100	Number of Non-Detects	12
Number of Distinct Detects	91	Number of Distinct Non-Detects	9
Minimum Detect	0.0033	Minimum Non-Detect	0.005
Maximum Detect	29.6	Maximum Non-Detect	0.586
Variance Detects	14.67	Percent Non-Detects	10.71%
Mean Detects	1.213	SD Detects	3.831
Median Detects	0.146	CV Detects	3.157
Skewness Detects	5.597	Kurtosis Detects	35.12
Mean of Logged Detects	-1.766	SD of Logged Detects	1.923

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.35	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.376	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0886	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1.088	Standard Error of Mean	0.344
SD	3.62	90% KM (BCA) UCL	1.439
90% KM (t) UCL	1.531	90% KM (Percentile Bootstrap) UCL	1.551
90% KM (z) UCL	1.528	90% KM Bootstrap t UCL	1.839
90% KM Chebyshev UCL	2.119	95% KM Chebyshev UCL	2.586
97.5% KM Chebyshev UCL	3.234	99% KM Chebyshev UCL	4.508

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	6.347	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.857	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.222	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0965	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.344	k star (bias corrected MLE)	0.341
Theta hat (MLE)	3.525	Theta star (bias corrected MLE)	3.563
nu hat (MLE)	68.83	nu star (bias corrected)	68.1
MLE Mean (bias corrected)	1.213	MLE Sd (bias corrected)	2.079

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0903	nu hat (KM)	20.23
Approximate Chi Square Value (20.23, α)	12.63	Adjusted Chi Square Value (20.23, β)	12.56
90% Gamma Approximate KM-UCL (use when n>=50)	1.743	90% Gamma Adjusted KM-UCL (use when n<50)	1.752
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Naphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0033	Mean	1.084
Maximum	29.6	Median	0.12
SD	3.637	CV	3.354
k hat (MLE)	0.318	k star (bias corrected MLE)	0.315
Theta hat (MLE)	3.414	Theta star (bias corrected MLE)	3.442
nu hat (MLE)	71.14	nu star (bias corrected)	70.57
MLE Mean (bias corrected)	1.084	MLE Sd (bias corrected)	1.932
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (70.57, α)	55.84	Adjusted Chi Square Value (70.57, β)	55.7
90% Gamma Approximate UCL (use when n>=50)	1.37	90% Gamma Adjusted UCL (use when n<50)	1.374

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0693	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0886	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.086	Mean in Log Scale	-2.048
SD in Original Scale	3.636	SD in Log Scale	2.047
90% t UCL (assumes normality of ROS data)	1.529	90% Percentile Bootstrap UCL	1.529
90% BCA Bootstrap UCL	1.729	90% Bootstrap t UCL	1.897
90% H-UCL (Log ROS)	1.723		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.042	90% H-UCL (KM -Log)	1.679
KM SD (logged)	2.034	90% Critical H Value (KM-Log)	2.549
KM Standard Error of Mean (logged)	0.195		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.092	Mean in Log Scale	-1.986
SD in Original Scale	3.635	SD in Log Scale	2.02
90% t UCL (Assumes normality)	1.535	90% H-Stat UCL	1.72

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Phenanthrene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	106
Number of Detects	106	Number of Non-Detects	6
Number of Distinct Detects	102	Number of Distinct Non-Detects	4
Minimum Detect	0.0076	Minimum Non-Detect	0.005
Maximum Detect	23.7	Maximum Non-Detect	0.383
Variance Detects	15.24	Percent Non-Detects	5.357%
Mean Detects	1.806	SD Detects	3.904
Median Detects	0.465	CV Detects	2.161
Skewness Detects	4.056	Kurtosis Detects	18.4
Mean of Logged Detects	-0.82	SD of Logged Detects	1.764

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.486	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.323	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0861	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1.711	Standard Error of Mean	0.361
SD	3.802	90% KM (BCA) UCL	2.216
90% KM (t) UCL	2.176	90% KM (Percentile Bootstrap) UCL	2.21
90% KM (z) UCL	2.174	90% KM Bootstrap t UCL	2.326
90% KM Chebyshev UCL	2.794	95% KM Chebyshev UCL	3.284
97.5% KM Chebyshev UCL	3.965	99% KM Chebyshev UCL	5.302

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.181	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.829	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.135	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0935	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.457	k star (bias corrected MLE)	0.45
Theta hat (MLE)	3.956	Theta star (bias corrected MLE)	4.014
nu hat (MLE)	96.8	nu star (bias corrected)	95.4
MLE Mean (bias corrected)	1.806	MLE Sd (bias corrected)	2.693

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.203	nu hat (KM)	45.37
Approximate Chi Square Value (45.37, α)	33.67	Adjusted Chi Square Value (45.37, β)	33.57
90% Gamma Approximate KM-UCL (use when n>=50)	2.305	90% Gamma Adjusted KM-UCL (use when n<50)	2.313

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Phenanthrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0076	Mean	1.71
Maximum	23.7	Median	0.396
SD	3.819	CV	2.233
k hat (MLE)	0.419	k star (bias corrected MLE)	0.414
Theta hat (MLE)	4.082	Theta star (bias corrected MLE)	4.134
nu hat (MLE)	93.85	nu star (bias corrected)	92.67
MLE Mean (bias corrected)	1.71	MLE Sd (bias corrected)	2.659
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (92.67, α)	75.7	Adjusted Chi Square Value (92.67, β)	75.54
90% Gamma Approximate UCL (use when n>=50)	2.093	90% Gamma Adjusted UCL (use when n<50)	2.098

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0451	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0861	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.711	Mean in Log Scale	-1.018
SD in Original Scale	3.819	SD in Log Scale	1.925
90% t UCL (assumes normality of ROS data)	2.176	90% Percentile Bootstrap UCL	2.187
90% BCA Bootstrap UCL	2.297	90% Bootstrap t UCL	2.32
90% H-UCL (Log ROS)	3.6		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.031	90% H-UCL (KM -Log)	3.7
KM SD (logged)	1.942	90% Critical H Value (KM-Log)	2.465
KM Standard Error of Mean (logged)	0.185		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.712	Mean in Log Scale	-1.038
SD in Original Scale	3.818	SD in Log Scale	1.979
90% t UCL (Assumes normality)	2.177	90% H-Stat UCL	4.015

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Pyrene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	104
Number of Detects	110	Number of Non-Detects	2
Number of Distinct Detects	102	Number of Distinct Non-Detects	2
Minimum Detect	0.015	Minimum Non-Detect	0.0129
Maximum Detect	15	Maximum Non-Detect	0.383
Variance Detects	7.223	Percent Non-Detects	1.786%
Mean Detects	1.463	SD Detects	2.687
Median Detects	0.4	CV Detects	1.837
Skewness Detects	3.346	Kurtosis Detects	12.08
Mean of Logged Detects	-0.775	SD of Logged Detects	1.609

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.552	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.295	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0845	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1.438	Standard Error of Mean	0.252
SD	2.658	90% KM (BCA) UCL	1.812
90% KM (t) UCL	1.763	90% KM (Percentile Bootstrap) UCL	1.746
90% KM (z) UCL	1.761	90% KM Bootstrap t UCL	1.859
90% KM Chebyshev UCL	2.195	95% KM Chebyshev UCL	2.538
97.5% KM Chebyshev UCL	3.014	99% KM Chebyshev UCL	3.948

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.609	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.815	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.13	**Kolmogrov-Smimoff GOF**	
5% K-S Critical Value	0.0916	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.543	k star (bias corrected MLE)	0.534
Theta hat (MLE)	2.695	Theta star (bias corrected MLE)	2.739
nu hat (MLE)	119.4	nu star (bias corrected)	117.5
MLE Mean (bias corrected)	1.463	MLE Sd (bias corrected)	2.002

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.293	nu hat (KM)	65.6
Approximate Chi Square Value (65.60, α)	51.41	Adjusted Chi Square Value (65.60, β)	51.28
90% Gamma Approximate KM-UCL (use when n>=50)	1.835	90% Gamma Adjusted KM-UCL (use when n<50)	1.84

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.437
Maximum	15	Median	0.375
SD	2.67	CV	1.859
k hat (MLE)	0.523	k star (bias corrected MLE)	0.515
Theta hat (MLE)	2.747	Theta star (bias corrected MLE)	2.79
nu hat (MLE)	117.1	nu star (bias corrected)	115.3
MLE Mean (bias corrected)	1.437	MLE Sd (bias corrected)	2.002
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (115.34, α)	96.35	Adjusted Chi Square Value (115.34, β)	96.17
90% Gamma Approximate UCL (use when n>=50)	1.72	90% Gamma Adjusted UCL (use when n<50)	1.723

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0495	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0845	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.438	Mean in Log Scale	-0.826
SD in Original Scale	2.67	SD in Log Scale	1.653
90% t UCL (assumes normality of ROS data)	1.763	90% Percentile Bootstrap UCL	1.782
90% BCA Bootstrap UCL	1.855	90% Bootstrap t UCL	1.821
90% H-UCL (Log ROS)	2.427		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.819	90% H-UCL (KM -Log)	2.335
KM SD (logged)	1.63	90% Critical H Value (KM-Log)	2.188
KM Standard Error of Mean (logged)	0.155		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.438	Mean in Log Scale	-0.821
SD in Original Scale	2.669	SD in Log Scale	1.647
90% t UCL (Assumes normality)	1.763	90% H-Stat UCL	2.409

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Diesel Range Organics

General Statistics			
Total Number of Observations	22	Number of Distinct Observations	22
Number of Detects	5	Number of Non-Detects	17
Number of Distinct Detects	5	Number of Distinct Non-Detects	17
Minimum Detect	33.5	Minimum Non-Detect	25
Maximum Detect	253	Maximum Non-Detect	111
Variance Detects	8550	Percent Non-Detects	77.27%
Mean Detects	116.8	SD Detects	92.47
Median Detects	93.6	CV Detects	0.792
Skewness Detects	0.836	Kurtosis Detects	-0.594
Mean of Logged Detects	4.473	SD of Logged Detects	0.876

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.904	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	48.6	Standard Error of Mean	13.13
SD	54.34	90% KM (BCA) UCL	69.01
90% KM (t) UCL	65.97	90% KM (Percentile Bootstrap) UCL	65.92
90% KM (z) UCL	65.42	90% KM Bootstrap t UCL	65.5
90% KM Chebyshev UCL	87.98	95% KM Chebyshev UCL	105.8
97.5% KM Chebyshev UCL	130.6	99% KM Chebyshev UCL	179.2

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.294	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.685	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.241	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.361	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.891	k star (bias corrected MLE)	0.89
Theta hat (MLE)	61.74	Theta star (bias corrected MLE)	131.2
nu hat (MLE)	18.91	nu star (bias corrected)	8.899
MLE Mean (bias corrected)	116.8	MLE Sd (bias corrected)	123.8

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.8	nu hat (KM)	35.19
Approximate Chi Square Value (35.19, α)	24.96	Adjusted Chi Square Value (35.19, β)	24.45
90% Gamma Approximate KM-UCL (use when n>=50)	68.53	90% Gamma Adjusted KM-UCL (use when n<50)	69.94

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Diesel Range Organics (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	26.54
Maximum	253	Median	0.01
SD	64.31	CV	2.423
k hat (MLE)	0.134	k star (bias corrected MLE)	0.146
Theta hat (MLE)	197.8	Theta star (bias corrected MLE)	181.6
nu hat (MLE)	5.903	nu star (bias corrected)	6.432
MLE Mean (bias corrected)	26.54	MLE Sd (bias corrected)	69.43
		Adjusted Level of Significance (β)	0.0873
Approximate Chi Square Value (6.43, α)	2.473	Adjusted Chi Square Value (6.43, β)	2.335
90% Gamma Approximate UCL (use when n>=50)	69.02	90% Gamma Adjusted UCL (use when n<50)	73.11

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.217	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	36.1	Mean in Log Scale	2.941
SD in Original Scale	60.32	SD in Log Scale	0.957
90% t UCL (assumes normality of ROS data)	53.11	90% Percentile Bootstrap UCL	53.76
90% BCA Bootstrap UCL	58.41	90% Bootstrap t UCL	72.37
90% H-UCL (Log ROS)	44.14		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	3.592	90% H-UCL (KM -Log)	54.93
KM SD (logged)	0.628	90% Critical H Value (KM-Log)	1.583
KM Standard Error of Mean (logged)	0.164		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	45.53	Mean in Log Scale	3.44
SD in Original Scale	57.22	SD in Log Scale	0.756
90% t UCL (Assumes normality)	61.67	90% H-Stat UCL	54.77

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Residual Range Hydrocarbons

General Statistics			
Total Number of Observations	22	Number of Distinct Observations	22
Number of Detects	9	Number of Non-Detects	13
Number of Distinct Detects	9	Number of Distinct Non-Detects	13
Minimum Detect	70.6	Minimum Non-Detect	50
Maximum Detect	289	Maximum Non-Detect	221
Variance Detects	5223	Percent Non-Detects	59.09%
Mean Detects	168.1	SD Detects	72.27
Median Detects	147	CV Detects	0.43
Skewness Detects	0.169	Kurtosis Detects	-0.705
Mean of Logged Detects	5.03	SD of Logged Detects	0.482

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.17	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	105.5	Standard Error of Mean	16.36
SD	69.6	90% KM (BCA) UCL	128.4
90% KM (t) UCL	127.2	90% KM (Percentile Bootstrap) UCL	127.7
90% KM (z) UCL	126.5	90% KM Bootstrap t UCL	128.8
90% KM Chebyshev UCL	154.6	95% KM Chebyshev UCL	176.8
97.5% KM Chebyshev UCL	207.7	99% KM Chebyshev UCL	268.3

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.342	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.723	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.189	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.28	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	5.436	k star (bias corrected MLE)	3.698
Theta hat (MLE)	30.92	Theta star (bias corrected MLE)	45.45
nu hat (MLE)	97.85	nu star (bias corrected)	66.57
MLE Mean (bias corrected)	168.1	MLE Sd (bias corrected)	87.4

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	2.3	nu hat (KM)	101.2
Approximate Chi Square Value (101.18, α)	83.43	Adjusted Chi Square Value (101.18, β)	82.48
90% Gamma Approximate KM-UCL (use when n>=50)	128	90% Gamma Adjusted KM-UCL (use when n<50)	129.5

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficent

Residual Range Hydrocarbons (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	9.106	Mean	94
Maximum	289	Median	46.57
SD	78.25	CV	0.832
k hat (MLE)	1.596	k star (bias corrected MLE)	1.408
Theta hat (MLE)	58.91	Theta star (bias corrected MLE)	66.74
nu hat (MLE)	70.21	nu star (bias corrected)	61.97
MLE Mean (bias corrected)	94	MLE Sd (bias corrected)	79.21
		Adjusted Level of Significance (β)	0.0873
Approximate Chi Square Value (61.97, α)	48.2	Adjusted Chi Square Value (61.97, β)	47.49
90% Gamma Approximate UCL (use when n>=50)	120.9	90% Gamma Adjusted UCL (use when n<50)	122.7

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.183	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	103.6	Mean in Log Scale	4.459
SD in Original Scale	71.1	SD in Log Scale	0.584
90% t UCL (assumes normality of ROS data)	123.6	90% Percentile Bootstrap UCL	123
90% BCA Bootstrap UCL	127.6	90% Bootstrap t UCL	129.5
90% H-UCL (Log ROS)	124.8		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	4.478	90% H-UCL (KM -Log)	126.1
KM SD (logged)	0.574	90% Critical H Value (KM-Log)	1.546
KM Standard Error of Mean (logged)	0.145		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	97.57	Mean in Log Scale	4.319
SD in Original Scale	76.35	SD in Log Scale	0.722
90% t UCL (Assumes normality)	119.1	90% H-Stat UCL	126.5

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

User Selected Options	
Date/Time of Computation	3/25/2014 10:25:39 AM
From File	SedSB_EPCs_20140325.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1_Methylnaphthalene

General Statistics

Total Number of Observations	37	Number of Distinct Observations	36
Number of Detects	34	Number of Non-Detects	3
Number of Distinct Detects	33	Number of Distinct Non-Detects	3
Minimum Detect	0.00614	Minimum Non-Detect	0.00625
Maximum Detect	2.11	Maximum Non-Detect	0.00804
Variance Detects	0.154	Percent Non-Detects	8.108%
Mean Detects	0.239	SD Detects	0.392
Median Detects	0.116	CV Detects	1.64
Skewness Detects	3.634	Kurtosis Detects	15.88
Mean of Logged Detects	-2.347	SD of Logged Detects	1.446

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.587	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.276	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.22	Standard Error of Mean	0.0628
SD	0.376	95% KM (BCA) UCL	0.342
95% KM (t) UCL	0.326	95% KM (Percentile Bootstrap) UCL	0.33
95% KM (z) UCL	0.324	95% KM Bootstrap t UCL	0.438
90% KM Chebyshev UCL	0.409	95% KM Chebyshev UCL	0.494
97.5% KM Chebyshev UCL	0.612	99% KM Chebyshev UCL	0.845

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.549	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.796	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.115	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.158	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.664	k star (bias corrected MLE)	0.625
Theta hat (MLE)	0.361	Theta star (bias corrected MLE)	0.383
nu hat (MLE)	45.13	nu star (bias corrected)	42.48
MLE Mean (bias corrected)	0.239	MLE Sd (bias corrected)	0.303

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.344	nu hat (KM)	25.43
Approximate Chi Square Value (25.43, α)	14.94	Adjusted Chi Square Value (25.43, β)	14.59
95% Gamma Approximate KM-UCL (use when n>=50)	0.375	95% Gamma Adjusted KM-UCL (use when n<50)	0.384

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

1_Methylnaphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.00614	Mean	0.221
Maximum	2.11	Median	0.0992
SD	0.381	CV	1.726
k hat (MLE)	0.605	k star (bias corrected MLE)	0.574
Theta hat (MLE)	0.365	Theta star (bias corrected MLE)	0.384
nu hat (MLE)	44.79	nu star (bias corrected)	42.49
MLE Mean (bias corrected)	0.221	MLE Sd (bias corrected)	0.291
		Adjusted Level of Significance (β)	0.0431
Approximate Chi Square Value (42.49, α)	28.55	Adjusted Chi Square Value (42.49, β)	28.05
95% Gamma Approximate UCL (use when n>=50)	0.329	95% Gamma Adjusted UCL (use when n<50)	0.334

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.979	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0925	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.22	Mean in Log Scale	-2.587
SD in Original Scale	0.381	SD in Log Scale	1.608
95% t UCL (assumes normality of ROS data)	0.326	95% Percentile Bootstrap UCL	0.329
95% BCA Bootstrap UCL	0.373	95% Bootstrap t UCL	0.422
95% H-UCL (Log ROS)	0.641		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.568	95% H-UCL (KM -Log)	0.573
KM SD (logged)	1.555	95% Critical H Value (KM-Log)	3.094
KM Standard Error of Mean (logged)	0.26		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.22	Mean in Log Scale	-2.616
SD in Original Scale	0.381	SD in Log Scale	1.661
95% t UCL (Assumes normality)	0.326	95% H-Stat UCL	0.712

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.494	95% GROS Adjusted Gamma UCL	0.334
95% Adjusted Gamma KM-UCL	0.384		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

2_Methylnaphthalene

General Statistics			
Total Number of Observations	94	Number of Distinct Observations	81
Number of Detects	81	Number of Non-Detects	13
Number of Distinct Detects	75	Number of Distinct Non-Detects	9
Minimum Detect	0.0039	Minimum Non-Detect	0.0022
Maximum Detect	4.89	Maximum Non-Detect	0.02
Variance Detects	0.432	Percent Non-Detects	13.83%
Mean Detects	0.291	SD Detects	0.657
Median Detects	0.072	CV Detects	2.259
Skewness Detects	5.026	Kurtosis Detects	30.96
Mean of Logged Detects	-2.503	SD of Logged Detects	1.591

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.465	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.331	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0984	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.251	Standard Error of Mean	0.0638
SD	0.614	95% KM (BCA) UCL	0.365
95% KM (t) UCL	0.357	95% KM (Percentile Bootstrap) UCL	0.368
95% KM (z) UCL	0.356	95% KM Bootstrap t UCL	0.455
90% KM Chebyshev UCL	0.443	95% KM Chebyshev UCL	0.529
97.5% KM Chebyshev UCL	0.649	99% KM Chebyshev UCL	0.886

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	2.931	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.819	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.156	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.105	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.501	k star (bias corrected MLE)	0.49
Theta hat (MLE)	0.581	Theta star (bias corrected MLE)	0.593
nu hat (MLE)	81.09	nu star (bias corrected)	79.42
MLE Mean (bias corrected)	0.291	MLE Sd (bias corrected)	0.415

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.167	nu hat (KM)	31.43
Approximate Chi Square Value (31.43, α)	19.62	Adjusted Chi Square Value (31.43, β)	19.48
95% Gamma Approximate KM-UCL (use when n>=50)	0.402	95% Gamma Adjusted KM-UCL (use when n<50)	0.405

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

2_Methylnaphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0039	Mean	0.252
Maximum	4.89	Median	0.0545
SD	0.617	CV	2.449
k hat (MLE)	0.455	k star (bias corrected MLE)	0.448
Theta hat (MLE)	0.554	Theta star (bias corrected MLE)	0.563
nu hat (MLE)	85.58	nu star (bias corrected)	84.18
MLE Mean (bias corrected)	0.252	MLE Sd (bias corrected)	0.377
		Adjusted Level of Significance (β)	0.0474
Approximate Chi Square Value (84.18, α)	64.04	Adjusted Chi Square Value (84.18, β)	63.76
95% Gamma Approximate UCL (use when n>=50)	0.331	95% Gamma Adjusted UCL (use when n<50)	0.333

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.059	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0984	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.251	Mean in Log Scale	-2.962
SD in Original Scale	0.618	SD in Log Scale	1.884
95% t UCL (assumes normality of ROS data)	0.357	95% Percentile Bootstrap UCL	0.366
95% BCA Bootstrap UCL	0.405	95% Bootstrap t UCL	0.455
95% H-UCL (Log ROS)	0.576		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.952	95% H-UCL (KM -Log)	0.545
KM SD (logged)	1.857	95% Critical H Value (KM-Log)	3.221
KM Standard Error of Mean (logged)	0.194		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.251	Mean in Log Scale	-2.951
SD in Original Scale	0.618	SD in Log Scale	1.872
95% t UCL (Assumes normality)	0.357	95% H-Stat UCL	0.565

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	0.649

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Acenaphthene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	100
Number of Detects	93	Number of Non-Detects	19
Number of Distinct Detects	85	Number of Distinct Non-Detects	17
Minimum Detect	0.0034	Minimum Non-Detect	0.0018
Maximum Detect	16.2	Maximum Non-Detect	0.586
Variance Detects	3.849	Percent Non-Detects	16.96%
Mean Detects	0.65	SD Detects	1.962
Median Detects	0.102	CV Detects	3.016
Skewness Detects	6.276	Kurtosis Detects	45.24
Mean of Logged Detects	-2.054	SD of Logged Detects	1.808

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.348	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.371	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0919	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.544	Standard Error of Mean	0.17
SD	1.794	95% KM (BCA) UCL	0.887
95% KM (t) UCL	0.827	95% KM (Percentile Bootstrap) UCL	0.853
95% KM (z) UCL	0.824	95% KM Bootstrap t UCL	1.191
90% KM Chebyshev UCL	1.055	95% KM Chebyshev UCL	1.287
97.5% KM Chebyshev UCL	1.608	99% KM Chebyshev UCL	2.24

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.902	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.842	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.154	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0994	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.405	k star (bias corrected MLE)	0.399
Theta hat (MLE)	1.608	Theta star (bias corrected MLE)	1.632
nu hat (MLE)	75.25	nu star (bias corrected)	74.16
MLE Mean (bias corrected)	0.65	MLE Sd (bias corrected)	1.03

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.092	nu hat (KM)	20.6
Approximate Chi Square Value (20.60, α)	11.3	Adjusted Chi Square Value (20.60, β)	11.21
95% Gamma Approximate KM-UCL (use when n>=50)	0.992	95% Gamma Adjusted KM-UCL (use when n<50)	1
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Acenaphthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0034	Mean	0.542
Maximum	16.2	Median	0.0824
SD	1.802	CV	3.327
k hat (MLE)	0.358	k star (bias corrected MLE)	0.354
Theta hat (MLE)	1.515	Theta star (bias corrected MLE)	1.531
nu hat (MLE)	80.11	nu star (bias corrected)	79.3
MLE Mean (bias corrected)	0.542	MLE Sd (bias corrected)	0.911
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (79.30, α)	59.78	Adjusted Chi Square Value (79.30, β)	59.56
95% Gamma Approximate UCL (use when n>=50)	0.719	95% Gamma Adjusted UCL (use when n<50)	0.721

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0558	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0919	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.542	Mean in Log Scale	-2.555
SD in Original Scale	1.802	SD in Log Scale	2.044
95% t UCL (assumes normality of ROS data)	0.825	95% Percentile Bootstrap UCL	0.834
95% BCA Bootstrap UCL	0.985	95% Bootstrap t UCL	1.18
95% H-UCL (Log ROS)	1.209		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.561	95% H-UCL (KM -Log)	1.25
KM SD (logged)	2.059	95% Critical H Value (KM-Log)	3.393
KM Standard Error of Mean (logged)	0.2		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.549	Mean in Log Scale	-2.463
SD in Original Scale	1.801	SD in Log Scale	2.006
95% t UCL (Assumes normality)	0.831	95% H-Stat UCL	1.201

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	1.608

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Acenaphthylene

General Statistics			
Total Number of Observations	108	Number of Distinct Observations	95
Number of Detects	73	Number of Non-Detects	35
Number of Distinct Detects	67	Number of Distinct Non-Detects	30
Minimum Detect	0.0036	Minimum Non-Detect	0.0037
Maximum Detect	0.49	Maximum Non-Detect	0.414
Variance Detects	0.00896	Percent Non-Detects	32.41%
Mean Detects	0.0664	SD Detects	0.0947
Median Detects	0.033	CV Detects	1.426
Skewness Detects	2.692	Kurtosis Detects	7.428
Mean of Logged Detects	-3.369	SD of Logged Detects	1.111

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.626	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.298	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.104	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0485	Standard Error of Mean	0.00808
SD	0.0826	95% KM (BCA) UCL	0.0629
95% KM (t) UCL	0.0619	95% KM (Percentile Bootstrap) UCL	0.062
95% KM (z) UCL	0.0618	95% KM Bootstrap t UCL	0.0665
90% KM Chebyshev UCL	0.0727	95% KM Chebyshev UCL	0.0837
97.5% KM Chebyshev UCL	0.0989	99% KM Chebyshev UCL	0.129

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.616	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.786	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.151	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.108	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.891	k star (bias corrected MLE)	0.864
Theta hat (MLE)	0.0745	Theta star (bias corrected MLE)	0.0769
nu hat (MLE)	130.1	nu star (bias corrected)	126.1
MLE Mean (bias corrected)	0.0664	MLE Sd (bias corrected)	0.0715

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.344	nu hat (KM)	74.35
Approximate Chi Square Value (74.35, α)	55.49	Adjusted Chi Square Value (74.35, β)	55.28
95% Gamma Approximate KM-UCL (use when n>=50)	0.0649	95% Gamma Adjusted KM-UCL (use when n<50)	0.0652

Acenaphthylene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0036	Mean	0.0481
Maximum	0.49	Median	0.017
SD	0.0821	CV	1.705
k hat (MLE)	0.806	k star (bias corrected MLE)	0.79
Theta hat (MLE)	0.0597	Theta star (bias corrected MLE)	0.0609
nu hat (MLE)	174.1	nu star (bias corrected)	170.6
MLE Mean (bias corrected)	0.0481	MLE Sd (bias corrected)	0.0541
		Adjusted Level of Significance (β)	0.0478
Approximate Chi Square Value (170.60, α)	141.4	Adjusted Chi Square Value (170.60, β)	141
95% Gamma Approximate UCL (use when n>=50)	0.0581	95% Gamma Adjusted UCL (use when n<50)	0.0582

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0776	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.104	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0473	Mean in Log Scale	-3.94
SD in Original Scale	0.0825	SD in Log Scale	1.286
95% t UCL (assumes normality of ROS data)	0.0604	95% Percentile Bootstrap UCL	0.0613
95% BCA Bootstrap UCL	0.0645	95% Bootstrap t UCL	0.0659
95% H-UCL (Log ROS)	0.0607		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.92	95% H-UCL (KM -Log)	0.0628
KM SD (logged)	1.296	95% Critical H Value (KM-Log)	2.503
KM Standard Error of Mean (logged)	0.132		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0542	Mean in Log Scale	-3.819
SD in Original Scale	0.0851	SD in Log Scale	1.382
95% t UCL (Assumes normality)	0.0678	95% H-Stat UCL	0.0807

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.0837

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Anthracene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	98
Number of Detects	101	Number of Non-Detects	11
Number of Distinct Detects	91	Number of Distinct Non-Detects	8
Minimum Detect	0.0059	Minimum Non-Detect	0.005
Maximum Detect	4.95	Maximum Non-Detect	1.73
Variance Detects	0.741	Percent Non-Detects	9.821%
Mean Detects	0.485	SD Detects	0.861
Median Detects	0.15	CV Detects	1.775
Skewness Detects	3.129	Kurtosis Detects	10.57
Mean of Logged Detects	-1.857	SD of Logged Detects	1.584

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.578	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.289	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0882	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.443	Standard Error of Mean	0.0784
SD	0.825	95% KM (BCA) UCL	0.583
95% KM (t) UCL	0.573	95% KM (Percentile Bootstrap) UCL	0.579
95% KM (z) UCL	0.572	95% KM Bootstrap t UCL	0.626
90% KM Chebyshev UCL	0.678	95% KM Chebyshev UCL	0.785
97.5% KM Chebyshev UCL	0.933	99% KM Chebyshev UCL	1.223

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.403	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.814	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.117	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.094	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.552	k star (bias corrected MLE)	0.542
Theta hat (MLE)	0.879	Theta star (bias corrected MLE)	0.895
nu hat (MLE)	111.5	nu star (bias corrected)	109.5
MLE Mean (bias corrected)	0.485	MLE Sd (bias corrected)	0.659

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.289	nu hat (KM)	64.67
Approximate Chi Square Value (64.67, α)	47.17	Adjusted Chi Square Value (64.67, β)	46.97
95% Gamma Approximate KM-UCL (use when n>=50)	0.607	95% Gamma Adjusted KM-UCL (use when n<50)	0.61

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0059	Mean	0.439
Maximum	4.95	Median	0.117
SD	0.829	CV	1.888
k hat (MLE)	0.496	k star (bias corrected MLE)	0.489
Theta hat (MLE)	0.885	Theta star (bias corrected MLE)	0.899
nu hat (MLE)	111.1	nu star (bias corrected)	109.4
MLE Mean (bias corrected)	0.439	MLE Sd (bias corrected)	0.628
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (109.43, α)	86.29	Adjusted Chi Square Value (109.43, β)	86.02
95% Gamma Approximate UCL (use when n>=50)	0.557	95% Gamma Adjusted UCL (use when n<50)	0.558

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0529	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0882	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.44	Mean in Log Scale	-2.103
SD in Original Scale	0.828	SD in Log Scale	1.735
95% t UCL (assumes normality of ROS data)	0.57	95% Percentile Bootstrap UCL	0.578
95% BCA Bootstrap UCL	0.602	95% Bootstrap t UCL	0.616
95% H-UCL (Log ROS)	0.902		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.096	95% H-UCL (KM -Log)	0.885
KM SD (logged)	1.723	95% Critical H Value (KM-Log)	2.987
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.451	Mean in Log Scale	-2.07
SD in Original Scale	0.827	SD in Log Scale	1.773
95% t UCL (Assumes normality)	0.581	95% H-Stat UCL	1.015

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	0.933

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(a)Anthracene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	102
Number of Detects	109	Number of Non-Detects	3
Number of Distinct Detects	99	Number of Distinct Non-Detects	3
Minimum Detect	0.0063	Minimum Non-Detect	0.0129
Maximum Detect	7	Maximum Non-Detect	0.383
Variance Detects	0.984	Percent Non-Detects	2.679%
Mean Detects	0.553	SD Detects	0.992
Median Detects	0.221	CV Detects	1.794
Skewness Detects	4.181	Kurtosis Detects	21.66
Mean of Logged Detects	-1.608	SD of Logged Detects	1.507

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.551	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.291	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0849	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.539	Standard Error of Mean	0.0928
SD	0.978	95% KM (BCA) UCL	0.723
95% KM (t) UCL	0.693	95% KM (Percentile Bootstrap) UCL	0.699
95% KM (z) UCL	0.692	95% KM Bootstrap t UCL	0.774
90% KM Chebyshev UCL	0.818	95% KM Chebyshev UCL	0.944
97.5% KM Chebyshev UCL	1.119	99% KM Chebyshev UCL	1.463

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.915	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.809	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.106	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0915	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.607	k star (bias corrected MLE)	0.596
Theta hat (MLE)	0.911	Theta star (bias corrected MLE)	0.927
nu hat (MLE)	132.3	nu star (bias corrected)	130
MLE Mean (bias corrected)	0.553	MLE Sd (bias corrected)	0.716

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.304	nu hat (KM)	68.18
Approximate Chi Square Value (68.18, α)	50.18	Adjusted Chi Square Value (68.18, β)	49.98
95% Gamma Approximate KM-UCL (use when n>=50)	0.733	95% Gamma Adjusted KM-UCL (use when n<50)	0.736

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(a)Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0063	Mean	0.538
Maximum	7	Median	0.196
SD	0.983	CV	1.825
k hat (MLE)	0.58	k star (bias corrected MLE)	0.571
Theta hat (MLE)	0.928	Theta star (bias corrected MLE)	0.943
nu hat (MLE)	130	nu star (bias corrected)	127.9
MLE Mean (bias corrected)	0.538	MLE Sd (bias corrected)	0.713
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (127.88, α)	102.8	Adjusted Chi Square Value (127.88, β)	102.5
95% Gamma Approximate UCL (use when n>=50)	0.67	95% Gamma Adjusted UCL (use when n<50)	0.672

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0574	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0849	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.539	Mean in Log Scale	-1.668
SD in Original Scale	0.982	SD in Log Scale	1.538
95% t UCL (assumes normality of ROS data)	0.693	95% Percentile Bootstrap UCL	0.698
95% BCA Bootstrap UCL	0.749	95% Bootstrap t UCL	0.777
95% H-UCL (Log ROS)	0.923		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.672	95% H-UCL (KM -Log)	0.924
KM SD (logged)	1.54	95% Critical H Value (KM-Log)	2.776
KM Standard Error of Mean (logged)	0.147		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.54	Mean in Log Scale	-1.667
SD in Original Scale	0.982	SD in Log Scale	1.548
95% t UCL (Assumes normality)	0.694	95% H-Stat UCL	0.943

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	1.119

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(a)Pyrene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	98
Number of Detects	104	Number of Non-Detects	8
Number of Distinct Detects	90	Number of Distinct Non-Detects	8
Minimum Detect	0.0077	Minimum Non-Detect	0.0129
Maximum Detect	3.6	Maximum Non-Detect	1.73
Variance Detects	0.372	Percent Non-Detects	7.143%
Mean Detects	0.368	SD Detects	0.61
Median Detects	0.155	CV Detects	1.66
Skewness Detects	3.391	Kurtosis Detects	13.59
Mean of Logged Detects	-1.905	SD of Logged Detects	1.371

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.584	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0869	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.351	Standard Error of Mean	0.0562
SD	0.59	95% KM (BCA) UCL	0.448
95% KM (t) UCL	0.444	95% KM (Percentile Bootstrap) UCL	0.445
95% KM (z) UCL	0.444	95% KM Bootstrap t UCL	0.473
90% KM Chebyshev UCL	0.52	95% KM Chebyshev UCL	0.596
97.5% KM Chebyshev UCL	0.702	99% KM Chebyshev UCL	0.91

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.563	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.802	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.125	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0924	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.672	k star (bias corrected MLE)	0.659
Theta hat (MLE)	0.547	Theta star (bias corrected MLE)	0.558
nu hat (MLE)	139.8	nu star (bias corrected)	137.1
MLE Mean (bias corrected)	0.368	MLE Sd (bias corrected)	0.453

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.354	nu hat (KM)	79.29
Approximate Chi Square Value (79.29, α)	59.77	Adjusted Chi Square Value (79.29, β)	59.55
95% Gamma Approximate KM-UCL (use when n>=50)	0.466	95% Gamma Adjusted KM-UCL (use when n<50)	0.467

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(a)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0077	Mean	0.346
Maximum	3.6	Median	0.122
SD	0.593	CV	1.716
k hat (MLE)	0.657	k star (bias corrected MLE)	0.646
Theta hat (MLE)	0.526	Theta star (bias corrected MLE)	0.536
nu hat (MLE)	147.2	nu star (bias corrected)	144.6
MLE Mean (bias corrected)	0.346	MLE Sd (bias corrected)	0.43
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (144.61, α)	117.8	Adjusted Chi Square Value (144.61, β)	117.5
95% Gamma Approximate UCL (use when n>=50)	0.424	95% Gamma Adjusted UCL (use when n<50)	0.425

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0642	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0869	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.348	Mean in Log Scale	-1.954
SD in Original Scale	0.592	SD in Log Scale	1.351
95% t UCL (assumes normality of ROS data)	0.441	95% Percentile Bootstrap UCL	0.446
95% BCA Bootstrap UCL	0.457	95% Bootstrap t UCL	0.463
95% H-UCL (Log ROS)	0.491		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.961	95% H-UCL (KM -Log)	0.506
KM SD (logged)	1.372	95% Critical H Value (KM-Log)	2.59
KM Standard Error of Mean (logged)	0.133		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.363	Mean in Log Scale	-1.893
SD in Original Scale	0.592	SD in Log Scale	1.373
95% t UCL (Assumes normality)	0.456	95% H-Stat UCL	0.542

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.596

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(b)Fluoranthene

General Statistics			
Total Number of Observations	97	Number of Distinct Observations	85
Number of Detects	94	Number of Non-Detects	3
Number of Distinct Detects	82	Number of Distinct Non-Detects	3
Minimum Detect	0.0087	Minimum Non-Detect	0.0129
Maximum Detect	7.6	Maximum Non-Detect	0.383
Variance Detects	1.686	Percent Non-Detects	3.093%
Mean Detects	0.715	SD Detects	1.298
Median Detects	0.23	CV Detects	1.815
Skewness Detects	3.349	Kurtosis Detects	12.58
Mean of Logged Detects	-1.473	SD of Logged Detects	1.583

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.567	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.293	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0914	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.695	Standard Error of Mean	0.13
SD	1.277	95% KM (BCA) UCL	0.927
95% KM (t) UCL	0.911	95% KM (Percentile Bootstrap) UCL	0.913
95% KM (z) UCL	0.909	95% KM Bootstrap t UCL	0.996
90% KM Chebyshev UCL	1.086	95% KM Chebyshev UCL	1.263
97.5% KM Chebyshev UCL	1.509	99% KM Chebyshev UCL	1.991

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.32	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.814	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.111	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0973	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.55	k star (bias corrected MLE)	0.54
Theta hat (MLE)	1.3	Theta star (bias corrected MLE)	1.326
nu hat (MLE)	103.4	nu star (bias corrected)	101.4
MLE Mean (bias corrected)	0.715	MLE Sd (bias corrected)	0.974

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.296	nu hat (KM)	57.43
Approximate Chi Square Value (57.43, α)	41.01	Adjusted Chi Square Value (57.43, β)	40.8
95% Gamma Approximate KM-UCL (use when n>=50)	0.973	95% Gamma Adjusted KM-UCL (use when n<50)	0.978

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(b)Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0087	Mean	0.693
Maximum	7.6	Median	0.21
SD	1.284	CV	1.851
k hat (MLE)	0.524	k star (bias corrected MLE)	0.514
Theta hat (MLE)	1.324	Theta star (bias corrected MLE)	1.348
nu hat (MLE)	101.6	nu star (bias corrected)	99.81
MLE Mean (bias corrected)	0.693	MLE Sd (bias corrected)	0.967
		Adjusted Level of Significance (β)	0.0475
Approximate Chi Square Value (99.81, α)	77.76	Adjusted Chi Square Value (99.81, β)	77.47
95% Gamma Approximate UCL (use when n>=50)	0.89	95% Gamma Adjusted UCL (use when n<50)	0.893

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0522	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0914	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.694	Mean in Log Scale	-1.545
SD in Original Scale	1.283	SD in Log Scale	1.621
95% t UCL (assumes normality of ROS data)	0.911	95% Percentile Bootstrap UCL	0.916
95% BCA Bootstrap UCL	0.992	95% Bootstrap t UCL	0.982
95% H-UCL (Log ROS)	1.289		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.549	95% H-UCL (KM -Log)	1.283
KM SD (logged)	1.62	95% Critical H Value (KM-Log)	2.937
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.695	Mean in Log Scale	-1.545
SD in Original Scale	1.283	SD in Log Scale	1.631
95% t UCL (Assumes normality)	0.912	95% H-Stat UCL	1.32

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	1.509

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(b+k)fluoranthene(s)

General Statistics

Total Number of Observations	1	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	0.301	Mean	0.301
Maximum	0.301	Median	0.301

Warning: This data set only has 1 observations!

Data set is too small to compute reliable and meaningful statistics and estimates!

The data set for variable Benzo(b+k)fluoranthene(s) was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!

If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(g,h,i)Perylene

General Statistics			
Total Number of Observations	109	Number of Distinct Observations	96
Number of Detects	99	Number of Non-Detects	10
Number of Distinct Detects	86	Number of Distinct Non-Detects	10
Minimum Detect	0.0071	Minimum Non-Detect	0.00759
Maximum Detect	1.75	Maximum Non-Detect	1.73
Variance Detects	0.0845	Percent Non-Detects	9.174%
Mean Detects	0.19	SD Detects	0.291
Median Detects	0.097	CV Detects	1.526
Skewness Detects	3.408	Kurtosis Detects	13.34
Mean of Logged Detects	-2.365	SD of Logged Detects	1.187

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.591	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.278	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.089	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.182	Standard Error of Mean	0.0271
SD	0.28	95% KM (BCA) UCL	0.23
95% KM (t) UCL	0.227	95% KM (Percentile Bootstrap) UCL	0.23
95% KM (z) UCL	0.226	95% KM Bootstrap t UCL	0.24
90% KM Chebyshev UCL	0.263	95% KM Chebyshev UCL	0.3
97.5% KM Chebyshev UCL	0.351	99% KM Chebyshev UCL	0.452

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.354	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.791	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.137	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0932	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.835	k star (bias corrected MLE)	0.816
Theta hat (MLE)	0.228	Theta star (bias corrected MLE)	0.233
nu hat (MLE)	165.3	nu star (bias corrected)	161.6
MLE Mean (bias corrected)	0.19	MLE Sd (bias corrected)	0.211

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.422	nu hat (KM)	91.9
Approximate Chi Square Value (91.90, α)	70.8	Adjusted Chi Square Value (91.90, β)	70.55
95% Gamma Approximate KM-UCL (use when n>=50)	0.236	95% Gamma Adjusted KM-UCL (use when n<50)	0.237

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(g,h,i)Perylene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0071	Mean	0.178
Maximum	1.75	Median	0.086
SD	0.28	CV	1.57
k hat (MLE)	0.835	k star (bias corrected MLE)	0.818
Theta hat (MLE)	0.213	Theta star (bias corrected MLE)	0.218
nu hat (MLE)	182	nu star (bias corrected)	178.3
MLE Mean (bias corrected)	0.178	MLE Sd (bias corrected)	0.197
		Adjusted Level of Significance (β)	0.0478
Approximate Chi Square Value (178.31, α)	148.4	Adjusted Chi Square Value (178.31, β)	148.1
95% Gamma Approximate UCL (use when n>=50)	0.214	95% Gamma Adjusted UCL (use when n<50)	0.215

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0547	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.089	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.179	Mean in Log Scale	-2.427
SD in Original Scale	0.279	SD in Log Scale	1.18
95% t UCL (assumes normality of ROS data)	0.223	95% Percentile Bootstrap UCL	0.226
95% BCA Bootstrap UCL	0.235	95% Bootstrap t UCL	0.239
95% H-UCL (Log ROS)	0.232		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.433	95% H-UCL (KM -Log)	0.242
KM SD (logged)	1.209	95% Critical H Value (KM-Log)	2.416
KM Standard Error of Mean (logged)	0.12		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.197	Mean in Log Scale	-2.345
SD in Original Scale	0.287	SD in Log Scale	1.244
95% t UCL (Assumes normality)	0.242	95% H-Stat UCL	0.278

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(k)Fluoranthene

General Statistics			
Total Number of Observations	97	Number of Distinct Observations	86
Number of Detects	94	Number of Non-Detects	3
Number of Distinct Detects	83	Number of Distinct Non-Detects	3
Minimum Detect	0.006	Minimum Non-Detect	0.0129
Maximum Detect	2.65	Maximum Non-Detect	0.383
Variance Detects	0.193	Percent Non-Detects	3.093%
Mean Detects	0.269	SD Detects	0.439
Median Detects	0.11	CV Detects	1.634
Skewness Detects	3.412	Kurtosis Detects	13.71
Mean of Logged Detects	-2.201	SD of Logged Detects	1.374

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.591	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0914	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.262	Standard Error of Mean	0.0441
SD	0.432	95% KM (BCA) UCL	0.34
95% KM (t) UCL	0.335	95% KM (Percentile Bootstrap) UCL	0.34
95% KM (z) UCL	0.334	95% KM Bootstrap t UCL	0.363
90% KM Chebyshev UCL	0.394	95% KM Chebyshev UCL	0.454
97.5% KM Chebyshev UCL	0.537	99% KM Chebyshev UCL	0.7

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.025	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.801	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.124	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0964	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.684	k star (bias corrected MLE)	0.669
Theta hat (MLE)	0.393	Theta star (bias corrected MLE)	0.401
nu hat (MLE)	128.6	nu star (bias corrected)	125.8
MLE Mean (bias corrected)	0.269	MLE Sd (bias corrected)	0.328

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.367	nu hat (KM)	71.21
Approximate Chi Square Value (71.21, α)	52.79	Adjusted Chi Square Value (71.21, β)	52.55
95% Gamma Approximate KM-UCL (use when n>=50)	0.353	95% Gamma Adjusted KM-UCL (use when n<50)	0.355

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzo(k)Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.006	Mean	0.261
Maximum	2.65	Median	0.107
SD	0.434	CV	1.663
k hat (MLE)	0.664	k star (bias corrected MLE)	0.651
Theta hat (MLE)	0.393	Theta star (bias corrected MLE)	0.401
nu hat (MLE)	128.9	nu star (bias corrected)	126.2
MLE Mean (bias corrected)	0.261	MLE Sd (bias corrected)	0.324
		Adjusted Level of Significance (β)	0.0475
Approximate Chi Square Value (126.24, α)	101.3	Adjusted Chi Square Value (126.24, β)	101
95% Gamma Approximate UCL (use when n>=50)	0.325	95% Gamma Adjusted UCL (use when n<50)	0.326

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0472	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0914	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.261	Mean in Log Scale	-2.252
SD in Original Scale	0.434	SD in Log Scale	1.392
95% t UCL (assumes normality of ROS data)	0.335	95% Percentile Bootstrap UCL	0.339
95% BCA Bootstrap UCL	0.346	95% Bootstrap t UCL	0.359
95% H-UCL (Log ROS)	0.405		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.256	95% H-UCL (KM -Log)	0.405
KM SD (logged)	1.395	95% Critical H Value (KM-Log)	2.673
KM Standard Error of Mean (logged)	0.143		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.263	Mean in Log Scale	-2.25
SD in Original Scale	0.434	SD in Log Scale	1.406
95% t UCL (Assumes normality)	0.336	95% H-Stat UCL	0.416

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.454

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Benzofluoranthenes

General Statistics			
Total Number of Observations	34	Number of Distinct Observations	33
Number of Detects	29	Number of Non-Detects	5
Number of Distinct Detects	29	Number of Distinct Non-Detects	5
Minimum Detect	0.0276	Minimum Non-Detect	0.383
Maximum Detect	5.6	Maximum Non-Detect	3.47
Variance Detects	1.506	Percent Non-Detects	14.71%
Mean Detects	0.892	SD Detects	1.227
Median Detects	0.35	CV Detects	1.376
Skewness Detects	2.509	Kurtosis Detects	7.297
Mean of Logged Detects	-0.94	SD of Logged Detects	1.39

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.696	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.241	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.165	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.817	Standard Error of Mean	0.202
SD	1.143	95% KM (BCA) UCL	1.171
95% KM (t) UCL	1.158	95% KM (Percentile Bootstrap) UCL	1.168
95% KM (z) UCL	1.149	95% KM Bootstrap t UCL	1.351
90% KM Chebyshev UCL	1.422	95% KM Chebyshev UCL	1.697
97.5% KM Chebyshev UCL	2.078	99% KM Chebyshev UCL	2.825

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.518	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.786	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.138	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.169	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.728	k star (bias corrected MLE)	0.676
Theta hat (MLE)	1.226	Theta star (bias corrected MLE)	1.321
nu hat (MLE)	42.22	nu star (bias corrected)	39.19
MLE Mean (bias corrected)	0.892	MLE Sd (bias corrected)	1.086

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.511	nu hat (KM)	34.72
Approximate Chi Square Value (34.72, α)	22.24	Adjusted Chi Square Value (34.72, β)	21.75
95% Gamma Approximate KM-UCL (use when n>=50)	1.275	95% Gamma Adjusted KM-UCL (use when n<50)	1.304

Benzofluoranthenes (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0276	Mean	0.792
Maximum	5.6	Median	0.277
SD	1.158	CV	1.463
k hat (MLE)	0.712	k star (bias corrected MLE)	0.669
Theta hat (MLE)	1.111	Theta star (bias corrected MLE)	1.183
nu hat (MLE)	48.44	nu star (bias corrected)	45.5
MLE Mean (bias corrected)	0.792	MLE Sd (bias corrected)	0.968
		Adjusted Level of Significance (β)	0.0422
Approximate Chi Square Value (45.50, α)	31.02	Adjusted Chi Square Value (45.50, β)	30.43
95% Gamma Approximate UCL (use when n>=50)	1.161	95% Gamma Adjusted UCL (use when n<50)	1.183

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.975	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.165	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.796	Mean in Log Scale	-1.017
SD in Original Scale	1.155	SD in Log Scale	1.299
95% t UCL (assumes normality of ROS data)	1.132	95% Percentile Bootstrap UCL	1.164
95% BCA Bootstrap UCL	1.228	95% Bootstrap t UCL	1.362
95% H-UCL (Log ROS)	1.599		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.031	95% H-UCL (KM -Log)	1.748
KM SD (logged)	1.348	95% Critical H Value (KM-Log)	2.904
KM Standard Error of Mean (logged)	0.247		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.876	Mean in Log Scale	-0.874
SD in Original Scale	1.15	SD in Log Scale	1.323
95% t UCL (Assumes normality)	1.21	95% H-Stat UCL	1.938

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	1.697	95% GROS Adjusted Gamma UCL	1.183
95% Adjusted Gamma KM-UCL	1.304		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Chrysene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	100
Number of Detects	108	Number of Non-Detects	4
Number of Distinct Detects	97	Number of Distinct Non-Detects	4
Minimum Detect	0.0092	Minimum Non-Detect	0.0129
Maximum Detect	11	Maximum Non-Detect	0.826
Variance Detects	2.82	Percent Non-Detects	3.571%
Mean Detects	0.863	SD Detects	1.679
Median Detects	0.313	CV Detects	1.946
Skewness Detects	4.165	Kurtosis Detects	19.84
Mean of Logged Detects	-1.207	SD of Logged Detects	1.513

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.508	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.306	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0853	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.836	Standard Error of Mean	0.156
SD	1.648	95% KM (BCA) UCL	1.117
95% KM (t) UCL	1.095	95% KM (Percentile Bootstrap) UCL	1.103
95% KM (z) UCL	1.093	95% KM Bootstrap t UCL	1.224
90% KM Chebyshev UCL	1.305	95% KM Chebyshev UCL	1.518
97.5% KM Chebyshev UCL	1.813	99% KM Chebyshev UCL	2.392

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.401	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.811	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.117	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0919	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.585	k star (bias corrected MLE)	0.575
Theta hat (MLE)	1.474	Theta star (bias corrected MLE)	1.5
nu hat (MLE)	126.4	nu star (bias corrected)	124.2
MLE Mean (bias corrected)	0.863	MLE Sd (bias corrected)	1.138

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.257	nu hat (KM)	57.64
Approximate Chi Square Value (57.64, α)	41.18	Adjusted Chi Square Value (57.64, β)	41
95% Gamma Approximate KM-UCL (use when n>=50)	1.17	95% Gamma Adjusted KM-UCL (use when n<50)	1.175

Chrysene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0092	Mean	0.832
Maximum	11	Median	0.295
SD	1.656	CV	1.99
k hat (MLE)	0.547	k star (bias corrected MLE)	0.538
Theta hat (MLE)	1.521	Theta star (bias corrected MLE)	1.546
nu hat (MLE)	122.6	nu star (bias corrected)	120.6
MLE Mean (bias corrected)	0.832	MLE Sd (bias corrected)	1.134
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (120.61, α)	96.25	Adjusted Chi Square Value (120.61, β)	95.96
95% Gamma Approximate UCL (use when n>=50)	1.043	95% Gamma Adjusted UCL (use when n<50)	1.046

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0353	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0853	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.835	Mean in Log Scale	-1.279
SD in Original Scale	1.655	SD in Log Scale	1.55
95% t UCL (assumes normality of ROS data)	1.094	95% Percentile Bootstrap UCL	1.096
95% BCA Bootstrap UCL	1.167	95% Bootstrap t UCL	1.208
95% H-UCL (Log ROS)	1.394		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.283	95% H-UCL (KM -Log)	1.402
KM SD (logged)	1.555	95% Critical H Value (KM-Log)	2.792
KM Standard Error of Mean (logged)	0.148		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.838	Mean in Log Scale	-1.273
SD in Original Scale	1.654	SD in Log Scale	1.563
95% t UCL (Assumes normality)	1.097	95% H-Stat UCL	1.44

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	1.813

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Dibenzo(A,H)anthracene

General Statistics			
Total Number of Observations	105	Number of Distinct Observations	85
Number of Detects	68	Number of Non-Detects	37
Number of Distinct Detects	59	Number of Distinct Non-Detects	30
Minimum Detect	0.0041	Minimum Non-Detect	0.0037
Maximum Detect	0.45	Maximum Non-Detect	0.414
Variance Detects	0.0088	Percent Non-Detects	35.24%
Mean Detects	0.067	SD Detects	0.0938
Median Detects	0.0299	CV Detects	1.4
Skewness Detects	2.6	Kurtosis Detects	7.192
Mean of Logged Detects	-3.404	SD of Logged Detects	1.175

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.652	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.27	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0475	Standard Error of Mean	0.00801
SD	0.0806	95% KM (BCA) UCL	0.0611
95% KM (t) UCL	0.0608	95% KM (Percentile Bootstrap) UCL	0.0614
95% KM (z) UCL	0.0607	95% KM Bootstrap t UCL	0.0648
90% KM Chebyshev UCL	0.0716	95% KM Chebyshev UCL	0.0824
97.5% KM Chebyshev UCL	0.0976	99% KM Chebyshev UCL	0.127

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	1.938	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.788	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.14	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.112	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.84	k star (bias corrected MLE)	0.813
Theta hat (MLE)	0.0797	Theta star (bias corrected MLE)	0.0824
nu hat (MLE)	114.3	nu star (bias corrected)	110.6
MLE Mean (bias corrected)	0.067	MLE Sd (bias corrected)	0.0743

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.348	nu hat (KM)	72.99
Approximate Chi Square Value (72.99, α)	54.32	Adjusted Chi Square Value (72.99, β)	54.09
95% Gamma Approximate KM-UCL (use when n>=50)	0.0639	95% Gamma Adjusted KM-UCL (use when n<50)	0.0641

Dibenzo(A,H)anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0041	Mean	0.0469
Maximum	0.45	Median	0.012
SD	0.0801	CV	1.707
k hat (MLE)	0.776	k star (bias corrected MLE)	0.76
Theta hat (MLE)	0.0605	Theta star (bias corrected MLE)	0.0618
nu hat (MLE)	162.9	nu star (bias corrected)	159.6
MLE Mean (bias corrected)	0.0469	MLE Sd (bias corrected)	0.0538
		Adjusted Level of Significance (β)	0.0477
Approximate Chi Square Value (159.56, α)	131.4	Adjusted Chi Square Value (159.56, β)	131
95% Gamma Approximate UCL (use when n>=50)	0.057	95% Gamma Adjusted UCL (use when n<50)	0.0572

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.057	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.107	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0458	Mean in Log Scale	-4.058
SD in Original Scale	0.0807	SD in Log Scale	1.375
95% t UCL (assumes normality of ROS data)	0.0589	95% Percentile Bootstrap UCL	0.0589
95% BCA Bootstrap UCL	0.0625	95% Bootstrap t UCL	0.0642
95% H-UCL (Log ROS)	0.063		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.976	95% H-UCL (KM -Log)	0.0619
KM SD (logged)	1.317	95% Critical H Value (KM-Log)	2.522
KM Standard Error of Mean (logged)	0.136		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0541	Mean in Log Scale	-3.843
SD in Original Scale	0.0831	SD in Log Scale	1.416
95% t UCL (Assumes normality)	0.0676	95% H-Stat UCL	0.0841

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.0824

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Fluoranthene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	95
Number of Detects	111	Number of Non-Detects	1
Number of Distinct Detects	94	Number of Distinct Non-Detects	1
Minimum Detect	0.0089	Minimum Non-Detect	0.0129
Maximum Detect	20	Maximum Non-Detect	0.0129
Variance Detects	15	Percent Non-Detects	0.893%
Mean Detects	2.053	SD Detects	3.873
Median Detects	0.465	CV Detects	1.886
Skewness Detects	3.181	Kurtosis Detects	10.2
Mean of Logged Detects	-0.554	SD of Logged Detects	1.72

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.543	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0841	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	2.035	Standard Error of Mean	0.365
SD	3.843	95% KM (BCA) UCL	2.6
95% KM (t) UCL	2.64	95% KM (Percentile Bootstrap) UCL	2.67
95% KM (z) UCL	2.635	95% KM Bootstrap t UCL	2.802
90% KM Chebyshev UCL	3.129	95% KM Chebyshev UCL	3.625
97.5% KM Chebyshev UCL	4.313	99% KM Chebyshev UCL	5.665

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.737	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.819	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.141	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0916	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.499	k star (bias corrected MLE)	0.492
Theta hat (MLE)	4.114	Theta star (bias corrected MLE)	4.177
nu hat (MLE)	110.8	nu star (bias corrected)	109.1
MLE Mean (bias corrected)	2.053	MLE Sd (bias corrected)	2.929

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.28	nu hat (KM)	62.8
Approximate Chi Square Value (62.80, α)	45.57	Adjusted Chi Square Value (62.80, β)	45.38
95% Gamma Approximate KM-UCL (use when n>=50)	2.804	95% Gamma Adjusted KM-UCL (use when n<50)	2.816

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0089	Mean	2.035
Maximum	20	Median	0.449
SD	3.861	CV	1.897
k hat (MLE)	0.49	k star (bias corrected MLE)	0.483
Theta hat (MLE)	4.153	Theta star (bias corrected MLE)	4.215
nu hat (MLE)	109.8	nu star (bias corrected)	108.1
MLE Mean (bias corrected)	2.035	MLE Sd (bias corrected)	2.929
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (108.15, α)	85.15	Adjusted Chi Square Value (108.15, β)	84.88
95% Gamma Approximate UCL (use when n>=50)	2.585	95% Gamma Adjusted UCL (use when n<50)	2.593

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0609	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0841	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.035	Mean in Log Scale	-0.592
SD in Original Scale	3.861	SD in Log Scale	1.76
95% t UCL (assumes normality of ROS data)	2.64	95% Percentile Bootstrap UCL	2.665
95% BCA Bootstrap UCL	2.757	95% Bootstrap t UCL	2.815
95% H-UCL (Log ROS)	4.317		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.591	95% H-UCL (KM -Log)	4.221
KM SD (logged)	1.749	95% Critical H Value (KM-Log)	3.018
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.035	Mean in Log Scale	-0.594
SD in Original Scale	3.861	SD in Log Scale	1.764
95% t UCL (Assumes normality)	2.64	95% H-Stat UCL	4.352

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	4.313

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Fluorene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	103
Number of Detects	95	Number of Non-Detects	17
Number of Distinct Detects	89	Number of Distinct Non-Detects	15
Minimum Detect	0.0045	Minimum Non-Detect	0.003
Maximum Detect	12.2	Maximum Non-Detect	0.586
Variance Detects	2.719	Percent Non-Detects	15.18%
Mean Detects	0.647	SD Detects	1.649
Median Detects	0.13	CV Detects	2.547
Skewness Detects	5.077	Kurtosis Detects	29.6
Mean of Logged Detects	-1.965	SD of Logged Detects	1.8

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.418	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.348	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0909	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.553	Standard Error of Mean	0.145
SD	1.527	95% KM (BCA) UCL	0.819
95% KM (t) UCL	0.794	95% KM (Percentile Bootstrap) UCL	0.812
95% KM (z) UCL	0.792	95% KM Bootstrap t UCL	1.011
90% KM Chebyshev UCL	0.988	95% KM Chebyshev UCL	1.185
97.5% KM Chebyshev UCL	1.459	99% KM Chebyshev UCL	1.996

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.265	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.837	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.149	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0981	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.426	k star (bias corrected MLE)	0.419
Theta hat (MLE)	1.52	Theta star (bias corrected MLE)	1.544
nu hat (MLE)	80.89	nu star (bias corrected)	79.67
MLE Mean (bias corrected)	0.647	MLE Sd (bias corrected)	1

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.131	nu hat (KM)	29.38
Approximate Chi Square Value (29.38, α)	18.01	Adjusted Chi Square Value (29.38, β)	17.89
95% Gamma Approximate KM-UCL (use when n>=50)	0.902	95% Gamma Adjusted KM-UCL (use when n<50)	0.908

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Fluorene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0045	Mean	0.551
Maximum	12.2	Median	0.0925
SD	1.535	CV	2.788
k hat (MLE)	0.376	k star (bias corrected MLE)	0.372
Theta hat (MLE)	1.465	Theta star (bias corrected MLE)	1.481
nu hat (MLE)	84.17	nu star (bias corrected)	83.24
MLE Mean (bias corrected)	0.551	MLE Sd (bias corrected)	0.903
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (83.24, α)	63.22	Adjusted Chi Square Value (83.24, β)	62.99
95% Gamma Approximate UCL (use when n>=50)	0.725	95% Gamma Adjusted UCL (use when n<50)	0.728

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0482	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0909	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.551	Mean in Log Scale	-2.392
SD in Original Scale	1.534	SD in Log Scale	1.997
95% t UCL (assumes normality of ROS data)	0.792	95% Percentile Bootstrap UCL	0.816
95% BCA Bootstrap UCL	0.88	95% Bootstrap t UCL	1.007
95% H-UCL (Log ROS)	1.258		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.376	95% H-UCL (KM -Log)	1.194
KM SD (logged)	1.97	95% Critical H Value (KM-Log)	3.283
KM Standard Error of Mean (logged)	0.19		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.557	Mean in Log Scale	-2.312
SD in Original Scale	1.533	SD in Log Scale	1.959
95% t UCL (Assumes normality)	0.798	95% H-Stat UCL	1.24

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	1.459

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Indeno(1,2,3_cd)Pyrene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	96
Number of Detects	103	Number of Non-Detects	9
Number of Distinct Detects	89	Number of Distinct Non-Detects	9
Minimum Detect	0.0062	Minimum Non-Detect	0.0129
Maximum Detect	1.92	Maximum Non-Detect	1.73
Variance Detects	0.11	Percent Non-Detects	8.036%
Mean Detects	0.216	SD Detects	0.331
Median Detects	0.11	CV Detects	1.535
Skewness Detects	3.222	Kurtosis Detects	11.73
Mean of Logged Detects	-2.299	SD of Logged Detects	1.257

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.602	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.285	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0873	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.207	Standard Error of Mean	0.0306
SD	0.32	95% KM (BCA) UCL	0.257
95% KM (t) UCL	0.257	95% KM (Percentile Bootstrap) UCL	0.259
95% KM (z) UCL	0.257	95% KM Bootstrap t UCL	0.27
90% KM Chebyshev UCL	0.298	95% KM Chebyshev UCL	0.34
97.5% KM Chebyshev UCL	0.398	99% KM Chebyshev UCL	0.511

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.206	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.794	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.133	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0921	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.778	k star (bias corrected MLE)	0.761
Theta hat (MLE)	0.278	Theta star (bias corrected MLE)	0.283
nu hat (MLE)	160.2	nu star (bias corrected)	156.8
MLE Mean (bias corrected)	0.216	MLE Sd (bias corrected)	0.247

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.416	nu hat (KM)	93.18
Approximate Chi Square Value (93.18, α)	71.92	Adjusted Chi Square Value (93.18, β)	71.68
95% Gamma Approximate KM-UCL (use when n>=50)	0.268	95% Gamma Adjusted KM-UCL (use when n<50)	0.269

Indeno(1,2,3_cd)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0062	Mean	0.203
Maximum	1.92	Median	0.0873
SD	0.321	CV	1.578
k hat (MLE)	0.773	k star (bias corrected MLE)	0.758
Theta hat (MLE)	0.263	Theta star (bias corrected MLE)	0.268
nu hat (MLE)	173.1	nu star (bias corrected)	169.8
MLE Mean (bias corrected)	0.203	MLE Sd (bias corrected)	0.233
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (169.81, α)	140.7	Adjusted Chi Square Value (169.81, β)	140.3
95% Gamma Approximate UCL (use when n>=50)	0.245	95% Gamma Adjusted UCL (use when n<50)	0.246

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.057	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0873	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.204	Mean in Log Scale	-2.356
SD in Original Scale	0.32	SD in Log Scale	1.245
95% t UCL (assumes normality of ROS data)	0.254	95% Percentile Bootstrap UCL	0.256
95% BCA Bootstrap UCL	0.266	95% Bootstrap t UCL	0.271
95% H-UCL (Log ROS)	0.275		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.362	95% H-UCL (KM -Log)	0.286
KM SD (logged)	1.273	95% Critical H Value (KM-Log)	2.485
KM Standard Error of Mean (logged)	0.124		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.22	Mean in Log Scale	-2.28
SD in Original Scale	0.326	SD in Log Scale	1.29
95% t UCL (Assumes normality)	0.272	95% H-Stat UCL	0.319

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.34

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Naphthalene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	98
Number of Detects	100	Number of Non-Detects	12
Number of Distinct Detects	91	Number of Distinct Non-Detects	9
Minimum Detect	0.0033	Minimum Non-Detect	0.005
Maximum Detect	29.6	Maximum Non-Detect	0.586
Variance Detects	14.67	Percent Non-Detects	10.71%
Mean Detects	1.213	SD Detects	3.831
Median Detects	0.146	CV Detects	3.157
Skewness Detects	5.597	Kurtosis Detects	35.12
Mean of Logged Detects	-1.766	SD of Logged Detects	1.923

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.35	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.376	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0886	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1.088	Standard Error of Mean	0.344
SD	3.62	95% KM (BCA) UCL	1.751
95% KM (t) UCL	1.658	95% KM (Percentile Bootstrap) UCL	1.714
95% KM (z) UCL	1.653	95% KM Bootstrap t UCL	2.45
90% KM Chebyshev UCL	2.119	95% KM Chebyshev UCL	2.586
97.5% KM Chebyshev UCL	3.234	99% KM Chebyshev UCL	4.508

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	6.347	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.857	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.222	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0965	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.344	k star (bias corrected MLE)	0.341
Theta hat (MLE)	3.525	Theta star (bias corrected MLE)	3.563
nu hat (MLE)	68.83	nu star (bias corrected)	68.1
MLE Mean (bias corrected)	1.213	MLE Sd (bias corrected)	2.079

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.0903	nu hat (KM)	20.23
Approximate Chi Square Value (20.23, α)	11.02	Adjusted Chi Square Value (20.23, β)	10.93
95% Gamma Approximate KM-UCL (use when n>=50)	1.997	95% Gamma Adjusted KM-UCL (use when n<50)	2.013
Gamma (KM) may not be used when k hat (KM) is < 0.1			

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Naphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0033	Mean	1.084
Maximum	29.6	Median	0.12
SD	3.637	CV	3.354
k hat (MLE)	0.318	k star (bias corrected MLE)	0.315
Theta hat (MLE)	3.414	Theta star (bias corrected MLE)	3.442
nu hat (MLE)	71.14	nu star (bias corrected)	70.57
MLE Mean (bias corrected)	1.084	MLE Sd (bias corrected)	1.932
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (70.57, α)	52.23	Adjusted Chi Square Value (70.57, β)	52.03
95% Gamma Approximate UCL (use when n>=50)	1.465	95% Gamma Adjusted UCL (use when n<50)	1.471

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0693	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0886	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.086	Mean in Log Scale	-2.048
SD in Original Scale	3.636	SD in Log Scale	2.047
95% t UCL (assumes normality of ROS data)	1.656	95% Percentile Bootstrap UCL	1.727
95% BCA Bootstrap UCL	1.898	95% Bootstrap t UCL	2.295
95% H-UCL (Log ROS)	2.018		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.042	95% H-UCL (KM -Log)	1.963
KM SD (logged)	2.034	95% Critical H Value (KM-Log)	3.361
KM Standard Error of Mean (logged)	0.195		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.092	Mean in Log Scale	-1.986
SD in Original Scale	3.635	SD in Log Scale	2.02
95% t UCL (Assumes normality)	1.662	95% H-Stat UCL	2.008

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	3.234

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Phenanthrene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	106
Number of Detects	106	Number of Non-Detects	6
Number of Distinct Detects	102	Number of Distinct Non-Detects	4
Minimum Detect	0.0076	Minimum Non-Detect	0.005
Maximum Detect	23.7	Maximum Non-Detect	0.383
Variance Detects	15.24	Percent Non-Detects	5.357%
Mean Detects	1.806	SD Detects	3.904
Median Detects	0.465	CV Detects	2.161
Skewness Detects	4.056	Kurtosis Detects	18.4
Mean of Logged Detects	-0.82	SD of Logged Detects	1.764

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.486	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.323	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0861	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1.711	Standard Error of Mean	0.361
SD	3.802	95% KM (BCA) UCL	2.31
95% KM (t) UCL	2.31	95% KM (Percentile Bootstrap) UCL	2.341
95% KM (z) UCL	2.305	95% KM Bootstrap t UCL	2.552
90% KM Chebyshev UCL	2.794	95% KM Chebyshev UCL	3.284
97.5% KM Chebyshev UCL	3.965	99% KM Chebyshev UCL	5.302

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	3.181	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.829	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.135	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0935	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.457	k star (bias corrected MLE)	0.45
Theta hat (MLE)	3.956	Theta star (bias corrected MLE)	4.014
nu hat (MLE)	96.8	nu star (bias corrected)	95.4
MLE Mean (bias corrected)	1.806	MLE Sd (bias corrected)	2.693

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.203	nu hat (KM)	45.37
Approximate Chi Square Value (45.37, α)	30.92	Adjusted Chi Square Value (45.37, β)	30.77
95% Gamma Approximate KM-UCL (use when n>=50)	2.511	95% Gamma Adjusted KM-UCL (use when n<50)	2.523

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Phenanthrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0076	Mean	1.71
Maximum	23.7	Median	0.396
SD	3.819	CV	2.233
k hat (MLE)	0.419	k star (bias corrected MLE)	0.414
Theta hat (MLE)	4.082	Theta star (bias corrected MLE)	4.134
nu hat (MLE)	93.85	nu star (bias corrected)	92.67
MLE Mean (bias corrected)	1.71	MLE Sd (bias corrected)	2.659
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (92.67, α)	71.47	Adjusted Chi Square Value (92.67, β)	71.23
95% Gamma Approximate UCL (use when n>=50)	2.217	95% Gamma Adjusted UCL (use when n<50)	2.225

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0451	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0861	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.711	Mean in Log Scale	-1.018
SD in Original Scale	3.819	SD in Log Scale	1.925
95% t UCL (assumes normality of ROS data)	2.309	95% Percentile Bootstrap UCL	2.354
95% BCA Bootstrap UCL	2.471	95% Bootstrap t UCL	2.618
95% H-UCL (Log ROS)	4.15		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.031	95% H-UCL (KM -Log)	4.275
KM SD (logged)	1.942	95% Critical H Value (KM-Log)	3.248
KM Standard Error of Mean (logged)	0.185		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.712	Mean in Log Scale	-1.038
SD in Original Scale	3.818	SD in Log Scale	1.979
95% t UCL (Assumes normality)	2.31	95% H-Stat UCL	4.662

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	3.965

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Pyrene

General Statistics			
Total Number of Observations	112	Number of Distinct Observations	104
Number of Detects	110	Number of Non-Detects	2
Number of Distinct Detects	102	Number of Distinct Non-Detects	2
Minimum Detect	0.015	Minimum Non-Detect	0.0129
Maximum Detect	15	Maximum Non-Detect	0.383
Variance Detects	7.223	Percent Non-Detects	1.786%
Mean Detects	1.463	SD Detects	2.687
Median Detects	0.4	CV Detects	1.837
Skewness Detects	3.346	Kurtosis Detects	12.08
Mean of Logged Detects	-0.775	SD of Logged Detects	1.609

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.552	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.295	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0845	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1.438	Standard Error of Mean	0.252
SD	2.658	95% KM (BCA) UCL	1.875
95% KM (t) UCL	1.857	95% KM (Percentile Bootstrap) UCL	1.852
95% KM (z) UCL	1.853	95% KM Bootstrap t UCL	2.024
90% KM Chebyshev UCL	2.195	95% KM Chebyshev UCL	2.538
97.5% KM Chebyshev UCL	3.014	99% KM Chebyshev UCL	3.948

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.609	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.815	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.13	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0916	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.543	k star (bias corrected MLE)	0.534
Theta hat (MLE)	2.695	Theta star (bias corrected MLE)	2.739
nu hat (MLE)	119.4	nu star (bias corrected)	117.5
MLE Mean (bias corrected)	1.463	MLE Sd (bias corrected)	2.002

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.293	nu hat (KM)	65.6
Approximate Chi Square Value (65.60, α)	47.96	Adjusted Chi Square Value (65.60, β)	47.77
95% Gamma Approximate KM-UCL (use when n>=50)	1.967	95% Gamma Adjusted KM-UCL (use when n<50)	1.975

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.437
Maximum	15	Median	0.375
SD	2.67	CV	1.859
k hat (MLE)	0.523	k star (bias corrected MLE)	0.515
Theta hat (MLE)	2.747	Theta star (bias corrected MLE)	2.79
nu hat (MLE)	117.1	nu star (bias corrected)	115.3
MLE Mean (bias corrected)	1.437	MLE Sd (bias corrected)	2.002
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (115.34, α)	91.54	Adjusted Chi Square Value (115.34, β)	91.27
95% Gamma Approximate UCL (use when n>=50)	1.81	95% Gamma Adjusted UCL (use when n<50)	1.816

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0495	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0845	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.438	Mean in Log Scale	-0.826
SD in Original Scale	2.67	SD in Log Scale	1.653
95% t UCL (assumes normality of ROS data)	1.856	95% Percentile Bootstrap UCL	1.891
95% BCA Bootstrap UCL	1.974	95% Bootstrap t UCL	2.006
95% H-UCL (Log ROS)	2.708		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.819	95% H-UCL (KM -Log)	2.598
KM SD (logged)	1.63	95% Critical H Value (KM-Log)	2.878
KM Standard Error of Mean (logged)	0.155		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.438	Mean in Log Scale	-0.821
SD in Original Scale	2.669	SD in Log Scale	1.647
95% t UCL (Assumes normality)	1.857	95% H-Stat UCL	2.686

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	3.014

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Diesel Range Organics

General Statistics

Total Number of Observations	22	Number of Distinct Observations	22
Number of Detects	5	Number of Non-Detects	17
Number of Distinct Detects	5	Number of Distinct Non-Detects	17
Minimum Detect	33.5	Minimum Non-Detect	25
Maximum Detect	253	Maximum Non-Detect	111
Variance Detects	8550	Percent Non-Detects	77.27%
Mean Detects	116.8	SD Detects	92.47
Median Detects	93.6	CV Detects	0.792
Skewness Detects	0.836	Kurtosis Detects	-0.594
Mean of Logged Detects	4.473	SD of Logged Detects	0.876

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.904	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.199	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	48.6	Standard Error of Mean	13.13
SD	54.34	95% KM (BCA) UCL	75.48
95% KM (t) UCL	71.19	95% KM (Percentile Bootstrap) UCL	70.46
95% KM (z) UCL	70.19	95% KM Bootstrap t UCL	74.67
90% KM Chebyshev UCL	87.98	95% KM Chebyshev UCL	105.8
97.5% KM Chebyshev UCL	130.6	99% KM Chebyshev UCL	179.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.294	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.685	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.241	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.361	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.891	k star (bias corrected MLE)	0.89
Theta hat (MLE)	61.74	Theta star (bias corrected MLE)	131.2
nu hat (MLE)	18.91	nu star (bias corrected)	8.899
MLE Mean (bias corrected)	116.8	MLE Sd (bias corrected)	123.8

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.8	nu hat (KM)	35.19
Approximate Chi Square Value (35.19, α)	22.62	Adjusted Chi Square Value (35.19, β)	21.86
95% Gamma Approximate KM-UCL (use when n>=50)	75.62	95% Gamma Adjusted KM-UCL (use when n<50)	78.22

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Diesel Range Organics (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	26.54
Maximum	253	Median	0.01
SD	64.31	CV	2.423
k hat (MLE)	0.134	k star (bias corrected MLE)	0.146
Theta hat (MLE)	197.8	Theta star (bias corrected MLE)	181.6
nu hat (MLE)	5.903	nu star (bias corrected)	6.432
MLE Mean (bias corrected)	26.54	MLE Sd (bias corrected)	69.43
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (6.43, α)	1.864	Adjusted Chi Square Value (6.43, β)	1.687
95% Gamma Approximate UCL (use when n>=50)	91.58	95% Gamma Adjusted UCL (use when n<50)	101.2

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.217	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	36.1	Mean in Log Scale	2.941
SD in Original Scale	60.32	SD in Log Scale	0.957
95% t UCL (assumes normality of ROS data)	58.23	95% Percentile Bootstrap UCL	57.72
95% BCA Bootstrap UCL	68.22	95% Bootstrap t UCL	99.11
95% H-UCL (Log ROS)	50.73		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	3.592	95% H-UCL (KM -Log)	59.17
KM SD (logged)	0.628	95% Critical H Value (KM-Log)	2.125
KM Standard Error of Mean (logged)	0.164		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	45.53	Mean in Log Scale	3.44
SD in Original Scale	57.22	SD in Log Scale	0.756
95% t UCL (Assumes normality)	66.52	95% H-Stat UCL	60.33

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	71.19	95% KM (Percentile Bootstrap) UCL	70.46

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Residual Range Hydrocarbons

General Statistics			
Total Number of Observations	22	Number of Distinct Observations	22
Number of Detects	9	Number of Non-Detects	13
Number of Distinct Detects	9	Number of Distinct Non-Detects	13
Minimum Detect	70.6	Minimum Non-Detect	50
Maximum Detect	289	Maximum Non-Detect	221
Variance Detects	5223	Percent Non-Detects	59.09%
Mean Detects	168.1	SD Detects	72.27
Median Detects	147	CV Detects	0.43
Skewness Detects	0.169	Kurtosis Detects	-0.705
Mean of Logged Detects	5.03	SD of Logged Detects	0.482

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.17	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	105.5	Standard Error of Mean	16.36
SD	69.6	95% KM (BCA) UCL	134.7
95% KM (t) UCL	133.7	95% KM (Percentile Bootstrap) UCL	133.7
95% KM (z) UCL	132.4	95% KM Bootstrap t UCL	137.4
90% KM Chebyshev UCL	154.6	95% KM Chebyshev UCL	176.8
97.5% KM Chebyshev UCL	207.7	99% KM Chebyshev UCL	268.3

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.342	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.723	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.189	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.28	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	5.436	k star (bias corrected MLE)	3.698
Theta hat (MLE)	30.92	Theta star (bias corrected MLE)	45.45
nu hat (MLE)	97.85	nu star (bias corrected)	66.57
MLE Mean (bias corrected)	168.1	MLE Sd (bias corrected)	87.4

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	2.3	nu hat (KM)	101.2
Approximate Chi Square Value (101.18, α)	78.97	Adjusted Chi Square Value (101.18, β)	77.51
95% Gamma Approximate KM-UCL (use when n>=50)	135.2	95% Gamma Adjusted KM-UCL (use when n<50)	137.8

Port of St. Helen's Scappoose Bay Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficent

Residual Range Hydrocarbons (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	9.106	Mean	94
Maximum	289	Median	46.57
SD	78.25	CV	0.832
k hat (MLE)	1.596	k star (bias corrected MLE)	1.408
Theta hat (MLE)	58.91	Theta star (bias corrected MLE)	66.74
nu hat (MLE)	70.21	nu star (bias corrected)	61.97
MLE Mean (bias corrected)	94	MLE Sd (bias corrected)	79.21
		Adjusted Level of Significance (β)	0.0386
Approximate Chi Square Value (61.97, α)	44.86	Adjusted Chi Square Value (61.97, β)	43.78
95% Gamma Approximate UCL (use when n>=50)	129.8	95% Gamma Adjusted UCL (use when n<50)	133.1

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.183	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	103.6	Mean in Log Scale	4.459
SD in Original Scale	71.1	SD in Log Scale	0.584
95% t UCL (assumes normality of ROS data)	129.6	95% Percentile Bootstrap UCL	129.3
95% BCA Bootstrap UCL	132.2	95% Bootstrap t UCL	138
95% H-UCL (Log ROS)	133.5		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	4.478	95% H-UCL (KM -Log)	134.6
KM SD (logged)	0.574	95% Critical H Value (KM-Log)	2.069
KM Standard Error of Mean (logged)	0.145		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	97.57	Mean in Log Scale	4.319
SD in Original Scale	76.35	SD in Log Scale	0.722
95% t UCL (Assumes normality)	125.6	95% H-Stat UCL	138.5

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	133.7	95% KM (Percentile Bootstrap) UCL	133.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

User Selected Options	
Date/Time of Computation	3/25/2014 1:06:50 PM
From File	SedMC_EPCs_20140321.xls
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

1_Methylnaphthalene

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	1	Number of Non-Detects	3
Number of Distinct Detects	1	Number of Distinct Non-Detects	3

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1_Methylnaphthalene was not processed!

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

2_Methylnaphthalene

General Statistics

Total Number of Observations	9	Number of Distinct Observations	9
Number of Detects	7	Number of Non-Detects	2
Number of Distinct Detects	7	Number of Distinct Non-Detects	2
Minimum Detect	0.0075	Minimum Non-Detect	0.00853
Maximum Detect	0.0458	Maximum Non-Detect	0.026
Variance Detects	1.6668E-4	Percent Non-Detects	22.22%
Mean Detects	0.0183	SD Detects	0.0129
Median Detects	0.015	CV Detects	0.706
Skewness Detects	2.023	Kurtosis Detects	4.569
Mean of Logged Detects	-4.166	SD of Logged Detects	0.588

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.774	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.304	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0165	Standard Error of Mean	0.00409
SD	0.0112	90% KM (BCA) UCL	0.0212
90% KM (t) UCL	0.0222	90% KM (Percentile Bootstrap) UCL	0.0217
90% KM (z) UCL	0.0217	90% KM Bootstrap t UCL	0.028
90% KM Chebyshev UCL	0.0288	95% KM Chebyshev UCL	0.0343
97.5% KM Chebyshev UCL	0.042	99% KM Chebyshev UCL	0.0572

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.379	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.221	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.314	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.197	k star (bias corrected MLE)	1.922
Theta hat (MLE)	0.00572	Theta star (bias corrected MLE)	0.00952
nu hat (MLE)	44.75	nu star (bias corrected)	26.91
MLE Mean (bias corrected)	0.0183	MLE Sd (bias corrected)	0.0132

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.148	nu hat (KM)	38.66
Approximate Chi Square Value (38.66, α)	27.9	Adjusted Chi Square Value (38.66, β)	26.38
90% Gamma Approximate KM-UCL (use when n>=50)	0.0228	90% Gamma Adjusted KM-UCL (use when n<50)	0.0242

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

2_Methylnaphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0075	Mean	0.0167
Maximum	0.0458	Median	0.0122
SD	0.0116	CV	0.697
k hat (MLE)	3.525	k star (bias corrected MLE)	2.424
Theta hat (MLE)	0.00474	Theta star (bias corrected MLE)	0.00689
nu hat (MLE)	63.45	nu star (bias corrected)	43.63
MLE Mean (bias corrected)	0.0167	MLE Sd (bias corrected)	0.0107
		Adjusted Level of Significance (β)	0.0666
Approximate Chi Square Value (43.63, α)	32.17	Adjusted Chi Square Value (43.63, β)	30.52
90% Gamma Approximate UCL (use when n>=50)	0.0226	90% Gamma Adjusted UCL (use when n<50)	0.0239

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0163	Mean in Log Scale	-4.29
SD in Original Scale	0.0119	SD in Log Scale	0.589
90% t UCL (assumes normality of ROS data)	0.0219	90% Percentile Bootstrap UCL	0.0212
90% BCA Bootstrap UCL	0.0238	90% Bootstrap t UCL	0.0289
90% H-UCL (Log ROS)	0.0233		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-4.275	90% H-UCL (KM -Log)	0.0223
KM SD (logged)	0.547	90% Critical H Value (KM-Log)	1.655
KM Standard Error of Mean (logged)	0.203		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0161	Mean in Log Scale	-4.329
SD in Original Scale	0.0122	SD in Log Scale	0.664
90% t UCL (Assumes normality)	0.0218	90% H-Stat UCL	0.0251

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Acenaphthene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.00987	Minimum Non-Detect	0.00853
Maximum Detect	0.268	Maximum Non-Detect	0.0273
Variance Detects	0.00858	Percent Non-Detects	27.27%
Mean Detects	0.0698	SD Detects	0.0926
Median Detects	0.0285	CV Detects	1.327
Skewness Detects	1.793	Kurtosis Detects	2.686
Mean of Logged Detects	-3.389	SD of Logged Detects	1.268

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.723	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.326	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0536	Standard Error of Mean	0.0253
SD	0.0785	90% KM (BCA) UCL	0.0827
90% KM (t) UCL	0.0883	90% KM (Percentile Bootstrap) UCL	0.085
90% KM (z) UCL	0.086	90% KM Bootstrap t UCL	0.187
90% KM Chebyshev UCL	0.13	95% KM Chebyshev UCL	0.164
97.5% KM Chebyshev UCL	0.212	99% KM Chebyshev UCL	0.305

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.596	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.249	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.303	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.815	k star (bias corrected MLE)	0.592
Theta hat (MLE)	0.0857	Theta star (bias corrected MLE)	0.118
nu hat (MLE)	13.03	nu star (bias corrected)	9.479
MLE Mean (bias corrected)	0.0698	MLE Sd (bias corrected)	0.0907

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.466	nu hat (KM)	10.26
Approximate Chi Square Value (10.26, α)	5.047	Adjusted Chi Square Value (10.26, β)	4.598
90% Gamma Approximate KM-UCL (use when n>=50)	0.109	90% Gamma Adjusted KM-UCL (use when n<50)	0.12

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Acenaphthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.00987	Mean	0.0535
Maximum	0.268	Median	0.012
SD	0.0824	CV	1.54
k hat (MLE)	0.755	k star (bias corrected MLE)	0.61
Theta hat (MLE)	0.0708	Theta star (bias corrected MLE)	0.0877
nu hat (MLE)	16.61	nu star (bias corrected)	13.41
MLE Mean (bias corrected)	0.0535	MLE Sd (bias corrected)	0.0685
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (13.41, α)	7.348	Adjusted Chi Square Value (13.41, β)	6.791
90% Gamma Approximate UCL (use when n>=50)	0.0976	90% Gamma Adjusted UCL (use when n<50)	0.106

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0526	Mean in Log Scale	-3.891
SD in Original Scale	0.0829	SD in Log Scale	1.433
90% t UCL (assumes normality of ROS data)	0.0869	90% Percentile Bootstrap UCL	0.0848
90% BCA Bootstrap UCL	0.0968	90% Bootstrap t UCL	0.159
90% H-UCL (Log ROS)	0.194		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.716	90% H-UCL (KM -Log)	0.109
KM SD (logged)	1.149	90% Critical H Value (KM-Log)	2.309
KM Standard Error of Mean (logged)	0.372		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0536	Mean in Log Scale	-3.746
SD in Original Scale	0.0824	SD in Log Scale	1.259
90% t UCL (Assumes normality)	0.0876	90% H-Stat UCL	0.139

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Acenaphthylene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	5	Number of Non-Detects	6
Number of Distinct Detects	5	Number of Distinct Non-Detects	6
Minimum Detect	0.00891	Minimum Non-Detect	0.005
Maximum Detect	0.086	Maximum Non-Detect	0.0273
Variance Detects	0.0011	Percent Non-Detects	54.55%
Mean Detects	0.0305	SD Detects	0.0332
Median Detects	0.011	CV Detects	1.091
Skewness Detects	1.646	Kurtosis Detects	2.336
Mean of Logged Detects	-3.931	SD of Logged Detects	1.012

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.759	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.321	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0169	Standard Error of Mean	0.00795
SD	0.0236	90% KM (BCA) UCL	0.0264
90% KM (t) UCL	0.0279	90% KM (Percentile Bootstrap) UCL	0.0269
90% KM (z) UCL	0.0271	90% KM Bootstrap t UCL	0.0358
90% KM Chebyshev UCL	0.0408	95% KM Chebyshev UCL	0.0516
97.5% KM Chebyshev UCL	0.0666	99% KM Chebyshev UCL	0.0961

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.583	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.689	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.349	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.363	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.28	k star (bias corrected MLE)	0.645
Theta hat (MLE)	0.0238	Theta star (bias corrected MLE)	0.0472
nu hat (MLE)	12.8	nu star (bias corrected)	6.451
MLE Mean (bias corrected)	0.0305	MLE Sd (bias corrected)	0.0379

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.517	nu hat (KM)	11.37
Approximate Chi Square Value (11.37, α)	5.844	Adjusted Chi Square Value (11.37, β)	5.355
90% Gamma Approximate KM-UCL (use when n>=50)	0.0329	90% Gamma Adjusted KM-UCL (use when n<50)	0.036

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Acenaphthylene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.00891	Mean	0.0193
Maximum	0.086	Median	0.01
SD	0.0236	CV	1.222
k hat (MLE)	1.571	k star (bias corrected MLE)	1.203
Theta hat (MLE)	0.0123	Theta star (bias corrected MLE)	0.016
nu hat (MLE)	34.57	nu star (bias corrected)	26.48
MLE Mean (bias corrected)	0.0193	MLE Sd (bias corrected)	0.0176
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (26.48, α)	17.68	Adjusted Chi Square Value (26.48, β)	16.78
90% Gamma Approximate UCL (use when n>=50)	0.0289	90% Gamma Adjusted UCL (use when n<50)	0.0305

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.826	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.316	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0151	Mean in Log Scale	-5.159
SD in Original Scale	0.0257	SD in Log Scale	1.374
90% t UCL (assumes normality of ROS data)	0.0257	90% Percentile Bootstrap UCL	0.0255
90% BCA Bootstrap UCL	0.03	90% Bootstrap t UCL	0.0736
90% H-UCL (Log ROS)	0.0461		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-4.625	90% H-UCL (KM -Log)	0.0257
KM SD (logged)	0.897	90% Critical H Value (KM-Log)	1.988
KM Standard Error of Mean (logged)	0.307		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0169	Mean in Log Scale	-4.71
SD in Original Scale	0.0249	SD in Log Scale	1.079
90% t UCL (Assumes normality)	0.0272	90% H-Stat UCL	0.0343

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Anthracene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.015	Minimum Non-Detect	0.005
Maximum Detect	0.27	Maximum Non-Detect	0.0273
Variance Detects	0.00842	Percent Non-Detects	27.27%
Mean Detects	0.0711	SD Detects	0.0918
Median Detects	0.0284	CV Detects	1.292
Skewness Detects	1.905	Kurtosis Detects	3.008
Mean of Logged Detects	-3.206	SD of Logged Detects	1.038

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.667	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.403	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.054	Standard Error of Mean	0.0253
SD	0.0784	90% KM (BCA) UCL	0.0886
90% KM (t) UCL	0.0887	90% KM (Percentile Bootstrap) UCL	0.0883
90% KM (z) UCL	0.0864	90% KM Bootstrap t UCL	0.274
90% KM Chebyshev UCL	0.13	95% KM Chebyshev UCL	0.164
97.5% KM Chebyshev UCL	0.212	99% KM Chebyshev UCL	0.306

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.975	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.735	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.366	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.301	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.024	k star (bias corrected MLE)	0.724
Theta hat (MLE)	0.0694	Theta star (bias corrected MLE)	0.0982
nu hat (MLE)	16.39	nu star (bias corrected)	11.58
MLE Mean (bias corrected)	0.0711	MLE Sd (bias corrected)	0.0835

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.474	nu hat (KM)	10.43
Approximate Chi Square Value (10.43, α)	5.17	Adjusted Chi Square Value (10.43, β)	4.714
90% Gamma Approximate KM-UCL (use when n>=50)	0.109	90% Gamma Adjusted KM-UCL (use when n<50)	0.119

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0544
Maximum	0.27	Median	0.0238
SD	0.0819	CV	1.506
k hat (MLE)	0.868	k star (bias corrected MLE)	0.692
Theta hat (MLE)	0.0627	Theta star (bias corrected MLE)	0.0786
nu hat (MLE)	19.1	nu star (bias corrected)	15.22
MLE Mean (bias corrected)	0.0544	MLE Sd (bias corrected)	0.0654
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (15.22, α)	8.718	Adjusted Chi Square Value (15.22, β)	8.104
90% Gamma Approximate UCL (use when n>=50)	0.095	90% Gamma Adjusted UCL (use when n<50)	0.102

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.827	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.306	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0536	Mean in Log Scale	-3.72
SD in Original Scale	0.0824	SD in Log Scale	1.266
90% t UCL (assumes normality of ROS data)	0.0877	90% Percentile Bootstrap UCL	0.087
90% BCA Bootstrap UCL	0.0995	90% Bootstrap t UCL	0.292
90% H-UCL (Log ROS)	0.145		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.692	90% H-UCL (KM -Log)	0.122
KM SD (logged)	1.187	90% Critical H Value (KM-Log)	2.361
KM Standard Error of Mean (logged)	0.389		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0535	Mean in Log Scale	-3.763
SD in Original Scale	0.0825	SD in Log Scale	1.347
90% t UCL (Assumes normality)	0.0877	90% H-Stat UCL	0.173

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(a)Anthracene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0052	Minimum Non-Detect	0.00853
Maximum Detect	0.48	Maximum Non-Detect	0.0273
Variance Detects	0.0243	Percent Non-Detects	27.27%
Mean Detects	0.11	SD Detects	0.156
Median Detects	0.0568	CV Detects	1.42
Skewness Detects	2.433	Kurtosis Detects	6.181
Mean of Logged Detects	-2.92	SD of Logged Detects	1.318

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.656	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.351	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0817	Standard Error of Mean	0.0427
SD	0.132	90% KM (BCA) UCL	0.12
90% KM (t) UCL	0.14	90% KM (Percentile Bootstrap) UCL	0.134
90% KM (z) UCL	0.136	90% KM Bootstrap t UCL	0.309
90% KM Chebyshev UCL	0.21	95% KM Chebyshev UCL	0.268
97.5% KM Chebyshev UCL	0.348	99% KM Chebyshev UCL	0.507

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.395	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.251	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.303	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.832	k star (bias corrected MLE)	0.603
Theta hat (MLE)	0.132	Theta star (bias corrected MLE)	0.182
nu hat (MLE)	13.31	nu star (bias corrected)	9.649
MLE Mean (bias corrected)	0.11	MLE Sd (bias corrected)	0.141

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.38	nu hat (KM)	8.37
Approximate Chi Square Value (8.37, α)	3.739	Adjusted Chi Square Value (8.37, β)	3.362
90% Gamma Approximate KM-UCL (use when n>=50)	0.183	90% Gamma Adjusted KM-UCL (use when n<50)	0.203

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(a)Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0052	Mean	0.0825
Maximum	0.48	Median	0.033
SD	0.138	CV	1.677
k hat (MLE)	0.685	k star (bias corrected MLE)	0.559
Theta hat (MLE)	0.12	Theta star (bias corrected MLE)	0.148
nu hat (MLE)	15.07	nu star (bias corrected)	12.29
MLE Mean (bias corrected)	0.0825	MLE Sd (bias corrected)	0.11
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (12.29, α)	6.52	Adjusted Chi Square Value (12.29, β)	5.999
90% Gamma Approximate UCL (use when n>=50)	0.156	90% Gamma Adjusted UCL (use when n<50)	0.169

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.172	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0815	Mean in Log Scale	-3.505
SD in Original Scale	0.139	SD in Log Scale	1.493
90% t UCL (assumes normality of ROS data)	0.139	90% Percentile Bootstrap UCL	0.136
90% BCA Bootstrap UCL	0.165	90% Bootstrap t UCL	0.314
90% H-UCL (Log ROS)	0.343		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.521	90% H-UCL (KM -Log)	0.303
KM SD (logged)	1.457	90% Critical H Value (KM-Log)	2.743
KM Standard Error of Mean (logged)	0.476		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.082	Mean in Log Scale	-3.464
SD in Original Scale	0.139	SD in Log Scale	1.468
90% t UCL (Assumes normality)	0.139	90% H-Stat UCL	0.331

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(a)Pyrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0095	Minimum Non-Detect	0.00853
Maximum Detect	0.9	Maximum Non-Detect	0.0273
Variance Detects	0.0922	Percent Non-Detects	27.27%
Mean Detects	0.187	SD Detects	0.304
Median Detects	0.0653	CV Detects	1.621
Skewness Detects	2.347	Kurtosis Detects	5.629
Mean of Logged Detects	-2.653	SD of Logged Detects	1.483

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.642	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.361	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.139	Standard Error of Mean	0.0821
SD	0.255	90% KM (BCA) UCL	0.222
90% KM (t) UCL	0.252	90% KM (Percentile Bootstrap) UCL	0.241
90% KM (z) UCL	0.244	90% KM Bootstrap t UCL	0.832
90% KM Chebyshev UCL	0.385	95% KM Chebyshev UCL	0.497
97.5% KM Chebyshev UCL	0.652	99% KM Chebyshev UCL	0.956

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.488	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.249	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.306	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.628	k star (bias corrected MLE)	0.476
Theta hat (MLE)	0.298	Theta star (bias corrected MLE)	0.394
nu hat (MLE)	10.05	nu star (bias corrected)	7.612
MLE Mean (bias corrected)	0.187	MLE Sd (bias corrected)	0.272

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.298	nu hat (KM)	6.566
Approximate Chi Square Value (6.57, α)	2.558	Adjusted Chi Square Value (6.57, β)	2.257
90% Gamma Approximate KM-UCL (use when n>=50)	0.357	90% Gamma Adjusted KM-UCL (use when n<50)	0.405

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(a)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0095	Mean	0.139
Maximum	0.9	Median	0.026
SD	0.267	CV	1.923
k hat (MLE)	0.521	k star (bias corrected MLE)	0.44
Theta hat (MLE)	0.267	Theta star (bias corrected MLE)	0.316
nu hat (MLE)	11.46	nu star (bias corrected)	9.67
MLE Mean (bias corrected)	0.139	MLE Sd (bias corrected)	0.21
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (9.67, α)	4.634	Adjusted Chi Square Value (9.67, β)	4.205
90% Gamma Approximate UCL (use when n>=50)	0.29	90% Gamma Adjusted UCL (use when n<50)	0.319

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.152	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.138	Mean in Log Scale	-3.431
SD in Original Scale	0.268	SD in Log Scale	1.858
90% t UCL (assumes normality of ROS data)	0.248	90% Percentile Bootstrap UCL	0.239
90% BCA Bootstrap UCL	0.289	90% Bootstrap t UCL	0.669
90% H-UCL (Log ROS)	1.297		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.185	90% H-UCL (KM -Log)	0.451
KM SD (logged)	1.478	90% Critical H Value (KM-Log)	2.773
KM Standard Error of Mean (logged)	0.479		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.138	Mean in Log Scale	-3.27
SD in Original Scale	0.268	SD in Log Scale	1.651
90% t UCL (Assumes normality)	0.249	90% H-Stat UCL	0.723

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(b)Fluoranthene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0096	Minimum Non-Detect	0.00853
Maximum Detect	0.58	Maximum Non-Detect	0.0273
Variance Detects	0.038	Percent Non-Detects	27.27%
Mean Detects	0.156	SD Detects	0.195
Median Detects	0.074	CV Detects	1.252
Skewness Detects	1.842	Kurtosis Detects	3.162
Mean of Logged Detects	-2.554	SD of Logged Detects	1.324

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.762	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.292	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.116	Standard Error of Mean	0.0543
SD	0.168	90% KM (BCA) UCL	0.185
90% KM (t) UCL	0.19	90% KM (Percentile Bootstrap) UCL	0.186
90% KM (z) UCL	0.186	90% KM Bootstrap t UCL	0.321
90% KM Chebyshev UCL	0.279	95% KM Chebyshev UCL	0.353
97.5% KM Chebyshev UCL	0.455	99% KM Chebyshev UCL	0.656

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.252	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.176	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.303	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.849	k star (bias corrected MLE)	0.614
Theta hat (MLE)	0.183	Theta star (bias corrected MLE)	0.253
nu hat (MLE)	13.59	nu star (bias corrected)	9.825
MLE Mean (bias corrected)	0.156	MLE Sd (bias corrected)	0.199

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.474	nu hat (KM)	10.43
Approximate Chi Square Value (10.43, α)	5.17	Adjusted Chi Square Value (10.43, β)	4.714
90% Gamma Approximate KM-UCL (use when n>=50)	0.234	90% Gamma Adjusted KM-UCL (use when n<50)	0.257

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(b)Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0096	Mean	0.116
Maximum	0.58	Median	0.0471
SD	0.177	CV	1.524
k hat (MLE)	0.639	k star (bias corrected MLE)	0.525
Theta hat (MLE)	0.181	Theta star (bias corrected MLE)	0.221
nu hat (MLE)	14.06	nu star (bias corrected)	11.56
MLE Mean (bias corrected)	0.116	MLE Sd (bias corrected)	0.16
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (11.56, α)	5.98	Adjusted Chi Square Value (11.56, β)	5.484
90% Gamma Approximate UCL (use when n>=50)	0.224	90% Gamma Adjusted UCL (use when n<50)	0.244

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.99	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.115	Mean in Log Scale	-3.305
SD in Original Scale	0.177	SD in Log Scale	1.72
90% t UCL (assumes normality of ROS data)	0.188	90% Percentile Bootstrap UCL	0.18
90% BCA Bootstrap UCL	0.198	90% Bootstrap t UCL	0.328
90% H-UCL (Log ROS)	0.886		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.123	90% H-UCL (KM -Log)	0.397
KM SD (logged)	1.415	90% Critical H Value (KM-Log)	2.681
KM Standard Error of Mean (logged)	0.459		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.115	Mean in Log Scale	-3.198
SD in Original Scale	0.177	SD in Log Scale	1.585
90% t UCL (Assumes normality)	0.189	90% H-Stat UCL	0.624

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(g,h,i)Perylene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	7	Number of Non-Detects	4
Number of Distinct Detects	7	Number of Distinct Non-Detects	4
Minimum Detect	0.014	Minimum Non-Detect	0.00853
Maximum Detect	0.91	Maximum Non-Detect	0.0805
Variance Detects	0.106	Percent Non-Detects	36.36%
Mean Detects	0.185	SD Detects	0.326
Median Detects	0.0491	CV Detects	1.765
Skewness Detects	2.442	Kurtosis Detects	6.092
Mean of Logged Detects	-2.766	SD of Logged Detects	1.506

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.606	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.339	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.122	Standard Error of Mean	0.083
SD	0.255	90% KM (BCA) UCL	0.244
90% KM (t) UCL	0.236	90% KM (Percentile Bootstrap) UCL	0.22
90% KM (z) UCL	0.229	90% KM Bootstrap t UCL	0.553
90% KM Chebyshev UCL	0.371	95% KM Chebyshev UCL	0.484
97.5% KM Chebyshev UCL	0.641	99% KM Chebyshev UCL	0.948

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.621	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.247	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.326	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.577	k star (bias corrected MLE)	0.425
Theta hat (MLE)	0.321	Theta star (bias corrected MLE)	0.435
nu hat (MLE)	8.072	nu star (bias corrected)	5.946
MLE Mean (bias corrected)	0.185	MLE Sd (bias corrected)	0.284

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.23	nu hat (KM)	5.055
Approximate Chi Square Value (5.06, α)	1.645	Adjusted Chi Square Value (5.06, β)	1.416
90% Gamma Approximate KM-UCL (use when n>=50)	0.376	90% Gamma Adjusted KM-UCL (use when n<50)	0.436

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(g,h,i)Perylene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.121
Maximum	0.91	Median	0.019
SD	0.268	CV	2.207
k hat (MLE)	0.482	k star (bias corrected MLE)	0.411
Theta hat (MLE)	0.252	Theta star (bias corrected MLE)	0.295
nu hat (MLE)	10.6	nu star (bias corrected)	9.046
MLE Mean (bias corrected)	0.121	MLE Sd (bias corrected)	0.189
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (9.05, α)	4.201	Adjusted Chi Square Value (9.05, β)	3.796
90% Gamma Approximate UCL (use when n>=50)	0.261	90% Gamma Adjusted UCL (use when n<50)	0.289

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.12	Mean in Log Scale	-3.739
SD in Original Scale	0.268	SD in Log Scale	1.851
90% t UCL (assumes normality of ROS data)	0.231	90% Percentile Bootstrap UCL	0.219
90% BCA Bootstrap UCL	0.295	90% Bootstrap t UCL	0.828
90% H-UCL (Log ROS)	0.929		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.397	90% H-UCL (KM -Log)	0.303
KM SD (logged)	1.416	90% Critical H Value (KM-Log)	2.682
KM Standard Error of Mean (logged)	0.467		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.124	Mean in Log Scale	-3.393
SD in Original Scale	0.267	SD in Log Scale	1.551
90% t UCL (Assumes normality)	0.234	90% H-Stat UCL	0.459

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(k)Fluoranthene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0063	Minimum Non-Detect	0.00853
Maximum Detect	0.54	Maximum Non-Detect	0.0273
Variance Detects	0.0332	Percent Non-Detects	27.27%
Mean Detects	0.108	SD Detects	0.182
Median Detects	0.035	CV Detects	1.685
Skewness Detects	2.434	Kurtosis Detects	6.051
Mean of Logged Detects	-3.188	SD of Logged Detects	1.416

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.613	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.384	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0807	Standard Error of Mean	0.049
SD	0.152	90% KM (BCA) UCL	0.13
90% KM (t) UCL	0.148	90% KM (Percentile Bootstrap) UCL	0.144
90% KM (z) UCL	0.143	90% KM Bootstrap t UCL	0.67
90% KM Chebyshev UCL	0.228	95% KM Chebyshev UCL	0.294
97.5% KM Chebyshev UCL	0.387	99% KM Chebyshev UCL	0.568

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.642	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.313	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.306	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.636	k star (bias corrected MLE)	0.481
Theta hat (MLE)	0.17	Theta star (bias corrected MLE)	0.225
nu hat (MLE)	10.18	nu star (bias corrected)	7.696
MLE Mean (bias corrected)	0.108	MLE Sd (bias corrected)	0.156

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.282	nu hat (KM)	6.198
Approximate Chi Square Value (6.20, α)	2.328	Adjusted Chi Square Value (6.20, β)	2.044
90% Gamma Approximate KM-UCL (use when n>=50)	0.215	90% Gamma Adjusted KM-UCL (use when n<50)	0.245

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzo(k)Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0063	Mean	0.0813
Maximum	0.54	Median	0.019
SD	0.159	CV	1.956
k hat (MLE)	0.583	k star (bias corrected MLE)	0.484
Theta hat (MLE)	0.14	Theta star (bias corrected MLE)	0.168
nu hat (MLE)	12.82	nu star (bias corrected)	10.66
MLE Mean (bias corrected)	0.0813	MLE Sd (bias corrected)	0.117
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (10.66, α)	5.331	Adjusted Chi Square Value (10.66, β)	4.867
90% Gamma Approximate UCL (use when n>=50)	0.163	90% Gamma Adjusted UCL (use when n<50)	0.178

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.221	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0801	Mean in Log Scale	-3.762
SD in Original Scale	0.16	SD in Log Scale	1.549
90% t UCL (assumes normality of ROS data)	0.146	90% Percentile Bootstrap UCL	0.14
90% BCA Bootstrap UCL	0.175	90% Bootstrap t UCL	0.611
90% H-UCL (Log ROS)	0.316		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.666	90% H-UCL (KM -Log)	0.211
KM SD (logged)	1.384	90% Critical H Value (KM-Log)	2.637
KM Standard Error of Mean (logged)	0.449		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0809	Mean in Log Scale	-3.659
SD in Original Scale	0.159	SD in Log Scale	1.458
90% t UCL (Assumes normality)	0.147	90% H-Stat UCL	0.264

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzofluoranthenes

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0587	Minimum Non-Detect	0.0171
Maximum Detect	0.123	Maximum Non-Detect	0.0171
Variance Detects	0.00207	Percent Non-Detects	33.33%
Mean Detects	0.0909	SD Detects	0.0455
Median Detects	0.0909	CV Detects	0.5
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-2.465	SD of Logged Detects	0.523

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0663	Standard Error of Mean	0.0356
SD	0.0436	90% KM (BCA) UCL	N/A
90% KM (t) UCL	0.133	90% KM (Percentile Bootstrap) UCL	N/A
90% KM (z) UCL	0.112	90% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.173	95% KM Chebyshev UCL	0.221
97.5% KM Chebyshev UCL	0.288	99% KM Chebyshev UCL	0.42

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	7.637	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0119	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	30.55	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.314	nu hat (KM)	13.88
		Adjusted Level of Significance (β)	0.0315
Approximate Chi Square Value (13.88, α)	7.702	Adjusted Chi Square Value (13.88, β)	5.845
90% Gamma Approximate KM-UCL (use when n>=50)	0.119	90% Gamma Adjusted KM-UCL (use when n<50)	0.157

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Benzofluoranthenes (cont.)

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0658	Mean in Log Scale	-3.026
SD in Original Scale	0.0539	SD in Log Scale	1.038
90% t UCL (assumes normality of ROS data)	0.125	90% Percentile Bootstrap UCL	N/A
90% BCA Bootstrap UCL	N/A	90% Bootstrap t UCL	N/A
90% H-UCL (Log ROS)	7.807		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0634	Mean in Log Scale	-3.231
SD in Original Scale	0.0574	SD in Log Scale	1.376
90% t UCL (Assumes normality)	0.126	90% H-Stat UCL	306.5

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Chrysene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0081	Minimum Non-Detect	0.00853
Maximum Detect	0.71	Maximum Non-Detect	0.0273
Variance Detects	0.0543	Percent Non-Detects	27.27%
Mean Detects	0.165	SD Detects	0.233
Median Detects	0.0785	CV Detects	1.414
Skewness Detects	2.322	Kurtosis Detects	5.544
Mean of Logged Detects	-2.524	SD of Logged Detects	1.316

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.664	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.372	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.122	Standard Error of Mean	0.064
SD	0.198	90% KM (BCA) UCL	0.19
90% KM (t) UCL	0.21	90% KM (Percentile Bootstrap) UCL	0.201
90% KM (z) UCL	0.204	90% KM Bootstrap t UCL	0.535
90% KM Chebyshev UCL	0.314	95% KM Chebyshev UCL	0.401
97.5% KM Chebyshev UCL	0.521	99% KM Chebyshev UCL	0.759

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.466	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.287	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.303	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.821	k star (bias corrected MLE)	0.597
Theta hat (MLE)	0.201	Theta star (bias corrected MLE)	0.276
nu hat (MLE)	13.14	nu star (bias corrected)	9.546
MLE Mean (bias corrected)	0.165	MLE Sd (bias corrected)	0.213

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.378	nu hat (KM)	8.313
Approximate Chi Square Value (8.31, α)	3.701	Adjusted Chi Square Value (8.31, β)	3.326
90% Gamma Approximate KM-UCL (use when n>=50)	0.274	90% Gamma Adjusted KM-UCL (use when n<50)	0.305

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Chrysene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0081	Mean	0.123
Maximum	0.71	Median	0.05
SD	0.208	CV	1.696
k hat (MLE)	0.62	k star (bias corrected MLE)	0.511
Theta hat (MLE)	0.198	Theta star (bias corrected MLE)	0.24
nu hat (MLE)	13.64	nu star (bias corrected)	11.25
MLE Mean (bias corrected)	0.123	MLE Sd (bias corrected)	0.171
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (11.25, α)	5.76	Adjusted Chi Square Value (11.25, β)	5.275
90% Gamma Approximate UCL (use when n>=50)	0.239	90% Gamma Adjusted UCL (use when n<50)	0.261

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.207	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.122	Mean in Log Scale	-3.146
SD in Original Scale	0.208	SD in Log Scale	1.532
90% t UCL (assumes normality of ROS data)	0.208	90% Percentile Bootstrap UCL	0.194
90% BCA Bootstrap UCL	0.246	90% Bootstrap t UCL	0.504
90% H-UCL (Log ROS)	0.554		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.149	90% H-UCL (KM -Log)	0.449
KM SD (logged)	1.464	90% Critical H Value (KM-Log)	2.753
KM Standard Error of Mean (logged)	0.472		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.122	Mean in Log Scale	-3.176
SD in Original Scale	0.208	SD in Log Scale	1.591
90% t UCL (Assumes normality)	0.208	90% H-Stat UCL	0.649

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Dibenzo(A,H)anthracene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	4	Number of Non-Detects	7
Number of Distinct Detects	4	Number of Distinct Non-Detects	7
Minimum Detect	0.007	Minimum Non-Detect	0.005
Maximum Detect	0.05	Maximum Non-Detect	0.0805
Variance Detects	4.3482E-4	Percent Non-Detects	63.64%
Mean Detects	0.0261	SD Detects	0.0209
Median Detects	0.0237	CV Detects	0.8
Skewness Detects	0.304	Kurtosis Detects	-4.047
Mean of Logged Detects	-3.958	SD of Logged Detects	0.958

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.888	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.275	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0137	Standard Error of Mean	0.00559
SD	0.0153	90% KM (BCA) UCL	N/A
90% KM (t) UCL	0.0214	90% KM (Percentile Bootstrap) UCL	N/A
90% KM (z) UCL	0.0209	90% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0305	95% KM Chebyshev UCL	0.0381
97.5% KM Chebyshev UCL	0.0486	99% KM Chebyshev UCL	0.0693

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.398	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.288	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.757	k star (bias corrected MLE)	0.606
Theta hat (MLE)	0.0148	Theta star (bias corrected MLE)	0.043
nu hat (MLE)	14.06	nu star (bias corrected)	4.848
MLE Mean (bias corrected)	0.0261	MLE Sd (bias corrected)	0.0335

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.811	nu hat (KM)	17.83
Approximate Chi Square Value (17.83, α)	10.73	Adjusted Chi Square Value (17.83, β)	10.04
90% Gamma Approximate KM-UCL (use when n>=50)	0.0228	90% Gamma Adjusted KM-UCL (use when n<50)	0.0244

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Dibenzo(A,H)anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.007	Mean	0.0158
Maximum	0.05	Median	0.01
SD	0.014	CV	0.884
k hat (MLE)	2.378	k star (bias corrected MLE)	1.79
Theta hat (MLE)	0.00666	Theta star (bias corrected MLE)	0.00885
nu hat (MLE)	52.31	nu star (bias corrected)	39.38
MLE Mean (bias corrected)	0.0158	MLE Sd (bias corrected)	0.0118
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (39.38, α)	28.52	Adjusted Chi Square Value (39.38, β)	27.35
90% Gamma Approximate UCL (use when n>=50)	0.0219	90% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.891	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.255	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0111	Mean in Log Scale	-5.315
SD in Original Scale	0.0165	SD in Log Scale	1.245
90% t UCL (assumes normality of ROS data)	0.0179	90% Percentile Bootstrap UCL	0.0175
90% BCA Bootstrap UCL	0.0192	90% Bootstrap t UCL	0.0377
90% H-UCL (Log ROS)	0.0279		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-4.715	90% H-UCL (KM -Log)	0.0207
KM SD (logged)	0.824	90% Critical H Value (KM-Log)	1.904
KM Standard Error of Mean (logged)	0.306		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0161	Mean in Log Scale	-4.688
SD in Original Scale	0.0175	SD in Log Scale	1.119
90% t UCL (Assumes normality)	0.0233	90% H-Stat UCL	0.0384

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Fluoranthene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.02	Minimum Non-Detect	0.00853
Maximum Detect	1.2	Maximum Non-Detect	0.0273
Variance Detects	0.138	Percent Non-Detects	18.18%
Mean Detects	0.249	SD Detects	0.371
Median Detects	0.129	CV Detects	1.489
Skewness Detects	2.587	Kurtosis Detects	7.037
Mean of Logged Detects	-2.124	SD of Logged Detects	1.278

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.631	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.206	Standard Error of Mean	0.105
SD	0.33	90% KM (BCA) UCL	0.344
90% KM (t) UCL	0.351	90% KM (Percentile Bootstrap) UCL	0.335
90% KM (z) UCL	0.341	90% KM Bootstrap t UCL	0.688
90% KM Chebyshev UCL	0.523	95% KM Chebyshev UCL	0.666
97.5% KM Chebyshev UCL	0.865	99% KM Chebyshev UCL	1.255

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.427	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.225	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.289	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.807	k star (bias corrected MLE)	0.612
Theta hat (MLE)	0.309	Theta star (bias corrected MLE)	0.407
nu hat (MLE)	14.53	nu star (bias corrected)	11.02
MLE Mean (bias corrected)	0.249	MLE Sd (bias corrected)	0.319

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.392	nu hat (KM)	8.626
Approximate Chi Square Value (8.63, α)	3.913	Adjusted Chi Square Value (8.63, β)	3.525
90% Gamma Approximate KM-UCL (use when n>=50)	0.455	90% Gamma Adjusted KM-UCL (use when n<50)	0.505

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.206
Maximum	1.2	Median	0.0825
SD	0.346	CV	1.681
k hat (MLE)	0.619	k star (bias corrected MLE)	0.511
Theta hat (MLE)	0.333	Theta star (bias corrected MLE)	0.403
nu hat (MLE)	13.61	nu star (bias corrected)	11.23
MLE Mean (bias corrected)	0.206	MLE Sd (bias corrected)	0.288
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (11.23, α)	5.747	Adjusted Chi Square Value (11.23, β)	5.262
90% Gamma Approximate UCL (use when n>=50)	0.402	90% Gamma Adjusted UCL (use when n<50)	0.439

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.143	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.206	Mean in Log Scale	-2.595
SD in Original Scale	0.346	SD in Log Scale	1.571
90% t UCL (assumes normality of ROS data)	0.349	90% Percentile Bootstrap UCL	0.335
90% BCA Bootstrap UCL	0.413	90% Bootstrap t UCL	0.715
90% H-UCL (Log ROS)	1.09		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.547	90% H-UCL (KM -Log)	0.729
KM SD (logged)	1.425	90% Critical H Value (KM-Log)	2.696
KM Standard Error of Mean (logged)	0.458		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.206	Mean in Log Scale	-2.624
SD in Original Scale	0.346	SD in Log Scale	1.617
90% t UCL (Assumes normality)	0.349	90% H-Stat UCL	1.229

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Fluorene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.011	Minimum Non-Detect	0.00853
Maximum Detect	0.168	Maximum Non-Detect	0.0273
Variance Detects	0.00241	Percent Non-Detects	18.18%
Mean Detects	0.0497	SD Detects	0.0491
Median Detects	0.049	CV Detects	0.988
Skewness Detects	2.002	Kurtosis Detects	4.751
Mean of Logged Detects	-3.382	SD of Logged Detects	0.926

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.749	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0426	Standard Error of Mean	0.0142
SD	0.0445	90% KM (BCA) UCL	0.0612
90% KM (t) UCL	0.0622	90% KM (Percentile Bootstrap) UCL	0.061
90% KM (z) UCL	0.0609	90% KM Bootstrap t UCL	0.0796
90% KM Chebyshev UCL	0.0854	95% KM Chebyshev UCL	0.105
97.5% KM Chebyshev UCL	0.132	99% KM Chebyshev UCL	0.184

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.517	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.284	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.457	k star (bias corrected MLE)	1.045
Theta hat (MLE)	0.0341	Theta star (bias corrected MLE)	0.0476
nu hat (MLE)	26.22	nu star (bias corrected)	18.81
MLE Mean (bias corrected)	0.0497	MLE Sd (bias corrected)	0.0486

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.918	nu hat (KM)	20.2
Approximate Chi Square Value (20.20, α)	12.6	Adjusted Chi Square Value (20.20, β)	11.85
90% Gamma Approximate KM-UCL (use when n>=50)	0.0684	90% Gamma Adjusted KM-UCL (use when n<50)	0.0727

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Fluorene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0425
Maximum	0.168	Median	0.019
SD	0.0468	CV	1.1
k hat (MLE)	1.261	k star (bias corrected MLE)	0.978
Theta hat (MLE)	0.0337	Theta star (bias corrected MLE)	0.0435
nu hat (MLE)	27.74	nu star (bias corrected)	21.51
MLE Mean (bias corrected)	0.0425	MLE Sd (bias corrected)	0.043
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (21.51, α)	13.64	Adjusted Chi Square Value (21.51, β)	12.86
90% Gamma Approximate UCL (use when n>=50)	0.067	90% Gamma Adjusted UCL (use when n<50)	0.0711

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.904	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0422	Mean in Log Scale	-3.67
SD in Original Scale	0.0471	SD in Log Scale	1.08
90% t UCL (assumes normality of ROS data)	0.0616	90% Percentile Bootstrap UCL	0.0606
90% BCA Bootstrap UCL	0.065	90% Bootstrap t UCL	0.0807
90% H-UCL (Log ROS)	0.0973		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.598	90% H-UCL (KM -Log)	0.0752
KM SD (logged)	0.92	90% Critical H Value (KM-Log)	2.016
KM Standard Error of Mean (logged)	0.296		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0423	Mean in Log Scale	-3.654
SD in Original Scale	0.047	SD in Log Scale	1.058
90% t UCL (Assumes normality)	0.0617	90% H-Stat UCL	0.0942

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Indeno(1,2,3_cd)Pyrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	7	Number of Non-Detects	4
Number of Distinct Detects	7	Number of Distinct Non-Detects	4
Minimum Detect	0.012	Minimum Non-Detect	0.00853
Maximum Detect	0.7	Maximum Non-Detect	0.0805
Variance Detects	0.0637	Percent Non-Detects	36.36%
Mean Detects	0.155	SD Detects	0.252
Median Detects	0.0436	CV Detects	1.631
Skewness Detects	2.211	Kurtosis Detects	4.936
Mean of Logged Detects	-2.904	SD of Logged Detects	1.516

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.655	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.355	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.103	Standard Error of Mean	0.0647
SD	0.198	90% KM (BCA) UCL	0.167
90% KM (t) UCL	0.192	90% KM (Percentile Bootstrap) UCL	0.186
90% KM (z) UCL	0.186	90% KM Bootstrap t UCL	0.662
90% KM Chebyshev UCL	0.297	95% KM Chebyshev UCL	0.385
97.5% KM Chebyshev UCL	0.507	99% KM Chebyshev UCL	0.747

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.586	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.27	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.325	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.596	k star (bias corrected MLE)	0.436
Theta hat (MLE)	0.26	Theta star (bias corrected MLE)	0.355
nu hat (MLE)	8.344	nu star (bias corrected)	6.101
MLE Mean (bias corrected)	0.155	MLE Sd (bias corrected)	0.234

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.271	nu hat (KM)	5.973
Approximate Chi Square Value (5.97, α)	2.189	Adjusted Chi Square Value (5.97, β)	1.916
90% Gamma Approximate KM-UCL (use when n>=50)	0.282	90% Gamma Adjusted KM-UCL (use when n<50)	0.322

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Indeno(1,2,3_cd)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.102
Maximum	0.7	Median	0.016
SD	0.209	CV	2.044
k hat (MLE)	0.51	k star (bias corrected MLE)	0.432
Theta hat (MLE)	0.2	Theta star (bias corrected MLE)	0.236
nu hat (MLE)	11.23	nu star (bias corrected)	9.499
MLE Mean (bias corrected)	0.102	MLE Sd (bias corrected)	0.155
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (9.50, α)	4.515	Adjusted Chi Square Value (9.50, β)	4.093
90% Gamma Approximate UCL (use when n>=50)	0.215	90% Gamma Adjusted UCL (use when n<50)	0.237

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.101	Mean in Log Scale	-3.767
SD in Original Scale	0.209	SD in Log Scale	1.755
90% t UCL (assumes normality of ROS data)	0.188	90% Percentile Bootstrap UCL	0.182
90% BCA Bootstrap UCL	0.224	90% Bootstrap t UCL	0.775
90% H-UCL (Log ROS)	0.632		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.465	90% H-UCL (KM -Log)	0.25
KM SD (logged)	1.372	90% Critical H Value (KM-Log)	2.62
KM Standard Error of Mean (logged)	0.455		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.104	Mean in Log Scale	-3.481
SD in Original Scale	0.208	SD in Log Scale	1.519
90% t UCL (Assumes normality)	0.19	90% H-Stat UCL	0.38

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Naphthalene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.013	Minimum Non-Detect	0.00853
Maximum Detect	0.195	Maximum Non-Detect	0.0273
Variance Detects	0.00353	Percent Non-Detects	27.27%
Mean Detects	0.0631	SD Detects	0.0594
Median Detects	0.0535	CV Detects	0.941
Skewness Detects	1.813	Kurtosis Detects	3.845
Mean of Logged Detects	-3.13	SD of Logged Detects	0.938

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.805	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0493	Standard Error of Mean	0.017
SD	0.0525	90% KM (BCA) UCL	0.0708
90% KM (t) UCL	0.0726	90% KM (Percentile Bootstrap) UCL	0.0708
90% KM (z) UCL	0.0711	90% KM Bootstrap t UCL	0.0948
90% KM Chebyshev UCL	0.1	95% KM Chebyshev UCL	0.123
97.5% KM Chebyshev UCL	0.155	99% KM Chebyshev UCL	0.218

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.298	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.157	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.299	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.506	k star (bias corrected MLE)	1.024
Theta hat (MLE)	0.0419	Theta star (bias corrected MLE)	0.0616
nu hat (MLE)	24.09	nu star (bias corrected)	16.39
MLE Mean (bias corrected)	0.0631	MLE Sd (bias corrected)	0.0624

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.882	nu hat (KM)	19.4
Approximate Chi Square Value (19.40, α)	11.96	Adjusted Chi Square Value (19.40, β)	11.23
90% Gamma Approximate KM-UCL (use when n>=50)	0.08	90% Gamma Adjusted KM-UCL (use when n<50)	0.0852

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Naphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0486
Maximum	0.195	Median	0.0228
SD	0.0555	CV	1.142
k hat (MLE)	1.12	k star (bias corrected MLE)	0.875
Theta hat (MLE)	0.0434	Theta star (bias corrected MLE)	0.0556
nu hat (MLE)	24.63	nu star (bias corrected)	19.25
MLE Mean (bias corrected)	0.0486	MLE Sd (bias corrected)	0.052
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (19.25, α)	11.85	Adjusted Chi Square Value (19.25, β)	11.12
90% Gamma Approximate UCL (use when n>=50)	0.079	90% Gamma Adjusted UCL (use when n<50)	0.0842

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0487	Mean in Log Scale	-3.559
SD in Original Scale	0.0556	SD in Log Scale	1.113
90% t UCL (assumes normality of ROS data)	0.0717	90% Percentile Bootstrap UCL	0.0688
90% BCA Bootstrap UCL	0.0772	90% Bootstrap t UCL	0.0911
90% H-UCL (Log ROS)	0.117		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.49	90% H-UCL (KM -Log)	0.0922
KM SD (logged)	0.969	90% Critical H Value (KM-Log)	2.076
KM Standard Error of Mean (logged)	0.318		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0487	Mean in Log Scale	-3.558
SD in Original Scale	0.0555	SD in Log Scale	1.113
90% t UCL (Assumes normality)	0.0717	90% H-Stat UCL	0.117

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Phenanthrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.023	Minimum Non-Detect	0.00853
Maximum Detect	1	Maximum Non-Detect	0.0273
Variance Detects	0.0898	Percent Non-Detects	18.18%
Mean Detects	0.221	SD Detects	0.3
Median Detects	0.124	CV Detects	1.357
Skewness Detects	2.724	Kurtosis Detects	7.776
Mean of Logged Detects	-2.034	SD of Logged Detects	1.033

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.605	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.37	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.183	Standard Error of Mean	0.0857
SD	0.268	90% KM (BCA) UCL	0.283
90% KM (t) UCL	0.3	90% KM (Percentile Bootstrap) UCL	0.287
90% KM (z) UCL	0.293	90% KM Bootstrap t UCL	0.557
90% KM Chebyshev UCL	0.44	95% KM Chebyshev UCL	0.556
97.5% KM Chebyshev UCL	0.718	99% KM Chebyshev UCL	1.035

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.568	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.238	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.286	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.091	k star (bias corrected MLE)	0.802
Theta hat (MLE)	0.202	Theta star (bias corrected MLE)	0.275
nu hat (MLE)	19.64	nu star (bias corrected)	14.43
MLE Mean (bias corrected)	0.221	MLE Sd (bias corrected)	0.247

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.466	nu hat (KM)	10.25
Approximate Chi Square Value (10.25, α)	5.043	Adjusted Chi Square Value (10.25, β)	4.593
90% Gamma Approximate KM-UCL (use when n>=50)	0.372	90% Gamma Adjusted KM-UCL (use when n<50)	0.408

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Phenanthrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.182
Maximum	1	Median	0.103
SD	0.281	CV	1.541
k hat (MLE)	0.748	k star (bias corrected MLE)	0.605
Theta hat (MLE)	0.244	Theta star (bias corrected MLE)	0.302
nu hat (MLE)	16.46	nu star (bias corrected)	13.3
MLE Mean (bias corrected)	0.182	MLE Sd (bias corrected)	0.235
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (13.30, α)	7.267	Adjusted Chi Square Value (13.30, β)	6.713
90% Gamma Approximate UCL (use when n>=50)	0.334	90% Gamma Adjusted UCL (use when n<50)	0.362

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.174	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.183	Mean in Log Scale	-2.444
SD in Original Scale	0.281	SD in Log Scale	1.304
90% t UCL (assumes normality of ROS data)	0.299	90% Percentile Bootstrap UCL	0.286
90% BCA Bootstrap UCL	0.353	90% Bootstrap t UCL	0.574
90% H-UCL (Log ROS)	0.575		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.485	90% H-UCL (KM -Log)	0.566
KM SD (logged)	1.314	90% Critical H Value (KM-Log)	2.537
KM Standard Error of Mean (logged)	0.424		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.182	Mean in Log Scale	-2.551
SD in Original Scale	0.281	SD in Log Scale	1.497
90% t UCL (Assumes normality)	0.299	90% H-Stat UCL	0.902

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Pyrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.017	Minimum Non-Detect	0.00853
Maximum Detect	1.2	Maximum Non-Detect	0.0273
Variance Detects	0.138	Percent Non-Detects	18.18%
Mean Detects	0.241	SD Detects	0.371
Median Detects	0.135	CV Detects	1.542
Skewness Detects	2.662	Kurtosis Detects	7.44
Mean of Logged Detects	-2.216	SD of Logged Detects	1.349

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.615	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.336	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.199	Standard Error of Mean	0.105
SD	0.329	90% KM (BCA) UCL	0.312
90% KM (t) UCL	0.343	90% KM (Percentile Bootstrap) UCL	0.323
90% KM (z) UCL	0.334	90% KM Bootstrap t UCL	0.689
90% KM Chebyshev UCL	0.515	95% KM Chebyshev UCL	0.658
97.5% KM Chebyshev UCL	0.856	99% KM Chebyshev UCL	1.246

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.417	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.207	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.289	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.754	k star (bias corrected MLE)	0.577
Theta hat (MLE)	0.319	Theta star (bias corrected MLE)	0.417
nu hat (MLE)	13.58	nu star (bias corrected)	10.39
MLE Mean (bias corrected)	0.241	MLE Sd (bias corrected)	0.317

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.367	nu hat (KM)	8.066
Approximate Chi Square Value (8.07, α)	3.535	Adjusted Chi Square Value (8.07, β)	3.169
90% Gamma Approximate KM-UCL (use when n>=50)	0.454	90% Gamma Adjusted KM-UCL (use when n<50)	0.507

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
90% Confidence Coefficient

Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.199
Maximum	1.2	Median	0.085
SD	0.345	CV	1.735
k hat (MLE)	0.597	k star (bias corrected MLE)	0.495
Theta hat (MLE)	0.333	Theta star (bias corrected MLE)	0.402
nu hat (MLE)	13.14	nu star (bias corrected)	10.89
MLE Mean (bias corrected)	0.199	MLE Sd (bias corrected)	0.283
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (10.89, α)	5.496	Adjusted Chi Square Value (10.89, β)	5.024
90% Gamma Approximate UCL (use when n>=50)	0.394	90% Gamma Adjusted UCL (use when n<50)	0.431

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.199	Mean in Log Scale	-2.713
SD in Original Scale	0.345	SD in Log Scale	1.657
90% t UCL (assumes normality of ROS data)	0.341	90% Percentile Bootstrap UCL	0.321
90% BCA Bootstrap UCL	0.396	90% Bootstrap t UCL	0.695
90% H-UCL (Log ROS)	1.288		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.637	90% H-UCL (KM -Log)	0.745
KM SD (logged)	1.463	90% Critical H Value (KM-Log)	2.751
KM Standard Error of Mean (logged)	0.469		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.199	Mean in Log Scale	-2.7
SD in Original Scale	0.345	SD in Log Scale	1.638
90% t UCL (Assumes normality)	0.341	90% H-Stat UCL	1.221

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

User Selected Options	
Date/Time of Computation	3/24/2014 3:23:09 PM
From File	SedMC_EPCs_20140321.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1_Methylnaphthalene

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	1	Number of Non-Detects	3
Number of Distinct Detects	1	Number of Distinct Non-Detects	3

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1_Methylnaphthalene was not processed!

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

2_Methylnaphthalene

General Statistics

Total Number of Observations	9	Number of Distinct Observations	9
Number of Detects	7	Number of Non-Detects	2
Number of Distinct Detects	7	Number of Distinct Non-Detects	2
Minimum Detect	0.0075	Minimum Non-Detect	0.00853
Maximum Detect	0.0458	Maximum Non-Detect	0.026
Variance Detects	1.6668E-4	Percent Non-Detects	22.22%
Mean Detects	0.0183	SD Detects	0.0129
Median Detects	0.015	CV Detects	0.706
Skewness Detects	2.023	Kurtosis Detects	4.569
Mean of Logged Detects	-4.166	SD of Logged Detects	0.588

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.774	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.304	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0165	Standard Error of Mean	0.00409
SD	0.0112	95% KM (BCA) UCL	0.0231
95% KM (t) UCL	0.0241	95% KM (Percentile Bootstrap) UCL	0.0235
95% KM (z) UCL	0.0232	95% KM Bootstrap t UCL	0.0313
90% KM Chebyshev UCL	0.0288	95% KM Chebyshev UCL	0.0343
97.5% KM Chebyshev UCL	0.042	99% KM Chebyshev UCL	0.0572

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.379	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.221	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.314	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.197	k star (bias corrected MLE)	1.922
Theta hat (MLE)	0.00572	Theta star (bias corrected MLE)	0.00952
nu hat (MLE)	44.75	nu star (bias corrected)	26.91
MLE Mean (bias corrected)	0.0183	MLE Sd (bias corrected)	0.0132

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.148	nu hat (KM)	38.66
Approximate Chi Square Value (38.66, α)	25.42	Adjusted Chi Square Value (38.66, β)	23.18
95% Gamma Approximate KM-UCL (use when n>=50)	0.0251	95% Gamma Adjusted KM-UCL (use when n<50)	0.0275

2_Methylnaphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0075	Mean	0.0167
Maximum	0.0458	Median	0.0122
SD	0.0116	CV	0.697
k hat (MLE)	3.525	k star (bias corrected MLE)	2.424
Theta hat (MLE)	0.00474	Theta star (bias corrected MLE)	0.00689
nu hat (MLE)	63.45	nu star (bias corrected)	43.63
MLE Mean (bias corrected)	0.0167	MLE Sd (bias corrected)	0.0107
		Adjusted Level of Significance (β)	0.0231
Approximate Chi Square Value (43.63, α)	29.48	Adjusted Chi Square Value (43.63, β)	27.05
95% Gamma Approximate UCL (use when n>=50)	0.0247	95% Gamma Adjusted UCL (use when n<50)	0.0269

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0163	Mean in Log Scale	-4.29
SD in Original Scale	0.0119	SD in Log Scale	0.589
95% t UCL (assumes normality of ROS data)	0.0237	95% Percentile Bootstrap UCL	0.0233
95% BCA Bootstrap UCL	0.0255	95% Bootstrap t UCL	0.0323
95% H-UCL (Log ROS)	0.0269		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-4.275	95% H-UCL (KM -Log)	0.0253
KM SD (logged)	0.547	95% Critical H Value (KM-Log)	2.313
KM Standard Error of Mean (logged)	0.203		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0161	Mean in Log Scale	-4.329
SD in Original Scale	0.0122	SD in Log Scale	0.664
95% t UCL (Assumes normality)	0.0237	95% H-Stat UCL	0.03

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0241	95% KM (Percentile Bootstrap) UCL	0.0235

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Acenaphthene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.00987	Minimum Non-Detect	0.00853
Maximum Detect	0.268	Maximum Non-Detect	0.0273
Variance Detects	0.00858	Percent Non-Detects	27.27%
Mean Detects	0.0698	SD Detects	0.0926
Median Detects	0.0285	CV Detects	1.327
Skewness Detects	1.793	Kurtosis Detects	2.686
Mean of Logged Detects	-3.389	SD of Logged Detects	1.268

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.723	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.326	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0536	Standard Error of Mean	0.0253
SD	0.0785	95% KM (BCA) UCL	0.0979
95% KM (t) UCL	0.0995	95% KM (Percentile Bootstrap) UCL	0.0954
95% KM (z) UCL	0.0952	95% KM Bootstrap t UCL	0.249
90% KM Chebyshev UCL	0.13	95% KM Chebyshev UCL	0.164
97.5% KM Chebyshev UCL	0.212	99% KM Chebyshev UCL	0.305

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.596	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.249	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.303	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.815	k star (bias corrected MLE)	0.592
Theta hat (MLE)	0.0857	Theta star (bias corrected MLE)	0.118
nu hat (MLE)	13.03	nu star (bias corrected)	9.479
MLE Mean (bias corrected)	0.0698	MLE Sd (bias corrected)	0.0907

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.466	nu hat (KM)	10.26
Approximate Chi Square Value (10.26, α)	4.103	Adjusted Chi Square Value (10.26, β)	3.492
95% Gamma Approximate KM-UCL (use when n>=50)	0.134	95% Gamma Adjusted KM-UCL (use when n<50)	0.157

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Acenaphthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.00987	Mean	0.0535
Maximum	0.268	Median	0.012
SD	0.0824	CV	1.54
k hat (MLE)	0.755	k star (bias corrected MLE)	0.61
Theta hat (MLE)	0.0708	Theta star (bias corrected MLE)	0.0877
nu hat (MLE)	16.61	nu star (bias corrected)	13.41
MLE Mean (bias corrected)	0.0535	MLE Sd (bias corrected)	0.0685
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (13.41, α)	6.17	Adjusted Chi Square Value (13.41, β)	5.39
95% Gamma Approximate UCL (use when n>=50)	0.116	95% Gamma Adjusted UCL (use when n<50)	0.133

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0526	Mean in Log Scale	-3.891
SD in Original Scale	0.0829	SD in Log Scale	1.433
95% t UCL (assumes normality of ROS data)	0.0979	95% Percentile Bootstrap UCL	0.0972
95% BCA Bootstrap UCL	0.116	95% Bootstrap t UCL	0.244
95% H-UCL (Log ROS)	0.332		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.716	95% H-UCL (KM -Log)	0.156
KM SD (logged)	1.149	95% Critical H Value (KM-Log)	3.292
KM Standard Error of Mean (logged)	0.372		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0536	Mean in Log Scale	-3.746
SD in Original Scale	0.0824	SD in Log Scale	1.259
95% t UCL (Assumes normality)	0.0986	95% H-Stat UCL	0.212

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.164	95% GROS Adjusted Gamma UCL	0.133
95% Adjusted Gamma KM-UCL	0.157		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Acenaphthylene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	5	Number of Non-Detects	6
Number of Distinct Detects	5	Number of Distinct Non-Detects	6
Minimum Detect	0.00891	Minimum Non-Detect	0.005
Maximum Detect	0.086	Maximum Non-Detect	0.0273
Variance Detects	0.0011	Percent Non-Detects	54.55%
Mean Detects	0.0305	SD Detects	0.0332
Median Detects	0.011	CV Detects	1.091
Skewness Detects	1.646	Kurtosis Detects	2.336
Mean of Logged Detects	-3.931	SD of Logged Detects	1.012

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.759	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.321	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level
Detected Data appear Approximate Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0169	Standard Error of Mean	0.00795
SD	0.0236	95% KM (BCA) UCL	0.0302
95% KM (t) UCL	0.0314	95% KM (Percentile Bootstrap) UCL	0.0295
95% KM (z) UCL	0.03	95% KM Bootstrap t UCL	0.0953
90% KM Chebyshev UCL	0.0408	95% KM Chebyshev UCL	0.0516
97.5% KM Chebyshev UCL	0.0666	99% KM Chebyshev UCL	0.0961

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.583	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.689	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.349	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.363	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.28	k star (bias corrected MLE)	0.645
Theta hat (MLE)	0.0238	Theta star (bias corrected MLE)	0.0472
nu hat (MLE)	12.8	nu star (bias corrected)	6.451
MLE Mean (bias corrected)	0.0305	MLE Sd (bias corrected)	0.0379

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.517	nu hat (KM)	11.37
Approximate Chi Square Value (11.37, α)	4.814	Adjusted Chi Square Value (11.37, β)	4.141
95% Gamma Approximate KM-UCL (use when n>=50)	0.04	95% Gamma Adjusted KM-UCL (use when n<50)	0.0465

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Acenaphthylene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.00891	Mean	0.0193
Maximum	0.086	Median	0.01
SD	0.0236	CV	1.222
k hat (MLE)	1.571	k star (bias corrected MLE)	1.203
Theta hat (MLE)	0.0123	Theta star (bias corrected MLE)	0.016
nu hat (MLE)	34.57	nu star (bias corrected)	26.48
MLE Mean (bias corrected)	0.0193	MLE Sd (bias corrected)	0.0176
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (26.48, α)	15.75	Adjusted Chi Square Value (26.48, β)	14.41
95% Gamma Approximate UCL (use when n>=50)	0.0324	95% Gamma Adjusted UCL (use when n<50)	0.0354

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.826	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.316	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0151	Mean in Log Scale	-5.159
SD in Original Scale	0.0257	SD in Log Scale	1.374
95% t UCL (assumes normality of ROS data)	0.0291	95% Percentile Bootstrap UCL	0.0289
95% BCA Bootstrap UCL	0.0349	95% Bootstrap t UCL	0.0847
95% H-UCL (Log ROS)	0.0756		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-4.625	95% H-UCL (KM -Log)	0.0324
KM SD (logged)	0.897	95% Critical H Value (KM-Log)	2.804
KM Standard Error of Mean (logged)	0.307		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0169	Mean in Log Scale	-4.71
SD in Original Scale	0.0249	SD in Log Scale	1.079
95% t UCL (Assumes normality)	0.0305	95% H-Stat UCL	0.0473

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0314	95% KM (Percentile Bootstrap) UCL	0.0295

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Anthracene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.015	Minimum Non-Detect	0.005
Maximum Detect	0.27	Maximum Non-Detect	0.0273
Variance Detects	0.00842	Percent Non-Detects	27.27%
Mean Detects	0.0711	SD Detects	0.0918
Median Detects	0.0284	CV Detects	1.292
Skewness Detects	1.905	Kurtosis Detects	3.008
Mean of Logged Detects	-3.206	SD of Logged Detects	1.038

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.667	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.403	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.054	Standard Error of Mean	0.0253
SD	0.0784	95% KM (BCA) UCL	0.102
95% KM (t) UCL	0.0998	95% KM (Percentile Bootstrap) UCL	0.0971
95% KM (z) UCL	0.0956	95% KM Bootstrap t UCL	0.333
90% KM Chebyshev UCL	0.13	95% KM Chebyshev UCL	0.164
97.5% KM Chebyshev UCL	0.212	99% KM Chebyshev UCL	0.306

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.975	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.735	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.366	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.301	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.024	k star (bias corrected MLE)	0.724
Theta hat (MLE)	0.0694	Theta star (bias corrected MLE)	0.0982
nu hat (MLE)	16.39	nu star (bias corrected)	11.58
MLE Mean (bias corrected)	0.0711	MLE Sd (bias corrected)	0.0835

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.474	nu hat (KM)	10.43
Approximate Chi Square Value (10.43, α)	4.212	Adjusted Chi Square Value (10.43, β)	3.591
95% Gamma Approximate KM-UCL (use when n>=50)	0.134	95% Gamma Adjusted KM-UCL (use when n<50)	0.157

Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0544
Maximum	0.27	Median	0.0238
SD	0.0819	CV	1.506
k hat (MLE)	0.868	k star (bias corrected MLE)	0.692
Theta hat (MLE)	0.0627	Theta star (bias corrected MLE)	0.0786
nu hat (MLE)	19.1	nu star (bias corrected)	15.22
MLE Mean (bias corrected)	0.0544	MLE Sd (bias corrected)	0.0654
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (15.22, α)	7.418	Adjusted Chi Square Value (15.22, β)	6.549
95% Gamma Approximate UCL (use when n>=50)	0.112	95% Gamma Adjusted UCL (use when n<50)	0.126

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.827	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.306	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0536	Mean in Log Scale	-3.72
SD in Original Scale	0.0824	SD in Log Scale	1.266
95% t UCL (assumes normality of ROS data)	0.0986	95% Percentile Bootstrap UCL	0.0976
95% BCA Bootstrap UCL	0.111	95% Bootstrap t UCL	0.343
95% H-UCL (Log ROS)	0.222		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.692	95% H-UCL (KM -Log)	0.179
KM SD (logged)	1.187	95% Critical H Value (KM-Log)	3.37
KM Standard Error of Mean (logged)	0.389		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0535	Mean in Log Scale	-3.763
SD in Original Scale	0.0825	SD in Log Scale	1.347
95% t UCL (Assumes normality)	0.0986	95% H-Stat UCL	0.278

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	0.212

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(a)Anthracene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0052	Minimum Non-Detect	0.00853
Maximum Detect	0.48	Maximum Non-Detect	0.0273
Variance Detects	0.0243	Percent Non-Detects	27.27%
Mean Detects	0.11	SD Detects	0.156
Median Detects	0.0568	CV Detects	1.42
Skewness Detects	2.433	Kurtosis Detects	6.181
Mean of Logged Detects	-2.92	SD of Logged Detects	1.318

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.656	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.351	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0817	Standard Error of Mean	0.0427
SD	0.132	95% KM (BCA) UCL	0.158
95% KM (t) UCL	0.159	95% KM (Percentile Bootstrap) UCL	0.157
95% KM (z) UCL	0.152	95% KM Bootstrap t UCL	0.376
90% KM Chebyshev UCL	0.21	95% KM Chebyshev UCL	0.268
97.5% KM Chebyshev UCL	0.348	99% KM Chebyshev UCL	0.507

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.395	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.251	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.303	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.832	k star (bias corrected MLE)	0.603
Theta hat (MLE)	0.132	Theta star (bias corrected MLE)	0.182
nu hat (MLE)	13.31	nu star (bias corrected)	9.649
MLE Mean (bias corrected)	0.11	MLE Sd (bias corrected)	0.141

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.38	nu hat (KM)	8.37
Approximate Chi Square Value (8.37, α)	2.951	Adjusted Chi Square Value (8.37, β)	2.452
95% Gamma Approximate KM-UCL (use when n>=50)	0.232	95% Gamma Adjusted KM-UCL (use when n<50)	0.279

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(a)Anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0052	Mean	0.0825
Maximum	0.48	Median	0.033
SD	0.138	CV	1.677
k hat (MLE)	0.685	k star (bias corrected MLE)	0.559
Theta hat (MLE)	0.12	Theta star (bias corrected MLE)	0.148
nu hat (MLE)	15.07	nu star (bias corrected)	12.29
MLE Mean (bias corrected)	0.0825	MLE Sd (bias corrected)	0.11
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (12.29, α)	5.421	Adjusted Chi Square Value (12.29, β)	4.699
95% Gamma Approximate UCL (use when n>=50)	0.187	95% Gamma Adjusted UCL (use when n<50)	0.216

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.172	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0815	Mean in Log Scale	-3.505
SD in Original Scale	0.139	SD in Log Scale	1.493
95% t UCL (assumes normality of ROS data)	0.157	95% Percentile Bootstrap UCL	0.157
95% BCA Bootstrap UCL	0.203	95% Bootstrap t UCL	0.387
95% H-UCL (Log ROS)	0.61		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.521	95% H-UCL (KM -Log)	0.526
KM SD (logged)	1.457	95% Critical H Value (KM-Log)	3.94
KM Standard Error of Mean (logged)	0.476		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.082	Mean in Log Scale	-3.464
SD in Original Scale	0.139	SD in Log Scale	1.468
95% t UCL (Assumes normality)	0.158	95% H-Stat UCL	0.578

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.268	95% GROS Adjusted Gamma UCL	0.216
95% Adjusted Gamma KM-UCL	0.279		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(a)Pyrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0095	Minimum Non-Detect	0.00853
Maximum Detect	0.9	Maximum Non-Detect	0.0273
Variance Detects	0.0922	Percent Non-Detects	27.27%
Mean Detects	0.187	SD Detects	0.304
Median Detects	0.0653	CV Detects	1.621
Skewness Detects	2.347	Kurtosis Detects	5.629
Mean of Logged Detects	-2.653	SD of Logged Detects	1.483

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.642	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.361	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.139	Standard Error of Mean	0.0821
SD	0.255	95% KM (BCA) UCL	0.272
95% KM (t) UCL	0.288	95% KM (Percentile Bootstrap) UCL	0.284
95% KM (z) UCL	0.274	95% KM Bootstrap t UCL	1.07
90% KM Chebyshev UCL	0.385	95% KM Chebyshev UCL	0.497
97.5% KM Chebyshev UCL	0.652	99% KM Chebyshev UCL	0.956

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.488	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.249	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.306	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.628	k star (bias corrected MLE)	0.476
Theta hat (MLE)	0.298	Theta star (bias corrected MLE)	0.394
nu hat (MLE)	10.05	nu star (bias corrected)	7.612
MLE Mean (bias corrected)	0.187	MLE Sd (bias corrected)	0.272

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.298	nu hat (KM)	6.566
Approximate Chi Square Value (6.57, α)	1.935	Adjusted Chi Square Value (6.57, β)	1.554
95% Gamma Approximate KM-UCL (use when n>=50)	0.472	95% Gamma Adjusted KM-UCL (use when n<50)	0.588

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(a)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0095	Mean	0.139
Maximum	0.9	Median	0.026
SD	0.267	CV	1.923
k hat (MLE)	0.521	k star (bias corrected MLE)	0.44
Theta hat (MLE)	0.267	Theta star (bias corrected MLE)	0.316
nu hat (MLE)	11.46	nu star (bias corrected)	9.67
MLE Mean (bias corrected)	0.139	MLE Sd (bias corrected)	0.21
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (9.67, α)	3.736	Adjusted Chi Square Value (9.67, β)	3.159
95% Gamma Approximate UCL (use when n>=50)	0.36	95% Gamma Adjusted UCL (use when n<50)	0.425

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.152	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.138	Mean in Log Scale	-3.431
SD in Original Scale	0.268	SD in Log Scale	1.858
95% t UCL (assumes normality of ROS data)	0.284	95% Percentile Bootstrap UCL	0.275
95% BCA Bootstrap UCL	0.357	95% Bootstrap t UCL	1.015
95% H-UCL (Log ROS)	3.104		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.185	95% H-UCL (KM -Log)	0.794
KM SD (logged)	1.478	95% Critical H Value (KM-Log)	3.984
KM Standard Error of Mean (logged)	0.479		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.138	Mean in Log Scale	-3.27
SD in Original Scale	0.268	SD in Log Scale	1.651
95% t UCL (Assumes normality)	0.285	95% H-Stat UCL	1.451

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.497	95% GROS Adjusted Gamma UCL	0.425
95% Adjusted Gamma KM-UCL	0.588		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(b)Fluoranthene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0096	Minimum Non-Detect	0.00853
Maximum Detect	0.58	Maximum Non-Detect	0.0273
Variance Detects	0.038	Percent Non-Detects	27.27%
Mean Detects	0.156	SD Detects	0.195
Median Detects	0.074	CV Detects	1.252
Skewness Detects	1.842	Kurtosis Detects	3.162
Mean of Logged Detects	-2.554	SD of Logged Detects	1.324

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.762	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.292	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level
Detected Data appear Approximate Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.116	Standard Error of Mean	0.0543
SD	0.168	95% KM (BCA) UCL	0.211
95% KM (t) UCL	0.214	95% KM (Percentile Bootstrap) UCL	0.206
95% KM (z) UCL	0.205	95% KM Bootstrap t UCL	0.394
90% KM Chebyshev UCL	0.279	95% KM Chebyshev UCL	0.353
97.5% KM Chebyshev UCL	0.455	99% KM Chebyshev UCL	0.656

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.252	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.176	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.303	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.849	k star (bias corrected MLE)	0.614
Theta hat (MLE)	0.183	Theta star (bias corrected MLE)	0.253
nu hat (MLE)	13.59	nu star (bias corrected)	9.825
MLE Mean (bias corrected)	0.156	MLE Sd (bias corrected)	0.199

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.474	nu hat (KM)	10.43
Approximate Chi Square Value (10.43, α)	4.212	Adjusted Chi Square Value (10.43, β)	3.591
95% Gamma Approximate KM-UCL (use when n>=50)	0.287	95% Gamma Adjusted KM-UCL (use when n<50)	0.337

Benzo(b)Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0096	Mean	0.116
Maximum	0.58	Median	0.0471
SD	0.177	CV	1.524
k hat (MLE)	0.639	k star (bias corrected MLE)	0.525
Theta hat (MLE)	0.181	Theta star (bias corrected MLE)	0.221
nu hat (MLE)	14.06	nu star (bias corrected)	11.56
MLE Mean (bias corrected)	0.116	MLE Sd (bias corrected)	0.16
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (11.56, α)	4.936	Adjusted Chi Square Value (11.56, β)	4.252
95% Gamma Approximate UCL (use when n>=50)	0.271	95% Gamma Adjusted UCL (use when n<50)	0.315

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.99	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.115	Mean in Log Scale	-3.305
SD in Original Scale	0.177	SD in Log Scale	1.72
95% t UCL (assumes normality of ROS data)	0.212	95% Percentile Bootstrap UCL	0.213
95% BCA Bootstrap UCL	0.251	95% Bootstrap t UCL	0.43
95% H-UCL (Log ROS)	1.883		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.123	95% H-UCL (KM -Log)	0.67
KM SD (logged)	1.415	95% Critical H Value (KM-Log)	3.848
KM Standard Error of Mean (logged)	0.459		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.115	Mean in Log Scale	-3.198
SD in Original Scale	0.177	SD in Log Scale	1.585
95% t UCL (Assumes normality)	0.212	95% H-Stat UCL	1.189

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.214	95% KM (Percentile Bootstrap) UCL	0.206

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(g,h,i)Perylene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	7	Number of Non-Detects	4
Number of Distinct Detects	7	Number of Distinct Non-Detects	4
Minimum Detect	0.014	Minimum Non-Detect	0.00853
Maximum Detect	0.91	Maximum Non-Detect	0.0805
Variance Detects	0.106	Percent Non-Detects	36.36%
Mean Detects	0.185	SD Detects	0.326
Median Detects	0.0491	CV Detects	1.765
Skewness Detects	2.442	Kurtosis Detects	6.092
Mean of Logged Detects	-2.766	SD of Logged Detects	1.506

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.606	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.339	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.122	Standard Error of Mean	0.083
SD	0.255	95% KM (BCA) UCL	0.286
95% KM (t) UCL	0.273	95% KM (Percentile Bootstrap) UCL	0.275
95% KM (z) UCL	0.259	95% KM Bootstrap t UCL	1.247
90% KM Chebyshev UCL	0.371	95% KM Chebyshev UCL	0.484
97.5% KM Chebyshev UCL	0.641	99% KM Chebyshev UCL	0.948

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.621	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.247	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.326	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.577	k star (bias corrected MLE)	0.425
Theta hat (MLE)	0.321	Theta star (bias corrected MLE)	0.435
nu hat (MLE)	8.072	nu star (bias corrected)	5.946
MLE Mean (bias corrected)	0.185	MLE Sd (bias corrected)	0.284

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.23	nu hat (KM)	5.055
Approximate Chi Square Value (5.06, α)	1.178	Adjusted Chi Square Value (5.06, β)	0.904
95% Gamma Approximate KM-UCL (use when n>=50)	0.524	95% Gamma Adjusted KM-UCL (use when n<50)	0.683

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(g,h,i)Perylene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.121
Maximum	0.91	Median	0.019
SD	0.268	CV	2.207
k hat (MLE)	0.482	k star (bias corrected MLE)	0.411
Theta hat (MLE)	0.252	Theta star (bias corrected MLE)	0.295
nu hat (MLE)	10.6	nu star (bias corrected)	9.046
MLE Mean (bias corrected)	0.121	MLE Sd (bias corrected)	0.189
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (9.05, α)	3.355	Adjusted Chi Square Value (9.05, β)	2.814
95% Gamma Approximate UCL (use when n>=50)	0.327	95% Gamma Adjusted UCL (use when n<50)	0.39

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.12	Mean in Log Scale	-3.739
SD in Original Scale	0.268	SD in Log Scale	1.851
95% t UCL (assumes normality of ROS data)	0.266	95% Percentile Bootstrap UCL	0.266
95% BCA Bootstrap UCL	0.363	95% Bootstrap t UCL	1.237
95% H-UCL (Log ROS)	2.21		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.397	95% H-UCL (KM -Log)	0.511
KM SD (logged)	1.416	95% Critical H Value (KM-Log)	3.85
KM Standard Error of Mean (logged)	0.467		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.124	Mean in Log Scale	-3.393
SD in Original Scale	0.267	SD in Log Scale	1.551
95% t UCL (Assumes normality)	0.269	95% H-Stat UCL	0.853

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	0.286	95% GROS Adjusted Gamma UCL	0.39
95% Adjusted Gamma KM-UCL	0.683		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(k)Fluoranthene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0063	Minimum Non-Detect	0.00853
Maximum Detect	0.54	Maximum Non-Detect	0.0273
Variance Detects	0.0332	Percent Non-Detects	27.27%
Mean Detects	0.108	SD Detects	0.182
Median Detects	0.035	CV Detects	1.685
Skewness Detects	2.434	Kurtosis Detects	6.051
Mean of Logged Detects	-3.188	SD of Logged Detects	1.416

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.613	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.384	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0807	Standard Error of Mean	0.049
SD	0.152	95% KM (BCA) UCL	0.172
95% KM (t) UCL	0.17	95% KM (Percentile Bootstrap) UCL	0.165
95% KM (z) UCL	0.161	95% KM Bootstrap t UCL	0.782
90% KM Chebyshev UCL	0.228	95% KM Chebyshev UCL	0.294
97.5% KM Chebyshev UCL	0.387	99% KM Chebyshev UCL	0.568

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.642	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.313	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.306	Detected Data Not Gamma Distributed at 5% Significance Level
Detected data follow Appr. Gamma Distribution at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.636	k star (bias corrected MLE)	0.481
Theta hat (MLE)	0.17	Theta star (bias corrected MLE)	0.225
nu hat (MLE)	10.18	nu star (bias corrected)	7.696
MLE Mean (bias corrected)	0.108	MLE Sd (bias corrected)	0.156

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.282	nu hat (KM)	6.198
Approximate Chi Square Value (6.20, α)	1.742	Adjusted Chi Square Value (6.20, β)	1.386
95% Gamma Approximate KM-UCL (use when n>=50)	0.287	95% Gamma Adjusted KM-UCL (use when n<50)	0.361

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzo(k)Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0063	Mean	0.0813
Maximum	0.54	Median	0.019
SD	0.159	CV	1.956
k hat (MLE)	0.583	k star (bias corrected MLE)	0.484
Theta hat (MLE)	0.14	Theta star (bias corrected MLE)	0.168
nu hat (MLE)	12.82	nu star (bias corrected)	10.66
MLE Mean (bias corrected)	0.0813	MLE Sd (bias corrected)	0.117
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (10.66, α)	4.356	Adjusted Chi Square Value (10.66, β)	3.722
95% Gamma Approximate UCL (use when n>=50)	0.199	95% Gamma Adjusted UCL (use when n<50)	0.233

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.221	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0801	Mean in Log Scale	-3.762
SD in Original Scale	0.16	SD in Log Scale	1.549
95% t UCL (assumes normality of ROS data)	0.167	95% Percentile Bootstrap UCL	0.161
95% BCA Bootstrap UCL	0.221	95% Bootstrap t UCL	0.727
95% H-UCL (Log ROS)	0.586		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.666	95% H-UCL (KM -Log)	0.349
KM SD (logged)	1.384	95% Critical H Value (KM-Log)	3.782
KM Standard Error of Mean (logged)	0.449		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0809	Mean in Log Scale	-3.659
SD in Original Scale	0.159	SD in Log Scale	1.458
95% t UCL (Assumes normality)	0.168	95% H-Stat UCL	0.458

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.294	95% GROS Adjusted Gamma UCL	0.233
95% Adjusted Gamma KM-UCL	0.361		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzofluoranthenes

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0587	Minimum Non-Detect	0.0171
Maximum Detect	0.123	Maximum Non-Detect	0.0171
Variance Detects	0.00207	Percent Non-Detects	33.33%
Mean Detects	0.0909	SD Detects	0.0455
Median Detects	0.0909	CV Detects	0.5
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-2.465	SD of Logged Detects	0.523

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0663	Standard Error of Mean	0.0356
SD	0.0436	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.17	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.125	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.173	95% KM Chebyshev UCL	0.221
97.5% KM Chebyshev UCL	0.288	99% KM Chebyshev UCL	0.42

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	7.637	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0119	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	30.55	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.314	nu hat (KM)	13.88
		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (13.88, α)	6.492	Adjusted Chi Square Value (13.88, β)	3.161
95% Gamma Approximate KM-UCL (use when n>=50)	0.142	95% Gamma Adjusted KM-UCL (use when n<50)	0.291

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Benzofluoranthenes (cont.)

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0658	Mean in Log Scale	-3.026
SD in Original Scale	0.0539	SD in Log Scale	1.038
95% t UCL (assumes normality of ROS data)	0.157	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	1740		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0634	Mean in Log Scale	-3.231
SD in Original Scale	0.0574	SD in Log Scale	1.376
95% t UCL (Assumes normality)	0.16	95% H-Stat UCL	4078172

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Chrysene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.0081	Minimum Non-Detect	0.00853
Maximum Detect	0.71	Maximum Non-Detect	0.0273
Variance Detects	0.0543	Percent Non-Detects	27.27%
Mean Detects	0.165	SD Detects	0.233
Median Detects	0.0785	CV Detects	1.414
Skewness Detects	2.322	Kurtosis Detects	5.544
Mean of Logged Detects	-2.524	SD of Logged Detects	1.316

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.664	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.372	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.122	Standard Error of Mean	0.064
SD	0.198	95% KM (BCA) UCL	0.24
95% KM (t) UCL	0.238	95% KM (Percentile Bootstrap) UCL	0.232
95% KM (z) UCL	0.227	95% KM Bootstrap t UCL	0.621
90% KM Chebyshev UCL	0.314	95% KM Chebyshev UCL	0.401
97.5% KM Chebyshev UCL	0.521	99% KM Chebyshev UCL	0.759

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.466	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.287	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.303	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.821	k star (bias corrected MLE)	0.597
Theta hat (MLE)	0.201	Theta star (bias corrected MLE)	0.276
nu hat (MLE)	13.14	nu star (bias corrected)	9.546
MLE Mean (bias corrected)	0.165	MLE Sd (bias corrected)	0.213

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.378	nu hat (KM)	8.313
Approximate Chi Square Value (8.31, α)	2.918	Adjusted Chi Square Value (8.31, β)	2.422
95% Gamma Approximate KM-UCL (use when n>=50)	0.348	95% Gamma Adjusted KM-UCL (use when n<50)	0.419

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Chrysene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0081	Mean	0.123
Maximum	0.71	Median	0.05
SD	0.208	CV	1.696
k hat (MLE)	0.62	k star (bias corrected MLE)	0.511
Theta hat (MLE)	0.198	Theta star (bias corrected MLE)	0.24
nu hat (MLE)	13.64	nu star (bias corrected)	11.25
MLE Mean (bias corrected)	0.123	MLE Sd (bias corrected)	0.171
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (11.25, α)	4.739	Adjusted Chi Square Value (11.25, β)	4.072
95% Gamma Approximate UCL (use when n>=50)	0.291	95% Gamma Adjusted UCL (use when n<50)	0.339

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.207	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.122	Mean in Log Scale	-3.146
SD in Original Scale	0.208	SD in Log Scale	1.532
95% t UCL (assumes normality of ROS data)	0.236	95% Percentile Bootstrap UCL	0.227
95% BCA Bootstrap UCL	0.285	95% Bootstrap t UCL	0.609
95% H-UCL (Log ROS)	1.015		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.149	95% H-UCL (KM -Log)	0.782
KM SD (logged)	1.464	95% Critical H Value (KM-Log)	3.955
KM Standard Error of Mean (logged)	0.472		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.122	Mean in Log Scale	-3.176
SD in Original Scale	0.208	SD in Log Scale	1.591
95% t UCL (Assumes normality)	0.236	95% H-Stat UCL	1.243

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.401	95% GROS Adjusted Gamma UCL	0.339
95% Adjusted Gamma KM-UCL	0.419		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Dibenzo(A,H)anthracene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	4	Number of Non-Detects	7
Number of Distinct Detects	4	Number of Distinct Non-Detects	7
Minimum Detect	0.007	Minimum Non-Detect	0.005
Maximum Detect	0.05	Maximum Non-Detect	0.0805
Variance Detects	4.3482E-4	Percent Non-Detects	63.64%
Mean Detects	0.0261	SD Detects	0.0209
Median Detects	0.0237	CV Detects	0.8
Skewness Detects	0.304	Kurtosis Detects	-4.047
Mean of Logged Detects	-3.958	SD of Logged Detects	0.958

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.888	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.275	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.443	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0137	Standard Error of Mean	0.00559
SD	0.0153	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0239	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0229	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0305	95% KM Chebyshev UCL	0.0381
97.5% KM Chebyshev UCL	0.0486	99% KM Chebyshev UCL	0.0693

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.398	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.661	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.288	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.399	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.757	k star (bias corrected MLE)	0.606
Theta hat (MLE)	0.0148	Theta star (bias corrected MLE)	0.043
nu hat (MLE)	14.06	nu star (bias corrected)	4.848
MLE Mean (bias corrected)	0.0261	MLE Sd (bias corrected)	0.0335

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.811	nu hat (KM)	17.83
Approximate Chi Square Value (17.83, α)	9.269	Adjusted Chi Square Value (17.83, β)	8.281
95% Gamma Approximate KM-UCL (use when n>=50)	0.0264	95% Gamma Adjusted KM-UCL (use when n<50)	0.0296

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Dibenzo(A,H)anthracene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.007	Mean	0.0158
Maximum	0.05	Median	0.01
SD	0.014	CV	0.884
k hat (MLE)	2.378	k star (bias corrected MLE)	1.79
Theta hat (MLE)	0.00666	Theta star (bias corrected MLE)	0.00885
nu hat (MLE)	52.31	nu star (bias corrected)	39.38
MLE Mean (bias corrected)	0.0158	MLE Sd (bias corrected)	0.0118
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (39.38, α)	26	Adjusted Chi Square Value (39.38, β)	24.24
95% Gamma Approximate UCL (use when n>=50)	0.024	95% Gamma Adjusted UCL (use when n<50)	N/A

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.891	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.255	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.443	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0111	Mean in Log Scale	-5.315
SD in Original Scale	0.0165	SD in Log Scale	1.245
95% t UCL (assumes normality of ROS data)	0.0201	95% Percentile Bootstrap UCL	0.0197
95% BCA Bootstrap UCL	0.0223	95% Bootstrap t UCL	0.0554
95% H-UCL (Log ROS)	0.0422		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-4.715	95% H-UCL (KM -Log)	0.0253
KM SD (logged)	0.824	95% Critical H Value (KM-Log)	2.674
KM Standard Error of Mean (logged)	0.306		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0161	Mean in Log Scale	-4.688
SD in Original Scale	0.0175	SD in Log Scale	1.119
95% t UCL (Assumes normality)	0.0257	95% H-Stat UCL	0.0539

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0239	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Fluoranthene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.02	Minimum Non-Detect	0.00853
Maximum Detect	1.2	Maximum Non-Detect	0.0273
Variance Detects	0.138	Percent Non-Detects	18.18%
Mean Detects	0.249	SD Detects	0.371
Median Detects	0.129	CV Detects	1.489
Skewness Detects	2.587	Kurtosis Detects	7.037
Mean of Logged Detects	-2.124	SD of Logged Detects	1.278

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.631	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.206	Standard Error of Mean	0.105
SD	0.33	95% KM (BCA) UCL	0.41
95% KM (t) UCL	0.397	95% KM (Percentile Bootstrap) UCL	0.394
95% KM (z) UCL	0.38	95% KM Bootstrap t UCL	0.874
90% KM Chebyshev UCL	0.523	95% KM Chebyshev UCL	0.666
97.5% KM Chebyshev UCL	0.865	99% KM Chebyshev UCL	1.255

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.427	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.225	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.289	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.807	k star (bias corrected MLE)	0.612
Theta hat (MLE)	0.309	Theta star (bias corrected MLE)	0.407
nu hat (MLE)	14.53	nu star (bias corrected)	11.02
MLE Mean (bias corrected)	0.249	MLE Sd (bias corrected)	0.319

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.392	nu hat (KM)	8.626
Approximate Chi Square Value (8.63, α)	3.102	Adjusted Chi Square Value (8.63, β)	2.587
95% Gamma Approximate KM-UCL (use when n>=50)	0.574	95% Gamma Adjusted KM-UCL (use when n<50)	0.688

Fluoranthene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.206
Maximum	1.2	Median	0.0825
SD	0.346	CV	1.681
k hat (MLE)	0.619	k star (bias corrected MLE)	0.511
Theta hat (MLE)	0.333	Theta star (bias corrected MLE)	0.403
nu hat (MLE)	13.61	nu star (bias corrected)	11.23
MLE Mean (bias corrected)	0.206	MLE Sd (bias corrected)	0.288
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (11.23, α)	4.727	Adjusted Chi Square Value (11.23, β)	4.061
95% Gamma Approximate UCL (use when n>=50)	0.489	95% Gamma Adjusted UCL (use when n<50)	0.569

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.143	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.206	Mean in Log Scale	-2.595
SD in Original Scale	0.346	SD in Log Scale	1.571
95% t UCL (assumes normality of ROS data)	0.395	95% Percentile Bootstrap UCL	0.399
95% BCA Bootstrap UCL	0.481	95% Bootstrap t UCL	0.865
95% H-UCL (Log ROS)	2.057		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.547	95% H-UCL (KM -Log)	1.237
KM SD (logged)	1.425	95% Critical H Value (KM-Log)	3.87
KM Standard Error of Mean (logged)	0.458		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.206	Mean in Log Scale	-2.624
SD in Original Scale	0.346	SD in Log Scale	1.617
95% t UCL (Assumes normality)	0.395	95% H-Stat UCL	2.401

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.666	95% GROS Adjusted Gamma UCL	0.569
95% Adjusted Gamma KM-UCL	0.688		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Fluorene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.011	Minimum Non-Detect	0.00853
Maximum Detect	0.168	Maximum Non-Detect	0.0273
Variance Detects	0.00241	Percent Non-Detects	18.18%
Mean Detects	0.0497	SD Detects	0.0491
Median Detects	0.049	CV Detects	0.988
Skewness Detects	2.002	Kurtosis Detects	4.751
Mean of Logged Detects	-3.382	SD of Logged Detects	0.926

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.749	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0426	Standard Error of Mean	0.0142
SD	0.0445	95% KM (BCA) UCL	0.068
95% KM (t) UCL	0.0685	95% KM (Percentile Bootstrap) UCL	0.0664
95% KM (z) UCL	0.0661	95% KM Bootstrap t UCL	0.0906
90% KM Chebyshev UCL	0.0854	95% KM Chebyshev UCL	0.105
97.5% KM Chebyshev UCL	0.132	99% KM Chebyshev UCL	0.184

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.517	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.284	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.457	k star (bias corrected MLE)	1.045
Theta hat (MLE)	0.0341	Theta star (bias corrected MLE)	0.0476
nu hat (MLE)	26.22	nu star (bias corrected)	18.81
MLE Mean (bias corrected)	0.0497	MLE Sd (bias corrected)	0.0486

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.918	nu hat (KM)	20.2
Approximate Chi Square Value (20.20, α)	11	Adjusted Chi Square Value (20.20, β)	9.911
95% Gamma Approximate KM-UCL (use when n>=50)	0.0783	95% Gamma Adjusted KM-UCL (use when n<50)	0.0869

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Fluorene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0425
Maximum	0.168	Median	0.019
SD	0.0468	CV	1.1
k hat (MLE)	1.261	k star (bias corrected MLE)	0.978
Theta hat (MLE)	0.0337	Theta star (bias corrected MLE)	0.0435
nu hat (MLE)	27.74	nu star (bias corrected)	21.51
MLE Mean (bias corrected)	0.0425	MLE Sd (bias corrected)	0.043
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (21.51, α)	11.97	Adjusted Chi Square Value (21.51, β)	10.82
95% Gamma Approximate UCL (use when n>=50)	0.0764	95% Gamma Adjusted UCL (use when n<50)	0.0844

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.904	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0422	Mean in Log Scale	-3.67
SD in Original Scale	0.0471	SD in Log Scale	1.08
95% t UCL (assumes normality of ROS data)	0.0679	95% Percentile Bootstrap UCL	0.0675
95% BCA Bootstrap UCL	0.076	95% Bootstrap t UCL	0.0874
95% H-UCL (Log ROS)	0.134		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.598	95% H-UCL (KM -Log)	0.0957
KM SD (logged)	0.92	95% Critical H Value (KM-Log)	2.847
KM Standard Error of Mean (logged)	0.296		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0423	Mean in Log Scale	-3.654
SD in Original Scale	0.047	SD in Log Scale	1.058
95% t UCL (Assumes normality)	0.068	95% H-Stat UCL	0.128

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0685	95% KM (Percentile Bootstrap) UCL	0.0664

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Indeno(1,2,3_cd)Pyrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	7	Number of Non-Detects	4
Number of Distinct Detects	7	Number of Distinct Non-Detects	4
Minimum Detect	0.012	Minimum Non-Detect	0.00853
Maximum Detect	0.7	Maximum Non-Detect	0.0805
Variance Detects	0.0637	Percent Non-Detects	36.36%
Mean Detects	0.155	SD Detects	0.252
Median Detects	0.0436	CV Detects	1.631
Skewness Detects	2.211	Kurtosis Detects	4.936
Mean of Logged Detects	-2.904	SD of Logged Detects	1.516

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.655	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.355	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.103	Standard Error of Mean	0.0647
SD	0.198	95% KM (BCA) UCL	0.208
95% KM (t) UCL	0.221	95% KM (Percentile Bootstrap) UCL	0.213
95% KM (z) UCL	0.21	95% KM Bootstrap t UCL	0.959
90% KM Chebyshev UCL	0.297	95% KM Chebyshev UCL	0.385
97.5% KM Chebyshev UCL	0.507	99% KM Chebyshev UCL	0.747

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.586	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.27	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.325	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.596	k star (bias corrected MLE)	0.436
Theta hat (MLE)	0.26	Theta star (bias corrected MLE)	0.355
nu hat (MLE)	8.344	nu star (bias corrected)	6.101
MLE Mean (bias corrected)	0.155	MLE Sd (bias corrected)	0.234

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.271	nu hat (KM)	5.973
Approximate Chi Square Value (5.97, α)	1.626	Adjusted Chi Square Value (5.97, β)	1.286
95% Gamma Approximate KM-UCL (use when n>=50)	0.38	95% Gamma Adjusted KM-UCL (use when n<50)	0.48

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Indeno(1,2,3_cd)Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.102
Maximum	0.7	Median	0.016
SD	0.209	CV	2.044
k hat (MLE)	0.51	k star (bias corrected MLE)	0.432
Theta hat (MLE)	0.2	Theta star (bias corrected MLE)	0.236
nu hat (MLE)	11.23	nu star (bias corrected)	9.499
MLE Mean (bias corrected)	0.102	MLE Sd (bias corrected)	0.155
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (9.50, α)	3.631	Adjusted Chi Square Value (9.50, β)	3.064
95% Gamma Approximate UCL (use when n>=50)	0.267	95% Gamma Adjusted UCL (use when n<50)	0.316

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.902	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.101	Mean in Log Scale	-3.767
SD in Original Scale	0.209	SD in Log Scale	1.755
95% t UCL (assumes normality of ROS data)	0.215	95% Percentile Bootstrap UCL	0.21
95% BCA Bootstrap UCL	0.267	95% Bootstrap t UCL	1.003
95% H-UCL (Log ROS)	1.383		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.465	95% H-UCL (KM -Log)	0.409
KM SD (logged)	1.372	95% Critical H Value (KM-Log)	3.756
KM Standard Error of Mean (logged)	0.455		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.104	Mean in Log Scale	-3.481
SD in Original Scale	0.208	SD in Log Scale	1.519
95% t UCL (Assumes normality)	0.218	95% H-Stat UCL	0.689

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	0.208	95% GROS Adjusted Gamma UCL	0.316
95% Adjusted Gamma KM-UCL	0.48		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Naphthalene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	8	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	3
Minimum Detect	0.013	Minimum Non-Detect	0.00853
Maximum Detect	0.195	Maximum Non-Detect	0.0273
Variance Detects	0.00353	Percent Non-Detects	27.27%
Mean Detects	0.0631	SD Detects	0.0594
Median Detects	0.0535	CV Detects	0.941
Skewness Detects	1.813	Kurtosis Detects	3.845
Mean of Logged Detects	-3.13	SD of Logged Detects	0.938

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.805	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level
Detected Data appear Approximate Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.0493	Standard Error of Mean	0.017
SD	0.0525	95% KM (BCA) UCL	0.0827
95% KM (t) UCL	0.0801	95% KM (Percentile Bootstrap) UCL	0.0787
95% KM (z) UCL	0.0772	95% KM Bootstrap t UCL	0.102
90% KM Chebyshev UCL	0.1	95% KM Chebyshev UCL	0.123
97.5% KM Chebyshev UCL	0.155	99% KM Chebyshev UCL	0.218

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	0.298	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.157	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.299	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.506	k star (bias corrected MLE)	1.024
Theta hat (MLE)	0.0419	Theta star (bias corrected MLE)	0.0616
nu hat (MLE)	24.09	nu star (bias corrected)	16.39
MLE Mean (bias corrected)	0.0631	MLE Sd (bias corrected)	0.0624

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.882	nu hat (KM)	19.4
Approximate Chi Square Value (19.40, α)	10.41	Adjusted Chi Square Value (19.40, β)	9.352
95% Gamma Approximate KM-UCL (use when n>=50)	0.0919	95% Gamma Adjusted KM-UCL (use when n<50)	0.102

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Naphthalene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0486
Maximum	0.195	Median	0.0228
SD	0.0555	CV	1.142
k hat (MLE)	1.12	k star (bias corrected MLE)	0.875
Theta hat (MLE)	0.0434	Theta star (bias corrected MLE)	0.0556
nu hat (MLE)	24.63	nu star (bias corrected)	19.25
MLE Mean (bias corrected)	0.0486	MLE Sd (bias corrected)	0.052
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (19.25, α)	10.3	Adjusted Chi Square Value (19.25, β)	9.248
95% Gamma Approximate UCL (use when n>=50)	0.0909	95% Gamma Adjusted UCL (use when n<50)	0.101

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.941	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0487	Mean in Log Scale	-3.559
SD in Original Scale	0.0556	SD in Log Scale	1.113
95% t UCL (assumes normality of ROS data)	0.079	95% Percentile Bootstrap UCL	0.0761
95% BCA Bootstrap UCL	0.0909	95% Bootstrap t UCL	0.106
95% H-UCL (Log ROS)	0.164		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.49	95% H-UCL (KM -Log)	0.12
KM SD (logged)	0.969	95% Critical H Value (KM-Log)	2.939
KM Standard Error of Mean (logged)	0.318		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0487	Mean in Log Scale	-3.558
SD in Original Scale	0.0555	SD in Log Scale	1.113
95% t UCL (Assumes normality)	0.0791	95% H-Stat UCL	0.164

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0801	95% KM (Percentile Bootstrap) UCL	0.0787

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Phenanthrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.023	Minimum Non-Detect	0.00853
Maximum Detect	1	Maximum Non-Detect	0.0273
Variance Detects	0.0898	Percent Non-Detects	18.18%
Mean Detects	0.221	SD Detects	0.3
Median Detects	0.124	CV Detects	1.357
Skewness Detects	2.724	Kurtosis Detects	7.776
Mean of Logged Detects	-2.034	SD of Logged Detects	1.033

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.605	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.37	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.183	Standard Error of Mean	0.0857
SD	0.268	95% KM (BCA) UCL	0.343
95% KM (t) UCL	0.338	95% KM (Percentile Bootstrap) UCL	0.335
95% KM (z) UCL	0.324	95% KM Bootstrap t UCL	0.642
90% KM Chebyshev UCL	0.44	95% KM Chebyshev UCL	0.556
97.5% KM Chebyshev UCL	0.718	99% KM Chebyshev UCL	1.035

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.568	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.238	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.286	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.091	k star (bias corrected MLE)	0.802
Theta hat (MLE)	0.202	Theta star (bias corrected MLE)	0.275
nu hat (MLE)	19.64	nu star (bias corrected)	14.43
MLE Mean (bias corrected)	0.221	MLE Sd (bias corrected)	0.247

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.466	nu hat (KM)	10.25
Approximate Chi Square Value (10.25, α)	4.099	Adjusted Chi Square Value (10.25, β)	3.488
95% Gamma Approximate KM-UCL (use when n>=50)	0.457	95% Gamma Adjusted KM-UCL (use when n<50)	0.537

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Phenanthrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.182
Maximum	1	Median	0.103
SD	0.281	CV	1.541
k hat (MLE)	0.748	k star (bias corrected MLE)	0.605
Theta hat (MLE)	0.244	Theta star (bias corrected MLE)	0.302
nu hat (MLE)	16.46	nu star (bias corrected)	13.3
MLE Mean (bias corrected)	0.182	MLE Sd (bias corrected)	0.235
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (13.30, α)	6.097	Adjusted Chi Square Value (13.30, β)	5.322
95% Gamma Approximate UCL (use when n>=50)	0.398	95% Gamma Adjusted UCL (use when n<50)	0.456

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.174	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.183	Mean in Log Scale	-2.444
SD in Original Scale	0.281	SD in Log Scale	1.304
95% t UCL (assumes normality of ROS data)	0.337	95% Percentile Bootstrap UCL	0.335
95% BCA Bootstrap UCL	0.409	95% Bootstrap t UCL	0.659
95% H-UCL (Log ROS)	0.901		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.485	95% H-UCL (KM -Log)	0.893
KM SD (logged)	1.314	95% Critical H Value (KM-Log)	3.633
KM Standard Error of Mean (logged)	0.424		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.182	Mean in Log Scale	-2.551
SD in Original Scale	0.281	SD in Log Scale	1.497
95% t UCL (Assumes normality)	0.336	95% H-Stat UCL	1.612

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.556	95% GROS Adjusted Gamma UCL	0.456
95% Adjusted Gamma KM-UCL	0.537		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Pyrene

General Statistics			
Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.017	Minimum Non-Detect	0.00853
Maximum Detect	1.2	Maximum Non-Detect	0.0273
Variance Detects	0.138	Percent Non-Detects	18.18%
Mean Detects	0.241	SD Detects	0.371
Median Detects	0.135	CV Detects	1.542
Skewness Detects	2.662	Kurtosis Detects	7.44
Mean of Logged Detects	-2.216	SD of Logged Detects	1.349

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.615	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.336	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.199	Standard Error of Mean	0.105
SD	0.329	95% KM (BCA) UCL	0.396
95% KM (t) UCL	0.39	95% KM (Percentile Bootstrap) UCL	0.384
95% KM (z) UCL	0.372	95% KM Bootstrap t UCL	0.864
90% KM Chebyshev UCL	0.515	95% KM Chebyshev UCL	0.658
97.5% KM Chebyshev UCL	0.856	99% KM Chebyshev UCL	1.246

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.417	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.207	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.289	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.754	k star (bias corrected MLE)	0.577
Theta hat (MLE)	0.319	Theta star (bias corrected MLE)	0.417
nu hat (MLE)	13.58	nu star (bias corrected)	10.39
MLE Mean (bias corrected)	0.241	MLE Sd (bias corrected)	0.317

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.367	nu hat (KM)	8.066
Approximate Chi Square Value (8.07, α)	2.773	Adjusted Chi Square Value (8.07, β)	2.293
95% Gamma Approximate KM-UCL (use when n>=50)	0.579	95% Gamma Adjusted KM-UCL (use when n<50)	0.7

Port of St. Helens' Milton Creek Sediment Statistics
UCL Statistics for Data Sets with Non-Detects
95% Confidence Coefficient

Pyrene (cont.)

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.199
Maximum	1.2	Median	0.085
SD	0.345	CV	1.735
k hat (MLE)	0.597	k star (bias corrected MLE)	0.495
Theta hat (MLE)	0.333	Theta star (bias corrected MLE)	0.402
nu hat (MLE)	13.14	nu star (bias corrected)	10.89
MLE Mean (bias corrected)	0.199	MLE Sd (bias corrected)	0.283
		Adjusted Level of Significance (β)	0.0278
Approximate Chi Square Value (10.89, α)	4.503	Adjusted Chi Square Value (10.89, β)	3.856
95% Gamma Approximate UCL (use when n>=50)	0.481	95% Gamma Adjusted UCL (use when n<50)	0.561

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.199	Mean in Log Scale	-2.713
SD in Original Scale	0.345	SD in Log Scale	1.657
95% t UCL (assumes normality of ROS data)	0.387	95% Percentile Bootstrap UCL	0.388
95% BCA Bootstrap UCL	0.499	95% Bootstrap t UCL	0.821
95% H-UCL (Log ROS)	2.599		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.637	95% H-UCL (KM -Log)	1.298
KM SD (logged)	1.463	95% Critical H Value (KM-Log)	3.951
KM Standard Error of Mean (logged)	0.469		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.199	Mean in Log Scale	-2.7
SD in Original Scale	0.345	SD in Log Scale	1.638
95% t UCL (Assumes normality)	0.387	95% H-Stat UCL	2.425

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	0.658	95% GROS Adjusted Gamma UCL	0.561
95% Adjusted Gamma KM-UCL	0.7		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.15/19/2019 1:54:09 PM
From File	Surfacewater.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(a)anthracene TEQ

General Statistics

Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	8.0100E-6	Mean	2.5968E-5
Maximum	6.1900E-5	Median	2.2500E-5
SD	1.6224E-5	Std. Error of Mean	5.4081E-6
Coefficient of Variation	N/A	Skewness	1.401

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.89	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.171	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.6024E-5	95% Adjusted-CLT UCL (Chen-1995)	3.7562E-5
		95% Modified-t UCL (Johnson-1978)	3.6445E-5

Gamma GOF Test

A-D Test Statistic	0.168	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.726	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.112	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.281	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.192	k star (bias corrected MLE)	2.202
Theta hat (MLE)	8.1357E-6	Theta star (bias corrected MLE)	1.1793E-5
nu hat (MLE)	57.45	nu star (bias corrected)	39.64
MLE Mean (bias corrected)	2.5968E-5	MLE Sd (bias corrected)	1.7500E-5
		Approximate Chi Square Value (0.05)	26.21

51	Adjusted Level of Significance				0.0231	Adjusted Chi Square Value					23.93	
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))				3.9266E-5	95% Adjusted Gamma UCL (use when n<50)					4.3004E-5	
55												
56	**Lognormal GOF Test**											
57	Shapiro Wilk Test Statistic				0.99	**Shapiro Wilk Lognormal GOF Test**						
58	5% Shapiro Wilk Critical Value				0.829	Data appear Lognormal at 5% Significance Level						
59	Lilliefors Test Statistic				0.123	**Lilliefors Lognormal GOF Test**						
60	5% Lilliefors Critical Value				0.274	Data appear Lognormal at 5% Significance Level						
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64	Minimum of Logged Data				-11.73	Mean of logged Data					-10.72	
65	Maximum of Logged Data				-9.69	SD of logged Data					0.615	
66												
67	**Assuming Lognormal Distribution**											
68	95% H-UCL				4.5544E-5	90% Chebyshev (MVUE) UCL					4.2305E-5	
69	95% Chebyshev (MVUE) UCL				4.9696E-5	97.5% Chebyshev (MVUE) UCL					5.9953E-5	
70	99% Chebyshev (MVUE) UCL				8.0102E-5							
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76	95% CLT UCL				3.4863E-5	95% Jackknife UCL					3.6024E-5	
77	95% Standard Bootstrap UCL				3.4249E-5	95% Bootstrap-t UCL					4.1508E-5	
78	95% Hall's Bootstrap UCL				7.3178E-5	95% Percentile Bootstrap UCL					3.4256E-5	
79	95% BCA Bootstrap UCL				3.7268E-5							
80	90% Chebyshev(Mean, Sd) UCL				4.2192E-5	95% Chebyshev(Mean, Sd) UCL					4.9541E-5	
81	97.5% Chebyshev(Mean, Sd) UCL				5.9741E-5	99% Chebyshev(Mean, Sd) UCL					7.9778E-5	
82												
83	**Suggested UCL to Use**											
84	95% Student's-t UCL				3.6024E-5							
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	Recommendations are based upon data size, data distribution, and skewness.											
88	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
89	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
90												
91												
92	**Chrysene TEQ**											
93												
94	**General Statistics**											
95	Total Number of Observations				9	Number of Distinct Observations					9	
96						Number of Missing Observations					0	
97	Minimum				9.5600E-8	Mean					2.6129E-7	
98	Maximum				5.6600E-7	Median					2.4700E-7	
99	SD				1.3949E-7	Std. Error of Mean					4.6496E-8	
100	Coefficient of Variation				N/A	Skewness					1.263	

101												
102	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
103	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
104	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
105	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
106												
107	**Normal GOF Test**											
108					Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**					
109					5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level					
110					Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**					
111					5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level					
112	**Data appear Normal at 5% Significance Level**											
113												
114	**Assuming Normal Distribution**											
115	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
116					95% Student's-t UCL	3.4775E-7	95% Adjusted-CLT UCL (Chen-1995)	3.5867E-7				
117							95% Modified-t UCL (Johnson-1978)	3.5101E-7				
118												
119	**Gamma GOF Test**											
120					A-D Test Statistic	0.177	**Anderson-Darling Gamma GOF Test**					
121					5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level					
122					K-S Test Statistic	0.148	**Kolmogorov-Smirnov Gamma GOF Test**					
123					5% K-S Critical Value	0.28	Detected data appear Gamma Distributed at 5% Significance Level					
124	**Detected data appear Gamma Distributed at 5% Significance Level**											
125												
126	**Gamma Statistics**											
127					k hat (MLE)	4.261	k star (bias corrected MLE)	2.914				
128					Theta hat (MLE)	6.1326E-8	Theta star (bias corrected MLE)	8.9651E-8				
129					nu hat (MLE)	76.69	nu star (bias corrected)	52.46				
130					MLE Mean (bias corrected)	2.6129E-7	MLE Sd (bias corrected)	1.5305E-7				
131							Approximate Chi Square Value (0.05)	36.82				
132					Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	34.08				
133												
134	**Assuming Gamma Distribution**											
135					95% Approximate Gamma UCL (use when n>=50))	3.7225E-7	95% Adjusted Gamma UCL (use when n<50)	4.0221E-7				
136												
137	**Lognormal GOF Test**											
138					Shapiro Wilk Test Statistic	0.986	**Shapiro Wilk Lognormal GOF Test**					
139					5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level					
140					Lilliefors Test Statistic	0.143	**Lilliefors Lognormal GOF Test**					
141					5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level					
142	**Data appear Lognormal at 5% Significance Level**											
143												
144	**Lognormal Statistics**											
145					Minimum of Logged Data	-16.16	Mean of logged Data	-15.28				
146					Maximum of Logged Data	-14.38	SD of logged Data	0.529				
147												
148	**Assuming Lognormal Distribution**											
149					95% H-UCL	4.0733E-7	90% Chebyshev (MVUE) UCL	4.0214E-7				
150					95% Chebyshev (MVUE) UCL	4.6582E-7	97.5% Chebyshev (MVUE) UCL	5.5420E-7				

151				99% Chebyshev (MVUE) UCL	7.2781E-7							
152												
153	**Nonparametric Distribution Free UCL Statistics**											
154	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
155												
156	**Nonparametric Distribution Free UCLs**											
157				95% CLT UCL	3.3777E-7			95% Jackknife UCL	3.4775E-7			
158				95% Standard Bootstrap UCL	3.3259E-7			95% Bootstrap-t UCL	3.8212E-7			
159				95% Hall's Bootstrap UCL	4.6626E-7			95% Percentile Bootstrap UCL	3.3840E-7			
160				95% BCA Bootstrap UCL	3.4862E-7							
161				90% Chebyshev(Mean, Sd) UCL	4.0078E-7			95% Chebyshev(Mean, Sd) UCL	4.6396E-7			
162				97.5% Chebyshev(Mean, Sd) UCL	5.5165E-7			99% Chebyshev(Mean, Sd) UCL	7.2391E-7			
163												
164	**Suggested UCL to Use**											
165				95% Student's-t UCL	3.4775E-7							
166												
167	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
168	Recommendations are based upon data size, data distribution, and skewness.											
169	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
170	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
171												
172												
173	**Benzo(b)fluoranthene TEQ**											
174												
175	**General Statistics**											
176				Total Number of Observations	9			Number of Distinct Observations	9			
177								Number of Missing Observations	0			
178				Minimum	3.3700E-6			Mean	8.8389E-6			
179				Maximum	2.0800E-5			Median	7.2900E-6			
180				SD	5.3531E-6			Std. Error of Mean	1.7844E-6			
181				Coefficient of Variation	N/A			Skewness	1.494			
182												
183	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
184	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
185	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
186	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
187												
188	**Normal GOF Test**											
189				Shapiro Wilk Test Statistic	0.87			**Shapiro Wilk GOF Test**				
190				5% Shapiro Wilk Critical Value	0.829			Data appear Normal at 5% Significance Level				
191				Lilliefors Test Statistic	0.179			**Lilliefors GOF Test**				
192				5% Lilliefors Critical Value	0.274			Data appear Normal at 5% Significance Level				
193	**Data appear Normal at 5% Significance Level**											
194												
195	**Assuming Normal Distribution**											
196	**95% Normal UCL**							**95% UCLs (Adjusted for Skewness)**				
197				95% Student's-t UCL	1.2157E-5			95% Adjusted-CLT UCL (Chen-1995)	1.2723E-5			
198								95% Modified-t UCL (Johnson-1978)	1.2305E-5			
199												
200	**Gamma GOF Test**											

201					A-D Test Statistic	0.216	**Anderson-Darling Gamma GOF Test**					
202					5% A-D Critical Value	0.726	Detected data appear Gamma Distributed at 5% Significance Level					
203					K-S Test Statistic	0.129	**Kolmogorov-Smirnov Gamma GOF Test**					
204					5% K-S Critical Value	0.281	Detected data appear Gamma Distributed at 5% Significance Level					
205	**Detected data appear Gamma Distributed at 5% Significance Level**											
206												
207	**Gamma Statistics**											
208					k hat (MLE)	3.601				k star (bias corrected MLE)	2.475	
209					Theta hat (MLE)	2.4547E-6				Theta star (bias corrected MLE)	3.5718E-6	
210					nu hat (MLE)	64.82				nu star (bias corrected)	44.54	
211					MLE Mean (bias corrected)	8.8389E-6				MLE Sd (bias corrected)	5.6188E-6	
212										Approximate Chi Square Value (0.05)	30.24	
213					Adjusted Level of Significance	0.0231				Adjusted Chi Square Value	27.77	
214												
215	**Assuming Gamma Distribution**											
216					95% Approximate Gamma UCL (use when n>=50))	1.3022E-5				95% Adjusted Gamma UCL (use when n<50)	1.4177E-5	
217												
218	**Lognormal GOF Test**											
219					Shapiro Wilk Test Statistic	0.981	**Shapiro Wilk Lognormal GOF Test**					
220					5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level					
221					Lilliefors Test Statistic	0.115	**Lilliefors Lognormal GOF Test**					
222					5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level					
223	**Data appear Lognormal at 5% Significance Level**											
224												
225	**Lognormal Statistics**											
226					Minimum of Logged Data	-12.6				Mean of logged Data	-11.78	
227					Maximum of Logged Data	-10.78				SD of logged Data	0.564	
228												
229	**Assuming Lognormal Distribution**											
230					95% H-UCL	1.4321E-5				90% Chebyshev (MVUE) UCL	1.3833E-5	
231					95% Chebyshev (MVUE) UCL	1.6119E-5				97.5% Chebyshev (MVUE) UCL	1.9290E-5	
232					99% Chebyshev (MVUE) UCL	2.5520E-5						
233												
234	**Nonparametric Distribution Free UCL Statistics**											
235	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
236												
237	**Nonparametric Distribution Free UCLs**											
238					95% CLT UCL	1.1774E-5				95% Jackknife UCL	1.2157E-5	
239					95% Standard Bootstrap UCL	1.1674E-5				95% Bootstrap-t UCL	1.3878E-5	
240					95% Hall's Bootstrap UCL	2.4340E-5				95% Percentile Bootstrap UCL	1.1933E-5	
241					95% BCA Bootstrap UCL	1.2584E-5						
242					90% Chebyshev(Mean, Sd) UCL	1.4192E-5				95% Chebyshev(Mean, Sd) UCL	1.6617E-5	
243					97.5% Chebyshev(Mean, Sd) UCL	1.9982E-5				99% Chebyshev(Mean, Sd) UCL	2.6593E-5	
244												
245	**Suggested UCL to Use**											
246					95% Student's-t UCL	1.2157E-5						
247												
248	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
249	Recommendations are based upon data size, data distribution, and skewness.											
250	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											

251	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
252												
253												
254	**Benzo(k)fluoranthene TEQ**											
255												
256	**General Statistics**											
257						Total Number of Observations	9				Number of Distinct Observations	9	
258											Number of Missing Observations	0
259						Minimum	1.2900E-7				Mean	3.6111E-7
260						Maximum	9.0800E-7				Median	2.9800E-7
261						SD	2.3373E-7				Std. Error of Mean	7.7910E-8
262						Coefficient of Variation	N/A				Skewness	1.804
263												
264	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
265	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
266	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
267	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
268												
269	**Normal GOF Test**											
270						Shapiro Wilk Test Statistic	0.831				**Shapiro Wilk GOF Test**	
271						5% Shapiro Wilk Critical Value	0.829				Data appear Normal at 5% Significance Level	
272						Lilliefors Test Statistic	0.222				**Lilliefors GOF Test**	
273						5% Lilliefors Critical Value	0.274				Data appear Normal at 5% Significance Level	
274	**Data appear Normal at 5% Significance Level**											
275												
276	**Assuming Normal Distribution**											
277						**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**	
278						95% Student's-t UCL	5.0599E-7				95% Adjusted-CLT UCL (Chen-1995)	5.3932E-7
279											95% Modified-t UCL (Johnson-1978)	5.1380E-7
280												
281	**Gamma GOF Test**											
282						A-D Test Statistic	0.258				**Anderson-Darling Gamma GOF Test**	
283						5% A-D Critical Value	0.726				Detected data appear Gamma Distributed at 5% Significance Level	
284						K-S Test Statistic	0.143				**Kolmogorov-Smirnov Gamma GOF Test**	
285						5% K-S Critical Value	0.281				Detected data appear Gamma Distributed at 5% Significance Level	
286	**Detected data appear Gamma Distributed at 5% Significance Level**											
287												
288	**Gamma Statistics**											
289						k hat (MLE)	3.38				k star (bias corrected MLE)	2.328
290						Theta hat (MLE)	1.0683E-7				Theta star (bias corrected MLE)	1.5514E-7
291						nu hat (MLE)	60.85				nu star (bias corrected)	41.9
292						MLE Mean (bias corrected)	3.6111E-7				MLE Sd (bias corrected)	2.3669E-7
293											Approximate Chi Square Value (0.05)	28.06
294						Adjusted Level of Significance	0.0231				Adjusted Chi Square Value	25.69
295												
296	**Assuming Gamma Distribution**											
297						95% Approximate Gamma UCL (use when n>=50))	5.3919E-7				95% Adjusted Gamma UCL (use when n<50)	5.8883E-7
298												
299	**Lognormal GOF Test**											
300						Shapiro Wilk Test Statistic	0.981				**Shapiro Wilk Lognormal GOF Test**	

301	5% Shapiro Wilk Critical Value					0.829	Data appear Lognormal at 5% Significance Level					
302	Lilliefors Test Statistic					0.115	**Lilliefors Lognormal GOF Test**					
303	5% Lilliefors Critical Value					0.274	Data appear Lognormal at 5% Significance Level					
304	**Data appear Lognormal at 5% Significance Level**											
305												
306	**Lognormal Statistics**											
307	Minimum of Logged Data					-15.86	Mean of logged Data					-14.99
308	Maximum of Logged Data					-13.91	SD of logged Data					0.577
309												
310	**Assuming Lognormal Distribution**											
311	95% H-UCL					5.9293E-7	90% Chebyshev (MVUE) UCL					5.6763E-7
312	95% Chebyshev (MVUE) UCL					6.6272E-7	97.5% Chebyshev (MVUE) UCL					7.9471E-7
313	99% Chebyshev (MVUE) UCL					1.0540E-6						
314												
315	**Nonparametric Distribution Free UCL Statistics**											
316	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
317												
318	**Nonparametric Distribution Free UCLs**											
319	95% CLT UCL					4.8926E-7	95% Jackknife UCL					5.0599E-7
320	95% Standard Bootstrap UCL					4.8223E-7	95% Bootstrap-t UCL					6.1664E-7
321	95% Hall's Bootstrap UCL					1.1009E-6	95% Percentile Bootstrap UCL					4.8844E-7
322	95% BCA Bootstrap UCL					5.2533E-7						
323	90% Chebyshev(Mean, Sd) UCL					5.9484E-7	95% Chebyshev(Mean, Sd) UCL					7.0071E-7
324	97.5% Chebyshev(Mean, Sd) UCL					8.4766E-7	99% Chebyshev(Mean, Sd) UCL					1.1363E-6
325												
326	**Suggested UCL to Use**											
327	95% Student's-t UCL					5.0599E-7						
328												
329	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
330	Recommendations are based upon data size, data distribution, and skewness.											
331	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
332	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
333												
334												
335	**Benzo(a)pyrene TEQ**											
336												
337	**General Statistics**											
338	Total Number of Observations					9	Number of Distinct Observations					9
339							Number of Missing Observations					0
340	Minimum					1.6100E-5	Mean					4.6733E-5
341	Maximum					1.2300E-4	Median					4.0800E-5
342	SD					3.3302E-5	Std. Error of Mean					1.1101E-5
343	Coefficient of Variation					N/A	Skewness					1.667
344												
345	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
346	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
347	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
348	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
349												
350	**Normal GOF Test**											

351				Shapiro Wilk Test Statistic		0.84	**Shapiro Wilk GOF Test**					
352				5% Shapiro Wilk Critical Value		0.829	Data appear Normal at 5% Significance Level					
353				Lilliefors Test Statistic		0.181	**Lilliefors GOF Test**					
354				5% Lilliefors Critical Value		0.274	Data appear Normal at 5% Significance Level					
355	**Data appear Normal at 5% Significance Level**											
356												
357	**Assuming Normal Distribution**											
358	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
359				95% Student's-t UCL		6.7375E-5	95% Adjusted-CLT UCL (Chen-1995)					7.1582E-5
360							95% Modified-t UCL (Johnson-1978)					6.8403E-5
361												
362	**Gamma GOF Test**											
363				A-D Test Statistic		0.244	**Anderson-Darling Gamma GOF Test**					
364				5% A-D Critical Value		0.728	Detected data appear Gamma Distributed at 5% Significance Level					
365				K-S Test Statistic		0.136	**Kolmogorov-Smirnov Gamma GOF Test**					
366				5% K-S Critical Value		0.282	Detected data appear Gamma Distributed at 5% Significance Level					
367	**Detected data appear Gamma Distributed at 5% Significance Level**											
368												
369	**Gamma Statistics**											
370				k hat (MLE)		2.705	k star (bias corrected MLE)					1.877
371				Theta hat (MLE)		1.7277E-5	Theta star (bias corrected MLE)					2.4893E-5
372				nu hat (MLE)		48.69	nu star (bias corrected)					33.79
373				MLE Mean (bias corrected)		4.6733E-5	MLE Sd (bias corrected)					3.4108E-5
374							Approximate Chi Square Value (0.05)					21.5
375				Adjusted Level of Significance		0.0231	Adjusted Chi Square Value					19.46
376												
377	**Assuming Gamma Distribution**											
378				95% Approximate Gamma UCL (use when n>=50))		7.3458E-5	95% Adjusted Gamma UCL (use when n<50)					8.1170E-5
379												
380	**Lognormal GOF Test**											
381				Shapiro Wilk Test Statistic		0.97	**Shapiro Wilk Lognormal GOF Test**					
382				5% Shapiro Wilk Critical Value		0.829	Data appear Lognormal at 5% Significance Level					
383				Lilliefors Test Statistic		0.125	**Lilliefors Lognormal GOF Test**					
384				5% Lilliefors Critical Value		0.274	Data appear Lognormal at 5% Significance Level					
385	**Data appear Lognormal at 5% Significance Level**											
386												
387	**Lognormal Statistics**											
388				Minimum of Logged Data		-11.04	Mean of logged Data					-10.17
389				Maximum of Logged Data		-9.003	SD of logged Data					0.653
390												
391	**Assuming Lognormal Distribution**											
392				95% H-UCL		8.5487E-5	90% Chebyshev (MVUE) UCL					7.7180E-5
393				95% Chebyshev (MVUE) UCL		9.1178E-5	97.5% Chebyshev (MVUE) UCL					1.1061E-4
394				99% Chebyshev (MVUE) UCL		1.4877E-4						
395												
396	**Nonparametric Distribution Free UCL Statistics**											
397	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
398												
399	**Nonparametric Distribution Free UCLs**											
400				95% CLT UCL		6.4992E-5	95% Jackknife UCL					6.7375E-5

401				95% Standard Bootstrap UCL	6.3955E-5				95% Bootstrap-t UCL	8.0634E-5		
402				95% Hall's Bootstrap UCL	1.4841E-4				95% Percentile Bootstrap UCL	6.5422E-5		
403				95% BCA Bootstrap UCL	6.9989E-5							
404				90% Chebyshev(Mean, Sd) UCL	8.0035E-5				95% Chebyshev(Mean, Sd) UCL	9.5120E-5		
405				97.5% Chebyshev(Mean, Sd) UCL	1.1606E-4				99% Chebyshev(Mean, Sd) UCL	1.5718E-4		
406												
407				**Suggested UCL to Use**								
408				95% Student's-t UCL	6.7375E-5							
409												
410	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
411	Recommendations are based upon data size, data distribution, and skewness.											
412	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
413	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
414												
415												
416	**Indeno(1,2,3-cd)pyrene TEQ**											
417												
418	**General Statistics**											
419				Total Number of Observations	9				Number of Distinct Observations	9		
420									Number of Missing Observations	0		
421				Minimum	8.1000E-9				Mean	7.3096E-7		
422				Maximum	1.7000E-6				Median	8.8100E-7		
423				SD	6.3223E-7				Std. Error of Mean	2.1074E-7		
424				Coefficient of Variation	N/A				Skewness	0.0367		
425												
426	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
427	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
428	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
429	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
430												
431	**Normal GOF Test**											
432				Shapiro Wilk Test Statistic	0.9				**Shapiro Wilk GOF Test**			
433				5% Shapiro Wilk Critical Value	0.829				Data appear Normal at 5% Significance Level			
434				Lilliefors Test Statistic	0.207				**Lilliefors GOF Test**			
435				5% Lilliefors Critical Value	0.274				Data appear Normal at 5% Significance Level			
436	**Data appear Normal at 5% Significance Level**											
437												
438	**Assuming Normal Distribution**											
439	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
440				95% Student's-t UCL	1.1228E-6				95% Adjusted-CLT UCL (Chen-1995)	1.0803E-6		
441									95% Modified-t UCL (Johnson-1978)	1.1233E-6		
442												
443	**Gamma GOF Test**											
444				A-D Test Statistic	1.051				**Anderson-Darling Gamma GOF Test**			
445				5% A-D Critical Value	0.771				Data Not Gamma Distributed at 5% Significance Level			
446				K-S Test Statistic	0.283				**Kolmogorov-Smirnov Gamma GOF Test**			
447				5% K-S Critical Value	0.294				Detected data appear Gamma Distributed at 5% Significance Level			
448	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
449												
450	**Gamma Statistics**											

451					k hat (MLE)	0.502				k star (bias corrected MLE)		0.409
452					Theta hat (MLE)	1.4549E-6				Theta star (bias corrected MLE)		1.7871E-6
453					nu hat (MLE)	9.043				nu star (bias corrected)		7.362
454					MLE Mean (bias corrected)	7.3096E-7				MLE Sd (bias corrected)		1.1429E-6
455										Approximate Chi Square Value (0.05)		2.372
456					Adjusted Level of Significance	0.0231				Adjusted Chi Square Value		1.819
457												
458	**Assuming Gamma Distribution**											
459	95% Approximate Gamma UCL (use when n>=50))					2.2692E-6				95% Adjusted Gamma UCL (use when n<50)		2.9582E-6
460												
461	**Lognormal GOF Test**											
462	Shapiro Wilk Test Statistic					0.724	**Shapiro Wilk Lognormal GOF Test**					
463	5% Shapiro Wilk Critical Value					0.829	Data Not Lognormal at 5% Significance Level					
464	Lilliefors Test Statistic					0.3	**Lilliefors Lognormal GOF Test**					
465	5% Lilliefors Critical Value					0.274	Data Not Lognormal at 5% Significance Level					
466	**Data Not Lognormal at 5% Significance Level**											
467												
468	**Lognormal Statistics**											
469	Minimum of Logged Data					-18.63				Mean of logged Data		-15.39
470	Maximum of Logged Data					-13.28				SD of logged Data		2.416
471												
472	**Assuming Lognormal Distribution**											
473	95% H-UCL					0.00127				90% Chebyshev (MVUE) UCL		5.8324E-6
474	95% Chebyshev (MVUE) UCL					7.6699E-6				97.5% Chebyshev (MVUE) UCL		1.0220E-5
475	99% Chebyshev (MVUE) UCL					1.5230E-5						
476												
477	**Nonparametric Distribution Free UCL Statistics**											
478	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
479												
480	**Nonparametric Distribution Free UCLs**											
481	95% CLT UCL					1.0776E-6				95% Jackknife UCL		1.1228E-6
482	95% Standard Bootstrap UCL					1.0602E-6				95% Bootstrap-t UCL		1.1120E-6
483	95% Hall's Bootstrap UCL					1.0479E-6				95% Percentile Bootstrap UCL		1.0491E-6
484	95% BCA Bootstrap UCL					1.0552E-6						
485	90% Chebyshev(Mean, Sd) UCL					1.3632E-6				95% Chebyshev(Mean, Sd) UCL		1.6496E-6
486	97.5% Chebyshev(Mean, Sd) UCL					2.0470E-6				99% Chebyshev(Mean, Sd) UCL		2.8278E-6
487												
488	**Suggested UCL to Use**											
489	95% Student's-t UCL					1.1228E-6						
490												
491	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
492	Recommendations are based upon data size, data distribution, and skewness.											
493	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
494	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
495												
496												
497	**Dibenzo(a,h)anthracene TEQ**											
498												
499	**General Statistics**											
500	Total Number of Observations					9				Number of Distinct Observations		9

501											Number of Missing Observations	0
502					Minimum	2.0500E-7					Mean	9.0922E-7
503					Maximum	3.4600E-6					Median	3.2600E-7
504					SD	1.2636E-6					Std. Error of Mean	4.2120E-7
505					Coefficient of Variation	N/A					Skewness	1.692
506												
507	**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use**											
508	**guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.**											
509	**For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).**											
510	**Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**											
511												
512	**Normal GOF Test**											
513					Shapiro Wilk Test Statistic	0.603	**Shapiro Wilk GOF Test**					
514					5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level					
515					Lilliefors Test Statistic	0.446	**Lilliefors GOF Test**					
516					5% Lilliefors Critical Value	0.274	Data Not Normal at 5% Significance Level					
517	**Data Not Normal at 5% Significance Level**											
518												
519	**Assuming Normal Distribution**											
520	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
521					95% Student's-t UCL	1.6925E-6					95% Adjusted-CLT UCL (Chen-1995)	1.8559E-6
522											95% Modified-t UCL (Johnson-1978)	1.7321E-6
523												
524	**Gamma GOF Test**											
525					A-D Test Statistic	1.592	**Anderson-Darling Gamma GOF Test**					
526					5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level					
527					K-S Test Statistic	0.426	**Kolmogorov-Smirnov Gamma GOF Test**					
528					5% K-S Critical Value	0.288	Data Not Gamma Distributed at 5% Significance Level					
529	**Data Not Gamma Distributed at 5% Significance Level**											
530												
531	**Gamma Statistics**											
532					k hat (MLE)	0.883					k star (bias corrected MLE)	0.663
533					Theta hat (MLE)	1.0300E-6					Theta star (bias corrected MLE)	1.3723E-6
534					nu hat (MLE)	15.89					nu star (bias corrected)	11.93
535					MLE Mean (bias corrected)	9.0922E-7					MLE Sd (bias corrected)	1.1170E-6
536											Approximate Chi Square Value (0.05)	5.178
537					Adjusted Level of Significance	0.0231					Adjusted Chi Square Value	4.279
538												
539	**Assuming Gamma Distribution**											
540					95% Approximate Gamma UCL (use when n>=50))	2.0940E-6					95% Adjusted Gamma UCL (use when n<50)	2.5339E-6
541												
542	**Lognormal GOF Test**											
543					Shapiro Wilk Test Statistic	0.705	**Shapiro Wilk Lognormal GOF Test**					
544					5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level					
545					Lilliefors Test Statistic	0.375	**Lilliefors Lognormal GOF Test**					
546					5% Lilliefors Critical Value	0.274	Data Not Lognormal at 5% Significance Level					
547	**Data Not Lognormal at 5% Significance Level**											
548												
549	**Lognormal Statistics**											
550					Minimum of Logged Data	-15.4					Mean of logged Data	-14.57

551	Maximum of Logged Data					-12.57	SD of logged Data					1.091
552												
553	**Assuming Lognormal Distribution**											
554	95% H-UCL					3.2000E-6	90% Chebyshev (MVUE) UCL					1.6509E-6
555	95% Chebyshev (MVUE) UCL					2.0479E-6	97.5% Chebyshev (MVUE) UCL					2.5989E-6
556	99% Chebyshev (MVUE) UCL					3.6812E-6						
557												
558	**Nonparametric Distribution Free UCL Statistics**											
559	**Data do not follow a Discernible Distribution (0.05)**											
560												
561	**Nonparametric Distribution Free UCLs**											
562	95% CLT UCL					1.6020E-6	95% Jackknife UCL					1.6925E-6
563	95% Standard Bootstrap UCL					1.5766E-6	95% Bootstrap-t UCL					1.4256E-5
564	95% Hall's Bootstrap UCL					1.0147E-5	95% Percentile Bootstrap UCL					1.6213E-6
565	95% BCA Bootstrap UCL					1.7546E-6						
566	90% Chebyshev(Mean, Sd) UCL					2.1728E-6	95% Chebyshev(Mean, Sd) UCL					2.7452E-6
567	97.5% Chebyshev(Mean, Sd) UCL					3.5396E-6	99% Chebyshev(Mean, Sd) UCL					5.1001E-6
568												
569	**Suggested UCL to Use**											
570	95% Hall's Bootstrap UCL					1.0147E-5						
571												
572	**Recommended UCL exceeds the maximum observation**											
573												
574	**In Case Bootstrap t and/or Hall's Bootstrap yields an unreasonably large UCL value, use 97.5% or 99% Chebyshev (Mean, Sd) UCL**											
575												
576	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
577	Recommendations are based upon data size, data distribution, and skewness.											
578	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
579	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
580												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.15/19/2019 2:25:00 PM
From File	Porewater.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(a)anthracene TEQ

General Statistics

Total Number of Observations	29	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	6.5800E-8	Mean	9.8546E-6
Maximum	1.1200E-4	Median	2.8000E-6
SD	2.1116E-5	Std. Error of Mean	3.9211E-6
Coefficient of Variation	N/A	Skewness	4.331

Normal GOF Test

Shapiro Wilk Test Statistic	0.458	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.321	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.161	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.6525E-5	95% Adjusted-CLT UCL (Chen-1995)	1.9674E-5
		95% Modified-t UCL (Johnson-1978)	1.7050E-5

Gamma GOF Test

A-D Test Statistic	1.032	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.819	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.215	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.173	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.465	k star (bias corrected MLE)	0.44
Theta hat (MLE)	2.1189E-5	Theta star (bias corrected MLE)	2.2399E-5
nu hat (MLE)	26.97	nu star (bias corrected)	25.52
MLE Mean (bias corrected)	9.8546E-6	MLE Sd (bias corrected)	1.4857E-5
		Approximate Chi Square Value (0.05)	15.01
Adjusted Level of Significance	0.0407	Adjusted Chi Square Value	14.53

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.6755E-5	95% Adjusted Gamma UCL (use when n<50)	1.7311E-5

51	**Lognormal GOF Test**											
52					Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk Lognormal GOF Test**					
53					5% Shapiro Wilk Critical Value	0.926	Data Not Lognormal at 5% Significance Level					
54					Lilliefors Test Statistic	0.17	**Lilliefors Lognormal GOF Test**					
55					5% Lilliefors Critical Value	0.161	Data Not Lognormal at 5% Significance Level					
56	**Data Not Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59					Minimum of Logged Data	-16.54	Mean of logged Data	-12.91				
60					Maximum of Logged Data	-9.097	SD of logged Data	1.921				
61												
62	**Assuming Lognormal Distribution**											
63					95% H-UCL	6.2023E-5	90% Chebyshev (MVUE) UCL	3.2439E-5				
64					95% Chebyshev (MVUE) UCL	4.1058E-5	97.5% Chebyshev (MVUE) UCL	5.3021E-5				
65					99% Chebyshev (MVUE) UCL	7.6519E-5						
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data do not follow a Discernible Distribution (0.05)**											
69												
70	**Nonparametric Distribution Free UCLs**											
71					95% CLT UCL	1.6304E-5	95% Jackknife UCL	1.6525E-5				
72					95% Standard Bootstrap UCL	1.6212E-5	95% Bootstrap-t UCL	2.6815E-5				
73					95% Hall's Bootstrap UCL	3.9006E-5	95% Percentile Bootstrap UCL	1.7105E-5				
74					95% BCA Bootstrap UCL	2.1990E-5						
75					90% Chebyshev(Mean, Sd) UCL	2.1618E-5	95% Chebyshev(Mean, Sd) UCL	2.6946E-5				
76					97.5% Chebyshev(Mean, Sd) UCL	3.4342E-5	99% Chebyshev(Mean, Sd) UCL	4.8869E-5				
77												
78	**Suggested UCL to Use**											
79					95% Chebyshev (Mean, Sd) UCL	2.6946E-5						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												
86												
87	**Chrysene TEQ**											
88												
89	**General Statistics**											
90					Total Number of Observations	29	Number of Distinct Observations	29				
91							Number of Missing Observations	0				
92					Minimum	5.850E-10	Mean	1.0808E-7				
93					Maximum	1.1400E-6	Median	2.8800E-8				
94					SD	2.2174E-7	Std. Error of Mean	4.1177E-8				
95					Coefficient of Variation	N/A	Skewness	3.951				
96												
97	**Normal GOF Test**											
98					Shapiro Wilk Test Statistic	0.495	**Shapiro Wilk GOF Test**					
99					5% Shapiro Wilk Critical Value	0.926	Data Not Normal at 5% Significance Level					
100					Lilliefors Test Statistic	0.317	**Lilliefors GOF Test**					

101	5% Lilliefors Critical Value				0.161	Data Not Normal at 5% Significance Level						
102	**Data Not Normal at 5% Significance Level**											
103												
104	**Assuming Normal Distribution**											
105	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
106	95% Student's-t UCL				1.7812E-7	95% Adjusted-CLT UCL (Chen-1995)						2.0809E-7
107						95% Modified-t UCL (Johnson-1978)						1.8316E-7
108												
109	**Gamma GOF Test**											
110	A-D Test Statistic				0.961	**Anderson-Darling Gamma GOF Test**						
111	5% A-D Critical Value				0.816	Data Not Gamma Distributed at 5% Significance Level						
112	K-S Test Statistic				0.201	**Kolmogorov-Smirnov Gamma GOF Test**						
113	5% K-S Critical Value				0.173	Data Not Gamma Distributed at 5% Significance Level						
114	**Data Not Gamma Distributed at 5% Significance Level**											
115												
116	**Gamma Statistics**											
117	k hat (MLE)				0.48	k star (bias corrected MLE)						0.454
118	Theta hat (MLE)				2.2495E-7	Theta star (bias corrected MLE)						2.3819E-7
119	nu hat (MLE)				27.87	nu star (bias corrected)						26.32
120	MLE Mean (bias corrected)				1.0808E-7	MLE Sd (bias corrected)						1.6044E-7
121						Approximate Chi Square Value (0.05)						15.62
122	Adjusted Level of Significance				0.0407	Adjusted Chi Square Value						15.13
123												
124	**Assuming Gamma Distribution**											
125	95% Approximate Gamma UCL (use when n>=50))				1.8205E-7	95% Adjusted Gamma UCL (use when n<50)						1.8797E-7
126												
127	**Lognormal GOF Test**											
128	Shapiro Wilk Test Statistic				0.944	**Shapiro Wilk Lognormal GOF Test**						
129	5% Shapiro Wilk Critical Value				0.926	Data appear Lognormal at 5% Significance Level						
130	Lilliefors Test Statistic				0.142	**Lilliefors Lognormal GOF Test**						
131	5% Lilliefors Critical Value				0.161	Data appear Lognormal at 5% Significance Level						
132	**Data appear Lognormal at 5% Significance Level**											
133												
134	**Lognormal Statistics**											
135	Minimum of Logged Data				-21.26	Mean of logged Data						-17.37
136	Maximum of Logged Data				-13.68	SD of logged Data						1.861
137												
138	**Assuming Lognormal Distribution**											
139	95% H-UCL				5.9084E-7	90% Chebyshev (MVUE) UCL						3.3115E-7
140	95% Chebyshev (MVUE) UCL				4.1774E-7	97.5% Chebyshev (MVUE) UCL						5.3792E-7
141	99% Chebyshev (MVUE) UCL				7.7400E-7							
142												
143	**Nonparametric Distribution Free UCL Statistics**											
144	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
145												
146	**Nonparametric Distribution Free UCLs**											
147	95% CLT UCL				1.7580E-7	95% Jackknife UCL						1.7812E-7
148	95% Standard Bootstrap UCL				1.7193E-7	95% Bootstrap-t UCL						2.8424E-7
149	95% Hall's Bootstrap UCL				4.3817E-7	95% Percentile Bootstrap UCL						1.8428E-7
150	95% BCA Bootstrap UCL				2.2098E-7							

151					90% Chebyshev(Mean, Sd) UCL	2.3161E-7				95% Chebyshev(Mean, Sd) UCL		2.8756E-7
152					97.5% Chebyshev(Mean, Sd) UCL	3.6522E-7				99% Chebyshev(Mean, Sd) UCL		5.1778E-7
153												
154					**Suggested UCL to Use**							
155					95% Chebyshev (Mean, Sd) UCL	2.8756E-7						
156												
157					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
158					Recommendations are based upon data size, data distribution, and skewness.							
159					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
160					However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.							
161												
162												
163	**Benzo(b)fluoranthene TEQ**											
164												
165					**General Statistics**							
166					Total Number of Observations	29				Number of Distinct Observations		28
167										Number of Missing Observations		0
168					Minimum	4.3400E-8				Mean		3.3181E-6
169					Maximum	3.3600E-5				Median		1.1800E-6
170					SD	6.4431E-6				Std. Error of Mean		1.1965E-6
171					Coefficient of Variation	N/A				Skewness		4.034
172												
173					**Normal GOF Test**							
174					Shapiro Wilk Test Statistic	0.495				**Shapiro Wilk GOF Test**		
175					5% Shapiro Wilk Critical Value	0.926				Data Not Normal at 5% Significance Level		
176					Lilliefors Test Statistic	0.307				**Lilliefors GOF Test**		
177					5% Lilliefors Critical Value	0.161				Data Not Normal at 5% Significance Level		
178					**Data Not Normal at 5% Significance Level**							
179												
180					**Assuming Normal Distribution**							
181					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
182					95% Student's-t UCL	5.3535E-6				95% Adjusted-CLT UCL (Chen-1995)		6.2439E-6
183										95% Modified-t UCL (Johnson-1978)		5.5029E-6
184												
185					**Gamma GOF Test**							
186					A-D Test Statistic	1.076				**Anderson-Darling Gamma GOF Test**		
187					5% A-D Critical Value	0.801				Data Not Gamma Distributed at 5% Significance Level		
188					K-S Test Statistic	0.227				**Kolmogorov-Smirnov Gamma GOF Test**		
189					5% K-S Critical Value	0.171				Data Not Gamma Distributed at 5% Significance Level		
190					**Data Not Gamma Distributed at 5% Significance Level**							
191												
192					**Gamma Statistics**							
193					k hat (MLE)	0.597				k star (bias corrected MLE)		0.558
194					Theta hat (MLE)	5.5585E-6				Theta star (bias corrected MLE)		5.9446E-6
195					nu hat (MLE)	34.62				nu star (bias corrected)		32.37
196					MLE Mean (bias corrected)	3.3181E-6				MLE Sd (bias corrected)		4.4413E-6
197										Approximate Chi Square Value (0.05)		20.37
198					Adjusted Level of Significance	0.0407				Adjusted Chi Square Value		19.8
199												
200					**Assuming Gamma Distribution**							

201	95% Approximate Gamma UCL (use when n>=50))					5.2738E-6	95% Adjusted Gamma UCL (use when n<50)					5.4255E-6
202												
203	**Lognormal GOF Test**											
204	Shapiro Wilk Test Statistic					0.943	**Shapiro Wilk Lognormal GOF Test**					
205	5% Shapiro Wilk Critical Value					0.926	Data appear Lognormal at 5% Significance Level					
206	Lilliefors Test Statistic					0.134	**Lilliefors Lognormal GOF Test**					
207	5% Lilliefors Critical Value					0.161	Data appear Lognormal at 5% Significance Level					
208	**Data appear Lognormal at 5% Significance Level**											
209												
210	**Lognormal Statistics**											
211	Minimum of Logged Data					-16.95	Mean of logged Data					-13.65
212	Maximum of Logged Data					-10.3	SD of logged Data					1.557
213												
214	**Assuming Lognormal Distribution**											
215	95% H-UCL					1.0233E-5	90% Chebyshev (MVUE) UCL					7.6401E-6
216	95% Chebyshev (MVUE) UCL					9.4524E-6	97.5% Chebyshev (MVUE) UCL					1.1968E-5
217	99% Chebyshev (MVUE) UCL					1.6909E-5						
218												
219	**Nonparametric Distribution Free UCL Statistics**											
220	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
221												
222	**Nonparametric Distribution Free UCLs**											
223	95% CLT UCL					5.2861E-6	95% Jackknife UCL					5.3535E-6
224	95% Standard Bootstrap UCL					5.2550E-6	95% Bootstrap-t UCL					7.7467E-6
225	95% Hall's Bootstrap UCL					1.2079E-5	95% Percentile Bootstrap UCL					5.4147E-6
226	95% BCA Bootstrap UCL					6.7360E-6						
227	90% Chebyshev(Mean, Sd) UCL					6.9075E-6	95% Chebyshev(Mean, Sd) UCL					8.5334E-6
228	97.5% Chebyshev(Mean, Sd) UCL					1.0790E-5	99% Chebyshev(Mean, Sd) UCL					1.5223E-5
229												
230	**Suggested UCL to Use**											
231	95% Chebyshev (Mean, Sd) UCL					8.5334E-6						
232												
233	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
234	Recommendations are based upon data size, data distribution, and skewness.											
235	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
236	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
237												
238												
239	**Benzo(k)fluoranthene TEQ**											
240												
241	**General Statistics**											
242	Total Number of Observations					29	Number of Distinct Observations					29
243							Number of Missing Observations					0
244	Minimum					3.9000E-9	Mean					1.7313E-7
245	Maximum					1.7700E-6	Median					6.7000E-8
246	SD					3.4324E-7	Std. Error of Mean					6.3738E-8
247	Coefficient of Variation					N/A	Skewness					3.92
248												
249	**Normal GOF Test**											
250	Shapiro Wilk Test Statistic					0.514	**Shapiro Wilk GOF Test**					

251	5% Shapiro Wilk Critical Value					0.926	Data Not Normal at 5% Significance Level					
252	Lilliefors Test Statistic					0.311	**Lilliefors GOF Test**					
253	5% Lilliefors Critical Value					0.161	Data Not Normal at 5% Significance Level					
254	**Data Not Normal at 5% Significance Level**											
255												
256	**Assuming Normal Distribution**											
257	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
258	95% Student's-t UCL					2.8156E-7	95% Adjusted-CLT UCL (Chen-1995)					3.2755E-7
259							95% Modified-t UCL (Johnson-1978)					2.8929E-7
260												
261	**Gamma GOF Test**											
262	A-D Test Statistic					1.025	**Anderson-Darling Gamma GOF Test**					
263	5% A-D Critical Value					0.813	Data Not Gamma Distributed at 5% Significance Level					
264	K-S Test Statistic					0.161	**Kolmogorov-Smirnov Gamma GOF Test**					
265	5% K-S Critical Value					0.172	Detected data appear Gamma Distributed at 5% Significance Level					
266	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
267												
268	**Gamma Statistics**											
269	k hat (MLE)					0.495	k star (bias corrected MLE)					0.467
270	Theta hat (MLE)					3.4986E-7	Theta star (bias corrected MLE)					3.7100E-7
271	nu hat (MLE)					28.7	nu star (bias corrected)					27.07
272	MLE Mean (bias corrected)					1.7313E-7	MLE Sd (bias corrected)					2.5344E-7
273							Approximate Chi Square Value (0.05)					16.2
274	Adjusted Level of Significance					0.0407	Adjusted Chi Square Value					15.7
275												
276	**Assuming Gamma Distribution**											
277	95% Approximate Gamma UCL (use when n>=50)					2.8921E-7	95% Adjusted Gamma UCL (use when n<50)					2.9847E-7
278												
279	**Lognormal GOF Test**											
280	Shapiro Wilk Test Statistic					0.924	**Shapiro Wilk Lognormal GOF Test**					
281	5% Shapiro Wilk Critical Value					0.926	Data Not Lognormal at 5% Significance Level					
282	Lilliefors Test Statistic					0.164	**Lilliefors Lognormal GOF Test**					
283	5% Lilliefors Critical Value					0.161	Data Not Lognormal at 5% Significance Level					
284	**Data Not Lognormal at 5% Significance Level**											
285												
286	**Lognormal Statistics**											
287	Minimum of Logged Data					-19.36	Mean of logged Data					-16.85
288	Maximum of Logged Data					-13.24	SD of logged Data					1.728
289												
290	**Assuming Lognormal Distribution**											
291	95% H-UCL					6.6618E-7	90% Chebyshev (MVUE) UCL					4.2801E-7
292	95% Chebyshev (MVUE) UCL					5.3571E-7	97.5% Chebyshev (MVUE) UCL					6.8518E-7
293	99% Chebyshev (MVUE) UCL					9.7880E-7						
294												
295	**Nonparametric Distribution Free UCL Statistics**											
296	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
297												
298	**Nonparametric Distribution Free UCLs**											
299	95% CLT UCL					2.7797E-7	95% Jackknife UCL					2.8156E-7
300	95% Standard Bootstrap UCL					2.7370E-7	95% Bootstrap-t UCL					4.3917E-7

301					95% Hall's Bootstrap UCL	6.5856E-7				95% Percentile Bootstrap UCL		2.8648E-7
302					95% BCA Bootstrap UCL	3.4080E-7						
303					90% Chebyshev(Mean, Sd) UCL	3.6435E-7				95% Chebyshev(Mean, Sd) UCL		4.5096E-7
304					97.5% Chebyshev(Mean, Sd) UCL	5.7118E-7				99% Chebyshev(Mean, Sd) UCL		8.0732E-7
305												
306					**Suggested UCL to Use**							
307					95% Adjusted Gamma UCL	2.9847E-7						
308												
309	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
310	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
311												
312	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
313	Recommendations are based upon data size, data distribution, and skewness.											
314	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
315	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
316												
317												
318	**Benzo(a)pyrene TEQ**											
319												
320					**General Statistics**							
321					Total Number of Observations	29				Number of Distinct Observations		29
322										Number of Missing Observations		0
323					Minimum	8.7200E-7				Mean		7.8863E-5
324					Maximum	0.00172				Median		2.9200E-6
325					SD	3.1924E-4				Std. Error of Mean		5.9281E-5
326					Coefficient of Variation	N/A				Skewness		5.207
327												
328					**Normal GOF Test**							
329					Shapiro Wilk Test Statistic	0.258				**Shapiro Wilk GOF Test**		
330					5% Shapiro Wilk Critical Value	0.926				Data Not Normal at 5% Significance Level		
331					Lilliefors Test Statistic	0.463				**Lilliefors GOF Test**		
332					5% Lilliefors Critical Value	0.161				Data Not Normal at 5% Significance Level		
333					**Data Not Normal at 5% Significance Level**							
334												
335					**Assuming Normal Distribution**							
336					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
337					95% Student's-t UCL	1.7971E-4				95% Adjusted-CLT UCL (Chen-1995)		2.3762E-4
338										95% Modified-t UCL (Johnson-1978)		1.8926E-4
339												
340					**Gamma GOF Test**							
341					A-D Test Statistic	4.043				**Anderson-Darling Gamma GOF Test**		
342					5% A-D Critical Value	0.865				Data Not Gamma Distributed at 5% Significance Level		
343					K-S Test Statistic	0.264				**Kolmogorov-Smirnov Gamma GOF Test**		
344					5% K-S Critical Value	0.177				Data Not Gamma Distributed at 5% Significance Level		
345					**Data Not Gamma Distributed at 5% Significance Level**							
346												
347					**Gamma Statistics**							
348					k hat (MLE)	0.282				k star (bias corrected MLE)		0.275
349					Theta hat (MLE)	2.8002E-4				Theta star (bias corrected MLE)		2.8627E-4
350					nu hat (MLE)	16.33				nu star (bias corrected)		15.98

351					MLE Mean (bias corrected)	7.8863E-5				MLE Sd (bias corrected)		1.5025E-4
352										Approximate Chi Square Value (0.05)		7.947
353					Adjusted Level of Significance	0.0407				Adjusted Chi Square Value		7.609
354												
355					**Assuming Gamma Distribution**							
356					95% Approximate Gamma UCL (use when n>=50))	1.5856E-4				95% Adjusted Gamma UCL (use when n<50)		1.6561E-4
357												
358					**Lognormal GOF Test**							
359					Shapiro Wilk Test Statistic	0.864				**Shapiro Wilk Lognormal GOF Test**		
360					5% Shapiro Wilk Critical Value	0.926				Data Not Lognormal at 5% Significance Level		
361					Lilliefors Test Statistic	0.207				**Lilliefors Lognormal GOF Test**		
362					5% Lilliefors Critical Value	0.161				Data Not Lognormal at 5% Significance Level		
363					**Data Not Lognormal at 5% Significance Level**							
364												
365					**Lognormal Statistics**							
366					Minimum of Logged Data	-13.95				Mean of logged Data		-11.92
367					Maximum of Logged Data	-6.365				SD of logged Data		1.845
368												
369					**Assuming Lognormal Distribution**							
370					95% H-UCL	1.3092E-4				90% Chebyshev (MVUE) UCL		7.4642E-5
371					95% Chebyshev (MVUE) UCL	9.4077E-5				97.5% Chebyshev (MVUE) UCL		1.2105E-4
372					99% Chebyshev (MVUE) UCL	1.7404E-4						
373												
374					**Nonparametric Distribution Free UCL Statistics**							
375					**Data do not follow a Discernible Distribution (0.05)**							
376												
377					**Nonparametric Distribution Free UCLs**							
378					95% CLT UCL	1.7637E-4				95% Jackknife UCL		1.7971E-4
379					95% Standard Bootstrap UCL	1.7285E-4				95% Bootstrap-t UCL		0.00152
380					95% Hall's Bootstrap UCL	7.3475E-4				95% Percentile Bootstrap UCL		1.9360E-4
381					95% BCA Bootstrap UCL	2.7206E-4						
382					90% Chebyshev(Mean, Sd) UCL	2.5671E-4				95% Chebyshev(Mean, Sd) UCL		3.3726E-4
383					97.5% Chebyshev(Mean, Sd) UCL	4.4908E-4				99% Chebyshev(Mean, Sd) UCL		6.6871E-4
384												
385					**Suggested UCL to Use**							
386					95% Chebyshev (Mean, Sd) UCL	3.3726E-4						
387												
388					Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.							
389					Recommendations are based upon data size, data distribution, and skewness.							
390					These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).							
391					However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.							
392												
393												
394	**Indeno(1,2,3-cd)pyrene TEQ**											
395												
396					**General Statistics**							
397					Total Number of Observations	29				Number of Distinct Observations		26
398										Number of Missing Observations		0
399					Minimum	2.4100E-8				Mean		1.6424E-7
400					Maximum	3.3700E-6				Median		4.6800E-8

401					SD	6.1674E-7				Std. Error of Mean		1.1453E-7
402					Coefficient of Variation	N/A				Skewness		5.38
403												
404	**Normal GOF Test**											
405					Shapiro Wilk Test Statistic	0.209	**Shapiro Wilk GOF Test**					
406					5% Shapiro Wilk Critical Value	0.926	Data Not Normal at 5% Significance Level					
407					Lilliefors Test Statistic	0.512	**Lilliefors GOF Test**					
408					5% Lilliefors Critical Value	0.161	Data Not Normal at 5% Significance Level					
409	**Data Not Normal at 5% Significance Level**											
410												
411	**Assuming Normal Distribution**											
412	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
413					95% Student's-t UCL	3.5906E-7				95% Adjusted-CLT UCL (Chen-1995)		4.7487E-7
414										95% Modified-t UCL (Johnson-1978)		3.7813E-7
415												
416	**Gamma GOF Test**											
417					A-D Test Statistic	8.25	**Anderson-Darling Gamma GOF Test**					
418					5% A-D Critical Value	0.804	Data Not Gamma Distributed at 5% Significance Level					
419					K-S Test Statistic	0.441	**Kolmogorov-Smirnov Gamma GOF Test**					
420					5% K-S Critical Value	0.171	Data Not Gamma Distributed at 5% Significance Level					
421	**Data Not Gamma Distributed at 5% Significance Level**											
422												
423	**Gamma Statistics**											
424					k hat (MLE)	0.571				k star (bias corrected MLE)		0.535
425					Theta hat (MLE)	2.8787E-7				Theta star (bias corrected MLE)		3.0727E-7
426					nu hat (MLE)	33.09				nu star (bias corrected)		31
427					MLE Mean (bias corrected)	1.6424E-7				MLE Sd (bias corrected)		2.2465E-7
428										Approximate Chi Square Value (0.05)		19.28
429					Adjusted Level of Significance	0.0407				Adjusted Chi Square Value		18.73
430												
431	**Assuming Gamma Distribution**											
432					95% Approximate Gamma UCL (use when n>=50))	2.6406E-7				95% Adjusted Gamma UCL (use when n<50)		2.7186E-7
433												
434	**Lognormal GOF Test**											
435					Shapiro Wilk Test Statistic	0.509	**Shapiro Wilk Lognormal GOF Test**					
436					5% Shapiro Wilk Critical Value	0.926	Data Not Lognormal at 5% Significance Level					
437					Lilliefors Test Statistic	0.273	**Lilliefors Lognormal GOF Test**					
438					5% Lilliefors Critical Value	0.161	Data Not Lognormal at 5% Significance Level					
439	**Data Not Lognormal at 5% Significance Level**											
440												
441	**Lognormal Statistics**											
442					Minimum of Logged Data	-17.54				Mean of logged Data		-16.71
443					Maximum of Logged Data	-12.6				SD of logged Data		0.843
444												
445	**Assuming Lognormal Distribution**											
446					95% H-UCL	1.1324E-7				90% Chebyshev (MVUE) UCL		1.1792E-7
447					95% Chebyshev (MVUE) UCL	1.3624E-7				97.5% Chebyshev (MVUE) UCL		1.6167E-7
448					99% Chebyshev (MVUE) UCL	2.1162E-7						
449												
450	**Nonparametric Distribution Free UCL Statistics**											

451	**Data do not follow a Discernible Distribution (0.05)**											
452												
453	**Nonparametric Distribution Free UCLs**											
454					95% CLT UCL	3.5262E-7				95% Jackknife UCL	3.5906E-7	
455					95% Standard Bootstrap UCL	3.4387E-7				95% Bootstrap-t UCL	6.0383E-6	
456					95% Hall's Bootstrap UCL	2.1651E-6				95% Percentile Bootstrap UCL	3.9260E-7	
457					95% BCA Bootstrap UCL	5.1101E-7						
458					90% Chebyshev(Mean, Sd) UCL	5.0782E-7				95% Chebyshev(Mean, Sd) UCL	6.6345E-7	
459					97.5% Chebyshev(Mean, Sd) UCL	8.7946E-7				99% Chebyshev(Mean, Sd) UCL	1.3038E-6	
460												
461	**Suggested UCL to Use**											
462					95% Chebyshev (Mean, Sd) UCL	6.6345E-7						
463												
464	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
465	Recommendations are based upon data size, data distribution, and skewness.											
466	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
467	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
468												
469												
470	**Dibenzo(a,h)anthracene TEQ**											
471												
472	**General Statistics**											
473					Total Number of Observations	29				Number of Distinct Observations	25	
474										Number of Missing Observations	0	
475					Minimum	9.7400E-7				Mean	1.9974E-6	
476					Maximum	3.7200E-6				Median	1.8400E-6	
477					SD	6.1950E-7				Std. Error of Mean	1.1504E-7	
478					Coefficient of Variation	N/A				Skewness	1.181	
479												
480	**Normal GOF Test**											
481					Shapiro Wilk Test Statistic	0.895				**Shapiro Wilk GOF Test**		
482					5% Shapiro Wilk Critical Value	0.926				Data Not Normal at 5% Significance Level		
483					Lilliefors Test Statistic	0.203				**Lilliefors GOF Test**		
484					5% Lilliefors Critical Value	0.161				Data Not Normal at 5% Significance Level		
485	**Data Not Normal at 5% Significance Level**											
486												
487	**Assuming Normal Distribution**											
488	**95% Normal UCL**									**95% UCLs (Adjusted for Skewness)**		
489					95% Student's-t UCL	2.1931E-6				95% Adjusted-CLT UCL (Chen-1995)	2.2136E-6	
490										95% Modified-t UCL (Johnson-1978)	2.1973E-6	
491												
492	**Gamma GOF Test**											
493					A-D Test Statistic	0.802				**Anderson-Darling Gamma GOF Test**		
494					5% A-D Critical Value	0.745				Data Not Gamma Distributed at 5% Significance Level		
495					K-S Test Statistic	0.163				**Kolmogorov-Smirnov Gamma GOF Test**		
496					5% K-S Critical Value	0.162				Data Not Gamma Distributed at 5% Significance Level		
497	**Data Not Gamma Distributed at 5% Significance Level**											
498												
499	**Gamma Statistics**											
500					k hat (MLE)	11.9				k star (bias corrected MLE)	10.69	

501					Theta hat (MLE)	1.6783E-7				Theta star (bias corrected MLE)		1.8679E-7
502					nu hat (MLE)	690.3				nu star (bias corrected)		620.2
503					MLE Mean (bias corrected)	1.9974E-6				MLE Sd (bias corrected)		6.1081E-7
504										Approximate Chi Square Value (0.05)		563.4
505					Adjusted Level of Significance	0.0407				Adjusted Chi Square Value		560.2
506												
507	**Assuming Gamma Distribution**											
508	95% Approximate Gamma UCL (use when n>=50))					2.1986E-6				95% Adjusted Gamma UCL (use when n<50)		2.2113E-6
509												
510	**Lognormal GOF Test**											
511	Shapiro Wilk Test Statistic					0.956	**Shapiro Wilk Lognormal GOF Test**					
512	5% Shapiro Wilk Critical Value					0.926	Data appear Lognormal at 5% Significance Level					
513	Lilliefors Test Statistic					0.162	**Lilliefors Lognormal GOF Test**					
514	5% Lilliefors Critical Value					0.161	Data Not Lognormal at 5% Significance Level					
515	**Data appear Approximate Lognormal at 5% Significance Level**											
516												
517	**Lognormal Statistics**											
518	Minimum of Logged Data					-13.84				Mean of logged Data		-13.17
519	Maximum of Logged Data					-12.5				SD of logged Data		0.294
520												
521	**Assuming Lognormal Distribution**											
522	95% H-UCL					2.2092E-6				90% Chebyshev (MVUE) UCL		2.3277E-6
523	95% Chebyshev (MVUE) UCL					2.4782E-6				97.5% Chebyshev (MVUE) UCL		2.6870E-6
524	99% Chebyshev (MVUE) UCL					3.0971E-6						
525												
526	**Nonparametric Distribution Free UCL Statistics**											
527	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
528												
529	**Nonparametric Distribution Free UCLs**											
530	95% CLT UCL					2.1866E-6				95% Jackknife UCL		2.1931E-6
531	95% Standard Bootstrap UCL					2.1852E-6				95% Bootstrap-t UCL		2.2363E-6
532	95% Hall's Bootstrap UCL					2.2406E-6				95% Percentile Bootstrap UCL		2.1897E-6
533	95% BCA Bootstrap UCL					2.2134E-6						
534	90% Chebyshev(Mean, Sd) UCL					2.3425E-6				95% Chebyshev(Mean, Sd) UCL		2.4988E-6
535	97.5% Chebyshev(Mean, Sd) UCL					2.7158E-6				99% Chebyshev(Mean, Sd) UCL		3.1420E-6
536												
537	**Suggested UCL to Use**											
538	95% Student's-t UCL					2.1931E-6				or 95% Modified-t UCL		2.1973E-6
539	or 95% H-UCL					2.2092E-6						
540												
541	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
542	Recommendations are based upon data size, data distribution, and skewness.											
543	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
544	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
545												
546	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
547	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
548	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
549	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
550												

UCL Statistics for Data Sets with Non-Detects		
User Selected Options		
Date/Time of Computation	ProUCL 5.110/31/2019 2:45:11 PM	
From File	WorkSheet.xls	
Full Precision	OFF	
Confidence Coefficient	95%	
Number of Bootstrap Operations	2000	

Total PCBs

General Statistics

Total Number of Observations	24	Number of Distinct Observations	12
Number of Detects	15	Number of Non-Detects	9
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	4.6	Maximum Non-Detect	0.1
Variance Detects	1.774	Percent Non-Detects	37.5%
Mean Detects	1.107	SD Detects	1.332
Median Detects	0.6	CV Detects	1.203
Skewness Detects	1.772	Kurtosis Detects	2.534
Mean of Logged Detects	-0.538	SD of Logged Detects	1.199

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.272	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.22	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.729	KM Standard Error of Mean	0.238
KM SD	1.128	95% KM (BCA) UCL	1.108
95% KM (t) UCL	1.138	95% KM (Percentile Bootstrap) UCL	1.117
95% KM (z) UCL	1.121	95% KM Bootstrap t UCL	1.459
90% KM Chebyshev UCL	1.444	95% KM Chebyshev UCL	1.768
97.5% KM Chebyshev UCL	2.217	99% KM Chebyshev UCL	3.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.439	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.767	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.144	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.912	k star (bias corrected MLE)	0.774
Theta hat (MLE)	1.213	Theta star (bias corrected MLE)	1.429
nu hat (MLE)	27.37	nu star (bias corrected)	23.23
Mean (detects)	1.107		

Gamma ROS Statistics using Imputed Non-Detects

53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
56	This is especially true when the sample size is small.											
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
58					Minimum	0.01					Mean	0.695
59					Maximum	4.6					Median	0.2
60					SD	1.172					CV	1.685
61					k hat (MLE)	0.389					k star (bias corrected MLE)	0.368
62					Theta hat (MLE)	1.788					Theta star (bias corrected MLE)	1.89
63					nu hat (MLE)	18.66					nu star (bias corrected)	17.66
64					Adjusted Level of Significance (β)	0.0392						
65					Approximate Chi Square Value (17.66, α)	9.149					Adjusted Chi Square Value (17.66, β)	8.719
66					95% Gamma Approximate UCL (use when n>=50)	1.343					95% Gamma Adjusted UCL (use when n<50)	1.409
67												
68	**Estimates of Gamma Parameters using KM Estimates**											
69					Mean (KM)	0.729					SD (KM)	1.128
70					Variance (KM)	1.272					SE of Mean (KM)	0.238
71					k hat (KM)	0.418					k star (KM)	0.394
72					nu hat (KM)	20.06					nu star (KM)	18.89
73					theta hat (KM)	1.745					theta star (KM)	1.853
74					80% gamma percentile (KM)	1.175					90% gamma percentile (KM)	2.066
75					95% gamma percentile (KM)	3.047					99% gamma percentile (KM)	5.519
76												
77	**Gamma Kaplan-Meier (KM) Statistics**											
78					Approximate Chi Square Value (18.89, α)	10.04					Adjusted Chi Square Value (18.89, β)	9.583
79					95% Gamma Approximate KM-UCL (use when n>=50)	1.372					95% Gamma Adjusted KM-UCL (use when n<50)	1.437
80												
81	**Lognormal GOF Test on Detected Observations Only**											
82					Shapiro Wilk Test Statistic	0.96					**Shapiro Wilk GOF Test**	
83					5% Shapiro Wilk Critical Value	0.881					Detected Data appear Lognormal at 5% Significance Level	
84					Lilliefors Test Statistic	0.111					**Lilliefors GOF Test**	
85					5% Lilliefors Critical Value	0.22					Detected Data appear Lognormal at 5% Significance Level	
86	**Detected Data appear Lognormal at 5% Significance Level**											
87												
88	**Lognormal ROS Statistics Using Imputed Non-Detects**											
89					Mean in Original Scale	0.705					Mean in Log Scale	-1.707
90					SD in Original Scale	1.166					SD in Log Scale	1.881
91					95% t UCL (assumes normality of ROS data)	1.113					95% Percentile Bootstrap UCL	1.118
92					95% BCA Bootstrap UCL	1.24					95% Bootstrap t UCL	1.451
93					95% H-UCL (Log ROS)	4.894						
94												
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
96					KM Mean (logged)	-1.2					KM Geo Mean	0.301
97					KM SD (logged)	1.252					95% Critical H Value (KM-Log)	2.898
98					KM Standard Error of Mean (logged)	0.265					95% H-UCL (KM -Log)	1.407
99					KM SD (logged)	1.252					95% Critical H Value (KM-Log)	2.898
100					KM Standard Error of Mean (logged)	0.265						
101												
102	**DL/2 Statistics**											
103	**DL/2 Normal**										**DL/2 Log-Transformed**	
104					Mean in Original Scale	0.71					Mean in Log Scale	-1.46

	A	B	C	D	E	F	G	H	I	J	K	L
105					SD in Original Scale	1.163					SD in Log Scale	1.534
106					95% t UCL (Assumes normality)	1.117					95% H-Stat UCL	2.183
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Gamma Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)					1.437						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

ATTACHMENT E

DEVELOPMENT OF SITE-SPECIFIC TPH RBCs FOR DEFAULT RECEPTORS

Risk-Based Concentrations for TPH: **Site-Specific Data**

Fuel Fraction	RBCss					RBCso			RBCsi			RBCsw			RBCtw			RBCwo			RBCwi			RBCwe	RBCair			RBCsg		
	Residential	Urban Residential	Occupational	Construction Worker	Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Construction & Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
Aliphatic C5-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	6.5E+04	6.5E+04	2.7E+05	2.9E+03	2.9E+03	3.7E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C6-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	4.3E+04	4.3E+04	1.8E+05	1.9E+03	1.9E+03	2.4E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C8-C10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+02	1.3E+02	5.5E+02	3.8E+03	3.8E+03	1.6E+04	1.7E+02	1.7E+02	2.2E+03	2.0E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C10-C12	3.9E-02	4.3E-02	4.3E-02	4.5E-02	2.3E-02	8.8E-03	8.8E-03	2.1E-03	7.2E-03	7.2E-03	5.7E-04	8.9E-05	8.9E-05	2.1E-05	1.3E+02	1.3E+02	5.5E+02	2.6E+03	2.6E+03	1.1E+04	1.1E+02	1.1E+02	1.4E+03	6.7E+02	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C12-C16	1.0E-01	1.2E-01	1.4E-01	1.6E-01	8.8E-02	1.9E-03	1.9E-03	4.6E-04	1.6E-03	1.6E-03	1.2E-04	2.3E-06	2.3E-06	3.9E-07	3.7E+02	3.7E+02	1.5E+03	5.9E+02	5.9E+02	2.5E+03	2.6E+01	2.6E+01	3.3E+02	1.2E+02	1.0E+02	1.0E+02	4.4E+02	-	-	-
Aliphatic >C16-C21	2.9E-04	3.3E-04	4.0E-04	4.5E-04	2.5E-04	3.7E-22	3.7E-22	8.9E-23	3.1E-22	3.1E-22	2.4E-23	1.9E-11	1.9E-11	2.7E-12	1.1E+05	1.1E+05	4.4E+05	6.3E+18	6.3E+18	2.6E+19	2.8E+17	2.8E+17	3.5E+18	2.4E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aliphatic >C21-C34	7.8E-04	8.9E-04	1.1E-03	1.2E-03	6.8E-04	8.4E-26	8.4E-26	2.0E-26	6.9E-26	6.9E-26	5.5E-27	2.3E-16	2.3E-16	2.9E-17	1.1E+05	1.1E+05	4.4E+05	3.1E+17	3.1E+17	1.3E+18	1.4E+16	1.4E+16	1.7E+17	9.0E+02	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C8-C10	1.2E-19	1.4E-19	1.3E-19	6.8E-20	3.6E-20	7.1E-19	7.1E-19	1.7E-19	5.8E-19	5.8E-19	4.6E-20	1.5E-19	1.5E-19	2.6E-19	2.0E+19	2.0E+19	8.3E+19	5.0E+22	5.0E+22	2.1E+23	2.7E+21	2.7E+21	3.4E+22	2.1E+21	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C10-C12	4.1E-02	4.3E-02	3.8E-02	3.4E-02	1.6E-02	1.8E-02	1.8E-02	4.2E-03	1.4E-02	1.4E-02	1.1E-03	2.5E-02	2.5E-02	2.6E-02	1.8E+02	1.8E+02	7.3E+02	1.2E+06	1.2E+06	4.9E+06	8.9E+04	8.9E+04	1.1E+06	1.4E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C12-C16	1.6E-01	1.6E-01	1.6E-01	1.7E-01	8.9E-02	8.2E-03	8.2E-03	1.9E-03	6.7E-03	6.7E-03	5.3E-04	6.4E-02	6.4E-02	3.2E-02	1.8E+02	1.8E+02	7.3E+02	1.9E+06	1.9E+06	7.9E+06	2.3E+05	2.3E+05	2.9E+06	1.2E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C16-C21	2.1E-01	2.4E-01	2.7E-01	3.1E-01	1.7E-01	3.5E-04	3.5E-04	8.2E-05	2.8E-04	2.8E-04	2.3E-05	2.4E-02	2.4E-02	5.6E-03	1.8E+02	1.8E+02	7.3E+02	3.8E+06	3.8E+06	1.6E+07	8.9E+05	8.9E+05	1.1E+07	9.5E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C21-C34	8.6E-02	9.8E-02	1.2E-01	1.3E-01	7.5E-02	6.2E-25	6.2E-25	1.5E-25	5.0E-25	5.0E-25	4.0E-26	1.8E-05	1.8E-05	2.4E-06	1.5E+03	1.5E+03	5.8E+03	4.2E+24	4.2E+24	1.8E+25	1.7E+24	1.7E+24	2.1E+25	7.3E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
n-Hexane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.8E+02	8.8E+02	3.6E+03	2.1E+05	2.1E+05	9.0E+05	9.5E+03	9.5E+03	1.2E+05	6.5E+04	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Benzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.4E+01	4.4E+01	1.8E+02	2.8E+05	2.8E+05	1.2E+06	1.9E+04	1.9E+04	2.4E+05	5.7E+03	3.1E+01	3.1E+01	1.3E+02	6.3E+03	6.3E+03	1.3E+05
Toluene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E+03	2.3E+03	9.2E+03	4.4E+07	4.4E+07	1.8E+08	2.7E+06	2.7E+06	3.4E+07	2.1E+05	5.2E+03	5.2E+03	2.2E+04	1.0E+06	1.0E+06	2.2E+07
Ethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.3E+03	5.5E+03	8.8E+06	8.8E+06	3.7E+07	5.3E+05	5.3E+05	6.6E+06	1.1E+05	1.0E+03	1.0E+03	4.4E+03	2.1E+05	2.1E+05	4.4E+06
Total Xylenes	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+02	2.0E+02	8.5E+02	9.2E+05	9.2E+05	3.9E+06	5.9E+04	5.9E+04	7.4E+05	2.3E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
1,2,4-trimethylbenzene	1.6E-02	1.9E-02	1.6E-02	5.7E-03	1.6E-03	3.6E-02	3.6E-02	8.6E-03	3.0E-02	3.0E-02	2.4E-03	1.0E-02	1.0E-02	3.2E-02	1.5E+01	1.5E+01	6.1E+01	8.0E+04	8.0E+04	3.3E+05	5.0E+03	5.0E+03	6.4E+04	1.7E+03	7.3E+00	7.3E+00	3.1E+01	1.5E+03	1.5E+03	3.1E+04
1,3,5-trimethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.7E+02	3.7E+02	1.5E+03	9.2E+22	9.2E+22	3.9E+23	5.4E+21	5.4E+21	6.8E+22	2.3E+04	1.0E+19	1.0E+19	4.4E+19	-	-	-
Naphthalene	3.4E-01	2.9E-01	2.1E-01	1.4E-01	3.6E-02	6.3E-02	6.3E-02	1.5E-02	5.1E-02	5.1E-02	4.1E-03	8.8E-01	8.8E-01	9.1E-01	6.2E+00	6.2E+00	2.6E+01	1.4E+05	1.4E+05	5.7E+05	2.9E+04	2.9E+04	3.7E+05	7.2E+02	3.1E+00	3.1E+00	1.3E+01	6.3E+02	6.3E+02	1.3E+04
TPH RBC* ⟶	1,300	2,900	22,000	7,700	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	120	120	13,000	22	22	93	>S	>S	>S	>S	>S	>S	2,500	62	62	260	12,000	12,000	260,000
Generic Gasoline	1,200	2,500	20,000	9,700	>MAX	5,900	5,900	69,000	94	94	>MAX	31	31	130	110	110	450	>S	>S	>S	22,000	22,000	>S	14,000	390	390	1,700	79,000	79,000	1,700,000
Generic Diesel / Heating Oil	1,100	2,200	14,000	4,600	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	9,500	9,500	>MAX	100	100	430	>S	>S	>S	>S	>S	>S	>S	100	100	440	21,000	21,000	440,000
Generic Mineral Insulating Oil	2,800	5,700	36,000	11,000	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	300	300	1,300	>S	>S	>S	>S	>S	>S	>S	150	150	620	30,000	30,000	620,000

Risk-Based Concentrations for TPH: **Site-Specific Data**

Fuel Fraction	RBCss					RBCso			RBCsi			RBCsw			RBCtw			RBCwo			RBCwi			RBCwe	RBCair			RBCsg		
	Residential	Urban Residential	Occupational	Construction Worker	Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Construction & Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
Aliphatic C5-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	6.5E+04	6.5E+04	2.7E+05	2.9E+03	2.9E+03	3.7E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C6-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	4.3E+04	4.3E+04	1.8E+05	1.9E+03	1.9E+03	2.4E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C8-C10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+02	1.3E+02	5.5E+02	3.8E+03	3.8E+03	1.6E+04	1.7E+02	1.7E+02	2.2E+03	2.0E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C10-C12	3.9E-02	4.3E-02	4.3E-02	4.5E-02	2.3E-02	8.8E-03	8.8E-03	2.1E-03	7.2E-03	7.2E-03	5.7E-04	8.9E-05	8.9E-05	2.1E-05	1.3E+02	1.3E+02	5.5E+02	2.6E+03	2.6E+03	1.1E+04	1.1E+02	1.1E+02	1.4E+03	6.7E+02	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C12-C16	1.0E-01	1.2E-01	1.4E-01	1.6E-01	8.8E-02	1.9E-03	1.9E-03	4.6E-04	1.6E-03	1.6E-03	1.2E-04	2.3E-06	2.3E-06	3.9E-07	3.7E+02	3.7E+02	1.5E+03	5.9E+02	5.9E+02	2.5E+03	2.6E+01	2.6E+01	3.3E+02	1.2E+02	1.0E+02	1.0E+02	4.4E+02	-	-	-
Aliphatic >C16-C21	2.9E-04	3.3E-04	4.0E-04	4.5E-04	2.5E-04	3.7E-22	3.7E-22	8.9E-23	3.1E-22	3.1E-22	2.4E-23	1.9E-11	1.9E-11	2.7E-12	1.1E+05	1.1E+05	4.4E+05	6.3E+18	6.3E+18	2.6E+19	2.8E+17	2.8E+17	3.5E+18	2.4E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aliphatic >C21-C34	7.8E-04	8.9E-04	1.1E-03	1.2E-03	6.8E-04	8.4E-26	8.4E-26	2.0E-26	6.9E-26	6.9E-26	5.5E-27	2.3E-16	2.3E-16	2.9E-17	1.1E+05	1.1E+05	4.4E+05	3.1E+17	3.1E+17	1.3E+18	1.4E+16	1.4E+16	1.7E+17	9.0E+02	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C8-C10	1.2E-19	1.4E-19	1.3E-19	6.8E-20	3.6E-20	7.1E-19	7.1E-19	1.7E-19	5.8E-19	5.8E-19	4.6E-20	1.5E-19	1.5E-19	2.6E-19	2.0E+19	2.0E+19	8.3E+19	5.0E+22	5.0E+22	2.1E+23	2.7E+21	2.7E+21	3.4E+22	2.1E+21	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C10-C12	4.1E-02	4.3E-02	3.8E-02	3.4E-02	1.6E-02	1.8E-02	1.8E-02	4.2E-03	1.4E-02	1.4E-02	1.1E-03	2.5E-02	2.5E-02	2.6E-02	1.8E+02	1.8E+02	7.3E+02	1.2E+06	1.2E+06	4.9E+06	8.9E+04	8.9E+04	1.1E+06	1.4E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C12-C16	1.6E-01	1.6E-01	1.6E-01	1.7E-01	8.9E-02	8.2E-03	8.2E-03	1.9E-03	6.7E-03	6.7E-03	5.3E-04	6.4E-02	6.4E-02	3.2E-02	1.8E+02	1.8E+02	7.3E+02	1.9E+06	1.9E+06	7.9E+06	2.3E+05	2.3E+05	2.9E+06	1.2E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C16-C21	2.1E-01	2.4E-01	2.7E-01	3.1E-01	1.7E-01	3.5E-04	3.5E-04	8.2E-05	2.8E-04	2.8E-04	2.3E-05	2.4E-02	2.4E-02	5.6E-03	1.8E+02	1.8E+02	7.3E+02	3.8E+06	3.8E+06	1.6E+07	8.9E+05	8.9E+05	1.1E+07	9.5E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C21-C34	8.6E-02	9.8E-02	1.2E-01	1.3E-01	7.5E-02	6.2E-25	6.2E-25	1.5E-25	5.0E-25	5.0E-25	4.0E-26	1.8E-05	1.8E-05	2.4E-06	1.5E+03	1.5E+03	5.8E+03	4.2E+24	4.2E+24	1.8E+25	1.7E+24	1.7E+24	2.1E+25	7.3E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
n-Hexane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.8E+02	8.8E+02	3.6E+03	2.1E+05	2.1E+05	9.0E+05	9.5E+03	9.5E+03	1.2E+05	6.5E+04	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Benzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.4E+01	4.4E+01	1.8E+02	2.8E+05	2.8E+05	1.2E+06	1.9E+04	1.9E+04	2.4E+05	5.7E+03	3.1E+01	3.1E+01	1.3E+02	6.3E+03	6.3E+03	1.3E+05
Toluene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E+03	2.3E+03	9.2E+03	4.4E+07	4.4E+07	1.8E+08	2.7E+06	2.7E+06	3.4E+07	2.1E+05	5.2E+03	5.2E+03	2.2E+04	1.0E+06	1.0E+06	2.2E+07
Ethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.3E+03	5.5E+03	8.8E+06	8.8E+06	3.7E+07	5.3E+05	5.3E+05	6.6E+06	1.1E+05	1.0E+03	1.0E+03	4.4E+03	2.1E+05	2.1E+05	4.4E+06
Total Xylenes	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+02	2.0E+02	8.5E+02	9.2E+05	9.2E+05	3.9E+06	5.9E+04	5.9E+04	7.4E+05	2.3E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
1,2,4-trimethylbenzene	1.6E-02	1.9E-02	1.6E-02	5.7E-03	1.6E-03	3.6E-02	3.6E-02	8.6E-03	3.0E-02	3.0E-02	2.4E-03	1.0E-02	1.0E-02	3.2E-02	1.5E+01	1.5E+01	6.1E+01	8.0E+04	8.0E+04	3.3E+05	5.0E+03	5.0E+03	6.4E+04	1.7E+03	7.3E+00	7.3E+00	3.1E+01	1.5E+03	1.5E+03	3.1E+04
1,3,5-trimethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.7E+02	3.7E+02	1.5E+03	9.2E+22	9.2E+22	3.9E+23	5.4E+21	5.4E+21	6.8E+22	2.3E+04	1.0E+19	1.0E+19	4.4E+19	-	-	-
Naphthalene	3.4E-01	2.9E-01	2.1E-01	1.4E-01	3.6E-02	6.3E-02	6.3E-02	1.5E-02	5.1E-02	5.1E-02	4.1E-03	8.8E-01	8.8E-01	9.1E-01	6.2E+00	6.2E+00	2.6E+01	1.4E+05	1.4E+05	5.7E+05	2.9E+04	2.9E+04	3.7E+05	7.2E+02	3.1E+00	3.1E+00	1.3E+01	6.3E+02	6.3E+02	1.3E+04
TPH RBC* ⟶	1,300	2,900	22,000	7,700	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	120	120	13,000	22	22	93	>S	>S	>S	>S	>S	>S	2,500	62	62	260	12,000	12,000	260,000
Generic Gasoline	1,200	2,500	20,000	9,700	>MAX	5,900	5,900	69,000	94	94	>MAX	31	31	130	110	110	450	>S	>S	>S	22,000	22,000	>S	14,000	390	390	1,700	79,000	79,000	1,700,000
Generic Diesel / Heating Oil	1,100	2,200	14,000	4,600	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	9,500	9,500	>MAX	100	100	430	>S	>S	>S	>S	>S	>S	>S	100	100	440	21,000	21,000	440,000
Generic Mineral Insulating Oil	2,800	5,700	36,000	11,000	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	300	300	1,300	>S	>S	>S	>S	>S	>S	>S	150	150	620	30,000	30,000	620,000

Chemical Data: **Site-Specific Data**

Fuel Fraction	Vol Class	MW (g/mol)	Density (g/cm^3)	Xi*MWi	Xi*MWi/rpi	S (mg/L)	P (ug/m^3)	K_H (m^3-atm/mol)	H'	Log K_{oc}	K_{oc} (cm^3/g)	D_{air} (cm^2/s)	D_w (cm^2/s)
Aliphatic C5-C6	v	81	0.68	0.00	0.00	3.6E+01	1.2E+09	7.94E-01	33	2.9	7.9E+02	1.0E-01	1.0E-05
Aliphatic >C6-C8	v	100	0.73	0.00	0.00	5.4E+00	2.7E+08	1.20E+00	50	3.6	4.0E+03	1.0E-01	1.0E-05
Aliphatic >C8-C10	v	130	0.73	0.00	0.00	4.3E-01	3.4E+07	1.92E+00	80	4.5	3.2E+04	1.0E-01	1.0E-05
Aliphatic >C10-C12	v	160	0.76	3.17	4.17	3.4E-02	4.1E+06	2.89E+00	120	5.4	2.5E+05	1.0E-01	1.0E-05
Aliphatic >C12-C16	nv	200	0.77	8.95	11.69	7.6E-04	4.0E+05	1.25E+01	520	6.7	5.0E+06	1.0E-01	1.0E-05
Aliphatic >C16-C21	nv	270	0.78	7.62	9.77	2.5E-06	1.2E+04	1.18E+02	4900	8.8	6.3E+08	1.0E-01	1.0E-05
Aliphatic >C21-C34	nv	400	0.78	20.62	26.44	1.5E-11	1.5E+00	2.41E+03	100000	10.0	1.1E+10	1.0E-01	1.0E-05
Aromatic >C8-C10	v	120	0.87	2.38	2.74	6.5E+01	3.1E+07	1.15E-02	0.48	3.2	1.6E+03	1.0E-01	1.0E-05
Aromatic >C10-C12	v	130	0.90	5.83	6.45	2.5E+01	3.5E+06	3.37E-03	0.14	3.4	2.5E+03	1.0E-01	1.0E-05
Aromatic >C12-C16	v	150	1.02	36.22	35.51	5.8E+00	3.1E+05	1.27E-03	0.053	3.7	5.0E+03	1.0E-01	1.0E-05
Aromatic >C16-C21	v	190	1.23	71.44	58.08	6.5E-01	8.5E+03	3.13E-04	0.013	4.2	1.6E+04	1.0E-01	1.0E-05
Aromatic >C21-C34	nv	240	1.28	30.48	23.81	6.6E-03	4.4E+00	1.61E-05	0.00067	5.1	1.3E+05	1.0E-01	1.0E-05
n-Hexane	v	86	0.70	0.00	0.00	1.8E+01	9.0E+07	1.20E-01	5.0	2.9	8.9E+02	2.0E-01	7.8E-06
Benzene	v	78	0.88	0.00	0.00	1.8E+03	4.0E+08	5.55E-03	0.23	1.8	5.9E+01	8.8E-02	9.8E-06
Toluene	v	92	0.87	0.00	0.00	5.3E+02	1.5E+08	6.64E-03	0.28	2.3	1.8E+02	8.7E-02	8.6E-06
Ethylbenzene	v	106	0.87	0.00	0.00	1.7E+02	5.5E+07	7.88E-03	0.33	2.6	3.6E+02	7.5E-02	7.8E-06
Total Xylenes	v	106	0.88	0.00	0.00	1.8E+02	4.9E+07	6.73E-03	0.28	2.6	3.9E+02	7.8E-02	8.8E-06
1,2,4-trimethylbenzene	v	120	0.88	0.25	0.28	5.7E+01	1.4E+07	5.70E-03	0.24	3.6	3.7E+03	7.5E-02	7.1E-06
1,3,5-trimethylbenzene	v	120	0.87	0.00	0.00	5.0E+01	1.6E+07	7.70E-03	0.32	2.9	8.2E+02	7.5E-02	7.1E-06
Naphthalene	v	128	1.15	5.83	5.10	3.1E+01	6.2E+05	4.83E-04	0.02	3.3	2.0E+03	5.9E-02	7.5E-06
TPH*	v	192.8	1.05	192.80	184	◄——— These two values are product specific.							

Calculations for	Site-Specific Data						Distribution of Constituent Concentrations Between 3 or 4 Phases					Weight Fractions for Product at Equilibrium with Air or Water Phase				Interim Risk
Fuel Fraction	Sample Concentration Adjusted (mg/kg)	Weight Fraction	mmoles	Initial Mole Fraction	Cw/Si	Xi	Cair (ug/m3)	Cwater (mg/L)	Csorbed (mg/kg)	Cproduct (mg/kg)	Trial Value Xi	Cair (ug/m3)	WFair	Cwater (mg/L)	WFwater	Calc's (HQ)
Aliphatic C5-C6	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C6-C8	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C8-C10	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C10-C12	207	0.016	1.296	0.020	4.78E+00	0.020	8.10E+04	6.75E-04	8.47E-01	1.64E+04	0.020	8.02E+04	7.64E-02	6.69E-04	1.16E-04	2.05E-05
Aliphatic >C12-C16	584	0.046	2.920	0.044	3.06E+01	0.045	1.77E+04	3.41E-05	8.54E-01	4.64E+04	0.045	1.75E+04	1.67E-02	3.37E-05	5.87E-06	3.89E-07
Aliphatic >C16-C21	496	0.039	1.838	0.028	6.29E+01	0.028	3.46E+02	7.06E-08	2.23E-01	3.95E+04	0.028	3.42E+02	3.25E-04	6.98E-08	1.21E-08	2.69E-12
Aliphatic >C21-C34	1343	0.106	3.358	0.051	1.67E+06	0.052	7.75E-02	7.75E-13	4.15E-05	1.07E+05	0.052	7.65E-02	7.28E-08	7.65E-13	1.33E-13	2.95E-17
Aromatic >C8-C10	166	0.013	1.380	0.021	3.16E-01	0.020	6.20E+05	1.29E+00	1.02E+01	1.24E+04	0.020	6.54E+05	6.22E-01	1.36E+00	2.37E-01	2.61E-19
Aromatic >C10-C12	394	0.031	3.032	0.046	1.25E+00	0.045	1.57E+05	1.12E+00	1.41E+01	3.03E+04	0.045	1.61E+05	1.53E-01	1.15E+00	2.00E-01	2.57E-02
Aromatic >C12-C16	2394	0.189	15.960	0.242	1.64E+01	0.241	7.43E+04	1.40E+00	3.51E+01	1.88E+05	0.242	7.45E+04	7.09E-02	1.41E+00	2.45E-01	3.20E-02
Aromatic >C16-C21	4671	0.369	24.586	0.373	9.06E+01	0.376	3.18E+03	2.45E-01	1.94E+01	3.71E+05	0.377	3.15E+03	3.00E-03	2.43E-01	4.22E-02	5.59E-03
Aromatic >C21-C34	1985	0.157	8.272	0.126	4.78E+02	0.127	5.62E-01	8.39E-04	5.28E-01	1.58E+05	0.127	5.55E-01	5.28E-07	8.29E-04	1.44E-04	2.40E-06
n-Hexane	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ethylbenzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Xylenes	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,2,4-trimethylbenzene	18	0.001	0.153	0.002	1.73E-02	0.002	2.79E+04	1.18E-01	2.18E+00	1.29E+03	0.002	3.13E+04	2.98E-02	1.32E-01	2.30E-02	3.20E-02
1,3,5-trimethylbenzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene	394	0.031	3.079	0.047	1.27E+00	0.046	2.84E+04	1.42E+00	1.41E+01	3.03E+04	0.046	2.91E+04	2.77E-02	1.45E+00	2.52E-01	9.05E-01
TPH	12653	1.000	65.873	1.000	##########	1.001	1.01E+06	5.60E+00	9.76E+01	1.00E+06	1.003	1.05E+06	1.000	5.74E+00	1.000	1.00E+00

TPH =
1.3E+04
ppm

Mass balance check: 1 cm^3 sample	
2.1E-02	grams product
2.4E-07	grams in air
6.7E-07	grams in water
1.7E-04	grams on soil
2.1E-02	total grams petroleum
1.7E+00	total grams of solid
1.3E+04	Must equal ppm TPH

If <=1, assume 3 phases.	Else If =1, assume 4 phases.	This solution is based on 4 phases.

Initial guess for value of n_p	Value of n_a if 4 phases
0.0205	0.2397
Corrected value for n_p	Value of n_a if only 3 phases
0.0203	0.2600

Risk-Based Concentrations for TPH: **Site-Specific Data**

Fuel Fraction	RBCss					RBCso			RBCsi			RBCsw			RBCtw			RBCwo			RBCwi			RBCwe	RBCair			RBCsg		
	Residential	Urban Residential	Occupational	Construction Worker	Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Construction & Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
Aliphatic C5-C6	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	6.5E+04	6.5E+04	2.7E+05	2.9E+03	2.9E+03	3.7E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C6-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	4.3E+04	4.3E+04	1.8E+05	1.9E+03	1.9E+03	2.4E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C8-C10	2.3E-03	2.8E-03	3.6E-03	4.0E-03	3.4E-03	1.2E-02	1.2E-02	2.9E-03	1.0E-02	1.0E-02	7.9E-04	5.0E-05	5.0E-05	3.4E-05	1.3E+02	1.3E+02	5.5E+02	3.8E+03	3.8E+03	1.6E+04	1.7E+02	1.7E+02	2.2E+03	2.0E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C10-C12	4.9E-02	6.0E-02	7.4E-02	8.7E-02	6.8E-02	2.5E-02	2.5E-02	6.0E-03	2.1E-02	2.1E-02	1.6E-03	1.3E-04	1.3E-04	6.6E-05	1.3E+02	1.3E+02	5.5E+02	2.6E+03	2.6E+03	1.1E+04	1.1E+02	1.1E+02	1.4E+03	6.7E+02	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C12-C16	6.5E-02	8.0E-02	1.2E-01	1.6E-01	1.3E-01	2.9E-03	2.9E-03	6.8E-04	2.3E-03	2.3E-03	1.9E-04	3.0E-06	3.0E-06	8.3E-07	3.7E+02	3.7E+02	1.5E+03	5.9E+02	5.9E+02	2.5E+03	2.6E+01	2.6E+01	3.3E+02	1.2E+02	1.0E+02	1.0E+02	4.4E+02	-	-	-
Aliphatic >C16-C21	1.4E-04	1.7E-04	2.4E-04	3.3E-04	2.8E-04	4.1E-22	4.1E-22	9.8E-23	3.4E-22	3.4E-22	2.7E-23	3.0E-11	3.0E-11	4.7E-12	1.1E+05	1.1E+05	4.4E+05	6.3E+18	6.3E+18	2.6E+19	2.8E+17	2.8E+17	3.5E+18	2.4E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aliphatic >C21-C34	2.7E-04	3.4E-04	4.9E-04	6.6E-04	5.6E-04	6.8E-26	6.8E-26	1.6E-26	5.6E-26	5.6E-26	4.4E-27	4.5E-16	4.5E-16	4.1E-17	1.1E+05	1.1E+05	4.4E+05	3.1E+17	3.1E+17	1.3E+18	1.4E+16	1.4E+16	1.7E+17	9.0E+02	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C8-C10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+19	2.0E+19	8.3E+19	5.0E+22	5.0E+22	2.1E+23	2.7E+21	2.7E+21	3.4E+22	2.1E+21	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C10-C12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+02	1.8E+02	7.3E+02	1.2E+06	1.2E+06	4.9E+06	8.9E+04	8.9E+04	1.1E+06	1.4E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C12-C16	6.4E-02	6.7E-02	7.8E-02	9.6E-02	7.4E-02	6.7E-03	6.7E-03	1.6E-03	5.5E-03	5.5E-03	4.3E-04	1.9E-02	1.9E-02	1.5E-02	1.8E+02	1.8E+02	7.3E+02	1.9E+06	1.9E+06	7.9E+06	2.3E+05	2.3E+05	2.9E+06	1.2E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C16-C21	8.1E-02	9.6E-02	1.3E-01	1.7E-01	1.5E-01	2.9E-04	2.9E-04	6.9E-05	2.4E-04	2.4E-04	1.9E-05	1.1E-02	1.1E-02	5.2E-03	1.8E+02	1.8E+02	7.3E+02	3.8E+06	3.8E+06	1.6E+07	8.9E+05	8.9E+05	1.1E+07	9.5E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C21-C34	3.7E-02	4.5E-02	6.6E-02	8.9E-02	7.5E-02	6.1E-25	6.1E-25	1.4E-25	5.0E-25	5.0E-25	3.9E-26	3.0E-05	3.0E-05	3.9E-06	1.5E+03	1.5E+03	5.8E+03	4.2E+24	4.2E+24	1.8E+25	1.7E+24	1.7E+24	2.1E+25	7.3E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
n-Hexane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.8E+02	8.8E+02	3.6E+03	2.1E+05	2.1E+05	9.0E+05	9.5E+03	9.5E+03	1.2E+05	6.5E+04	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Benzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.4E+01	4.4E+01	1.8E+02	2.8E+05	2.8E+05	1.2E+06	1.9E+04	1.9E+04	2.4E+05	5.7E+03	3.1E+01	3.1E+01	1.3E+02	6.3E+03	6.3E+03	1.3E+05
Toluene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E+03	2.3E+03	9.2E+03	4.4E+07	4.4E+07	1.8E+08	2.7E+06	2.7E+06	3.4E+07	2.1E+05	5.2E+03	5.2E+03	2.2E+04	1.0E+06	1.0E+06	2.2E+07
Ethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.3E+03	5.5E+03	8.8E+06	8.8E+06	3.7E+07	5.3E+05	5.3E+05	6.6E+06	1.1E+05	1.0E+03	1.0E+03	4.4E+03	2.1E+05	2.1E+05	4.4E+06
Total Xylenes	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+02	2.0E+02	8.5E+02	9.2E+05	9.2E+05	3.9E+06	5.9E+04	5.9E+04	7.4E+05	2.3E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
1,2,4-trimethylbenzene	3.3E-03	4.1E-03	4.2E-03	1.8E-03	7.5E-04	1.7E-02	1.7E-02	4.1E-03	1.4E-02	1.4E-02	1.1E-03	1.4E-03	1.4E-03	1.6E-03	1.5E+01	1.5E+01	6.1E+01	8.0E+04	8.0E+04	3.3E+05	5.0E+03	5.0E+03	6.4E+04	1.7E+03	7.3E+00	7.3E+00	3.1E+01	1.5E+03	1.5E+03	3.1E+04
1,3,5-trimethylbenzene	1.5E-04	1.9E-04	2.6E-04	3.7E-04	3.1E-04	4.6E-21	4.6E-21	1.1E-21	3.8E-21	3.8E-21	3.0E-22	7.7E-05	7.7E-05	7.7E-05	3.7E+02	3.7E+02	1.5E+03	9.2E+22	9.2E+22	3.9E+23	5.4E+21	5.4E+21	6.8E+22	2.3E+04	1.0E+19	1.0E+19	4.4E+19	-	-	-
Naphthalene	7.0E-01	6.4E-01	5.3E-01	3.9E-01	1.3E-01	2.2E-01	2.2E-01	5.3E-02	1.8E-01	1.8E-01	1.5E-02	9.7E-01	9.7E-01	9.8E-01	6.2E+00	6.2E+00	2.6E+01	1.4E+05	1.4E+05	5.7E+05	2.9E+04	2.9E+04	3.7E+05	7.2E+02	3.1E+00	3.1E+00	1.3E+01	6.3E+02	6.3E+02	1.3E+04
TPH RBC* ⟶	530	1,300	12,000	5,000	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	32	32	160	7.8	7.8	33	>S	>S	>S	>S	>S	>S	890	14	14	59	2,800	2,800	59,000
Generic Gasoline	1,200	2,500	20,000	9,700	>MAX	5,900	5,900	69,000	94	94	>MAX	31	31	130	110	110	450	>S	>S	>S	22,000	22,000	>S	14,000	390	390	1,700	79,000	79,000	1,700,000
Generic Diesel / Heating Oil	1,100	2,200	14,000	4,600	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	9,500	9,500	>MAX	100	100	430	>S	>S	>S	>S	>S	>S	>S	100	100	440	21,000	21,000	440,000
Generic Mineral Insulating Oil	2,800	5,700	36,000	11,000	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	300	300	1,300	>S	>S	>S	>S	>S	>S	>S	150	150	620	30,000	30,000	620,000

Risk-Based Concentrations for TPH: **Site-Specific Data**

Fuel Fraction	RBCss					RBCso			RBCsi			RBCsw			RBCtw			RBCwo			RBCwi			RBCwe	RBCair			RBCsg		
	Residential	Urban Residential	Occupational	Construction Worker	Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Construction & Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
Aliphatic C5-C6	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	6.5E+04	6.5E+04	2.7E+05	2.9E+03	2.9E+03	3.7E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C6-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	4.3E+04	4.3E+04	1.8E+05	1.9E+03	1.9E+03	2.4E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C8-C10	2.3E-03	2.8E-03	3.6E-03	4.0E-03	3.4E-03	1.2E-02	1.2E-02	2.9E-03	1.0E-02	1.0E-02	7.9E-04	5.0E-05	5.0E-05	3.4E-05	1.3E+02	1.3E+02	5.5E+02	3.8E+03	3.8E+03	1.6E+04	1.7E+02	1.7E+02	2.2E+03	2.0E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C10-C12	4.9E-02	6.0E-02	7.4E-02	8.7E-02	6.8E-02	2.5E-02	2.5E-02	6.0E-03	2.1E-02	2.1E-02	1.6E-03	1.3E-04	1.3E-04	6.6E-05	1.3E+02	1.3E+02	5.5E+02	2.6E+03	2.6E+03	1.1E+04	1.1E+02	1.1E+02	1.4E+03	6.7E+02	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C12-C16	6.5E-02	8.0E-02	1.2E-01	1.6E-01	1.3E-01	2.9E-03	2.9E-03	6.8E-04	2.3E-03	2.3E-03	1.9E-04	3.0E-06	3.0E-06	8.3E-07	3.7E+02	3.7E+02	1.5E+03	5.9E+02	5.9E+02	2.5E+03	2.6E+01	2.6E+01	3.3E+02	1.2E+02	1.0E+02	1.0E+02	4.4E+02	-	-	-
Aliphatic >C16-C21	1.4E-04	1.7E-04	2.4E-04	3.3E-04	2.8E-04	4.1E-22	4.1E-22	9.8E-23	3.4E-22	3.4E-22	2.7E-23	3.0E-11	3.0E-11	4.7E-12	1.1E+05	1.1E+05	4.4E+05	6.3E+18	6.3E+18	2.6E+19	2.8E+17	2.8E+17	3.5E+18	2.4E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aliphatic >C21-C34	2.7E-04	3.4E-04	4.9E-04	6.6E-04	5.6E-04	6.8E-26	6.8E-26	1.6E-26	5.6E-26	5.6E-26	4.4E-27	4.5E-16	4.5E-16	4.1E-17	1.1E+05	1.1E+05	4.4E+05	3.1E+17	3.1E+17	1.3E+18	1.4E+16	1.4E+16	1.7E+17	9.0E+02	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C8-C10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+19	2.0E+19	8.3E+19	5.0E+22	5.0E+22	2.1E+23	2.7E+21	2.7E+21	3.4E+22	2.1E+21	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C10-C12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+02	1.8E+02	7.3E+02	1.2E+06	1.2E+06	4.9E+06	8.9E+04	8.9E+04	1.1E+06	1.4E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C12-C16	6.4E-02	6.7E-02	7.8E-02	9.6E-02	7.4E-02	6.7E-03	6.7E-03	1.6E-03	5.5E-03	5.5E-03	4.3E-04	1.9E-02	1.9E-02	1.5E-02	1.8E+02	1.8E+02	7.3E+02	1.9E+06	1.9E+06	7.9E+06	2.3E+05	2.3E+05	2.9E+06	1.2E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C16-C21	8.1E-02	9.6E-02	1.3E-01	1.7E-01	1.5E-01	2.9E-04	2.9E-04	6.9E-05	2.4E-04	2.4E-04	1.9E-05	1.1E-02	1.1E-02	5.2E-03	1.8E+02	1.8E+02	7.3E+02	3.8E+06	3.8E+06	1.6E+07	8.9E+05	8.9E+05	1.1E+07	9.5E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C21-C34	3.7E-02	4.5E-02	6.6E-02	8.9E-02	7.5E-02	6.1E-25	6.1E-25	1.4E-25	5.0E-25	5.0E-25	3.9E-26	3.0E-05	3.0E-05	3.9E-06	1.5E+03	1.5E+03	5.8E+03	4.2E+24	4.2E+24	1.8E+25	1.7E+24	1.7E+24	2.1E+25	7.3E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
n-Hexane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.8E+02	8.8E+02	3.6E+03	2.1E+05	2.1E+05	9.0E+05	9.5E+03	9.5E+03	1.2E+05	6.5E+04	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Benzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.4E+01	4.4E+01	1.8E+02	2.8E+05	2.8E+05	1.2E+06	1.9E+04	1.9E+04	2.4E+05	5.7E+03	3.1E+01	3.1E+01	1.3E+02	6.3E+03	6.3E+03	1.3E+05
Toluene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E+03	2.3E+03	9.2E+03	4.4E+07	4.4E+07	1.8E+08	2.7E+06	2.7E+06	3.4E+07	2.1E+05	5.2E+03	5.2E+03	2.2E+04	1.0E+06	1.0E+06	2.2E+07
Ethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.3E+03	5.5E+03	8.8E+06	8.8E+06	3.7E+07	5.3E+05	5.3E+05	6.6E+06	1.1E+05	1.0E+03	1.0E+03	4.4E+03	2.1E+05	2.1E+05	4.4E+06
Total Xylenes	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+02	2.0E+02	8.5E+02	9.2E+05	9.2E+05	3.9E+06	5.9E+04	5.9E+04	7.4E+05	2.3E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
1,2,4-trimethylbenzene	3.3E-03	4.1E-03	4.2E-03	1.8E-03	7.5E-04	1.7E-02	1.7E-02	4.1E-03	1.4E-02	1.4E-02	1.1E-03	1.4E-03	1.4E-03	1.6E-03	1.5E+01	1.5E+01	6.1E+01	8.0E+04	8.0E+04	3.3E+05	5.0E+03	5.0E+03	6.4E+04	1.7E+03	7.3E+00	7.3E+00	3.1E+01	1.5E+03	1.5E+03	3.1E+04
1,3,5-trimethylbenzene	1.5E-04	1.9E-04	2.6E-04	3.7E-04	3.1E-04	4.6E-21	4.6E-21	1.1E-21	3.8E-21	3.8E-21	3.0E-22	7.7E-05	7.7E-05	7.7E-05	3.7E+02	3.7E+02	1.5E+03	9.2E+22	9.2E+22	3.9E+23	5.4E+21	5.4E+21	6.8E+22	2.3E+04	1.0E+19	1.0E+19	4.4E+19	-	-	-
Naphthalene	7.0E-01	6.4E-01	5.3E-01	3.9E-01	1.3E-01	2.2E-01	2.2E-01	5.3E-02	1.8E-01	1.8E-01	1.5E-02	9.7E-01	9.7E-01	9.8E-01	6.2E+00	6.2E+00	2.6E+01	1.4E+05	1.4E+05	5.7E+05	2.9E+04	2.9E+04	3.7E+05	7.2E+02	3.1E+00	3.1E+00	1.3E+01	6.3E+02	6.3E+02	1.3E+04
TPH RBC* ⟶	530	1,300	12,000	5,000	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	32	32	160	7.8	7.8	33	>S	>S	>S	>S	>S	>S	890	14	14	59	2,800	2,800	59,000
Generic Gasoline	1,200	2,500	20,000	9,700	>MAX	5,900	5,900	69,000	94	94	>MAX	31	31	130	110	110	450	>S	>S	>S	22,000	22,000	>S	14,000	390	390	1,700	79,000	79,000	1,700,000
Generic Diesel / Heating Oil	1,100	2,200	14,000	4,600	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	9,500	9,500	>MAX	100	100	430	>S	>S	>S	>S	>S	>S	>S	100	100	440	21,000	21,000	440,000
Generic Mineral Insulating Oil	2,800	5,700	36,000	11,000	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	300	300	1,300	>S	>S	>S	>S	>S	>S	>S	150	150	620	30,000	30,000	620,000

Chemical Data: **Site-Specific Data**

Fuel Fraction	Vol Class	MW (g/mol)	Density (g/cm^3)	Xi*MWi	Xi*MWi/rpi	S (mg/L)	P (ug/m^3)	K_H (m^3-atm/mol)	H'	Log K_{oc}	K_{oc} (cm^3/g)	D_{air} (cm^2/s)	D_w (cm^2/s)
Aliphatic C5-C6	v	81	0.68	0.00	0.00	3.6E+01	1.2E+09	7.94E-01	33	2.9	7.9E+02	1.0E-01	1.0E-05
Aliphatic >C6-C8	v	100	0.73	0.00	0.00	5.4E+00	2.7E+08	1.20E+00	50	3.6	4.0E+03	1.0E-01	1.0E-05
Aliphatic >C8-C10	v	130	0.73	0.34	0.46	4.3E-01	3.4E+07	1.92E+00	80	4.5	3.2E+04	1.0E-01	1.0E-05
Aliphatic >C10-C12	v	160	0.76	10.13	13.33	3.4E-02	4.1E+06	2.89E+00	120	5.4	2.5E+05	1.0E-01	1.0E-05
Aliphatic >C12-C16	nv	200	0.77	19.08	24.91	7.6E-04	4.0E+05	1.25E+01	520	6.7	5.0E+06	1.0E-01	1.0E-05
Aliphatic >C16-C21	nv	270	0.78	13.42	17.21	2.5E-06	1.2E+04	1.18E+02	4900	8.8	6.3E+08	1.0E-01	1.0E-05
Aliphatic >C21-C34	nv	400	0.78	28.42	36.43	1.5E-11	1.5E+00	2.41E+03	100000	10.0	1.1E+10	1.0E-01	1.0E-05
Aromatic >C8-C10	v	120	0.87	0.00	0.00	6.5E+01	3.1E+07	1.15E-02	0.48	3.2	1.6E+03	1.0E-01	1.0E-05
Aromatic >C10-C12	v	130	0.90	0.00	0.00	2.5E+01	3.5E+06	3.37E-03	0.14	3.4	2.5E+03	1.0E-01	1.0E-05
Aromatic >C12-C16	v	150	1.02	17.34	17.00	5.8E+00	3.1E+05	1.27E-03	0.053	3.7	5.0E+03	1.0E-01	1.0E-05
Aromatic >C16-C21	v	190	1.23	66.24	53.85	6.5E-01	8.5E+03	3.13E-04	0.013	4.2	1.6E+04	1.0E-01	1.0E-05
Aromatic >C21-C34	nv	240	1.28	49.43	38.62	6.6E-03	4.4E+00	1.61E-05	0.00067	5.1	1.3E+05	1.0E-01	1.0E-05
n-Hexane	v	86	0.70	0.00	0.00	1.8E+01	9.0E+07	1.20E-01	5.0	2.9	8.9E+02	2.0E-01	7.8E-06
Benzene	v	78	0.88	0.00	0.00	1.8E+03	4.0E+08	5.55E-03	0.23	1.8	5.9E+01	8.8E-02	9.8E-06
Toluene	v	92	0.87	0.00	0.00	5.3E+02	1.5E+08	6.64E-03	0.28	2.3	1.8E+02	8.7E-02	8.6E-06
Ethylbenzene	v	106	0.87	0.00	0.00	1.7E+02	5.5E+07	7.88E-03	0.33	2.6	3.6E+02	7.5E-02	7.8E-06
Total Xylenes	v	106	0.88	0.00	0.00	1.8E+02	4.9E+07	6.73E-03	0.28	2.6	3.9E+02	7.8E-02	8.8E-06
1,2,4-trimethylbenzene	v	120	0.88	0.01	0.01	5.7E+01	1.4E+07	5.70E-03	0.24	3.6	3.7E+03	7.5E-02	7.1E-06
1,3,5-trimethylbenzene	v	120	0.87	0.02	0.02	5.0E+01	1.6E+07	7.70E-03	0.32	2.9	8.2E+02	7.5E-02	7.1E-06
Naphthalene	v	128	1.15	6.30	5.50	3.1E+01	6.2E+05	4.83E-04	0.02	3.3	2.0E+03	5.9E-02	7.5E-06
TPH*	v	210.7	1.02	210.73	207	◄——— These two values are product specific.							

Calculations for	Site-Specific Data																
	Sample Concentration			Initial			Distribution of Constituent Concentrations Between 3 or 4 Phases					Weight Fractions for Product at Equilibrium with Air or Water Phase				Interim Risk
Fuel Fraction	Adjusted (mg/kg)	Weight Fraction	mmoles	Mole Fraction	Cw/Si	Xi	Cair (ug/m3)	Cwater (mg/L)	Csorbed (mg/kg)	Cproduct (mg/kg)	Trial Value Xi	Cair (ug/m3)	WFair	Cwater (mg/L)	WFwater	Calc's (HQ)
Aliphatic C5-C6	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C6-C8	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C8-C10	0	0.002	0.003	0.003	4.93E-03	0.003	9.01E+04	1.13E-03	1.78E-01	1.61E+03	0.003	1.11E+05	2.00E-01	1.39E-03	2.09E-04	3.43E-05
Aliphatic >C10-C12	8	0.048	0.049	0.057	1.80E-01	0.063	2.59E+05	2.16E-03	2.71E+00	4.81E+04	0.063	2.31E+05	4.15E-01	1.92E-03	2.90E-04	6.57E-05
Aliphatic >C12-C16	11	0.070	0.057	0.066	5.93E-01	0.095	3.78E+04	7.27E-05	1.82E+00	9.05E+04	0.096	2.60E+04	4.68E-02	5.01E-05	7.54E-06	8.30E-07
Aliphatic >C16-C21	7	0.044	0.026	0.031	8.98E-01	0.050	6.11E+02	1.25E-07	3.93E-01	6.37E+04	0.050	3.74E+02	6.71E-04	7.63E-08	1.15E-08	4.74E-12
Aliphatic >C21-C34	14	0.088	0.035	0.041	1.76E+04	0.071	1.07E-01	1.07E-12	5.73E-05	1.35E+05	0.071	6.18E-02	1.11E-07	6.18E-13	9.30E-14	4.07E-17
Aromatic >C8-C10	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aromatic >C10-C12	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aromatic >C12-C16	25	0.158	0.170	0.198	1.75E-01	0.116	3.56E+04	6.71E-01	1.68E+01	8.23E+04	0.116	6.08E+04	1.09E-01	1.15E+00	1.73E-01	1.53E-02
Aromatic >C16-C21	51	0.316	0.268	0.312	9.89E-01	0.349	2.95E+03	2.27E-01	1.80E+01	3.14E+05	0.349	2.64E+03	4.74E-03	2.03E-01	3.06E-02	5.19E-03
Aromatic >C21-C34	25	0.158	0.106	0.124	6.14E+00	0.206	9.14E-01	1.36E-03	8.59E-01	2.35E+05	0.207	5.46E-01	9.81E-07	8.15E-04	1.23E-04	3.89E-06
n-Hexane	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ethylbenzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Xylenes	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,2,4-trimethylbenzene	0	0.001	0.001	0.001	1.06E-04	0.000	1.36E+03	5.73E-03	1.06E-01	5.73E+01	0.000	1.47E+04	2.65E-02	6.22E-02	9.37E-03	1.56E-03
1,3,5-trimethylbenzene	0	0.000	0.000	0.000	1.73E-04	0.000	2.16E+03	6.75E-03	2.77E-02	7.68E+01	0.000	5.67E+03	1.02E-02	1.77E-02	2.67E-03	7.71E-05
Naphthalene	18	0.115	0.144	0.168	5.93E-02	0.049	3.07E+04	1.53E+00	1.52E+01	2.99E+04	0.049	1.05E+05	1.88E-01	5.21E+00	7.84E-01	9.77E-01
TPH	161	1.000	0.860	1.000	17627.715	1.002	4.60E+05	2.44E+00	5.61E+01	1.00E+06	1.004	5.57E+05	1.000	6.64E+00	1.000	1.00E+00

TPH =
1.6E+02
ppm

Mass balance check: 1 cm^3 sample	
1.8E-04	grams product
1.2E-07	grams in air
2.9E-07	grams in water
9.5E-05	grams on soil
2.7E-04	total grams petroleum
1.7E+00	total grams of solid
1.6E+02	Must equal ppm TPH

If <=1, assume 3 phases.	Else If =1, assume 4 phases.	This solution is based on 4 phases.

Initial guess for value of n_p	Value of n_a if 4 phases
0.0003	0.2598
Corrected value for n_p	Value of n_a if only 3 phases
0.0002	0.2600

Risk-Based Concentrations for TPH: **Site-Specific Data**

Fuel Fraction	RBCss					RBCso			RBCsi			RBCsw			RBCtw			RBCwo			RBCwi			RBCwe	RBCair			RBCsg		
	Residential	Urban Residential	Occupational	Construction Worker	Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Construction & Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
Aliphatic C5-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	6.5E+04	6.5E+04	2.7E+05	2.9E+03	2.9E+03	3.7E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C6-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	4.3E+04	4.3E+04	1.8E+05	1.9E+03	1.9E+03	2.4E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C8-C10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+02	1.3E+02	5.5E+02	3.8E+03	3.8E+03	1.6E+04	1.7E+02	1.7E+02	2.2E+03	2.0E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C10-C12	1.0E-01	9.7E-02	8.7E-02	8.2E-02	4.0E-02	1.7E-02	1.7E-02	4.0E-03	1.4E-02	1.4E-02	1.1E-03	1.6E-04	1.6E-04	3.9E-05	1.3E+02	1.3E+02	5.5E+02	2.6E+03	2.6E+03	1.1E+04	1.1E+02	1.1E+02	1.4E+03	6.7E+02	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C12-C16	2.9E-01	3.0E-01	3.2E-01	3.3E-01	1.7E-01	4.2E-03	4.2E-03	9.9E-04	3.4E-03	3.4E-03	2.7E-04	3.4E-06	3.4E-06	8.4E-07	3.7E+02	3.7E+02	1.5E+03	5.9E+02	5.9E+02	2.5E+03	2.6E+01	2.6E+01	3.3E+02	1.2E+02	1.0E+02	1.0E+02	4.4E+02	-	-	-
Aliphatic >C16-C21	6.5E-04	6.7E-04	7.1E-04	7.1E-04	3.7E-04	6.3E-22	6.3E-22	1.5E-22	5.1E-22	5.1E-22	4.1E-23	1.8E-11	1.8E-11	4.5E-12	1.1E+05	1.1E+05	4.4E+05	6.3E+18	6.3E+18	2.6E+19	2.8E+17	2.8E+17	3.5E+18	2.4E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aliphatic >C21-C34	2.0E-03	2.1E-03	2.2E-03	2.2E-03	1.2E-03	1.6E-25	1.6E-25	3.9E-26	1.3E-25	1.3E-25	1.1E-26	2.3E-16	2.3E-16	5.7E-17	1.1E+05	1.1E+05	4.4E+05	3.1E+17	3.1E+17	1.3E+18	1.4E+16	1.4E+16	1.7E+17	9.0E+02	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C8-C10	8.7E-20	9.0E-20	7.2E-20	3.4E-20	1.7E-20	3.7E-19	3.7E-19	8.8E-20	3.0E-19	3.0E-19	2.4E-20	6.0E-19	6.0E-19	1.4E-19	2.0E+19	2.0E+19	8.3E+19	5.0E+22	5.0E+22	2.1E+23	2.7E+21	2.7E+21	3.4E+22	2.1E+21	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C10-C12	3.3E-02	2.9E-02	2.3E-02	1.9E-02	8.2E-03	1.0E-02	1.0E-02	2.5E-03	8.4E-03	8.4E-03	6.7E-04	6.5E-02	6.5E-02	1.6E-02	1.8E+02	1.8E+02	7.3E+02	1.2E+06	1.2E+06	4.9E+06	8.9E+04	8.9E+04	1.1E+06	1.4E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C12-C16	1.1E-01	1.0E-01	9.2E-02	8.9E-02	4.3E-02	4.4E-03	4.4E-03	1.1E-03	3.6E-03	3.6E-03	2.9E-04	7.3E-02	7.3E-02	1.8E-02	1.8E+02	1.8E+02	7.3E+02	1.9E+06	1.9E+06	7.9E+06	2.3E+05	2.3E+05	2.9E+06	1.2E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C16-C21	2.6E-01	2.7E-01	2.6E-01	2.7E-01	1.4E-01	3.2E-04	3.2E-04	7.6E-05	2.6E-04	2.6E-04	2.1E-05	2.2E-02	2.2E-02	5.2E-03	1.8E+02	1.8E+02	7.3E+02	3.8E+06	3.8E+06	1.6E+07	8.9E+05	8.9E+05	1.1E+07	9.5E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C21-C34	1.9E-01	1.9E-01	2.0E-01	2.1E-01	1.1E-01	9.8E-25	9.8E-25	2.3E-25	8.1E-25	8.1E-25	6.4E-26	1.5E-05	1.5E-05	3.8E-06	1.5E+03	1.5E+03	5.8E+03	4.2E+24	4.2E+24	1.8E+25	1.7E+24	1.7E+24	2.1E+25	7.3E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
n-Hexane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.8E+02	8.8E+02	3.6E+03	2.1E+05	2.1E+05	9.0E+05	9.5E+03	9.5E+03	1.2E+05	6.5E+04	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Benzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.4E+01	4.4E+01	1.8E+02	2.8E+05	2.8E+05	1.2E+06	1.9E+04	1.9E+04	2.4E+05	5.7E+03	3.1E+01	3.1E+01	1.3E+02	6.3E+03	6.3E+03	1.3E+05
Toluene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E+03	2.3E+03	9.2E+03	4.4E+07	4.4E+07	1.8E+08	2.7E+06	2.7E+06	3.4E+07	2.1E+05	5.2E+03	5.2E+03	2.2E+04	1.0E+06	1.0E+06	2.2E+07
Ethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.3E+03	5.5E+03	8.8E+06	8.8E+06	3.7E+07	5.3E+05	5.3E+05	6.6E+06	1.1E+05	1.0E+03	1.0E+03	4.4E+03	2.1E+05	2.1E+05	4.4E+06
Total Xylenes	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+02	2.0E+02	8.5E+02	9.2E+05	9.2E+05	3.9E+06	5.9E+04	5.9E+04	7.4E+05	2.3E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
1,2,4-trimethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+01	1.5E+01	6.1E+01	8.0E+04	8.0E+04	3.3E+05	5.0E+03	5.0E+03	6.4E+04	1.7E+03	7.3E+00	7.3E+00	3.1E+01	1.5E+03	1.5E+03	3.1E+04
1,3,5-trimethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.7E+02	3.7E+02	1.5E+03	9.2E+22	9.2E+22	3.9E+23	5.4E+21	5.4E+21	6.8E+22	2.3E+04	1.0E+19	1.0E+19	4.4E+19	-	-	-
Naphthalene	1.1E-02	8.7E-03	5.8E-03	3.7E-03	9.0E-04	1.7E-03	1.7E-03	4.1E-04	1.4E-03	1.4E-03	1.1E-04	1.1E-01	1.1E-01	2.6E-02	6.2E+00	6.2E+00	2.6E+01	1.4E+05	1.4E+05	5.7E+05	2.9E+04	2.9E+04	3.7E+05	7.2E+02	3.1E+00	3.1E+00	1.3E+01	6.3E+02	6.3E+02	1.3E+04
TPH RBC* ⟶	1,900	3,900	26,000	8,200	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	150	150	640	>S	>S	>S	>S	>S	>S	>S	200	200	830	39,000	39,000	830,000
Generic Gasoline	1,200	2,500	20,000	9,700	>MAX	5,900	5,900	69,000	94	94	>MAX	31	31	130	110	110	450	>S	>S	>S	22,000	22,000	>S	14,000	390	390	1,700	79,000	79,000	1,700,000
Generic Diesel / Heating Oil	1,100	2,200	14,000	4,600	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	9,500	9,500	>MAX	100	100	430	>S	>S	>S	>S	>S	>S	>S	100	100	440	21,000	21,000	440,000
Generic Mineral Insulating Oil	2,800	5,700	36,000	11,000	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	300	300	1,300	>S	>S	>S	>S	>S	>S	>S	150	150	620	30,000	30,000	620,000

TPH Fraction Composition (Weight Fraction)

Fuel Fractions	Site-Specific Data			Generic Weight Fraction Data		
	Raw Data mg/kg (ppm)	Adjusted Data mg/kg (ppm)	Weight Fraction	Gasoline	Diesel	Mineral Oil
Aliphatic C5-C6	0	0	0.00E+00	2.06E-01	0.00E+00	0.00E+00
Aliphatic >C6-C8	0	0	0.00E+00	2.20E-01	0.00E+00	0.00E+00
Aliphatic >C8-C10	0	0	0.00E+00	9.00E-02	2.00E-02	1.00E-03
Aliphatic >C10-C12	110	110	2.79E-02	3.00E-02	7.00E-02	3.00E-03
Aliphatic >C12-C16	350	350	8.88E-02	0.00E+00	3.50E-01	1.60E-01
Aliphatic >C16-C21	230	230	5.84E-02	0.00E+00	3.40E-01	7.00E-01
Aliphatic >C21-C34	720	720	1.83E-01	0.00E+00	0.00E+00	0.00E+00
Aromatic >C8-C10	24	24	6.09E-03	9.02E-02	2.52E-03	1.00E-03
Aromatic >C10-C12	67	64	1.62E-02	2.25E-02	7.40E-03	1.00E-03
Aromatic >C12-C16	360	360	9.13E-02	0.00E+00	8.00E-02	7.00E-03
Aromatic >C16-C21	1200	1200	3.04E-01	0.00E+00	1.20E-01	8.00E-02
Aromatic >C21-C34	880	880	2.23E-01	0.00E+00	0.00E+00	4.60E-02
n-Hexane	0.0	0.0	0.00E+00	2.40E-02	0.00E+00	0.00E+00
Benzene	0.0	0.0	0.00E+00	2.50E-02	2.90E-04	0.00E+00
Toluene	0.0	0.0	0.00E+00	1.20E-01	1.80E-03	0.00E+00
Ethylbenzene	0.0	0.0	0.00E+00	2.00E-02	6.80E-04	0.00E+00
Total Xylenes	0.0	0.0	0.00E+00	1.10E-01	5.00E-03	0.00E+00
1,2,4-trimethylbenzene	0.0	0.0	0.00E+00	3.00E-02	0.00E+00	0.00E+00
1,3,5-trimethylbenzene	0.0	0.0	0.00E+00	9.80E-03	1.80E-03	0.00E+00
Naphthalene	3.0	3.0	7.59E-04	2.50E-03	2.60E-03	0.00E+00
Total	3944	3941	1.00	1.00	1.00	1.00

Use one of the following two options for site-specific TPH RBC calculations.

OPTION 1: (1) Enter TPH data (mg/kg or ppm) into the cell on the right. →

Estimate TPH Fractions (2) Enter BTEX, TMB, and naphthalene data in the "Raw Data" column above.

(3) Use one of the buttons at the right to identify the predominant product.

Gasoline Estimate

Diesel Estimate

OR

OPTION 2: (1) Enter TPH fraction and constituent data in the "Raw Data" column above.

Use VPH and EPH Results (2) Use one of the buttons at the right to identify the predominant product.

Gasoline Fractions

Non-Gas Fractions

For references, please refer to *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites* (DEQ, 2003).

Chemical Data: **Site-Specific Data**

Fuel Fraction	Vol Class	MW (g/mol)	Density (g/cm^3)	Xi*MWi	Xi*MWi/rpi	S (mg/L)	P (ug/m^3)	K_H (m^3-atm/mol)	H'	Log K_{oc}	K_{oc} (cm^3/g)	D_{air} (cm^2/s)	D_w (cm^2/s)
Aliphatic C5-C6	v	81	0.68	0.00	0.00	3.6E+01	1.2E+09	7.94E-01	33	2.9	7.9E+02	1.0E-01	1.0E-05
Aliphatic >C6-C8	v	100	0.73	0.00	0.00	5.4E+00	2.7E+08	1.20E+00	50	3.6	4.0E+03	1.0E-01	1.0E-05
Aliphatic >C8-C10	v	130	0.73	0.00	0.00	4.3E-01	3.4E+07	1.92E+00	80	4.5	3.2E+04	1.0E-01	1.0E-05
Aliphatic >C10-C12	v	160	0.76	6.06	7.97	3.4E-02	4.1E+06	2.89E+00	120	5.4	2.5E+05	1.0E-01	1.0E-05
Aliphatic >C12-C16	nv	200	0.77	19.29	25.18	7.6E-04	4.0E+05	1.25E+01	520	6.7	5.0E+06	1.0E-01	1.0E-05
Aliphatic >C16-C21	nv	270	0.78	12.68	16.25	2.5E-06	1.2E+04	1.18E+02	4900	8.8	6.3E+08	1.0E-01	1.0E-05
Aliphatic >C21-C34	nv	400	0.78	39.68	50.88	1.5E-11	1.5E+00	2.41E+03	100000	10.0	1.1E+10	1.0E-01	1.0E-05
Aromatic >C8-C10	v	120	0.87	1.31	1.51	6.5E+01	3.1E+07	1.15E-02	0.48	3.2	1.6E+03	1.0E-01	1.0E-05
Aromatic >C10-C12	v	130	0.90	3.51	3.89	2.5E+01	3.5E+06	3.37E-03	0.14	3.4	2.5E+03	1.0E-01	1.0E-05
Aromatic >C12-C16	v	150	1.02	19.81	19.42	5.8E+00	3.1E+05	1.27E-03	0.053	3.7	5.0E+03	1.0E-01	1.0E-05
Aromatic >C16-C21	v	190	1.23	66.11	53.75	6.5E-01	8.5E+03	3.13E-04	0.013	4.2	1.6E+04	1.0E-01	1.0E-05
Aromatic >C21-C34	nv	240	1.28	48.50	37.89	6.6E-03	4.4E+00	1.61E-05	0.00067	5.1	1.3E+05	1.0E-01	1.0E-05
n-Hexane	v	86	0.70	0.00	0.00	1.8E+01	9.0E+07	1.20E-01	5.0	2.9	8.9E+02	2.0E-01	7.8E-06
Benzene	v	78	0.88	0.00	0.00	1.8E+03	4.0E+08	5.55E-03	0.23	1.8	5.9E+01	8.8E-02	9.8E-06
Toluene	v	92	0.87	0.00	0.00	5.3E+02	1.5E+08	6.64E-03	0.28	2.3	1.8E+02	8.7E-02	8.6E-06
Ethylbenzene	v	106	0.87	0.00	0.00	1.7E+02	5.5E+07	7.88E-03	0.33	2.6	3.6E+02	7.5E-02	7.8E-06
Total Xylenes	v	106	0.88	0.00	0.00	1.8E+02	4.9E+07	6.73E-03	0.28	2.6	3.9E+02	7.8E-02	8.8E-06
1,2,4-trimethylbenzene	v	120	0.88	0.00	0.00	5.7E+01	1.4E+07	5.70E-03	0.24	3.6	3.7E+03	7.5E-02	7.1E-06
1,3,5-trimethylbenzene	v	120	0.87	0.00	0.00	5.0E+01	1.6E+07	7.70E-03	0.32	2.9	8.2E+02	7.5E-02	7.1E-06
Naphthalene	v	128	1.15	0.16	0.14	3.1E+01	6.2E+05	4.83E-04	0.02	3.3	2.0E+03	5.9E-02	7.5E-06
TPH*	v	217.1	1.00	217.11	217	◄——— These two values are product specific.							

Calculations for	Site-Specific Data																
	Sample Concentration			Initial			Distribution of Constituent Concentrations Between 3 or 4 Phases					Weight Fractions for Product at Equilibrium with Air or Water Phase				Interim Risk
Fuel Fraction	Adjusted (mg/kg)	Weight Fraction	mmoles	Mole Fraction	Cw/Si	Xi	Cair (ug/m3)	Cwater (mg/L)	Csorbed (mg/kg)	Cproduct (mg/kg)	Trial Value Xi	Cair (ug/m3)	WFair	Cwater (mg/L)	WFwater	Calc's (HQ)
Aliphatic C5-C6	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C6-C8	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C8-C10	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C10-C12	3297	0.028	20.605	0.038	7.61E+01	0.038	1.55E+05	1.30E-03	1.63E+00	2.79E+04	0.038	1.54E+05	2.28E-01	1.29E-03	5.30E-04	3.94E-05
Aliphatic >C12-C16	10490	0.089	52.448	0.096	5.49E+02	0.096	3.83E+04	7.37E-05	1.85E+00	8.88E+04	0.097	3.80E+04	5.63E-02	7.31E-05	3.02E-05	8.42E-07
Aliphatic >C16-C21	6893	0.058	25.530	0.047	8.74E+02	0.047	5.78E+02	1.18E-07	3.72E-01	5.84E+04	0.047	5.74E+02	8.50E-04	1.17E-07	4.83E-08	4.49E-12
Aliphatic >C21-C34	21579	0.183	53.947	0.099	2.68E+07	0.099	1.50E-01	1.50E-12	8.02E-05	1.83E+05	0.100	1.48E-01	2.20E-07	1.48E-12	6.12E-13	5.70E-17
Aromatic >C8-C10	719	0.006	5.994	0.011	1.37E+00	0.011	3.43E+05	7.15E-01	5.67E+00	6.04E+03	0.011	3.43E+05	5.08E-01	7.15E-01	2.95E-01	1.44E-19
Aromatic >C10-C12	1918	0.016	14.757	0.027	6.07E+00	0.027	9.51E+04	6.79E-01	8.53E+00	1.62E+04	0.027	9.48E+04	1.40E-01	6.77E-01	2.79E-01	1.55E-02
Aromatic >C12-C16	10789	0.091	71.929	0.132	7.40E+01	0.132	4.08E+04	7.70E-01	1.93E+01	9.12E+04	0.133	4.06E+04	6.01E-02	7.65E-01	3.16E-01	1.76E-02
Aromatic >C16-C21	35964	0.304	189.286	0.347	6.98E+02	0.348	2.96E+03	2.27E-01	1.80E+01	3.04E+05	0.350	2.93E+03	4.35E-03	2.26E-01	9.31E-02	5.19E-03
Aromatic >C21-C34	26374	0.223	109.891	0.202	6.35E+03	0.202	8.99E-01	1.34E-03	8.44E-01	2.23E+05	0.203	8.91E-01	1.32E-06	1.33E-03	5.49E-04	3.83E-06
n-Hexane	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ethylbenzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Xylenes	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,2,4-trimethylbenzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,3,5-trimethylbenzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene	90	0.001	0.700	0.001	2.88E-01	0.001	8.02E+02	4.00E-02	3.99E-01	7.56E+02	0.001	7.99E+02	1.18E-03	3.98E-02	1.64E-02	2.56E-02
TPH	118113	1.000	545.087	1.000	##########	1.002	6.77E+05	2.43E+00	5.66E+01	1.00E+06	1.008	6.75E+05	1.000	2.43E+00	1.000	6.39E-02

TPH =
1.2E+05
ppm

Mass balance check: 1 cm^3 sample	
2.0E-01	grams product
4.1E-08	grams in air
2.9E-07	grams in water
9.6E-05	grams on soil
2.0E-01	total grams petroleum
1.7E+00	total grams of solid
1.2E+05	Must equal ppm TPH

If <=1, assume 3 phases.	Else If =1, assume 4 phases.	This solution is based on 4 phases.

Initial guess for value of n_p	Value of n_a if 4 phases
0.2006	0.0607
Corrected value for n_p	Value of n_a if only 3 phases
0.1993	0.2600

Risk-Based Concentrations for TPH: **Site-Specific Data**

Fuel Fraction	RBCss					RBCso			RBCsi			RBCsw			RBCtw			RBCwo			RBCwi			RBCwe	RBCair			RBCsg		
	Residential	Urban Residential	Occupational	Construction Worker	Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Construction & Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
Aliphatic C5-C6	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	6.5E+04	6.5E+04	2.7E+05	2.9E+03	2.9E+03	3.7E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C6-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	4.3E+04	4.3E+04	1.8E+05	1.9E+03	1.9E+03	2.4E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C8-C10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+02	1.3E+02	5.5E+02	3.8E+03	3.8E+03	1.6E+04	1.7E+02	1.7E+02	2.2E+03	2.0E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C10-C12	1.8E-02	1.9E-02	1.9E-02	1.9E-02	9.5E-03	3.5E-03	3.5E-03	8.4E-04	2.9E-03	2.9E-03	2.3E-04	3.6E-05	3.6E-05	8.2E-06	1.3E+02	1.3E+02	5.5E+02	2.6E+03	2.6E+03	1.1E+04	1.1E+02	1.1E+02	1.4E+03	6.7E+02	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C12-C16	6.2E-02	6.9E-02	8.1E-02	8.8E-02	4.8E-02	1.0E-03	1.0E-03	2.4E-04	8.3E-04	8.3E-04	6.6E-05	1.1E-06	1.1E-06	2.1E-07	3.7E+02	3.7E+02	1.5E+03	5.9E+02	5.9E+02	2.5E+03	2.6E+01	2.6E+01	3.3E+02	1.2E+02	1.0E+02	1.0E+02	4.4E+02	-	-	-
Aliphatic >C16-C21	1.3E-04	1.5E-04	1.7E-04	1.9E-04	1.0E-04	1.5E-22	1.5E-22	3.6E-23	1.2E-22	1.2E-22	9.7E-24	6.5E-12	6.5E-12	1.1E-12	1.1E+05	1.1E+05	4.4E+05	6.3E+18	6.3E+18	2.6E+19	2.8E+17	2.8E+17	3.5E+18	2.4E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aliphatic >C21-C34	2.8E-04	3.2E-04	3.8E-04	4.1E-04	2.2E-04	2.7E-26	2.7E-26	6.4E-27	2.2E-26	2.2E-26	1.7E-27	6.0E-17	6.0E-17	9.4E-18	1.1E+05	1.1E+05	4.4E+05	3.1E+17	3.1E+17	1.3E+18	1.4E+16	1.4E+16	1.7E+17	9.0E+02	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C8-C10	1.5E-20	1.7E-20	1.5E-20	7.7E-21	3.9E-21	7.7E-20	7.7E-20	1.8E-20	6.3E-20	6.3E-20	5.0E-21	2.2E-20	2.2E-20	3.0E-20	2.0E+19	2.0E+19	8.3E+19	5.0E+22	5.0E+22	2.1E+23	2.7E+21	2.7E+21	3.4E+22	2.1E+21	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C10-C12	1.7E-02	1.7E-02	1.5E-02	1.3E-02	5.9E-03	6.4E-03	6.4E-03	1.5E-03	5.3E-03	5.3E-03	4.2E-04	1.2E-02	1.2E-02	9.7E-03	1.8E+02	1.8E+02	7.3E+02	1.2E+06	1.2E+06	4.9E+06	8.9E+04	8.9E+04	1.1E+06	1.4E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C12-C16	1.7E-01	1.7E-01	1.7E-01	1.7E-01	8.8E-02	7.9E-03	7.9E-03	1.9E-03	6.4E-03	6.4E-03	5.1E-04	7.5E-02	7.5E-02	3.1E-02	1.8E+02	1.8E+02	7.3E+02	1.9E+06	1.9E+06	7.9E+06	2.3E+05	2.3E+05	2.9E+06	1.2E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C16-C21	3.4E-01	3.7E-01	4.1E-01	4.5E-01	2.4E-01	4.8E-04	4.8E-04	1.1E-04	3.9E-04	3.9E-04	3.1E-05	3.5E-02	3.5E-02	7.7E-03	1.8E+02	1.8E+02	7.3E+02	3.8E+06	3.8E+06	1.6E+07	8.9E+05	8.9E+05	1.1E+07	9.5E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C21-C34	1.0E-01	1.2E-01	1.4E-01	1.5E-01	8.0E-02	6.4E-25	6.4E-25	1.5E-25	5.3E-25	5.3E-25	4.2E-26	1.6E-05	1.6E-05	2.5E-06	1.5E+03	1.5E+03	5.8E+03	4.2E+24	4.2E+24	1.8E+25	1.7E+24	1.7E+24	2.1E+25	7.3E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
n-Hexane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.8E+02	8.8E+02	3.6E+03	2.1E+05	2.1E+05	9.0E+05	9.5E+03	9.5E+03	1.2E+05	6.5E+04	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Benzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.4E+01	4.4E+01	1.8E+02	2.8E+05	2.8E+05	1.2E+06	1.9E+04	1.9E+04	2.4E+05	5.7E+03	3.1E+01	3.1E+01	1.3E+02	6.3E+03	6.3E+03	1.3E+05
Toluene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E+03	2.3E+03	9.2E+03	4.4E+07	4.4E+07	1.8E+08	2.7E+06	2.7E+06	3.4E+07	2.1E+05	5.2E+03	5.2E+03	2.2E+04	1.0E+06	1.0E+06	2.2E+07
Ethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.3E+03	5.5E+03	8.8E+06	8.8E+06	3.7E+07	5.3E+05	5.3E+05	6.6E+06	1.1E+05	1.0E+03	1.0E+03	4.4E+03	2.1E+05	2.1E+05	4.4E+06
Total Xylenes	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+02	2.0E+02	8.5E+02	9.2E+05	9.2E+05	3.9E+06	5.9E+04	5.9E+04	7.4E+05	2.3E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
1,2,4-trimethylbenzene	9.5E-03	1.1E-02	8.9E-03	3.0E-03	8.1E-04	1.8E-02	1.8E-02	4.4E-03	1.5E-02	1.5E-02	1.2E-03	7.2E-03	7.2E-03	1.8E-02	1.5E+01	1.5E+01	6.1E+01	8.0E+04	8.0E+04	3.3E+05	5.0E+03	5.0E+03	6.4E+04	1.7E+03	7.3E+00	7.3E+00	3.1E+01	1.5E+03	1.5E+03	3.1E+04
1,3,5-trimethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.7E+02	3.7E+02	1.5E+03	9.2E+22	9.2E+22	3.9E+23	5.4E+21	5.4E+21	6.8E+22	2.3E+04	1.0E+19	1.0E+19	4.4E+19	-	-	-
Naphthalene	2.8E-01	2.3E-01	1.6E-01	1.1E-01	2.8E-02	4.7E-02	4.7E-02	1.1E-02	3.9E-02	3.9E-02	3.1E-03	8.7E-01	8.7E-01	7.1E-01	6.2E+00	6.2E+00	2.6E+01	1.4E+05	1.4E+05	5.7E+05	2.9E+04	2.9E+04	3.7E+05	7.2E+02	3.1E+00	3.1E+00	1.3E+01	6.3E+02	6.3E+02	1.3E+04
TPH RBC* ⟶	1,400	3,100	23,000	7,800	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	160	160	>MAX	18	18	74	>S	>S	>S	>S	>S	>S	2,000	26	26	110	5,200	5,200	110,000
Generic Gasoline	1,200	2,500	20,000	9,700	>MAX	5,900	5,900	69,000	94	94	>MAX	31	31	130	110	110	450	>S	>S	>S	22,000	22,000	>S	14,000	390	390	1,700	79,000	79,000	1,700,000
Generic Diesel / Heating Oil	1,100	2,200	14,000	4,600	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	9,500	9,500	>MAX	100	100	430	>S	>S	>S	>S	>S	>S	>S	100	100	440	21,000	21,000	440,000
Generic Mineral Insulating Oil	2,800	5,700	36,000	11,000	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	300	300	1,300	>S	>S	>S	>S	>S	>S	>S	150	150	620	30,000	30,000	620,000

TPH Fraction Composition (Weight Fraction)

Fuel Fractions	Site-Specific Data			Generic Weight Fraction Data		
	Raw Data mg/kg (ppm)	Adjusted Data mg/kg (ppm)	Weight Fraction	Gasoline	Diesel	Mineral Oil
Aliphatic C5-C6	0	0	0.00E+00	2.06E-01	0.00E+00	0.00E+00
Aliphatic >C6-C8	0	0	0.00E+00	2.20E-01	0.00E+00	0.00E+00
Aliphatic >C8-C10	0	0	0.00E+00	9.00E-02	2.00E-02	1.00E-03
Aliphatic >C10-C12	18	18	6.73E-03	3.00E-02	7.00E-02	3.00E-03
Aliphatic >C12-C16	67	67	2.51E-02	0.00E+00	3.50E-01	1.60E-01
Aliphatic >C16-C21	43	43	1.61E-02	0.00E+00	3.40E-01	7.00E-01
Aliphatic >C21-C34	93	93	3.48E-02	0.00E+00	0.00E+00	0.00E+00
Aromatic >C8-C10	6	4	1.45E-03	9.02E-02	2.52E-03	1.00E-03
Aromatic >C10-C12	96	31	1.17E-02	2.25E-02	7.40E-03	1.00E-03
Aromatic >C12-C16	500	500	1.87E-01	0.00E+00	8.00E-02	7.00E-03
Aromatic >C16-C21	1400	1400	5.24E-01	0.00E+00	1.20E-01	8.00E-02
Aromatic >C21-C34	450	450	1.68E-01	0.00E+00	0.00E+00	4.60E-02
n-Hexane	0.0	0.0	0.00E+00	2.40E-02	0.00E+00	0.00E+00
Benzene	0.0	0.0	0.00E+00	2.50E-02	2.90E-04	0.00E+00
Toluene	0.0	0.0	0.00E+00	1.20E-01	1.80E-03	0.00E+00
Ethylbenzene	0.0	0.0	0.00E+00	2.00E-02	6.80E-04	0.00E+00
Total Xylenes	0.0	0.0	0.00E+00	1.10E-01	5.00E-03	0.00E+00
1,2,4-trimethylbenzene	2.0	2.0	7.56E-04	3.00E-02	0.00E+00	0.00E+00
1,3,5-trimethylbenzene	0.0	0.0	0.00E+00	9.80E-03	1.80E-03	0.00E+00
Naphthalene	64.7	64.7	2.42E-02	2.50E-03	2.60E-03	0.00E+00
Total	2740	2673	1.00	1.00	1.00	1.00

Use one of the following two options for site-specific TPH RBC calculations.

OPTION 1: **Estimate TPH Fractions**

(1) Enter TPH data (mg/kg or ppm) into the cell on the right. →

(2) Enter BTEX, TMB, and naphthalene data in the "Raw Data" column above.

(3) Use one of the buttons at the right to identify the predominant product.

Gasoline Estimate

Diesel Estimate

OR

OPTION 2: **Use VPH and EPH Results**

(1) Enter TPH fraction and constituent data in the "Raw Data" column above.

(2) Use one of the buttons at the right to identify the predominant product.

Gasoline Fractions

Non-Gas Fractions

For references, please refer to *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites* (DEQ, 2003).

Chemical Data: **Site-Specific Data**

Fuel Fraction	Vol Class	MW (g/mol)	Density (g/cm^3)	Xi*MWi	Xi*MWi/rpi	S (mg/L)	P (ug/m^3)	K_H (m^3-atm/mol)	H'	Log K_{oc}	K_{oc} (cm^3/g)	D_{air} (cm^2/s)	D_w (cm^2/s)
Aliphatic C5-C6	v	81	0.68	0.00	0.00	3.6E+01	1.2E+09	7.94E-01	33	2.9	7.9E+02	1.0E-01	1.0E-05
Aliphatic >C6-C8	v	100	0.73	0.00	0.00	5.4E+00	2.7E+08	1.20E+00	50	3.6	4.0E+03	1.0E-01	1.0E-05
Aliphatic >C8-C10	v	130	0.73	0.00	0.00	4.3E-01	3.4E+07	1.92E+00	80	4.5	3.2E+04	1.0E-01	1.0E-05
Aliphatic >C10-C12	v	160	0.76	1.27	1.67	3.4E-02	4.1E+06	2.89E+00	120	5.4	2.5E+05	1.0E-01	1.0E-05
Aliphatic >C12-C16	nv	200	0.77	4.72	6.16	7.6E-04	4.0E+05	1.25E+01	520	6.7	5.0E+06	1.0E-01	1.0E-05
Aliphatic >C16-C21	nv	270	0.78	3.03	3.88	2.5E-06	1.2E+04	1.18E+02	4900	8.8	6.3E+08	1.0E-01	1.0E-05
Aliphatic >C21-C34	nv	400	0.78	6.55	8.40	1.5E-11	1.5E+00	2.41E+03	100000	10.0	1.1E+10	1.0E-01	1.0E-05
Aromatic >C8-C10	v	120	0.87	0.27	0.31	6.5E+01	3.1E+07	1.15E-02	0.48	3.2	1.6E+03	1.0E-01	1.0E-05
Aromatic >C10-C12	v	130	0.90	2.20	2.43	2.5E+01	3.5E+06	3.37E-03	0.14	3.4	2.5E+03	1.0E-01	1.0E-05
Aromatic >C12-C16	v	150	1.02	35.18	34.49	5.8E+00	3.1E+05	1.27E-03	0.053	3.7	5.0E+03	1.0E-01	1.0E-05
Aromatic >C16-C21	v	190	1.23	98.61	80.17	6.5E-01	8.5E+03	3.13E-04	0.013	4.2	1.6E+04	1.0E-01	1.0E-05
Aromatic >C21-C34	nv	240	1.28	31.71	24.77	6.6E-03	4.4E+00	1.61E-05	0.00067	5.1	1.3E+05	1.0E-01	1.0E-05
n-Hexane	v	86	0.70	0.00	0.00	1.8E+01	9.0E+07	1.20E-01	5.0	2.9	8.9E+02	2.0E-01	7.8E-06
Benzene	v	78	0.88	0.00	0.00	1.8E+03	4.0E+08	5.55E-03	0.23	1.8	5.9E+01	8.8E-02	9.8E-06
Toluene	v	92	0.87	0.00	0.00	5.3E+02	1.5E+08	6.64E-03	0.28	2.3	1.8E+02	8.7E-02	8.6E-06
Ethylbenzene	v	106	0.87	0.00	0.00	1.7E+02	5.5E+07	7.88E-03	0.33	2.6	3.6E+02	7.5E-02	7.8E-06
Total Xylenes	v	106	0.88	0.00	0.00	1.8E+02	4.9E+07	6.73E-03	0.28	2.6	3.9E+02	7.8E-02	8.8E-06
1,2,4-trimethylbenzene	v	120	0.88	0.14	0.16	5.7E+01	1.4E+07	5.70E-03	0.24	3.6	3.7E+03	7.5E-02	7.1E-06
1,3,5-trimethylbenzene	v	120	0.87	0.00	0.00	5.0E+01	1.6E+07	7.70E-03	0.32	2.9	8.2E+02	7.5E-02	7.1E-06
Naphthalene	v	128	1.15	4.54	3.97	3.1E+01	6.2E+05	4.83E-04	0.02	3.3	2.0E+03	5.9E-02	7.5E-06
TPH*	v	188.2	1.13	188.22	166	◄——— These two values are product specific.							

Calculations for	Site-Specific Data			
Fuel Fraction	Sample Concentration Adjusted (mg/kg)	Weight Fraction	mmoles	Initial Mole Fraction
Aliphatic C5-C6	0	0.000	0.000	0.000
Aliphatic >C6-C8	0	0.000	0.000	0.000
Aliphatic >C8-C10	0	0.000	0.000	0.000
Aliphatic >C10-C12	795	0.007	4.971	0.008
Aliphatic >C12-C16	2961	0.025	14.803	0.024
Aliphatic >C16-C21	1900	0.016	7.038	0.011
Aliphatic >C21-C34	4110	0.035	10.274	0.016
Aromatic >C8-C10	171	0.001	1.429	0.002
Aromatic >C10-C12	1383	0.012	10.639	0.017
Aromatic >C12-C16	22095	0.187	147.297	0.235
Aromatic >C16-C21	61865	0.524	325.604	0.518
Aromatic >C21-C34	19885	0.168	82.855	0.132
n-Hexane	0	0.000	0.000	0.000
Benzene	0	0.000	0.000	0.000
Toluene	0	0.000	0.000	0.000
Ethylbenzene	0	0.000	0.000	0.000
Total Xylenes	0	0.000	0.000	0.000
1,2,4-trimethylbenzene	89	0.001	0.744	0.001
1,3,5-trimethylbenzene	0	0.000	0.000	0.000
Naphthalene	2859	0.024	22.336	0.036
TPH	118113	1.000	627.990	1.000

		Distribution of Constituent Concentrations Between 3 or 4 Phases				
Cw/Si	Xi	Cair (ug/m3)	Cwater (mg/L)	Csorbed (mg/kg)	Cproduct (mg/kg)	Trial Value Xi
0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000
0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000
0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000
1.84E+01	0.008	3.25E+04	2.71E-04	3.40E-01	6.74E+03	0.008
1.55E+02	0.024	9.38E+03	1.80E-05	4.52E-01	2.51E+04	0.024
2.41E+02	0.011	1.38E+02	2.82E-08	8.90E-02	1.61E+04	0.011
5.11E+06	0.016	2.47E-02	2.47E-13	1.32E-05	3.48E+04	0.016
3.27E-01	0.002	7.10E+04	1.48E-01	1.17E+00	1.44E+03	0.002
4.37E+00	0.017	5.95E+04	4.25E-01	5.34E+00	1.17E+04	0.017
1.52E+02	0.235	7.25E+04	1.37E+00	3.43E+01	1.87E+05	0.236
1.20E+03	0.519	4.41E+03	3.39E-01	2.69E+01	5.24E+05	0.522
4.79E+03	0.132	5.87E-01	8.77E-04	5.52E-01	1.68E+05	0.133
0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000
0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000
0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000
0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000
0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000
8.42E-02	0.001	1.59E+04	6.70E-02	1.24E+00	7.46E+02	0.001
0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000
9.18E+00	0.035	2.22E+04	1.11E+00	1.10E+01	2.41E+04	0.036
##########	1.001	2.87E+05	3.45E+00	8.14E+01	1.00E+06	1.006

Weight Fractions for Product at Equilibrium with Air or Water Phase			
Cair (ug/m3)	WFair	Cwater (mg/L)	WFwater
0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.23E+04	1.13E-01	2.69E-04	7.82E-05
9.32E+03	3.25E-02	1.79E-05	5.21E-06
1.37E+02	4.79E-04	2.80E-08	8.14E-09
2.45E-02	8.56E-08	2.45E-13	7.13E-14
7.10E+04	2.48E-01	1.48E-01	4.30E-02
5.93E+04	2.07E-01	4.24E-01	1.23E-01
7.21E+04	2.52E-01	1.36E+00	3.95E-01
4.38E+03	1.53E-02	3.37E-01	9.80E-02
5.83E-01	2.04E-06	8.71E-04	2.53E-04
0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.60E+04	5.58E-02	6.75E-02	1.96E-02
0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.21E+04	7.72E-02	1.10E+00	3.21E-01
2.87E+05	1.000	3.44E+00	1.000

Interim Risk Calc's (HQ)
0.00E+00
0.00E+00
0.00E+00
8.25E-06
2.06E-07
1.07E-12
9.40E-18
2.98E-20
9.70E-03
3.12E-02
7.74E-03
2.50E-06
0.00E+00
0.00E+00
0.00E+00
0.00E+00
0.00E+00
1.82E-02
0.00E+00
7.08E-01
7.75E-01

TPH =
1.2E+05
ppm

Mass balance check: 1 cm^3 sample	
2.0E-01	grams product
2.4E-08	grams in air
4.1E-07	grams in water
1.4E-04	grams on soil
2.0E-01	total grams petroleum
1.7E+00	total grams of solid
1.2E+05	Must equal ppm TPH

If <=1, assume 3 phases.	Else If =1, assume 4 phases.	This solution is based on 4 phases.

Initial guess for value of n_p	Value of n_a if 4 phases
0.1775	0.0836
Corrected value for n_p	Value of n_a if only 3 phases
0.1764	0.2600

Risk-Based Concentrations for TPH: **Site-Specific Data**

	RBCss					RBCso			RBCsi			RBCsw			RBCtw			RBCwo			RBCwi			RBCwe	RBCair			RBCsg		
Fuel Fraction	Residential	Urban Residential	Occupational	Construction Worker	Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational	Construction & Excavation Worker	Residential	Urban Residential	Occupational	Residential	Urban Residential	Occupational
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)	(ug/m^3)
Aliphatic C5-C6	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	6.5E+04	6.5E+04	2.7E+05	2.9E+03	2.9E+03	3.7E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C6-C8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+03	1.5E+03	6.1E+03	4.3E+04	4.3E+04	1.8E+05	1.9E+03	1.9E+03	2.4E+04	1.7E+05	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Aliphatic >C8-C10	5.5E-03	5.7E-03	5.4E-03	4.6E-03	2.4E-03	8.6E-03	8.6E-03	2.1E-03	7.1E-03	7.1E-03	5.6E-04	1.3E-04	1.3E-04	3.0E-05	1.3E+02	1.3E+02	5.5E+02	3.8E+03	3.8E+03	1.6E+04	1.7E+02	1.7E+02	2.2E+03	2.0E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C10-C12	4.9E-02	4.7E-02	4.3E-02	4.1E-02	2.0E-02	7.5E-03	7.5E-03	1.8E-03	6.2E-03	6.2E-03	4.9E-04	7.3E-05	7.3E-05	1.8E-05	1.3E+02	1.3E+02	5.5E+02	2.6E+03	2.6E+03	1.1E+04	1.1E+02	1.1E+02	1.4E+03	6.7E+02	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aliphatic >C12-C16	1.1E-01	1.1E-01	1.2E-01	1.2E-01	6.3E-02	1.4E-03	1.4E-03	3.2E-04	1.1E-03	1.1E-03	8.8E-05	1.1E-06	1.1E-06	2.7E-07	3.7E+02	3.7E+02	1.5E+03	5.9E+02	5.9E+02	2.5E+03	2.6E+01	2.6E+01	3.3E+02	1.2E+02	1.0E+02	1.0E+02	4.4E+02	-	-	-
Aliphatic >C16-C21	1.3E-04	1.3E-04	1.4E-04	1.4E-04	7.6E-05	1.1E-22	1.1E-22	2.7E-23	9.2E-23	9.2E-23	7.3E-24	3.2E-12	3.2E-12	8.0E-13	1.1E+05	1.1E+05	4.4E+05	6.3E+18	6.3E+18	2.6E+19	2.8E+17	2.8E+17	3.5E+18	2.4E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aliphatic >C21-C34	2.1E-04	2.1E-04	2.3E-04	2.3E-04	1.2E-04	1.5E-26	1.5E-26	3.6E-27	1.2E-26	1.2E-26	9.9E-28	2.1E-17	2.1E-17	5.3E-18	1.1E+05	1.1E+05	4.4E+05	3.1E+17	3.1E+17	1.3E+18	1.4E+16	1.4E+16	1.7E+17	9.0E+02	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C8-C10	2.7E-20	2.8E-20	2.3E-20	1.1E-20	5.3E-21	1.0E-19	1.0E-19	2.5E-20	8.5E-20	8.5E-20	6.8E-21	1.7E-19	1.7E-19	4.0E-20	2.0E+19	2.0E+19	8.3E+19	5.0E+22	5.0E+22	2.1E+23	2.7E+21	2.7E+21	3.4E+22	2.1E+21	1.0E+19	1.0E+19	4.4E+19	-	-	-
Aromatic >C10-C12	2.4E-02	2.1E-02	1.7E-02	1.4E-02	6.2E-03	6.9E-03	6.9E-03	1.6E-03	5.7E-03	5.7E-03	4.5E-04	4.3E-02	4.3E-02	1.0E-02	1.8E+02	1.8E+02	7.3E+02	1.2E+06	1.2E+06	4.9E+06	8.9E+04	8.9E+04	1.1E+06	1.4E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C12-C16	1.5E-01	1.5E-01	1.4E-01	1.3E-01	6.5E-02	5.9E-03	5.9E-03	1.4E-03	4.8E-03	4.8E-03	3.8E-04	9.7E-02	9.7E-02	2.3E-02	1.8E+02	1.8E+02	7.3E+02	1.9E+06	1.9E+06	7.9E+06	2.3E+05	2.3E+05	2.9E+06	1.2E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C16-C21	5.0E-01	5.1E-01	5.2E-01	5.3E-01	2.8E-01	5.6E-04	5.6E-04	1.3E-04	4.6E-04	4.6E-04	3.6E-05	3.8E-02	3.8E-02	9.0E-03	1.8E+02	1.8E+02	7.3E+02	3.8E+06	3.8E+06	1.6E+07	8.9E+05	8.9E+05	1.1E+07	9.5E+03	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
Aromatic >C21-C34	1.3E-01	1.3E-01	1.4E-01	1.5E-01	7.7E-02	6.2E-25	6.2E-25	1.5E-25	5.1E-25	5.1E-25	4.1E-26	9.7E-06	9.7E-06	2.4E-06	1.5E+03	1.5E+03	5.8E+03	4.2E+24	4.2E+24	1.8E+25	1.7E+24	1.7E+24	2.1E+25	7.3E+03	1.0E+19	1.0E+19	4.4E+19	-	-	-
n-Hexane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.8E+02	8.8E+02	3.6E+03	2.1E+05	2.1E+05	9.0E+05	9.5E+03	9.5E+03	1.2E+05	6.5E+04	7.3E+02	7.3E+02	3.1E+03	1.5E+05	1.5E+05	3.1E+06
Benzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.4E+01	4.4E+01	1.8E+02	2.8E+05	2.8E+05	1.2E+06	1.9E+04	1.9E+04	2.4E+05	5.7E+03	3.1E+01	3.1E+01	1.3E+02	6.3E+03	6.3E+03	1.3E+05
Toluene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E+03	2.3E+03	9.2E+03	4.4E+07	4.4E+07	1.8E+08	2.7E+06	2.7E+06	3.4E+07	2.1E+05	5.2E+03	5.2E+03	2.2E+04	1.0E+06	1.0E+06	2.2E+07
Ethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+03	1.3E+03	5.5E+03	8.8E+06	8.8E+06	3.7E+07	5.3E+05	5.3E+05	6.6E+06	1.1E+05	1.0E+03	1.0E+03	4.4E+03	2.1E+05	2.1E+05	4.4E+06
Total Xylenes	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E+02	2.0E+02	8.5E+02	9.2E+05	9.2E+05	3.9E+06	5.9E+04	5.9E+04	7.4E+05	2.3E+04	1.0E+02	1.0E+02	4.4E+02	2.1E+04	2.1E+04	4.4E+05
1,2,4-trimethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E+01	1.5E+01	6.1E+01	8.0E+04	8.0E+04	3.3E+05	5.0E+03	5.0E+03	6.4E+04	1.7E+03	7.3E+00	7.3E+00	3.1E+01	1.5E+03	1.5E+03	3.1E+04
1,3,5-trimethylbenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.7E+02	3.7E+02	1.5E+03	9.2E+22	9.2E+22	3.9E+23	5.4E+21	5.4E+21	6.8E+22	2.3E+04	1.0E+19	1.0E+19	4.4E+19	-	-	-
Naphthalene	3.3E-02	2.6E-02	1.7E-02	1.1E-02	2.8E-03	4.7E-03	4.7E-03	1.1E-03	3.9E-03	3.9E-03	3.1E-04	3.0E-01	3.0E-01	7.1E-02	6.2E+00	6.2E+00	2.6E+01	1.4E+05	1.4E+05	5.7E+05	2.9E+04	2.9E+04	3.7E+05	7.2E+02	3.1E+00	3.1E+00	1.3E+01	6.3E+02	6.3E+02	1.3E+04
TPH RBC* ⟶	1,800	3,800	26,000	8,100	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	77	77	320	>S	>S	>S	>S	>S	>S	>S	110	110	470	22,000	22,000	470,000
Generic Gasoline	1,200	2,500	20,000	9,700	>MAX	5,900	5,900	69,000	94	94	>MAX	31	31	130	110	110	450	>S	>S	>S	22,000	22,000	>S	14,000	390	390	1,700	79,000	79,000	1,700,000
Generic Diesel / Heating Oil	1,100	2,200	14,000	4,600	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	9,500	9,500	>MAX	100	100	430	>S	>S	>S	>S	>S	>S	>S	100	100	440	21,000	21,000	440,000
Generic Mineral Insulating Oil	2,800	5,700	36,000	11,000	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	>MAX	300	300	1,300	>S	>S	>S	>S	>S	>S	>S	150	150	620	30,000	30,000	620,000

TPH Fraction Composition (Weight Fraction)

Fuel Fractions	Site-Specific Data			Generic Weight Fraction Data		
	Raw Data mg/kg (ppm)	Adjusted Data mg/kg (ppm)	Weight Fraction	Gasoline	Diesel	Mineral Oil
Aliphatic C5-C6	0	0	0.00E+00	2.06E-01	0.00E+00	0.00E+00
Aliphatic >C6-C8	0	0	0.00E+00	2.20E-01	0.00E+00	0.00E+00
Aliphatic >C8-C10	8	8	1.58E-03	9.00E-02	2.00E-02	1.00E-03
Aliphatic >C10-C12	73	73	1.42E-02	3.00E-02	7.00E-02	3.00E-03
Aliphatic >C12-C16	170	170	3.31E-02	0.00E+00	3.50E-01	1.60E-01
Aliphatic >C16-C21	61	61	1.19E-02	0.00E+00	3.40E-01	7.00E-01
Aliphatic >C21-C34	100	100	1.95E-02	0.00E+00	0.00E+00	0.00E+00
Aromatic >C8-C10	10	10	1.95E-03	9.02E-02	2.52E-03	1.00E-03
Aromatic >C10-C12	76	64	1.24E-02	2.25E-02	7.40E-03	1.00E-03
Aromatic >C12-C16	710	710	1.38E-01	0.00E+00	8.00E-02	7.00E-03
Aromatic >C16-C21	3100	3100	6.03E-01	0.00E+00	1.20E-01	8.00E-02
Aromatic >C21-C34	830	830	1.62E-01	0.00E+00	0.00E+00	4.60E-02
n-Hexane	0.0	0.0	0.00E+00	2.40E-02	0.00E+00	0.00E+00
Benzene	0.0	0.0	0.00E+00	2.50E-02	2.90E-04	0.00E+00
Toluene	0.0	0.0	0.00E+00	1.20E-01	1.80E-03	0.00E+00
Ethylbenzene	0.0	0.0	0.00E+00	2.00E-02	6.80E-04	0.00E+00
Total Xylenes	0.0	0.0	0.00E+00	1.10E-01	5.00E-03	0.00E+00
1,2,4-trimethylbenzene	0.0	0.0	0.00E+00	3.00E-02	0.00E+00	0.00E+00
1,3,5-trimethylbenzene	0.0	0.0	0.00E+00	9.80E-03	1.80E-03	0.00E+00
Naphthalene	12.3	12.3	2.39E-03	2.50E-03	2.60E-03	0.00E+00
Total	5150	5138	1.00	1.00	1.00	1.00

Use one of the following two options for site-specific TPH RBC calculations.

OPTION 1: **Estimate TPH Fractions**

(1) Enter TPH data (mg/kg or ppm) into the cell on the right. →

(2) Enter BTEX, TMB, and naphthalene data in the "Raw Data" column above.

(3) Use one of the buttons at the right to identify the predominant product.

Gasoline Estimate

Diesel Estimate

OR

OPTION 2: **Use VPH and EPH Results**

(1) Enter TPH fraction and constituent data in the "Raw Data" column above.

(2) Use one of the buttons at the right to identify the predominant product.

Gasoline Fractions

Non-Gas Fractions

For references, please refer to *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites* (DEQ, 2003).

Chemical Data: **Site-Specific Data**

Fuel Fraction	Vol Class	MW (g/mol)	Density (g/cm^3)	Xi*MWi	Xi*MWi/rpi	S (mg/L)	P (ug/m^3)	K_H (m^3-atm/mol)	H'	Log K_{oc}	K_{oc} (cm^3/g)	D_{air} (cm^2/s)	D_w (cm^2/s)
Aliphatic C5-C6	v	81	0.68	0.00	0.00	3.6E+01	1.2E+09	7.94E-01	33	2.9	7.9E+02	1.0E-01	1.0E-05
Aliphatic >C6-C8	v	100	0.73	0.00	0.00	5.4E+00	2.7E+08	1.20E+00	50	3.6	4.0E+03	1.0E-01	1.0E-05
Aliphatic >C8-C10	v	130	0.73	0.30	0.41	4.3E-01	3.4E+07	1.92E+00	80	4.5	3.2E+04	1.0E-01	1.0E-05
Aliphatic >C10-C12	v	160	0.76	2.71	3.56	3.4E-02	4.1E+06	2.89E+00	120	5.4	2.5E+05	1.0E-01	1.0E-05
Aliphatic >C12-C16	nv	200	0.77	6.30	8.23	7.6E-04	4.0E+05	1.25E+01	520	6.7	5.0E+06	1.0E-01	1.0E-05
Aliphatic >C16-C21	nv	270	0.78	2.26	2.90	2.5E-06	1.2E+04	1.18E+02	4900	8.8	6.3E+08	1.0E-01	1.0E-05
Aliphatic >C21-C34	nv	400	0.78	3.71	4.75	1.5E-11	1.5E+00	2.41E+03	100000	10.0	1.1E+10	1.0E-01	1.0E-05
Aromatic >C8-C10	v	120	0.87	0.37	0.42	6.5E+01	3.1E+07	1.15E-02	0.48	3.2	1.6E+03	1.0E-01	1.0E-05
Aromatic >C10-C12	v	130	0.90	2.35	2.60	2.5E+01	3.5E+06	3.37E-03	0.14	3.4	2.5E+03	1.0E-01	1.0E-05
Aromatic >C12-C16	v	150	1.02	26.28	25.77	5.8E+00	3.1E+05	1.27E-03	0.053	3.7	5.0E+03	1.0E-01	1.0E-05
Aromatic >C16-C21	v	190	1.23	114.89	93.41	6.5E-01	8.5E+03	3.13E-04	0.013	4.2	1.6E+04	1.0E-01	1.0E-05
Aromatic >C21-C34	nv	240	1.28	30.77	24.04	6.6E-03	4.4E+00	1.61E-05	0.00067	5.1	1.3E+05	1.0E-01	1.0E-05
n-Hexane	v	86	0.70	0.00	0.00	1.8E+01	9.0E+07	1.20E-01	5.0	2.9	8.9E+02	2.0E-01	7.8E-06
Benzene	v	78	0.88	0.00	0.00	1.8E+03	4.0E+08	5.55E-03	0.23	1.8	5.9E+01	8.8E-02	9.8E-06
Toluene	v	92	0.87	0.00	0.00	5.3E+02	1.5E+08	6.64E-03	0.28	2.3	1.8E+02	8.7E-02	8.6E-06
Ethylbenzene	v	106	0.87	0.00	0.00	1.7E+02	5.5E+07	7.88E-03	0.33	2.6	3.6E+02	7.5E-02	7.8E-06
Total Xylenes	v	106	0.88	0.00	0.00	1.8E+02	4.9E+07	6.73E-03	0.28	2.6	3.9E+02	7.8E-02	8.8E-06
1,2,4-trimethylbenzene	v	120	0.88	0.00	0.00	5.7E+01	1.4E+07	5.70E-03	0.24	3.6	3.7E+03	7.5E-02	7.1E-06
1,3,5-trimethylbenzene	v	120	0.87	0.00	0.00	5.0E+01	1.6E+07	7.70E-03	0.32	2.9	8.2E+02	7.5E-02	7.1E-06
Naphthalene	v	128	1.15	0.45	0.40	3.1E+01	6.2E+05	4.83E-04	0.02	3.3	2.0E+03	5.9E-02	7.5E-06
TPH*	v	190.4	1.14	190.41	166	◄——— These two values are product specific.							

Calculations for	Site-Specific Data						Distribution of Constituent Concentrations Between 3 or 4 Phases					Weight Fractions for Product at Equilibrium with Air or Water Phase				Interim Risk
Fuel Fraction	Sample Concentration Adjusted (mg/kg)	Weight Fraction	mmoles	Initial Mole Fraction	Cw/Si	Xi	Cair (ug/m3)	Cwater (mg/L)	Csorbed (mg/kg)	Cproduct (mg/kg)	Trial Value Xi	Cair (ug/m3)	WFair	Cwater (mg/L)	WFwater	Calc's (HQ)
Aliphatic C5-C6	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C6-C8	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aliphatic >C8-C10	186	0.002	1.432	0.002	2.54E+00	0.002	7.99E+04	9.98E-04	1.58E-01	1.58E+03	0.002	7.93E+04	2.08E-01	9.92E-04	4.56E-04	3.04E-05
Aliphatic >C10-C12	1678	0.014	10.488	0.017	3.87E+01	0.017	6.94E+04	5.78E-04	7.26E-01	1.42E+04	0.017	6.89E+04	1.81E-01	5.74E-04	2.64E-04	1.76E-05
Aliphatic >C12-C16	3908	0.033	19.540	0.031	2.05E+02	0.032	1.25E+04	2.41E-05	6.04E-01	3.31E+04	0.032	1.24E+04	3.26E-02	2.39E-05	1.10E-05	2.75E-07
Aliphatic >C16-C21	1402	0.012	5.194	0.008	1.78E+02	0.008	1.03E+02	2.11E-08	6.64E-02	1.19E+04	0.008	1.02E+02	2.68E-04	2.09E-08	9.61E-09	8.01E-13
Aliphatic >C21-C34	2299	0.019	5.747	0.009	2.86E+06	0.009	1.40E-02	1.40E-13	7.49E-06	1.95E+04	0.009	1.39E-02	3.64E-08	1.39E-13	6.38E-14	5.32E-18
Aromatic >C8-C10	230	0.002	1.916	0.003	4.38E-01	0.003	9.63E+04	2.01E-01	1.59E+00	1.93E+03	0.003	9.62E+04	2.52E-01	2.00E-01	9.22E-02	4.05E-20
Aromatic >C10-C12	1464	0.012	11.264	0.018	4.63E+00	0.018	6.37E+04	4.55E-01	5.71E+00	1.24E+04	0.018	6.35E+04	1.66E-01	4.53E-01	2.08E-01	1.04E-02
Aromatic >C12-C16	16321	0.138	108.808	0.175	1.12E+02	0.175	5.42E+04	1.02E+00	2.56E+01	1.38E+05	0.176	5.38E+04	1.41E-01	1.02E+00	4.67E-01	2.33E-02
Aromatic >C16-C21	71262	0.603	375.063	0.604	1.38E+03	0.605	5.14E+03	3.95E-01	3.13E+01	6.03E+05	0.608	5.10E+03	1.34E-02	3.92E-01	1.80E-01	9.02E-03
Aromatic >C21-C34	19080	0.162	79.499	0.128	4.59E+03	0.128	5.70E-01	8.51E-04	5.36E-01	1.62E+05	0.129	5.66E-01	1.48E-06	8.45E-04	3.88E-04	2.43E-06
n-Hexane	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ethylbenzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Xylenes	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,2,4-trimethylbenzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1,3,5-trimethylbenzene	0	0.000	0.000	0.000	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene	283	0.002	2.209	0.004	9.08E-01	0.004	2.22E+03	1.11E-01	1.10E+00	2.39E+03	0.004	2.21E+03	5.80E-03	1.10E-01	5.07E-02	7.08E-02
TPH	118113	1.000	621.159	1.000	##########	1.001	3.83E+05	2.19E+00	6.74E+01	1.00E+06	1.007	3.82E+05	1.000	2.17E+00	1.000	1.14E-01

TPH =
1.2E+05
ppm

Mass balance check: 1 cm^3 sample	
2.0E-01	grams product
3.3E-08	grams in air
2.6E-07	grams in water
1.1E-04	grams on soil
2.0E-01	total grams petroleum
1.7E+00	total grams of solid
1.2E+05	Must equal ppm TPH

If <=1, assume 3 phases.	Else If =1, assume 4 phases.	This solution is based on 4 phases.

Initial guess for value of n_p	Value of n_a if 4 phases
0.1756	0.0855
Corrected value for n_p	Value of n_a if only 3 phases
0.1745	0.2600

Exposure Factors

Reasonable Maximum Exposure

Parameter (unit)	Symbol	Residential	Urban Residential	Occupational	Construction Worker	Excavation Worker
ACCEPTABLE RISK LEVELS						
Acceptable Risk Level - Carcinogens	ARLc	1.00E-06	=	=	=	=
Acceptable Risk Level - Noncarcinogens	ARLn	1	=	=	=	=
EXPOSURE PARAMETERS						
Averaging Time - Carcinogen (yr)	ATc	70	=	=	=	=
Averaging Time - Noncarcinogen (yr)	ATn	30	11	25	1	1
Averaging Time - Noncarcinogen, Child (yr)	ATnc	6	6	NA	NA	NA
Body Weight - Adult (kg)	BWa	70	=	=	=	=
Body Weight - Child (kg)	BWc	15	=	NA	NA	NA
Exposure Duration - Adult (yr)	ED	30	11	25	1	1
Exposure Duration - Child (yr)	EDc	6	6	NA	NA	NA
Exposure Frequency (day/yr)	EF	350	175	250	250	9
Exposure Time (hr/day)	ET	24	24	8	8	8
Event Frequency - Groundwater (events/day)	EvFwe	NA	NA	NA	2	=
Event Time - Groundwater (hr/event)	t_{event}	NA	NA	NA	2	=
Inhalation Rate - Adult (m^3/day)	IRA	20	20	7	7	7
Inhalation Rate - Child (m^3/day)	IRAc	8.3	=	NA	NA	NA
Soil Ingestion Rate - Adult (mg/day)	IRS	100	100	100	330	330
Soil Ingestion Rate - Child (mg/day)	IRSc	200	200	NA	NA	NA
Water Ingestion Rate - Adult (L/day)	IRW	2.0	2.0	0.7	NA	NA
Water Ingestion Rate - Child (L/day)	IRWc	1.5	=	NA	NA	NA
Skin Surface Area - Adult to Soil (cm^2)	SA	5700	5700	3300	3300	3300
Skin Surface Area - Child to Soil (cm^2)	SAc	2800	=	NA	NA	NA
Skin Surface Area - Adult to Groundwater (cm^2)	SAw	NA	NA	NA	5700	5700
Soil to Skin Adherence Factor - Adult (mg/cm^2-day)	AF	0.07	0.07	0.10	0.30	0.30
Soil to Skin Adherence Factor - Child (mg/cm^2-day)	AFc	0.20	=	NA	NA	NA
AGE-ADJUSTED EXPOSURE FACTORS						
Ingestion Factor - Soil (mg-yr/kg-d)	IFSadj	114	87	NA	NA	NA
Ingestion Factor - Water (L-yr/kg-d)	IFWadj	1.29	0.74	NA	NA	NA
Surface Area Factor - Skin (mg-yr/kg-d)	SFSadj	361	253	NA	NA	NA

Toxicological Data

Chemical	Risk Type	SF_o $(mg/Kg\text{-}day)^{-1}$	iUR $(ug/m^3)^{-1}$	Chronic RfD_o (mg/Kg-day)	Chronic RfC_i (mg/m^3)	Subchronic RfD_o (mg/Kg-day)	Subchronic RfC_i (mg/m^3)	RAF_d	K_p (cm/hr)	□ (hr)	t* (hr)	B	DA_w $(L/cm^2\text{-}event)$
Aliphatic C5-C6	nc	NA	NA	NA	0.7	0.3	2	0.00E+00	6.30E-02	2.98E-01	7.16E-01	2.18E-01	1.49E-04
Aliphatic >C6-C8	nc	NA	NA	NA	0.7	0.3	2	0.00E+00	1.43E-01	3.81E-01	9.15E-01	5.49E-01	3.45E-04
Aliphatic >C8-C10	nc	NA	NA	0.01	0.1	0.1	0.1	0.00E+00	3.81E-01	5.61E-01	2.25E+00	1.67E+00	1.11E-03
Aliphatic >C10-C12	nc	NA	NA	1.0E-02	1.0E-01	1.0E-01	1.0E-01	0.00E+00	1.02E+00	8.26E-01	3.62E+00	4.94E+00	3.61E-03
Aliphatic >C12-C16	nc	NA	NA	1.0E-02	1.0E-01	1.0E-01	1.0E-01	1.30E-01	4.37E+00	1.38E+00	6.41E+00	2.38E+01	2.01E-02
Aliphatic >C16-C21	nc	NA	NA	3.0E+00	NA	3.0E+01	NA	1.30E-01	4.31E+01	3.41E+00	1.61E+01	2.72E+02	3.11E-01
Aliphatic >C21-C34	nc	NA	NA	3.0E+00	NA	3.0E+01	NA	1.30E-01	5.00E+01	1.82E+01	8.58E+01	3.84E+02	8.34E-01
Aromatic >C8-C10	nc	NA	NA	NA	NA	NA	NA	0.00E+00	6.01E-02	4.93E-01	1.18E+00	2.53E-01	1.70E-04
Aromatic >C10-C12	nc	NA	NA	3.0E-02	1.0E-01	3.0E-01	1.0E+00	0.00E+00	7.15E-02	5.61E-01	1.35E+00	3.14E-01	2.13E-04
Aromatic >C12-C16	nc	NA	NA	3.0E-02	1.0E-01	3.0E-01	1.0E+00	0.00E+00	8.72E-02	7.26E-01	1.74E+00	4.11E-01	2.98E-04
Aromatic >C16-C21	nc	NA	NA	3.0E-02	1.0E-01	3.0E-01	1.0E+00	0.00E+00	1.11E-01	1.22E+00	2.92E+00	5.90E-01	4.80E-04
Aromatic >C21-C34	nc	NA	NA	4.0E-02	NA	4.0E-01	NA	1.30E-01	2.29E-01	2.32E+00	9.13E+00	1.37E+00	1.37E-03
n-Hexane	nc	NA	NA	6.0E-02	7.0E-01	3.0E-01	2.0E+00	0.00E+00	5.90E-02	3.18E-01	7.64E-01	2.11E-01	1.43E-04
Benzene	nc	NA	NA	4.0E-03	3.0E-02	1.0E-02	8.0E-02	0.00E+00	1.50E-02	2.90E-01	7.00E-01	1.00E-01	3.68E-05
Toluene	nc	NA	NA	8.0E-02	5.0E+00	8.0E-01	5.0E+00	0.00E+00	3.10E-02	3.50E-01	8.40E-01	1.00E-01	8.02E-05
Ethylbenzene	nc	NA	NA	1.0E-01	1.0E+00	NA	9.0E+00	0.00E+00	4.90E-02	4.20E-01	1.01E+00	2.00E-01	1.31E-04
Total Xylenes	nc	NA	NA	2.0E-01	1.0E-01	4.0E-01	4.0E-01	0.00E+00	5.30E-02	4.20E-01	1.01E+00	2.00E-01	1.42E-04
1,2,4-trimethylbenzene	nc	NA	NA	NA	7.0E-03	NA	7.0E-02	0.00E+00	1.10E-01	4.93E-01	1.18E+00	4.65E-01	3.05E-04
1,3,5-trimethylbenzene	nc	NA	NA	1.0E-02	NA	1.0E-01	1.0E-02	0.00E+00	3.81E-02	4.93E-01	1.18E+00	1.60E-01	1.09E-04
Naphthalene	nc	NA	NA	2.0E-02	3.0E-03	NA	NA	0.00E+00	4.70E-02	5.60E-01	1.34E+00	2.00E-01	1.41E-04

NA - No currently accepted value is available for use.

For references, please refer to *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites* (DEQ, 2003).

Transport Factors

Data provided for reference only. Changes cannot be made to this page.

Fuel Fraction	$D_v$eff (cm^2/s)	D_{cap}eff (cm^2/s)	$D_T$eff (cm^2/s)	D_A (cm^2/s)	Ksw (L/kg)	Rsw (L/kg)	LF (kg/L)	VFwo (L/m^3)	VFw (L/m^3)	VFwe (L/m^3)
Aliphatic C5-C6	7.77E-03	1.28E-05	7.02E-04	1.07E-04	9.09E+00	1.41E+03	1.18E-05	1.12E-02	5.00E-01	5.00E-01
Aliphatic >C6-C8	7.77E-03	1.28E-05	7.01E-04	1.97E-05	2.76E+01	1.16E+04	1.44E-06	1.70E-02	5.00E-01	5.00E-01
Aliphatic >C8-C10	7.77E-03	1.28E-05	7.00E-04	1.94E-06	1.70E+02	1.89E+05	8.83E-08	2.71E-02	5.00E-01	5.00E-01
Aliphatic >C10-C12	7.77E-03	1.28E-05	7.00E-04	1.87E-07	1.27E+03	2.94E+06	5.68E-09	4.07E-02	5.00E-01	5.00E-01
Aliphatic >C12-C16	7.77E-03	1.28E-05	6.99E-04	1.45E-08	2.51E+04	1.64E+08	1.02E-10	1.76E-01	0.00E+00	0.00E+00
Aliphatic >C16-C21	7.77E-03	1.28E-05	6.99E-04	3.32E-10	3.16E+06	6.74E+10	2.47E-13	1.66E+00	0.00E+00	0.00E+00
Aliphatic >C21-C34	7.77E-03	1.28E-05	6.99E-04	2.75E-14	5.36E+07	1.66E+16	1.00E-18	3.39E+01	0.00E+00	0.00E+00
Aromatic >C8-C10	7.77E-03	1.68E-05	8.94E-04	1.89E-06	8.07E+00	1.16E+03	1.44E-05	2.08E-04	5.00E-01	5.00E-01
Aromatic >C10-C12	7.77E-03	2.66E-05	1.33E-03	1.97E-07	1.27E+01	3.26E+03	5.12E-06	9.01E-05	5.00E-01	5.00E-01
Aromatic >C12-C16	7.77E-03	4.93E-05	2.15E-03	1.50E-08	2.51E+01	1.62E+04	1.03E-06	5.53E-05	5.00E-01	5.00E-01
Aromatic >C16-C21	7.77E-03	1.62E-04	4.36E-03	3.26E-10	7.93E+01	1.82E+05	9.14E-08	2.74E-05	5.00E-01	5.00E-01
Aromatic >C21-C34	7.86E-03	2.90E-03	7.64E-03	1.37E-13	6.30E+02	2.27E+07	7.35E-10	2.48E-06	0.00E+00	0.00E+00
n-Hexane	1.55E-02	2.59E-05	1.41E-03	1.53E-05	5.29E+00	2.98E+03	5.58E-06	3.42E-03	5.00E-01	5.00E-01
Benzene	6.84E-03	1.95E-05	1.00E-03	3.30E-05	4.00E-01	2.82E+01	5.92E-04	1.12E-04	5.00E-01	5.00E-01
Toluene	6.76E-03	1.71E-05	8.95E-04	9.98E-06	1.02E+00	1.10E+02	1.51E-04	1.20E-04	5.00E-01	5.00E-01
Ethylbenzene	5.83E-03	1.42E-05	7.45E-04	2.86E-06	1.94E+00	3.93E+02	4.24E-05	1.18E-04	5.00E-01	5.00E-01
Total Xylenes	6.06E-03	1.60E-05	8.32E-04	2.63E-06	2.04E+00	3.80E+02	4.39E-05	1.13E-04	5.00E-01	5.00E-01
1,2,4-trimethylbenzene	5.83E-03	1.54E-05	7.99E-04	6.10E-07	1.86E+01	1.33E+03	1.25E-05	9.17E-05	5.00E-01	5.00E-01
1,3,5-trimethylbenzene	5.83E-03	1.39E-05	7.30E-04	7.31E-07	4.22E+00	1.50E+03	1.11E-05	1.13E-04	5.00E-01	5.00E-01
Naphthalene	4.59E-03	7.99E-05	2.36E-03	2.10E-08	1.00E+01	2.59E+03	6.45E-06	2.30E-05	5.00E-01	5.00E-01

ATTACHMENT F

EXPOSURE ASSUMPTIONS FOR DIRECT CONTACT WITH SEDIMENT AND CALCULATION OF HUMAN HEALTH SEDIMENT PRG (FROM DEQ [2019])

Tables

Table 1A. Exposure Assumptions for Direct Contact with Sediment and Calculation of Human Health Sediment PRG

Sediment PRG cancer (mg/kg)= ARLc*BW*AT / (SIR*EF*ED*CF + SA*AF*ABS*EV*EF*ED*CF) / CSF
Sediment PRG noncancer (mg/kg)= ARLnc*BW*AT*RfD / (SIR*EF*ED*CF + SA*AF*ABS*EV*EF*ED*CF)

Parameter		Units	Adult Angler	Child Angler	Combined Adult/Child Angler(a)	Transient
Exposure Frequency	EF	days/yr	24	12		14
Exposure Duration	ED	yr	24	6		1
Averaging Time, carcinogen	ATc	days	25,550	25,550		25,550
Averaging Time, noncarcinogen	ATnc	days(= ED)	8,760	2,190		365
Conversion Factor	CF	kg/mg	1.00E-06	1.00E-06		1.00E-06
Body Weight	BW	kg	80	32		80
Soil Ingestion Rate	SIR	mg/day	100	200		100
Absorption Factor	ABS	fraction	0.13	0.13		0.13
Skin Surface Area	SA	cm^2	5,700	2,650		5,700
Soil Adherence Factor	AF	mg/cm^2-event	0.07	0.02		0.07
Events	EV	events/day	1	1		1
Acceptable Risk Level, cancer	ARLc	Cancer Risk	1.00E-06	1.00E-06		1.00E-06
Acceptable Risk Level, non cancer	ARLnc	Hazard Quotient	1	1		1
Cancer Slope Factor, Benzo[a]pyrene	CSF	$(mg/kg/day)^{-1}$	1	1		1
Reference Dose, Benzo[a]pyrene	RfD	mg/kg/day	0.0003	0.0003		0.0003
Reference Dose, Naphthalene	RfD	mg/kg/day	0.02	0.02		
Reference Dose, TPH (b)	RfD	mg/kg/day	0.004	0.004		
Age Dependent Adjustment Factor	ADAF	unitless	3	3		3

Parameter		Units	Adult Angler	Child Angler	Combined Adult/Child Angler(a)	Transient
Preliminary Remediation Goal						
Benzo[a]pyrene TEQ (c)	PRG1,c	mg/kg	23	14	8.8	960
Benzo[a]pyrene noncancer	PRG1,nc	mg/kg	2,400	1,100		4,100
Naphthalene noncancer	PRG1,nc	mg/kg	160,000	72,000		270000
Total Petroleum Hydrocarbons	PRG1,nc	mg/kg	32,000	14,000		55,000

Notes:

Exposure assumptions taken from site-specific values used for adjacent Armstrong site.

(a) Combined PRGab = 1 / (1/RBCa + 1/RBCb)

(b) TPH = total petroleum hydrocarbons.

RfD from EPA for total TPH, aromatic low and medium molecular weight fractions.

(c) TEQ = toxic equivalency

Cascadia
Associates, LLC

APPENDIX G

UPDATED SUPPLEMENTAL ERA

Updated Supplemental Ecological Risk Assessment

Former Pope & Talbot Wood-Treating Site

St. Helens, Oregon

ECSI ID #959

Prepared for:

Port of Columbia County
P.O. Box 190
Columbia City, Oregon 97018

Prepared by:

Cascadia Associates, LLC
5820 SW Kelly Avenue, Suite B
Portland, Oregon 97239

Project No. 0034-001-005
January 2020

Updated Supplemental Ecological Risk Assessment

Former Pope & Talbot Wood-Treating Site

St. Helens, Oregon

ECSI ID #959

Prepared for:

Port of Columbia County
Project No. 0034-001-005
January 2020

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1.0 INTRODUCTION

This appendix has been prepared by Cascadia Associates, LLC (Cascadia), to supplement the ecological risk assessment (ERA) previously submitted to the Oregon Department of Environmental Quality (DEQ) for the former Pope & Talbot wood-treating property located at 1550 Railroad Avenue in St. Helens, Oregon, (the "Site"). This supplement is necessitated by three main factors:

- Recent (2011, 2012, and 2017) collection of additional data from Site media (specifically sediment, porewater, and surface water) with potential direct exposure pathways to ecological receptors;
- Recent progress in the science of evaluating the potential for adverse effects to benthic invertebrate infauna from exposure to polycyclic aromatic hydrocarbons (PAHs) in these media; and
- Recent (2010, 2011, 2012, 2013, 2017, and 2018) investigations on non-aqueous phase liquid (NAPL) delineation.

The scope of this Updated Supplemental ERA (as detailed in Section 2.0) is limited to data collected since 2005 and to the exposure pathways and receptors associated with media related to those data.

This supplemental assessment focuses on application of new methods and research to the evaluation of these data (Section 3.1) as additional lines of evidence (LOEs) to be used in overall assessment of ecological risk at this Site. However, as described in Section 3.2, updates to the direct screening of media concentrations (porewater and sediment) have also been included. Section 4.0 describes the LOEs used to assess ecological risk in this Updated Supplemental ERA. A summary of the previously submitted ERA documents is presented in Section 5.0 followed by a summary and analysis of sediment data collected in 2011 (Section 6.0). Section 6.0 provides a newly examined LOE associated with historic (2010 – 2012) groundwater data to begin to analyze potential risk to aquatic receptors from dissolved phase constituents in upland groundwater following discharge to surface water. Section 7.0 presents the results of analysis of porewater and sediment samples collected in 2012 (two rounds). Section 8.0 provides an analysis of the LOEs based on 2012 data that are relevant to the potential for risk to receptors associated with the benthic environment of the Site and a discussion of the uncertainties associated with those LOEs. Section 9.0 describes the LOEs associated with the most recent (2017) data. Section 10.0 summarizes the LOEs and Section 11.0 provides overall ERA conclusions.

NAPL has been found to occur in soil, groundwater, groundwater seeps, and sediment at the Site. The nature of NAPL has been investigated, and results provided in the 2000 Remedial Investigation (RI) Report (GeoEngineers, 2000) indicate a NAPL composition consistent with analytical results for creosote-related constituents in NAPL reported in the Supplemental RI Report (Table 5-2). The extent of NAPL at the Site has been inferred based on field observations of NAPL during the multiple investigation events conducted as part of the Supplemental RI. The inferred extent of

subsurface NAPL is shown on Figure G-2. The presence of NAPL is presumed to present an unacceptable risk for ecological receptors. Therefore, media within the estimated extent of NAPL at the Site has not been evaluated in this Updated Supplemental ERA.

2.0 SCOPE OF THE UPDATED SUPPLEMENTAL ERA

As indicated in Section 1.0, the scope of this Updated Supplemental ERA is limited to new data (collected since 2005) and exposure pathways and receptors associated with the sampled media. Although historical data (1996-2005) is evaluated herein using updated methods (Section 5.4), this is done as part of the review of the previous ERAs and is not considered to be directly part of the Updated Supplemental ERA scope. The historical data are, however, used in the determination of sediment exposure point concentrations (EPCs) for the evaluation of potential bioaccumulation risk for fluoranthene and pyrene.

DEQ has requested that Cascadia prepare an update to the ecological conceptual site model (CSM) for the entire Site as part of the Updated Supplemental ERA. This CSM is presented diagrammatically on Figure G-1. Based on discussions with DEQ, the scope of this ERA is limited to potential risks associated with PAH residues in near- and offshore sediments and associated porewater (including Milton Creek), but excluding delineated areas of inferred NAPL presence (based on observed sheen) where risk to ecological receptors is presumed to occur.

This evaluation primarily focused on the biological active zone (0 to 12 inches below the mudline), which is the zone of significant biological activity based on observed macroinvertebrates in sediment core samples. Deeper sediment porewater (2 to 2.4 feet below the mudline) was analyzed to assess the spatial distribution of dissolved phase PAHs. Figures G-3 and G-4 show the locations of all sediment samples collected within the upper 1 foot from 1996 through 2017. Figure G-3 shows RI sampling locations before initiating the Supplemental RI in 2010 and Figure G-4 shows the Supplemental RI sampling locations (2011 – 2017). It should be noted that for the purposes of this evaluation, the Site was divided into two ecologically distinct exposure units—Milton Creek and Scappoose Bay. Receptors included in this assessment (for both exposure areas) are benthic invertebrates that may be exposed to dissolved-phase PAHs in the interstitial water of the Site sediments, and fish (resident and anadromous) exposed through direct contact with these waters (released to surface water).

Sediment data collected in July 2011, July 2012, October 2012, and September 2017 serve as the basis for this Supplemental ERA. The July samples represented high-water conditions of the Columbia River, and September and October represented low-water conditions. These sediment samples were analyzed for bulk PAH concentrations. Most of the samples collected in 2011 were analyzed for the 16 priority PAHs, but some were analyzed for the full suite of 34 PAH analytes (18 parent PAHs and 16 groups of alkylated PAHs). All of the 2012 and 2017 sediment samples were analyzed for the full suite of 34 PAH analytes. All 2017 samples were also analyzed for volatile organic compounds (VOCs), volatile petroleum hydrocarbons (VPH), and extractable petroleum hydrocarbons (EPH). All of these samples (2011, 2012, and 2017) were analyzed for total organic

carbon (TOC), and the 2012 and 2017 samples were also analyzed for black carbon (BC). Although some of the 2011 samples were also analyzed for metals and a limited suite of VOCs, the metals were found to be within site-specific background ranges as established in the 2000 RI Report (GeoEngineers, 2000), and no VOCs were detected in the one sample located outside of the inferred NAPL area that was analyzed for VOCs.

Sediment samples collected in 2012 (both rounds) were centrifuged to extract porewater for PAH analysis using ASTM International (ASTM) method D7376. The extracted porewaters were analyzed for the full suite of 34 PAH analytes as well as dissolved organic carbon (DOC). To get a better understanding of the bioavailability of PAHs (and therefore, a better understanding of risk to benthic organisms as a result of exposure), the 2017 sediment porewater samples were collected through the use of passive samplers (i.e., low density polyethylene [LDPE] passive sampling media within sediment probes), described in further detail in Section 3.7 of the Updated Supplemental RI Report. The locations where porewater samples were collected are shown on Figure G-4.

In addition to sediment and porewater, this Updated Supplemental ERA included a screening of surface water and groundwater data. Groundwater was collected from monitoring wells (shown on Figure G-4) from 2010 to 2012 as part of DEQ objectives for the supplemental RI to assess the quality of groundwater discharging to adjacent surface water bodies. This Updated Supplemental ERA included an analysis of this groundwater data from nearshore monitoring wells to evaluate the potential risks from dissolved phase constituents from discharge of upland groundwater into adjacent surface water. Surface water was examined directly in 2017 via passive samplers deployed for 21 days at locations shown on Figure G-4.

3.0 ASSESSMENT METHODS

This Updated Supplemental ERA generally utilized two main assessment methods to evaluate risk. The first method, which is targeted at risk to benthic organisms, is based on narcosis as the mode of toxicity and assesses risk as a sum of toxic units (TUs) calculated over all (34) PAH analytes (EPA, 2003; EPA, 2012). The second method is based on more traditional comparisons of environmental concentrations to screening level values (SLVs) based on toxic responses in aquatic organisms to individual chemical constituents. These two approaches are described in detail in the following sections. A description of how they were used specifically as LOEs in risk evaluation are described in Section 4.0.

3.1 NARCOSIS MODELS FOR PAH RISK TO BENTHIC INVERTEBRATES

The narcosis model for PAH risk to benthic invertebrates LOE is based on narcosis as the mode of toxicity and assesses risk as a sum of TUs calculated over all (34) PAH analytes. The United States Environmental Protection Agency (EPA) has developed an approach to evaluating the toxicity of PAHs in sediment based on the target lipid model of narcosis and equilibrium partitioning theory (EPA, 2003; EPA, 2012). PAHs are non-polar organic compounds that can be classified as type I narcotic chemicals that exhibit an inverse correlation between their median lethal concentrations

(LC50, in millimoles per liter [mmol/L]) and the logarithms of their octanol-water partition coefficients (log Kow). This inverse relationship relates the toxicity of the aqueous medium (e.g., interstitial water) to chemical body burden (or more specifically, the lipids) of the exposed organism.

The target lipid model is based on the assumption that mortality occurs when the chemical concentration in the target lipid reaches a threshold concentration. In the EPA (2003) approach, that threshold (the final chronic value [FCV] for lipid concentration [FCV_{lipid}]) in benthic invertebrates is established as 2.24 micromoles (µmoles) per gram of lipid (µmol/g) for all PAHs (here, "lipid" is used as an equivalent to octanol for the purposes of describing partitioning in the environment). This FCV_{lipid} can be converted to an equivalent concentration of dissolved PAH in the interstitial water (FCV_D) assuming that equilibrium has been achieved between the lipid and the freely dissolved PAH in the interstitial water. Further, an equivalent FCV for the PAH concentration in sediment organic carbon ([OC], FCV_{OC}) can be determined based on the assumption that equilibrium has been achieved between the dissolved PAH and the sediment OC. However, it should be noted that for both of these cases, these FCV concentrations (FCV_D and FCV_{OC}) are unique to individual PAHs, because each PAH has a distinct molecular weight and log Kow that are used in the conversions.

The FCV benchmarks for water and sediment OC are presented in Table G-1. In the following subsections, methods are described for the calculation of TU values for individual PAHs based on the FCV benchmark values. Section 3.1.1 describes methods by which the TU values are calculated from bulk sediment PAH concentrations using equilibrium partitioning (EqP) as the basis. Section 3.1.2 describes a method that uses data from direct measurements of PAHs in porewater samples to calculate TUs. For the TU calculations performed for this assessment, non-detections were treated as the method detection limit (MDL) to account for elevated reporting limits and to provide a more conservative assessment.

The narcosis-based TUs are considered additive, and evaluation of the sum of the TUs requires that either all 34 PAH analytes have been included in the sum or that the sum has been adjusted to account for the absence of some analytes. A potential for risk to benthic invertebrates exists when the sum of 34 individual TUs exceeds 1.

3.1.1 Equilibrium Partitioning-Based TU Estimation

The EPA has published guidance for two approaches to calculate narcosis-based TUs for benthic invertebrates based on bulk sediment data for PAHs. These are referred to as the one-carbon model (EPA, 2003) and the two-carbon model (EPA, 2012). These names refer to the number of carbon compartments addressed in the model (one-carbon indicates only TOC as a single compartment, and two-carbon indicates that BC is included as a distinct compartment in the partitioning model from "natural sediment OC").

One-Carbon Model

In the one-carbon model approach, the concentration of each PAH partitioned to the sediment OC is estimated by Equation (1):

$$C_{OC,i} = \frac{C_{S,i}}{f_{OC}} \quad \text{Equation (1)}$$

where:

COC,i = Concentration of PAH i in sediment OC (in milligrams per kilogram [mg/kg])

CS,i = Concentration of PAH i in bulk sediment (in mg/kg)

fOC = Fraction of sediment consisting of OC (unitless).

Here, fOC is based directly on the TOC measurement expressed as grams OC per gram of bulk sediment. The PAH-specific TU (referred to in the EPA guidance as the equilibrium partitioning sediment benchmark TU [ESBTU] is calculated as:

$$ESBTU_i = \frac{C_{OC,i}}{FCV_{OC,i}} \quad \text{Equation (2)}$$

where:

ESBTUi = Equilibrium partitioning sediment benchmark TU of PAH i (in toxic units)

COC,i = Concentration of PAH i in sediment OC (mg/kg OC)

FCVOC,i = Final chronic value of PAH i in OC (mg/kg OC)

Based on the additivity of TUs, the sum of the ESBTUs over the k PAHs for which analytical data are available is:

$$\Sigma ESBTU_k = \sum_{i=1}^{k} ESBTU_i \quad \text{Equation (3)}$$

If k is less than 34, then an uncertainty factor (UF) is applied that is specific to the number of PAHs available (k) and a level of confidence (cl) that the adjusted ΣESBTU does not underestimate its true value:

$$\Sigma ESBTU_{34,cl} = UF_{k,cl} \cdot \Sigma ESBTU_k \quad \text{Equation (4)}$$

In this assessment for the Site, the confidence level for all adjusted ΣESBTU values is 90%. EPA (2003) provided empirically based UF values for two k values—13 and 23. The UF13,0.9 is 8.45 and that for UF23,0.9 is 3.37. The data evaluated in this ERA have analyses for 15, 16, 17, or all 34 PAH analytes. Linear interpolation (i.e., using a line between the two values specified by EPA as the basis

of estimating intervening values) was used in this assessment to estimate the UFs for samples with fewer than 34 PAHs analyzed. The resulting UF values were 7.43, 6.93, and 6.42 for k = 15, 16, and 17, respectively.

Calculations of ΣESBTU values using the one-carbon model are shown in Attachment G-A.

Two-Carbon Model

The two-carbon model approach (EPA, 2012) is based on estimating the dissolved concentration of each PAH in the interstitial water from its bulk sediment concentration using Equation (5):

$$C_{D,i} = \frac{C_{S,i}}{f_{NSOC} \cdot K_{OC} + f_{BC} \cdot K_{BC} \cdot C_{D,i}^{(n-1)}} \qquad \text{Equation (5)}$$

where:

CD,i = Concentration of dissolved PAH i in the interstitial water (in micrograms per liter [µg/L])

CS,i = Concentration of PAH i in bulk sediment (in micrograms per kilogram [µg/kg])

fNSOC = Fraction of sediment consisting of natural OC (unitless)

KOC = OC-water partition coefficient (unitless)

fBC = Fraction of sediment consisting of BC (unitless)

KBC = BC-water partition coefficient (unitless)

n = Freundlich exponent for nonlinear sorption behavior.

Values of KOC and KBC are taken from EPA (2012) and are listed in Table G-1. The value of n (0.6) is also from EPA (2012). The value of fNSOC is calculated as the difference between fOC and fBC. Because CD,i occurs on both sides of the equation, its value was derived through an iterative process in Microsoft® Excel by allowing circular calculations with a maximum of 300 iterations and a maximum difference of 1 x 10-6.

The PAH-specific TU (referred to in the EPA guidance as the interstitial water TU [IWTU]) is calculated as:

$$IWTU_i = \frac{C_{D,i}}{FCV_{D,i}} \qquad \text{Equation (6)}$$

Based on the additivity of TUs, the sum of the IWTUs over the 34 PAHs is:

$$\Sigma IWTU_{34} = \sum_{i=1}^{34} IWTU_i \qquad \text{Equation (7)}$$

Because all samples for which BC was included as an analyte also included all 34 PAHs, the use of UFs was not necessary for the ΣIWTU calculations.

Calculations of ΣIWTU values using the two-carbon model are shown in Attachment G-B.

3.1.2 Freely Dissolved PAH

For cases where porewater was sampled directly, the concentration of freely dissolved PAH in the porewater was estimated based on the following equation from EPA (2012):

$$C_{FD,i} = \frac{C_{PW,i}}{f_{DOC} \cdot K_{DOC} + 1} \qquad \text{Equation (8)}$$

where:

CFD,i = Concentration of freely dissolved PAH i in the porewater (in µg/L)

CPW,i = Concentration of PAH i measured in the porewater sample (in µg/L)

FDOC = Fraction of DOC in the porewater (unitless)

KDOC = Dissolved OC-water partition coefficient (unitless)

Values of KDOC were obtained from EPA (2012) and are listed in Table G-1. The PAH-specific IWTU is calculated as:

$$IWTU_i = \frac{C_{FD,i}}{FCV_{D,i}} \qquad \text{Equation (9)}$$

The sum of the IWTUs over the 34 PAHs is:

$$\Sigma IWTU_{34} = \sum_{i=1}^{34} IWTU_i \qquad \text{Equation (10)}$$

Again, because all samples for which porewater was collected also included all 34 PAHs, the use of UFs was not necessary for the ΣIWTU calculations for porewater.

Calculations of ΣIWTU values using directly measured concentrations of freely dissolved PAHs are shown in Attachment G-C.

The same method was used to calculate TUs for surface water (to obtain a surface water TU [SWTU]) and groundwater (to obtain a groundwater TU [GWTU]). Groundwater was not analyzed for the full 34 PAHs and there currently is no UF appropriate for groundwater use; therefore, GWTUs were calculated using either the 14 or 16 parent PAHs and may be biased low as a result.

3.2 DIRECT CONCENTRATION SCREENING

The potential for risk to fish was evaluated based on the concentrations of freely dissolved PAHs (CFD,i) calculated from the measured porewater concentrations as described in Section 3.1.2. Because fish are mobile, EPCs were used to represent each of the two exposure areas (Milton Creek and Scappoose Bay). When a sufficient number of data points (10 or more) were available and a sufficient number of detections were made among those data points (three or more), the ProUCL software package, Version 5.0 (EPA, 2013), was used to estimate the 90% upper confidence limit (UCL) of the mean, which was used as the EPC for that PAH analyte. When insufficient data points were available (as was the case for Milton Creek) or insufficient detections made for statistical analysis of the dataset, the maximum detected concentration was used as the EPC.

The SLVs used to evaluate these EPCs for potential risk to fish are presented in Tables G-2a-c. When possible, fish-specific SLVs were used; however, several of the SLVs are based on Tier II secondary chronic values (SCVs) according to Suter and Tsao (1996) and EPA regional screening levels for surface water. As noted in Table G-2a, some correspond to DEQ Level II SLVs for surface water.

The DEQ guidance for bioaccumulative chemicals in sediment (DEQ, 2007) provides sediment-based SLVs for evaluating potential risk to fish from the bioaccumulation of selected chemicals in tissues. These include two PAHs: fluoranthene (SLV = 37 mg/kg) and pyrene (SLV = 1.9 mg/kg). However, this guidance was released after the completion of the previous ERAs for the Site; therefore, comparisons of sediment PAH concentrations to these screening levels have not previously been performed. To fill this gap, EPCs for these two PAHs were calculated as the 90% UCLs of the sediment data (0- to 12-inch depth interval) for each of the two exposure areas. For completeness, these UCLs included both the recent (2011 and 2012) sediment data as well as the historical (1996 to 2005) data.

Additional comparisons of concentrations to SLVs are described in the following section.

4.0 LINES OF EVIDENCE

This Updated Supplemental ERA utilized multiple LOEs to evaluate risk. The first, and primary, LOE involved the presence or absence of a surface sheen. Additional LOEs included comparisons of environmental concentrations (of various environmental media) to SLVs based on toxic responses in aquatic organisms (e.g. benthic organisms and fish) to individual chemical constituents. The various LOEs are discussed in detail in the following sections.

4.1 PRESENCE/ABSENCE OF SHEEN

The presence or absence of NAPL or a sheen was used as a primary LOE in evaluating risk to aquatic receptors. The presence of NAPL or a sheen is a violation of narrative water quality criteria and is considered an unacceptable risk to ecological receptors due to the potential for fouling of membranes and gills or ingestion of accumulated product on feathers or fur during preening.

Multiple field events (2010, 2011, 2012, 2013, 2017, and 2018) were conducted to properly delineate the boundary of NAPL/sheen, and the results are shown on Figure G-2.

4.2 SEDIMENT TOXICITY

4.2.1 Total PAHs

Bulk sediment concentrations of total PAHs were compared with the threshold effects concentration (TEC) and probable effects concentration (PEC) to evaluate risk to direct contact with sediment to benthic organisms (Macdonald et al., 2000). TECs and PECs were developed from a number of published sediment quality guidelines (SQGs). TECs reflect lower limits of sediment toxicity where toxicity is not predicted to occur; PECs reflect upper limits, above which adverse effects are predicted to have a high probability of occurring. Evaluating bulk sediment concentrations against both TECs and PECs provides a bracket for expected toxicity and provides a secondary LOE in assessing risk of sediment toxicity to the benthos. Concentrations of total PAHs and a comparison to PEC and TEC values are presented in Table G-10.

4.2.2 Total Petroleum Hydrocarbons

No PECs/TECs exist for TPH, so TPH fractions were screened against criteria developed as part of the Portland Harbor ERA, with values updated to correct a calculation error. Use of Portland Harbor SLVs are considered a secondary LOE in risk evaluation. Concentrations and SLVs are presented in Table G-10.

4.3 POREWATER TOXICITY

4.3.1 PAHs

Concentrations of total PAHs in porewater samples were converted into total TU values (i.e., the sum of interstitial water toxic unit, ΣIWTU) to evaluate the potential for narcosis risk to benthic invertebrates. Each individual PAH congener concentration was divided by its unique final chronic value (based on narcotic effects to benthic organisms) to calculate the TU. The sum of all TUs for a sample was calculated as the ΣIWTU. ΣIWTU values greater than 1 indicate potential risk to benthic organisms. ΣIWTU values are presented in Table G-6a and Table G-11a.

4.3.2 VPH

Concentrations of VPH in 2017 porewater samples were used as a secondary LOE for determining risk at the Site. Concentrations were compared to Portland Harbor ERA SLV and presented in Table G-11b.

4.3.3 Oxygenated PAHs

Oxygenated PAHs (OPAHs) were measured in 2017 porewater samples to provide a secondary LOE for determining risk at the Site. Due to their greater polarity, OPAHs have the potential for increased dissolved concentrations, which can lead to increased metabolite concentrations. No

SLVs exist for OPAHs, so there was no quantitative assessment of risk based on OPAH concentrations. Concentrations of OPAHs in surface water samples are presented in Table G-12a.

4.4 SURFACE WATER TOXICITY

4.4.1 PAHs

As with porewater, concentrations of PAHs in surface water samples were converted to TUs. The sum of all TUs for a given sample were calculated as the ΣSWTU (sum of surface water toxic units). A ΣSWTU greater than 1 indicates the potential risk to benthic organisms, and these calculations were used as a primary LOE in risk evaluation. ΣSWTUs are presented in Table G-6b and G-12a.

Concentrations of C_{free} PAHs in surface water were also compared to published SLVs for individual PAHs where available and presented in Table G-12b.

4.4.2 Oxygenated PAHs

As with porewater, OPAHs were measured at a number of samples to further define risk from PAHs. Concentrations of OPAHs in surface water were not screened against any SLVs, as no risk-based screening criteria exists. Total OPAH concentrations are presented in Table G-12a.

4.5 GROUNDWATER TOXICITY

Groundwater was evaluated to determine if upland dissolved phase constituents have the potential to adversely affect Scappoose Bay. Dissolved phase concentrations in groundwater were evaluated based on the same approach used for surface water and porewater. This approach was completed for nearshore groundwater wells and did not account for any potential change in concentrations during migration to Scappoose Bay.

4.5.1 PAHs

As with porewater and surface water, concentrations of PAHs in groundwater were converted to TUs. The sum of all TUs in a given sample were calculated as the ΣGWTU (sum of groundwater TUs). A ΣGWTU greater than 1 indicates the potential risk to benthic organisms. As mentioned above, benthic organisms are not directly exposed to groundwater; thus, this analysis is strictly used to examine the potential for risk to benthic organisms following upland groundwater migration to Scappoose Bay. PAH concentrations and ΣGWTUs are presented in Table G-13.

Concentrations of individual PAHs in groundwater were compared to DEQ Level II SLVs (DEQ, 2001) to evaluate potential risk after upland groundwater migration to Scappoose Bay. Concentrations and associated SLVs are presented in Table G-13.

4.5.2 TPH

Concentrations of diesel- and gasoline-range hydrocarbons were compared to Freshwater Ecotox Aquatic Habitat Goal Levels from San Francisco Bay Regional Water Quality Control Board (SFBRWQCB, 2019). As described above, this approach was used as a conservative analysis of

potential risk to Scappoose Bay from upland groundwater migration. Concentrations and comparisons to SLVs are presented in Table G-13.

5.0 SUMMARY OF PREVIOUS ERA ACTIVITIES (2003 – 2006)

In 2003, a Level II (screening) ERA was performed by the Bridgewater Group and Hart Crowser (Bridgewater, 2003) based on Phase I and Phase II RI data collected by GeoEngineers (2000). The Phase I investigation was conducted between July 1996 and November 1997 to characterize constituents of concern in soil, sediment, surface water, and groundwater at the Site. The Phase II investigation (conducted between September and November 1998) involved collection of additional soil, surface water, and groundwater data as well as investigations of the Basalt Bedrock and seep water. The Level II ERA was conducted in accordance with DEQ (2001) guidance and involved the comparison of maximum measured Site concentrations to DEQ-established SLVs. Chemical constituents for which the maximum detected concentration exceeded the SLV or which were detected but lacked an SLV for the medium in question were identified as chemicals of potential ecological concern (CPECs). (Metals and dioxins/furans were identified as CPECs for Scappoose Bay groundwater with NAPL seeps due only to the absence of analytical data for these analytes in that medium.)

The Level II ERA found no CPECs associated with soils at the Site. Therefore, ecological soil pathways were eliminated from further consideration. No CPECs were identified for surface water and seeps along Milton Creek; however, several PAHs (including 2-methylnaphthalene) were identified as CPECs from Scappoose Bay surface water (8 PAHs) and seep (15 PAHs) samples, either due to detected concentrations exceeding SLVs or to the lack of SLVs for detected PAH compounds. For sediments from Scappoose Bay, 16 PAHs were identified as CPECs. These were:

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Benzo(g,h,i)perylene
- Chrysene
- Dibenz(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Naphthalene
- Phenanthrene
- Pyrene

Benzo(a)pyrene was also found to exceed its SLV for bioaccumulation of 0.1 mg/kg. In addition to these 16 PAHs, arsenic was identified as a CPEC pending further analysis of its regional background.

5.1 ADDITIONAL SEDIMENT SAMPLING

Between 2003 and 2005, three rounds of additional sediment sampling were conducted to further assess the potential for risk to aquatic organisms (benthic invertebrates and fish) and piscivorous mammals and birds (Bridgewater, 2006). During Phase IA sampling (December 2003), near-surface sediments were collected from 22 offshore locations at the Site and five locations representing regional background. These samples were analyzed for PAHs, arsenic, TOC, and grain size distribution. The Phase IB and Phase II sampling (June 2004) involved collection of near-surface sediment from 27 offshore locations (including 5 from Milton Creek). Eight of these samples were used for bioassay tests. Three additional samples were collected upstream on the Columbia River to serve as reference sediments for the bioassay tests. PAHs, TOC, total sulfides, ammonia, and grain size distribution were measured in all of these samples. The Phase III sampling (April 2005) involved collection of an additional 17 offshore sediment samples, of which 6 were used for bioassay, and 2 were used as reference sediment samples. Analytes measured in these samples were the same as those for the Phase Ib and Phase II samples. It should be noted that only one of the reference sediments was used in each of the two rounds of bioassay tests.

5.2 BIOASSAY ANALYSIS

The bioassay tests were performed by Kennedy/Jenks Consultants. On each of the 14 Site samples and two reference samples submitted, the following bioassay tests were conducted:

- Amphipod (*Hyallela azteca*) 10-day survival
- Midge larva (*Chironomus tentans*) 10-day survival
- Midge larva (*C. tentans*) 10-day growth

A negative control group was also evaluated for each round of bioassays. The results were interpreted based on two criteria levels: "one-hit" criteria and "two-hit" criteria. The one-hit criteria consisted of predetermined levels of difference between the test and reference group results. These were:

- Amphipod survival—test group mortality is 15% greater than that of the reference group and is statistically different from the reference group ($\alpha = 0.05$).
- Midge larva survival—test group mortality is 20% greater than that of the reference group and is statistically different from the reference group ($\alpha = 0.05$).
- Midge larva growth—test group growth (as mean biomass) is less than 60% that of the reference group and is statistically different from the reference group ($\alpha = 0.05$).

If any one of the above criteria is true, the test sediment is interpreted as potentially toxic. For the two-hit criteria, if any two of the responses in the test group are less than the predetermined margins of difference shown above for the one-hit criteria, but are still found to be significantly different from the reference group ($\alpha = 0.05$), the test sediment is interpreted as potentially toxic.

The results of the bioassay tests (Bridgewater, 2006) showed that none of the 14 sediment samples from the Site resulted in a failure based on the one-hit or two-hit criteria described above.

5.3 2006 ERA SUMMARY REPORT

In 2006, Bridgewater Group, Inc., and Hart/Crowser prepared an ERA report that addressed the following issues concerning the potential for ecological risk at the Site:

1. Potential risk from Site-related arsenic in sediment,
2. Potential risk to piscivorous birds and mammals from exposure to benzo(a)pyrene and dioxins/furans due to bioaccumulation in the food chain, and
3. Potential risk to benthic invertebrates and fish (resident and anadromous) from direct contact to sediments.

The report concluded that the arsenic measured in the sediments at the Site were not Site related because arsenic concentrations were not correlated to PAH concentrations and upstream concentrations of arsenic were higher than those at the Site. Further, based on food-chain modeling, neither benzo(a)pyrene nor dioxins/furans posed a significant bioaccumulation risk to mammalian and avian predators foraging on the Site.

The evaluation of potential risk to benthic invertebrates and fish relied heavily on the results of the bioassay tests, which failed to show a toxic response in any tested sediments despite the fact that the sediments were selected for testing based on high total PAH as a selection criterion. Based on this result, it was concluded that the PAHs in the sediments (and overlying surface water) did not pose a significant risk to benthic invertebrates in direct contact with these sediments and that these benthic invertebrates served as conservative surrogate receptors for resident and anadromous fish (the latter having lower exposure than the former due to their low ingestion rates while migrating and lower residence time at the Site). Therefore, the 2006 ERA report (Bridgewater, 2006) concluded that the Site does not pose a risk to terrestrial or aquatic receptors.

5.4 NARCOSIS EVALUATION OF HISTORICAL DATA

Although the mechanism of narcotic toxicity in aquatic organisms is briefly discussed in the Bridgewater (2006) ERA report, the method described by EPA (2003) (based on the one-carbon estimation model) had only recently been published at that time of that analysis and was not applied to these data. To fill this gap in the complete evaluation of the historical dataset, the one-carbon ESBTU method (Section 3.1.1) was applied to the historical (1996 – 2005) data collected from the upper 1 foot of sediment at locations outside of the currently delineated NAPL area (Attachment G-A).

The analysis included data from the following 63 samples:

- 3 from October/November 1996 (Scappoose Bay),
- 17 from December 2003 (Scappoose Bay),
- 22 from June 2004 (Scappoose Bay),
- 5 from June 2004 (Milton Creek), and
- 16 (including one duplicate) from April 2005 (Scappoose Bay).

None of these samples was analyzed for the full suite of 34 PAH analytes. The samples from 2003–2005 were tested for 17 PAH analytes each, and the three samples from 1996 were tested for only 15. Therefore, UFs were applied to adjust the ΣESBTU for all of these samples. The UFs were linearly interpolated from UFs presented by EPA (2003) for datasets containing either 13 or 23 PAH measurements. For 90% confidence that the UF-adjusted ΣESBTU will not underestimate the true ΣESBTU, the UF for 13 PAHs is 8.45 and that for 23 PAHs is 3.37. Based on interpolation, the UF was estimated at 7.43 for 15 PAHs and 6.42 for 17 PAHs. Non-detections were represented in the ΣESBTU calculations by the full MDL value.

The ΣESBTU values for the historical data are presented in Table G-3. Values greater than 1 are interpreted as having a potential for risk to benthic invertebrates from narcosis (pending uncertainty analysis). Of the five samples from Milton Creek, only one (SD-MC-A) showed an ΣESBTU value greater than 1 (ΣESBTU = 3.5). This sample was collected near a point where a visible sheen on the sediment had been observed. Of the 59 samples from Scappoose Bay, nearly half (28 samples) showed ΣESBTU values greater than 1, with a maximum of 22 at SD-131 (located in the small embayment west of the former hog fuel loading hopper). Only one other sample (SD-108, also west of the hopper, but farther from the shore than SD-131) had a ΣESBTU value greater than 10 (ΣESBTU = 13.6).

Thirteen of the fourteen samples submitted for bioassay are part of the non-NAPL area dataset. The ΣESBTU values for these samples ranged from 0.41 to the maximum ΣESBTU of 22. All but three showed ΣESBTU greater than 1. These included the high-concentration sample from Milton Creek (SD-MC-A).

Despite showing calculated ΣESBTU greater than 1, these samples did not show toxicity in the bioassay tests. These apparently contradictory results call into question the capacity of the ΣESBTU method (based on the one-carbon model and adjusted for 17 PAHs using a conservative UF) to predict the actual risk to benthic organisms. Uncertainties associated with both of these results are discussed in Section 7.2. As discussed in Section 7.2, this discrepancy between predicted toxicity based on equilibrium partitioning and the narcosis model is consistent with the recent literature on benthic toxicity of PAHs.

6.0 2010 - 2012 GROUNDWATER DATA

As described in Section 4.5, historic (2010 – 2012) groundwater data were evaluated per DEQ's request to determine potential risks to aquatic receptors from dissolved phase constituents after discharge of groundwater to Scappoose Bay. Data are presented in Table G-13 and on Figures G-5, G-6, and G-7.

PAHs

Concentrations of PAHs in the upland nearshore groundwater were screened against DEQ Level II SLVs, as shown in Table G-13. Monitoring wells MW-5, MW-7, and MW-18 had no exceedances; all other monitoring wells had one or more exceedance. Exceedances in one or more sample were found for all PAHs with a DEQ Level II SLV (acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, fluoranthene, fluorene, naphthalene, and phenanthrene). Concentrations of naphthalene in groundwater are shown on Figure G-5.

ΣGWTUs were calculated for groundwater samples, as described in Section 3.0. Nearshore monitoring wells with ΣGWTUs greater than 1 in one or more sample included MW-3A, MW-3B, MW-6A, MW-10, MW-19, and MW-25. ΣGWTUs are shown spatially on Figure G-5.

As mentioned in Section 4.5, this approach of analyzing potential risk to benthic organisms from groundwater is highly conservative as there is no exposure at the source and it does not account for any changes in concentration as water migrates from upland to Scappoose Bay.

TPH

Concentrations of gasoline- and diesel-range hydrocarbons in upland groundwater samples were compared to Freshwater Ecotox Aquatic Habitat Goal Levels (HGLs), as shown in Table G-13 and on Figure G-6. There were exceedances of diesel-range hydrocarbon HGLs in one or more groundwater sample from nearshore monitoring wells MW-3A, MW-3B, MW-6A, MW-10, MW-19, and MW-25. There were exceedances of gasoline-range hydrocarbon HGLs in one or more sample from nearshore monitoring wells MW-3A, MW-3B, and MW-6A; all other monitoring wells had no exceedances detected in samples. No HGLs exist for oil-range hydrocarbons.

7.0 2011 SEDIMENT SAMPLING DATA

In 2011, AMEC collected approximately 120 sediment samples from Scappoose Bay and Milton Creek to further characterize the nature and extent of NAPL and related PAHs in the offshore areas of the Site. The depth of these samples extended as far as 30 feet below sediment surface (BSS); however, for the purposes of this ERA, only the top 1 foot of sediment is considered to be biologically active. Of the samples collected in 2011, 36 were from the upper 1 foot of sediment: 34 from Scappoose Bay (one as duplicate) and two from Milton Creek. Five of the Scappoose Bay samples (including the duplicate) were field screened for total PAHs but were not further analyzed. The remaining 31 samples were submitted for laboratory analysis of PAHs and TOC. Twenty of the

samples were analyzed for 16 specific PAHs and 11 were analyzed for the full suite of 34 PAH analytes.

Of the 31 surface sediment samples analyzed, 20 were from locations outside of the currently delineated NAPL areas in Scappoose Bay and Milton Creek and are, therefore, included in the evaluation of potential ecological risk on the non-NAPL areas. Although the analyses of these samples included TOC, BC was not evaluated in these samples and porewater was not specifically sampled or analyzed. Therefore, the evaluation of potential narcosis toxicity to benthic invertebrates is limited to the use of ΣESBTU based on the one-carbon model of PAH solubility (see Section 3.1.1). Further, only five of these 20 samples (one from Milton Creek and four from Scappoose Bay) were analyzed for the full suite of 34 PAH analytes. For this reason, a UF of 6.93 (representing 90% confidence) was applied to the ΣESBTU values for samples analyzed for only 16 PAHs (this UF is interpolated from UFs presented in EPA [2003], as described in Section 3.1.1). Non-detections were represented in the ΣESBTU calculations by one-half the MDL value.

Calculation of the ΣESBTU values for the (July) 2011 sediment data are shown in Attachment G-A. The resulting ΣESBTU values are listed in Table G-4.

7.1 MILTON CREEK

As shown in Table G-4, neither of the two surface sediment samples from Milton Creek (from locations MC-03 and MC-04) resulted in ΣESBTU values greater than 1. MC-03 (ΣESBTU = 0.23) was based on data for all 34 PAH analytes and MC-04 (ΣESBTU = 0.82) was based on data for 16 PAHs with the uncertainty factor of 6.93 applied. Although both of these locations are well below the delineated NAPL seep area, MC-03 was collected near a point where a visible sheen on the sediment had been observed and near the 2004 sampling location SD-MC-A, which showed a ΣESBTU value of 3.5.

7.2 SCAPPOOSE BAY

Twelve of the 18 sediment samples from Scappoose Bay showed ΣESBTU values greater than 1 (Table G-4). The maximum ΣESBTU was 39 from SB-27, located in the small embayment west of the former hog fuel loading hopper; however, this is an adjusted value based on 16 PAHs. Of the four samples analyzed for the full suite of 34 PAH analytes (no UF applied), the maximum ΣESBTU was 11.1 for SB-28, which is also located in the small embayment.

8.0 2012 SEDIMENT AND POREWATER DATA

In 2012, AMEC conducted two rounds of sampling in the offshore environment of the Site: the first in July to represent high-water conditions, and the second in October to represent low-water conditions. These sampling efforts were expanded and enhanced over previous efforts (as described in the previous sections). First, porewater samples were extracted from the sediment through centrifugation and analyzed separately from the sediment. Second, all samples (both porewater and sediment) were analyzed for the full suite of 34 PAH analytes. Third, BC was

analyzed in the sediment samples along with TOC to allow application of the two-carbon model to estimate the dissolved fraction of PAHs. And finally, DOC was measured in the porewater samples to allow estimation of freely dissolved PAH in the interstitial water. This enhanced dataset provides a basis for a more accurate, state-of-the-art evaluation of potential risk to both benthic invertebrates and fish than was previously possible with the previous datasets.

The evaluation of risk to invertebrates and fish described in this section is based on the following:

1. Risk to benthic invertebrates from narcosis based on ΣIWTU determined by estimating dissolved-fraction PAH concentrations from measured PAH concentrations in sediments based on the two-carbon model (incorporating BC measurements; Section 3.1.1);
2. Risk to benthic invertebrates from narcosis based on ΣIWTU determined by estimating freely dissolved PAH concentrations in porewater samples using measured PAH concentrations in porewater based on the method described in Section 3.1.2; and
3. Risk to fish from direct contact with interstitial water based on the comparison of PAH concentrations in interstitial water throughout the exposure area to PAH-specific screening levels for fish as described in Section 3.2.

The data and calculations are presented in Attachments G-B (sediment) and G-C (porewater). Results of the calculations are summarized in Tables G-5 through G-7. The results of the evaluations for the two exposure areas (Milton Creek and Scappoose Bay) are described in the following sections.

8.1 MILTON CREEK EXPOSURE AREA

This risk assessment includes data for 2012 sampling in the Milton Creek exposure area at three locations: PWS-17, PWS-27, and PWS-30. PWS-17 is located immediately upstream of the reach delineated along the creek's southern bank, where NAPL seeps have been observed. PWS-30 is located immediately downstream of this reach. Each of these locations was sampled for both sediment and porewater during the low-water period (October) of 2012. PWS-27 is located near the mouth of Milton Creek, where it discharges into Scappoose Bay. This location was sampled twice during 2012, once during the high-water period (July), and again during the low-water period (October). Both of these sampling events included sediment and porewater.

8.1.1 Sediment

The two-carbon model was used to estimate dissolved PAH concentrations in the porewater of sediments from Milton Creek. These estimates were used to calculate ΣIWTU values (Table G-5) to evaluate the potential for narcosis risk to benthic invertebrates. Using ½ the detection limit to calculate ΣIWTU values, all were less than 1, with a maximum of 0.017 at PWS-17.

8.1.2 Porewater

ΣIWTUs were calculated for each of the four porewater samples collected from Milton Creek (Table G-6a; Figure G-7). Using 1/2 the detection limit to calculate ΣIWTU values, all were less than 1, with a maximum of 0.34 at PWS-17. Using the full detection limit to replace non-detects when calculating ΣIWTU values, all samples were greater than 1, with a maximum of 1.53 from sample PWS-27_8-11_PW. This sample had the lowest ΣIWTU value (0.077) when calculating using 1/2 the detection limit for non-detects, indicating the high degree of uncertainty that exists due to elevated detection limits.

Because the porewater dataset for the Milton Creek exposure area is limited to four samples, insufficient data are available to calculate an area-wide EPC based on a 90% UCL. Therefore, for the purposes of evaluating the potential risk to fish from direct exposure to interstitial water, the maximum detected concentration (dissolved fraction) among the four samples was used to represent area-wide exposure. These maximum concentrations were compared to the surface water screening values shown in Table G-2. No detected concentrations of PAHs from Milton Creek porewater exceeded their respective screening values for fish toxicity (Table G-7).

Twenty-six of 36 PAH analytes (1- and 2-methylnaphthalene being included as separate analytes) were not detected in any of the four porewater samples. In most cases where an SLV was available, the maximum MDL (converted to dissolved fraction concentration) did not exceed the SLV. However, in the case for benzo(a)pyrene, the maximum MDL (0.024 µg/L) was greater than the SLV of 0.014 µg/L. Although this SLV is derived directly from the Oregon Level II screening values (DEQ, 2001), it was based on the Tier II SCV presented in Suter and Tsao (1996). However, that document also states that the lowest 20% effective concentration (EC20) for fish is greater than 2.99 µg/L. Therefore, because the maximum MDL for benzo(a)pyrene is less than two-times the SLV value and more than two-orders of magnitude less than the reported EC20 for fish, it can be concluded that the potential for risk to fish from exposure to benzo(a)pyrene in the interstitial water is negligible.

8.2 SCAPPOOSE BAY EXPOSURE AREA

The 2012 data from Scappoose Bay used in this risk assessment include 20 locations within the non-NAPL area. Of these, 15 were sampled in July during the high-water period and 19 were sampled in October during the low-water period. All locations are represented by at least one sediment sample and all except one (PWS-22) by at least one porewater sample. Of the 15 locations sampled in July, sediments were collected from the 8- to 9- or 11-inch depth interval at all locations, and additional shallow sediment samples (1- to 4-inch interval) were collected at PWS-4 and PWS-13. A replicate sample was collected at PWS-16 (designated PWS-16B), and a duplicate sample was collected at PWS-12. Porewater samples were collected with all of these sediment samples with the exceptions of PWS-22 and the shallow sediment sample at PWS-4. Thus, the total number of sediment samples from the July 2012 sampling event is 19 and the number of porewater samples is 17.

Of the 19 locations sampled in October, sediments were collected from the 8- to 10- or 11-inch depth interval at all locations except PWS-25, where the sediment sample was from the 4- to 8-inch

interval. No additional shallow sediment samples were collected. Duplicate samples were collected at PWS-7, PWS-13, and PWS-26 with a triplicate sample collected at PWS-13. Porewater samples were collected with all of these sediment samples with the exceptions of the duplicate and triplicate samples from PWS-13. Thus, the total number of sediment samples from the October 2012 sampling event is 23 and the number of porewater samples is 21.

8.2.1 Sediment

The two-carbon model was used to estimate dissolved PAH concentrations in the porewater for the 42 sediment samples from Scappoose Bay. These estimates were used to calculate ΣIWTU values (Table G-5) to evaluate the potential for narcosis risk to benthic invertebrates. Of the 19 samples collected in July, five showed ΣIWTU values greater than 1: PWS-03 (ΣIWTU = 3.5), PWS-05 (ΣIWTU = 1.1), PWS-06 (ΣIWTU = 4.1), PWS-07 (ΣIWTU = 1.3), and PWS-16 (ΣIWTU = 1.5). Of the 23 samples collected the following October, only one (one of the triplicate samples collected at PWS-13) showed a ΣIWTU value greater than 1 (ΣIWTU = 1.1). The other two sediment samples at that location resulted in ΣIWTU values of 0.97 and 0.6, indicating that the mean is within an acceptable level of potential risk. It should also be noted that none of the five locations where ΣIWTU values were found to exceed 1 in the July (high-water) samples exhibited similar levels in the October (low-water) samples. All showed ΣIWTU values less than 1, including the two duplicate samples collected at PWS-07.

8.2.2 Porewater

The ΣIWTU values calculated for each of the 38 porewater samples collected from Scappoose Bay are presented in Table G-6a and shown on Figure G-8. When using the full detection limit to replace non-detect values, all samples showed a ΣIWTU greater than 1. Of the 17 samples collected in July, all ΣIWTU values were less than 1 when replacing non-detect values with 1/2 the detection limit. Of the 21 porewater samples collected in October, two ΣIWTU values exceeded 1 using 1/2 the detection limit. These were from PWS-07 (ΣIWTU = 1.4) and PWS-13 (ΣIWTU = 2.8). PWS-07 is located in the embayment west of the former hog fuel loading hopper structure and is near the boundary of the inferred NAPL extent (Figure G-2). A duplicate porewater sample was collected at this location which showed a ΣIWTU value of 0.5, indicating that the level of potential risk to benthic invertebrates from narcosis (based on the average of these two samples) is acceptable.

The ΣIWTU value from PWS-13 reflects the relatively high ΣIWTU value (1.1) found for this location in the sediment evaluation. Because this location is approximately 400 feet south of the inferred NAPL source with no other intervening locations indicating transport from the shoreline across that distance, these results appear anomalous. Further, no PAHs were detected in the two porewater samples (shallow and deep) collected from this location in July. It is also notable that the PAHs detected in the October sample do not correspond with the typical “fingerprint” of PAHs from near the NAPL areas of the Site. The PWS-13 porewater sample shows high concentrations of C2-, C3-, and C4-alkylated naphthalenes, which were rarely detected in the other samples. A similar pattern is seen in the three sediment samples collected from this location in October, but this pattern is not reflected in the two sediment samples (shallow and deep) collected in July.

Sufficient detections were made in the porewater samples from Scappoose Bay to allow the estimation of 90% UCLs for 14 of the 36 PAH analytes using ProUCL Version 5.0 (EPA, 2013). Model output is presented in Attachment G-D. Only six analytes were detected in one or two samples, which was considered insufficient for statistical analysis, and 16 analytes were not detected in any of the porewater samples. The results of the statistical analysis are presented in Table G-8. The potential for risk to fish in the Scappoose Bay exposure area was evaluated through the comparison of either 90% UCLs (when available) or maximum detected concentrations (when insufficient detections were available to estimate the 90% UCL) to the SLVs listed in Table G-2. As shown in Table G-8, all of these EPC values were less than their corresponding SLVs.

In most of the 16 cases where the analyte was not detected and an SLV was available, the maximum MDL (converted to dissolved fraction concentration) did not exceed the SLV. However, in the case for benzo(a)pyrene, the maximum MDL (0.046 µg/L) was greater than the SLV of 0.014 µg/L. As previously described, this SLV is based on the Tier II SCV presented in Suter and Tsao (1996), which also presents the EC20 for fish as being greater than 2.99 µg/L. Therefore, because the maximum MDL for benzo(a)pyrene is less than four times the SLV value and is much less (by a factor of 65) than the reported EC20 for fish, it can be concluded that the potential for risk to fish from exposure to benzo(a)pyrene in the interstitial water of Scappoose Bay is negligible.

8.3 BIOACCUMULATION RISK TO FISH

The 90% UCLs of fluoranthene and pyrene in sediment (Table G-9) were compared to sediment benchmarks for bioaccumulation (DEQ, 2007). For both exposure areas (Milton Creek and Scappoose Bay), the 90% UCLs for these two PAHs were less than their respective SLVs.

9.0 2017 SEDIMENT, POREWATER, AND SURFACE WATER DATA

In September 2017, Cascadia conducted sampling of sediment, porewater, and surface water to expand upon and improve previous investigations. As with the 2012 sampling event, samples were analyzed for the full suite (34) PAHs as well as BC. Select porewater and bulk sediment samples were also analyzed for VPH and/or EPH and select VOCs. Porewater and surface water samples were also analyzed for OPAHs.

In contrast with the 2012 event, *in-situ* sampling methodology was utilized to improve the prediction of risks from porewater exposure. The direct measurement of dissolved water concentrations integrates site-specific environmental factors, including diffusion, advection, bioturbation, resuspension, and partitioning (particle- and colloid-bound).

9.1 MILTON CREEK EXPOSURE AREA

This risk assessment includes data for 2017 sampling from one sample location within the Milton Creek exposure area: PWS-090617-2. PWS-090617-2 is located near the mouth of Milton Creek, where it discharges into Scappoose Bay.

9.1.1 Sediment

Total PAHs

Total PAHs were compared to Threshold Effects Concentrations (TECs) and Probable Effects Concentrations (PECs), as shown in Table G-10 (MacDonald, Ingersoll, and Berger, 2000). Comparing concentrations to TECs and PECs allows for an examination of toxicity via the same mode of action. The only Milton Creek sample collected, PWS-090617-2, had a total PAH concentration between the TEC and PEC, indicating the possibility of toxicity to occur. The spatial distribution of PAHs in surface sediment are shown on Figure G-10.

Total Petroleum Hydrocarbons

There were no detections of VPH in the Milton Creek sample collected, PWS-090617-2. EPH was not analyzed in PWS-090617-2. No indications of risk were identified in Milton Creek from petroleum hydrocarbons, but uncertainty exists with the limited sampling efforts and high detection limits.

9.1.2 Porewater

PAHs

Sediment porewater was analyzed to determine PAH concentrations in the porewater of sediments from Milton Creek. These estimates were used to calculate ΣIWTU values (Table G-11a) to evaluate the potential for narcosis risk to benthic invertebrates. ΣIWTU values greater than 1 indicate potential risk to benthic organisms. Both the shallow and deep sample from Milton Creek (Shallow Porewater Site 2 and Deep Porewater Site 2, respectively) had ΣIWTU values greater than 1 (16.2 and 1.89, respectively). The distribution of ΣIWTUs is shown on Figure G-9.

It is important to note, that while most parent PAHs (and many of their perdeuterated analogs) are available as pure standards, few alkyl PAHs are available, so their response must be estimated rather than measured in many cases. The calibration and quantitation of the more highly alkylated PAHs is increasingly complicated by the fact that a single group can have multiple (even hundreds of C_3- and C_4-alkyl PAHs) alkylated isomers that are listed as a single PAH in the total 34 PAH list. Care must be taken to avoid including non-target compounds in the integration of a group of alkyl PAHs. For example, dibenzothiophene elutes at the end of the C_4-naphthalene cluster and frequently has a higher concentration than the total C_4-naphthalene group. Since both dibenzothiophene and C_4-naphthalenes have *m/z* 184 as their molecular ion, care must be taken not to include the peak area of dibenzothiophene in the C_4-naphthalene peak area. Similarly, the deuterated internal standard, fluorene-d10, elutes in the middle of the C_3-naphthalene cluster and has an approximately 15% ion at *m/z* 170, which is the same mass as monitored to determine the C_3-naphthalene compounds. This interfering peak from fluorene-d10 was substantially larger than the total alkyl C_3-naphthalene peaks, and therefore, care is needed to remove its peak area to avoid grossly overestimating the alkyl C_3-naphthalene concentrations (Hawthorne, et al., 2005). OSU FSES was asked to provide non-background corrected 34 PAHs. Given the above-mentioned concerns

with co-eluting non-target compounds, the background corrected 34 PAH data were used in the ecological risk assessment.

VPH and VOCs

VPH and select VOCs were measured using permeable diffusive bags to evaluate risk associated with TPH fractions. No samples had detections of any measured constituents. A comparison of VPH fraction detection limits to Portland Harbor ERA SLVs is found in Table G-11b.

Oxygenated PAHs

Total concentrations of OPAHs in the shallow and deep porewater sample collected from Milton Creek were 0.0102 and 0.0018 µg/L, respectively. No risk-based SLVs exist for OPAHs.

9.1.3 Surface Water

PAHs

Concentrations of PAHs in surface water were used to calculate ΣSWTU values (Table G-12a) to evaluate potential risk to benthic organisms. As with the porewater evaluation, a TU greater than 1 indicates potential risk to benthic organisms. The one sample analyzed for PAHs in Milton Creek had a ΣSWTU less than 1, indicating no predicted risk to benthic organisms.

For potential risk to fish in Milton Creek from direct exposure to dissolved PAHs, it was found that none of the surface water PAHs exceeded their corresponding SLVs, indicating that no unacceptable risk exists to fish for these cases. However, it should be noted that SLVs were found only for the 18 priority PAHs (including 1- and 2-methylnaphthalene) typically evaluated in environmental samples; therefore (with the exception of C_1–naphthalene, for which 1-methylnaphthalene was used as a surrogate), risk to fish could not be evaluated for the alkylated PAHs, benzo(e)pyrene, and perylene (the latter two, and six of the alkylated PAH analytes, were not detected in the porewater samples).

Oxygenated PAHs

The total concentration of OPAHs in the surface water sample collected from Milton Creek was 0.0001 µg/L. No risk-based SLVs exist for OPAHs.

9.2 SCAPPOOSE BAY EXPOSURE AREA

This risk assessment includes data for 2017 sampling from 15 sample locations within the Scappoose Bay exposure area.

9.2.1 Sediment

Total PAHs

Total PAHs were compared to TECs and PECs, as shown in Table G-9 (MacDonald, Ingersoll, and Berger, 2000). Comparing concentrations to TECs and PECs allows for an examination of toxicity via

the same mode of action. Two samples (PWS-090517-9 and PWS-090617-13) had concentrations of total PAHs greater than the PEC (22.8 mg/kg), indicating a higher probability of exhibiting toxic effects. One sample (PWS-090517-6) had a concentration of total PAHs below the TEC (1.7 mg/kg), indicating a low likelihood of exhibiting toxic effects. The remaining samples had total PAH concentrations greater than the TEC but less than the PEC, indicating the potential for toxic effects. The spatial distribution of PAHs in surface sediment are shown on Figure G-10.

Total Petroleum Hydrocarbons

TPH aliphatic and aromatic fractions were compared to sediment ecological criteria created for the Portland Harbor Baseline Ecological Risk Assessment, corrected for a solubility error and presented in Table G-10. There were no detections of VPH in the Scappoose Bay samples collected; however, the detection limits of the VPH analysis were elevated above criteria. All samples had concentrations of $C_{>16}$-C_{21} aromatics and $C_{>21}$-C_{34} aromatics greater than the Portland Harbor ERA SLVs of 0.6 and 19 mg/kg, respectively. Samples PWS-090517-10 and PWS-090617-13 exceeded Portland Harbor ERA SLVs for $C_{>10}$-C_{12} aromatics and $C_{>12}$-C_{16} aromatics. Sample PWS-090517-10 also exceeded the SLV for $C_{>12}$-C_{16} aromatics.

9.2.2 Porewater

Total PAHs

Sediment porewater was analyzed to determine PAH concentrations in the porewater of sediments from Scappoose Bay. These estimates were used to calculate ΣIWTU values (Table G-11) to evaluate the potential for narcosis risk to benthic invertebrates. ΣIWTU values greater than 1 indicate potential risk to benthic organisms. No shallow samples had ΣIWTU values greater than 1, indicating no apparent risk to benthic organisms in the biologically active zone. Five deep samples (PWS-1, PWS-5, PWS-11, PWS-14, and PWS-15) had ΣIWTU values greater than 1; however, the deep samples were collected below the biologically active zone where there is no current complete exposure pathway for benthic organisms. The distribution of ΣIWTUs is shown on Figure G-9.

The same uncertainties associated with inclusion of non-target compounds co-eluting (as described in Section 8.1.2) apply for Scappoose Bay PAH data.

VPH and VOCs

VPH and select VOCs were measured using passive diffusive bags (PBDs) to evaluate risk associated with TPH fractions. No samples had detections of any measured constituents, as shown in Table G-11b.

Oxygenated PAHs

Total concentrations of OPAHs in the porewater samples collected from Scappoose Bay ranged from 0.0 to 0.630 µg/L, as shown in Table G-11a. No risk-based SLVs exist for OPAHs.

9.2.3 Surface Water

PAHs

Concentrations of PAHs in surface water were used to calculate ΣSWTU values (Table G-12b) to evaluate potential risk to benthic organisms. As with the porewater evaluation, a TU greater than 1 indicates potential risk to benthic organisms. Samples that had a TU greater than 1 included those from PWS-09, PWS-10, PWS-12, and PWS-13 and ranged from 1.04 to 1.07. PAHs contributing to increased SWTUs are similar to those driving risk in porewater, including C-3 and C-4 naphthalenes, C-2 and C-3 fluorenes, and C-2, C-3 and C-4 phenanthracenes/anthracenes. The spatial distribution of ΣSWTUs is shown on Figure G-9.

For potential risk to fish in Scappoose Bay from direct exposure to dissolved PAHs, it was found that none of the surface water PAHs exceeded their corresponding SLVs, indicating that no unacceptable risk exists to fish for these cases. However, it should be noted that SLVs were found only for the 18 priority PAHs (including 1- and 2-methylnaphthalene) typically evaluated in environmental samples; therefore (with the exception of C_1–naphthalene, for which 1-methylnaphthalene was used as a surrogate), risk to fish could not be evaluated for the alkylated PAHs, benzo(e)pyrene, and perylene (the latter two, and six of the alkylated PAH analytes, were not detected in the porewater samples).

Oxygenated PAHs

Total concentrations of OPAHs in the surface water samples collected from Scappoose Bay ranged from 0.0008 to 0.438 µg/L, as shown in Table G-12a. No risk-based SLVs exist for OPAHs.

9.3 OTHER POREWATER AND SURFACE WATER TOXICITY INDICATORS: MILTON CREEK AND SCAPPOOSE BAY

Total of 63 C_{free} PAHs

The highest concentrations of the sum of the 63 freely dissolved PAHs were detected at porewater location PWS-090617-1 at 5 µg/L and PWS-090617-2 at 1.3 µg/L.

Hopanes and Cholestanes

The results of the analysis of hopanes and cholestanes are presented in Appendix B of the Phase 3 Offshore Data Gap Progress Report (Cascadia, 2018). The highest concentrations were found at surface water location PWS-090517-9, and porewater locations PWS-090517-14 and PWS-090617-15.

10.0 SUMMARY OF LINES OF EVIDENCE

This Updated Supplemental ERA presents several new LOEs for the evaluation of potential ecological risk from PAHs in sediment at the former Pope & Talbot wood-treating site. These LOEs

were made possible by additional sediment sampling conducted at the Site, which included the full suite of 34 PAH analytes, direct measurement of PAHs in porewater samples, and recent advances of knowledge and techniques in assessment of narcosis-based risk to benthic organisms.

10.1 MILTON CREEK EXPOSURE AREA

The multiple LOEs examined indicate a low potential for ecological risk within the Milton Creek exposure area beyond the inferred NAPL seep area. Exposure to creosote NAPL and sheen present an unacceptable risk to ecological receptors where it is observed (Figure G-2). The one sediment sample taken within the Milton Creek exposure area in the 2017 sampling event had a total PAH concentration between the TEC and the PEC, indicating the possibility of toxicity to occur. ΣIWTU values from both the shallow and deep porewater samples were greater than 1, indicating a potential risk to benthic organisms. The corresponding ΣSWTU value was less than 1, indicating no predicted risk to benthic organisms. No analyzed VPH or VOC analytes were detected in interstitial water or sediment samples.

Of the five historical sediment samples from this area, only one (SD-MC-A) showed a ΣESBTU value greater than 1 (ΣESBTU = 3.5 based on the EPA UF for 17 PAHs). This sample was used for a bioassay test and showed no significant toxic effect (see discussion below of the relationship between toxicity and ΣESBTU). Further, sample MC-03, collected from nearly the same location in 2011 and analyzed for all 34 PAH analytes, showed a ΣESBTU value of only 0.23.

The four samples collected from Milton Creek in 2012 (which included BC analysis and porewater samples) showed no ΣIWTU values exceeding 1 for either the two-carbon equilibrium partitioning (EqP) model or the direct porewater measurement. All detected porewater concentrations of PAHs from Milton Creek were less than their corresponding SLVs, although the maximum MDL for benzo(a)pyrene (which was not detected in any porewater samples) slightly exceeded the SLV in some cases. Because this exceedance did not exceed a factor of 2, it was not considered significant. Finally, the 90% UCLs for fluoranthene and pyrene at Milton Creek were less than their bioaccumulation SLVs.

10.2 SCAPPOOSE BAY EXPOSURE AREA

The multiple LOEs examined indicate a low potential for ecological risk within the Scappoose Bay exposure area beyond the inferred NAPL seep area. Exposure to creosote NAPL and sheen present an unacceptable risk to ecological receptors where it is observed (Figure G-2).

No shallow samples within the Scappoose Bay exposure unit had ΣIWTU values greater than 1, indicating no apparent risk to benthic organisms in the biologically active zone. Four deep samples (PWS-1, PWS-5, PWS-14, and PWS-15) had ΣIWTU values greater than 1; however, the deep samples were collected below the biologically active zone where there is no current complete exposure pathway for benthic organisms. Samples that had a ΣSWTU greater than 1 included those from PWS-09, PWS-10, PWS-12, and PWS-13 and ranged from 1.04 to 1.07. PAHs contributing to increased SWTUs are similar to those driving risk in porewater, including C-3 and C-4

naphthalenes, C-2 and C-3 fluorenes, and C-2, C-3 and C-4 phenanthracenes/anthracenes, indicating that site-derived sources are the likeliest source of contribution to surface water risk at the Site.

Secondary LOEs indicate a low potential for ecological risk within the Scappoose Bay exposure area. Two samples had concentrations of total PAHs in sediment greater than the PEC, indicating a higher probability of exhibiting toxic effects. The majority of sediment samples had concentrations of total PAHs less than the PEC but greater than the TEC, indicating a potential for toxic effects. No analyzed samples had detectable concentrations of VPH. All samples had concentrations of C>16-C21 Aromatics and C>21-C34 Aromatics greater than the Portland Harbor ERA SLVs. Two samples exceeded Portland Harbor ERA SLVs for C>10-C12 Aromatics and C>12-C16 Aromatics. One sample also exceeded the SLV for C>12-C16 Aromatics.

With regard to potential risk within the Scappoose Bay exposure area based on historic data, the LOEs are more varied. EPA (2009) suggests a three-tiered approach to evaluate bioavailability of PAHs in sediment:

Tier 1—Analysis of whole (bulk) sediments (using EqP methodologies),

Tier 2—Analysis of interstitial water, and

Tier 3—Analysis through toxicity testing.

Data collection and analyses have been completed for Scappoose Bay that support the first two tiers of this approach. Although bioassays have also been performed, their utility in providing definitive support to a decision of potential risk is questionable and is discussed in greater detail later in this section.

The EqP methodologies (based on the one-carbon and two-carbon models) were applied to three sets of bulk sediment data: historical data, 2011 data, and 2012 data. Maximum ΣESBTU values in the historical and 2011 datasets (22 and 39, respectively) were significantly higher than the maximum ΣIWTU value (4.1) for the 2012 dataset. It should be noted that the ΣESBTU values for the historical and 2011 data incorporate UFs for 90% confidence based on UF values from EPA (2003).

However, EPA (2009) recommends that, if possible, site-specific UF values be determined and used, since the values from the earlier publication (EPA, 2003) tend to be highly conservative. To this end, the 2012 dataset, which included data for all 34 PAH analytes, was used to derive site-specific UF values for the previous datasets. These site-specific UFs were based on the 90th percentile of the ratios between the ΣESBTUk and the corresponding ΣESBTU34 value, where k was either 16 or 17 PAHs. The resulting site-specific UFs were 3.07 for the historical data (17 PAHs analyzed) and 3.24 for the 2011 data (16 PAHs analyzed). Results of TU calculations using these site-specific UF values are shown in Tables G-3 and G-4.

Applying the site-specific UFs reduced the ΣESBTU values by approximately one-half, with a maximum ΣESBTU of 10 for the historical data and 18 for the 2011 data. It should be noted that the 2011 sample (SB-28) with the highest total PAH concentration (118 mg/kg) of all of the sediment

samples included in this Supplemental ERA was analyzed for all 34 PAHs and had a ΣESBTU value of 11.

The ΣIWTU values calculated from the 2012 sediment data using the two-carbon EqP model were generally found to be lower than the ΣESBTU value. Applying both the one-carbon and two-carbon models to the 2012 sediment data showed that, on average, the two-carbon ΣIWTU value was about 13 times lower than the one-carbon ΣESBTU value for the same sample. Of the six ΣIWTU values that exceeded 1, five were from the high-water sampling event in July. These included three samples from the former hog fuel loading hopper area of the Site (PWS-05, PWS-06, and PWS-07) and two samples that were near the delineated boundary of the inferred NAPL area (PWS-03 and PWS-16). However, none of these locations showed exceedances in the low-water (October) samples in which only one sediment-based ΣIWTU value exceeded 1 (ΣIWTU = 1.1 at PWS-13, which was one of three samples collected in triplicate). As previously noted in Section 6.2.2, both the sediment and porewater samples from PWS-13 exhibited high levels of certain PAH analytes (e.g., C2-, C3-, and C4-alkylated naphthalenes) that were not found in similar proportions in other samples, potentially indicating an off-Site source.

In general, the ΣIWTU values calculated from the 2012 porewater data (representing Tier 2 of EPA's [2009] three-tiered approach) showed a low potential for risk to benthic invertebrates. ΣIWTU exceeded 1 for only 2 of the 38 total samples. Both of these were from the low-water (October) sampling event. These were PWS-07 (ΣIWTU = 1.4), which is located in the small embayment west of the former hog fuel loading hopper (and very near SD-131 and SB-28, which showed the highest total PAH concentrations in the sediment for the historical and 2011 datasets, respectively), and PWS-13 (ΣIWTU = 2.8), previously described for its atypical PAH fingerprint. It is again noted that the porewater data used to calculate these ΣIWTU values were converted to freely dissolved concentrations based on the measured concentration of DOC in each sample. Although this type of conversion adds an element of uncertainty to the risk result, it should be noted that basing the ΣIWTU values on the raw PAH concentrations in porewater had little appreciable effect on the result. The ΣIWTU value for PWS-07 rose to 1.9, that for PWS-13 rose to 6.4, and only one additional sample (PWS-01) showed a ΣIWTU value exceeding 1 (ΣIWTU = 1.1).

As discussed in Section 5.0, the conclusion of no risk to aquatic receptors at the Site in the 2006 ERA (Bridgewater, 2006) relied heavily upon the finding of no significant toxicity to benthic invertebrates in the bioassay of 14 sediment samples. This result was obtained despite the fact that the second round of six samples were specifically selected to include samples with high total PAH concentrations (including sample SD-131, which had the highest total PAH concentration [79.9 mg/kg] of the sediment samples that had been collected up to that time). Further, the post hoc calculation of ΣESBTU values for the historical data showed that 10 of the samples used in the bioassays produced ΣESBTU values greater than 1 (based on the EPA-based UF for 17 PAHs at 90% confidence). These samples included the highest historical ΣESBTU of 22 at SD-131. This result opens the question as to whether the bioassay test design (which was based on 10-day survival of amphipods [*H. azteca*] and 10-day survival and growth of midge larva [*C. tentans*]) was stringent

enough to detect toxicity in these samples or whether the more quantitative approaches to estimating potential risk (e.g., ΣESBTU) are overly conservative in their predictions of risk.

A recent paper by McDonough et al. (2010) sheds light on this question. Researchers conducted 28-day *H. azteca* survival and growth tests on 192 PAH-contaminated sediments from 12 sites and also estimated potential risk based on the one-carbon (ΣESBTU), two-carbon (ΣIWTU), and direct porewater measurement (ΣIWTU) methods to determine the capability of each of these methods to predict toxicity. Although none of the methods was entirely accurate in discriminating between toxic and nontoxic samples, the direct measure of PAHs in porewater was found to be superior to either of the two EqP-based methods, correctly predicting 100% of toxic samples and 71% of the nontoxic samples, based on the threshold benchmark of ΣIWTU = 1. Note that this result shows a bias toward false positives, and not false negatives, so a prediction of no toxicity is more robust than a prediction of toxicity.

Surprisingly, the one-carbon EqP approach (ΣESBTU) was found to be superior to the two-carbon approach in predicting toxic sediments (100% versus 43% correct predictions, respectively); however, the one-carbon model performed poorly in its ability to discriminate between toxic and nontoxic samples (only 17% of nontoxic samples correctly predicted versus 97% by the two-carbon model). In fact, nontoxic samples showed ΣESBTU values as high as 100, which indicates that none of the ΣESBTU values calculated for the Site (including those with conservative UFs applied) exclude the possibility that all samples used for bioassay were nontoxic (as reflected in the actual empirical test results) and are consistent with the hypothesis that the potential for risk was overpredicted by ΣESBTU.

McDonough et al. (2010) used their toxicity results to optimize the benchmark ΣESBTU and ΣIWTU values for both sensitivity (the ability to predict toxic sediment) and specificity (the ability to discriminate nontoxic from toxic sediments). For the one-carbon and two-carbon EqP methods, the optimal ΣESBTU and ΣIWTU threshold values were 12 and 0.06, respectively (both maintaining a sensitivity of 95% or greater, but having specificities of only 77 and 75%, respectively). For direct porewater measurements, the optimal ΣIWTU benchmark value was 7.0, which also had a sensitivity of 95% or greater, but also had a specificity of 94%, emphasizing this method's greater ability to discriminate between toxic and nontoxic sediments. It should be noted that all ΣIWTU values calculated from the 2012 porewater samples (with or without adjustment for adsorption to DOC) were less than 7. This finding includes the outlier sample from PWS-13 and is consistent with the observed lack of toxicity in the earlier bioassay tests.

Therefore, based on the three-tiered approach to evaluating PAHs in sediment (the third tier being inferred from outside research and supported by Site-specific bioassay tests), the weight of evidence indicates that PAHs in the sediments of the non-NAPL areas of Scappoose Bay do not pose an unacceptable risk to benthic invertebrates from narcosis-based toxicity.

The potential for risk to fish in Scappoose Bay was evaluated through two LOEs. The first considered the potential for toxic effects from direct exposure to dissolved PAHs in the water

column as derived from (and being assumed to be equal to) the concentrations in porewater. The second addressed the potential of exposure to PAHs through bioaccumulation.

For the first LOE (direct exposure to dissolved PAHs), EPCs for the entire Scappoose Bay exposure area (excluding the inferred NAPL areas) were determined based on the 90% UCLs of the freely dissolved PAH concentration or maximum detected concentration for all detected PAHs in the 2012 porewater samples. These EPCs were compared to SLVs considered protective of fish. None of the EPCs for this exposure pathway exceeded their corresponding SLVs, indicating that no unacceptable risk exists to fish for these cases. For PAHs not detected, the maximum MDLs were less than their corresponding SLVs in all but one case (benzo[a]pyrene) for which the maximum MDL exceeded the SLV by a factor of about 3.

The potential for risk to fish from exposure to benzo(a)pyrene is considered low, because its area-wide average concentration is likely to be much less than the maximum MDL because none of the samples showed detectable levels of benzo(a)pyrene even when the MDLs were 20 times less than this maximum. It should also be noted that SLVs were found only for the 18 priority PAHs (including 1- and 2-methylnaphthalene) typically evaluated in environmental samples; therefore (with the exception of C1-naphthalenes, for which 1-methylnaphthalene was used as a surrogate), risk to fish could not be evaluated for the alkylated PAHs, benzo(e)pyene, and perylene (the latter two and six of the alkylated PAH analytes were not detected in the porewater samples).

The evaluation of risk to fish from bioaccumulation was evaluated based on comparison of area-wide EPCs (again as 90% UCLs) for sediment concentration to DEQ-defined SLVs for bioaccumulation risk to freshwater fish (DEQ, 2007). These SLVs, however, are limited to two PAHs—fluoranthene (SLV = 37 mg/kg) and pyrene (SLV = 1.9 mg/kg). The 90% UCLs for each exposure area were based on all available data from that area (0 to 12 inches). In all cases, the EPCs were less than the corresponding SLV for bioaccumulation. Therefore, the potential for risk to fish from fluoranthene or pyrene bioaccumulation can be considered negligible.

11.0 CONCLUSIONS

Based on the Updated Supplemental ERA, the following conclusions can be drawn:

- Presence of creosote NAPL and moderate-heavy petroleum sheen present unacceptable risk to ecological receptors where it is observed in surface sediment porewater and surface water. Areas exhibiting moderate to heavy petroleum sheen in surface sediment are shown on Figure G-2.
- Issues with the 2012 measurement of freely dissolved PAHs in sediment porewater centered around elevated detection limits, particularly high molecular weight PAHs, and a perceived low bias for detecting select low molecular weight PAHs (e.g., naphthalene and its alkylated isomers). This uncertainty to confidently assess porewater toxicity led DEQ to consider other LOEs. Subsequently, the 2017 passive samplers were deployed within offshore areas where prior efforts to assess porewater toxicity and habitat impairment posed by Site-

related contamination had been inconclusive. The quantitation of chemicals in sediment porewater using the LDPE passive sampling devices developed by the Food Safety and Environmental Stewardship (FSES) program at Oregon State University (OSU) appears to be significantly more robust and precise than the 2012 direct measurements of freely dissolved PAHs in sediment porewater. For example, naphthalene, a key component of PAHs in upland groundwater, was detected in 26 of 30 Phase 2017 porewater samples versus only 4 out of 59 porewater samples analyzed by the ASTM SPME approach in 2012.

- The 2017 porewater data demonstrate the low or nonexistent potential narcosis risk to benthic organisms outside of delineated offshore NAPL areas. Specifically, the ΣIWTU exceeded 1 in only one of the 15 Phase 3 locations, PWS-090617-2, based on porewater measurements obtained within the biologically active zone (i.e., upper 12 inches of sediment). It is important to note that the 2017 PWS-090617-2 sediment porewater sample was obtained in Milton Creek near the confluence with Scappoose Bay. A comparison of the ratio of select stable PAH isomers (e.g., C_{free} fluoranthene and pyrene) in PWS-090617-2 is markedly lower (0.29) than ratios of fluoranthene to pyrene (Fl/Py ratio) typically found in creosote (1.36 to 1.75) (Zemo, 2009). The Fl/Py ratio and other diagnostic ratios (e.g., Pyrogenic Index) provided in Appendix 6 of the FSES report support field observations (i.e., no creosote NAPL noted) that elevated concentrations of the C_3- and C_4-naphthalene at passive sampling site PWS-090617-2 are not Site related.

- Like porewater, surface water samples with a ΣSWTU ≥ 1 are considered unacceptable. Four of the eight 2017 surface water passive sampling sites (PWS-090917-9, PWS-090517-10, PWS-090617-12, and PWS-090617-13) resulted in a ΣSWTU slightly above 1 (≤1.07). Detected concentrations of alkyl PAHs C_4-naphthalene appear to be the primary risk driver in surface water and it's unclear if they are attributed to the Site-related contamination.

- The quantitation of chemicals in sediment porewater and surface water using the passive samplers developed by the FSES program at OSU is significantly more robust and precise than bulk sediment analysis of PAHs and TPH. After reviewing the 2017 LDPE PDS data, there appears to be little to no correlation of total PAHs detected in bulk sediment samples to freely dissolved concentrations in porewater and overlying surface water. Extraction and analysis of bulk sediment samples combine both the C_{free} fraction and the contaminant fraction that is bound to particulate materials and carbon in the matrix that is sampled. The standard screening benchmarks used to evaluate the potential toxicity of PAHs in bulk sediment (e.g., TEC, PEC, TPH SLVs) appear to overestimate the toxicity of creosote-derived PAH to benthic invertebrates.

- Risk to fish is negligible for the Scappoose Bay exposure area from either direct exposure to surface water or from the bioaccumulation of fluoranthene or pyrene.

- A screening of monitoring wells along Scappoose Bay indicates dissolved phase constituents may pose a risk to aquatic receptors from discharge of upland groundwater to surface water based on exceedances of select SLVs for PAHs and TPH and ΣGWTU values greater than 1.

There is still a large degree of uncertainty associated with this pathway; further evaluation is needed, including additional sampling at the Site of groundwater discharge.

These conclusions are consistent with earlier bioassay results and the multiple LOEs considered, therefore, demonstrate the low or nonexistent potential risk to ecological receptors at the Site outside of delineated NAPL areas.

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13.0 LIMITATIONS

This report was prepared exclusively for the Port of Columbia County (formerly, the Port of St. Helens; the Port) by Cascadia. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Cascadia's services and based on: (i) information available at the time of preparation, (ii) data supplied by outside sources, and (iii) the assumptions, conditions, and qualifications set forth in this report. This Ecological Risk Assessment is intended to be used by the Port for the Former Pope & Talbot Wood-Treating Site in St. Helens, Oregon, only, subject to the terms and conditions of its contract with Cascadia. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

The findings contained herein are relevant to the dates of Site visits and should not be relied upon to represent conditions at later dates. In the event that changes in the nature, usage, or layout of the property or nearby properties are made, the conclusions and recommendations contained in this report may not be valid. If additional information becomes available, it should be provided to the Port so the original conclusions and recommendations can be modified as necessary.

TABLES

Table G-1
Partition Coefficients and Toxicity Benchmarks Used in Narcosis-Based Modeling of Risk to Benthic Invertebrates
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	Log K_{OC}	Log K_{BC}	Log K_{DOC}	FCV_D (µg/L)	FCV_{OC} (mg/kg OC)
Acenaphthene	3.944	5.58	3.09	55.85	491
Acenaphthylene	3.168	5.15	2.31	306.9	452
Anthracene	4.457	5.86	3.61	20.73	594
Benzo(a)anthracene	5.577	6.47	4.74	2.227	841
Benzo(a)pyrene	6.003	6.71	5.17	0.9573	965
Benzo(b)fluoranthene	6.16	6.79	5.32	0.6774	979
Benzo(e)pyrene	6.031	6.72	5.19	0.9008	967
Benzo(g,h,i)perylene	6.397	6.92	5.56	0.4391	1095
Benzo(k)fluoranthene	6.184	6.81	5.35	0.6415	981
C-1 Benz(a)anthracenes/Chrysenes	6.036	6.73	5.2	0.8557	929
C-1 Fluoranthrenes/Pyrenes	5.197	6.26	4.35	4.887	770
C-1 Fluorenes	4.64	5.96	3.79	13.99	611
C-1 Naphthalenes	3.736	5.46	2.88	81.69	444
C-1 Phenanthrenes/Anthracenes	4.955	6.13	4.11	7.436	670
C-2 Benz(a)anthracenes/Chrysenes	6.32	6.88	5.48	0.4827	1,008
C-2 Fluorenes	5.112	6.22	4.27	5.305	686
C-2 Naphthalenes	4.227	5.73	3.38	30.24	510
C-2 Phenanthrenes/Anthracenes	5.367	6.36	4.53	3.199	746
C-3 Benz(a)anthracenes/Chrysenes	6.822	7.16	5.99	0.1675	1,112
C-3 Fluorenes	5.603	6.49	4.76	1.916	769
C-3 Naphthalenes	4.719	6.00	3.87	11.1	581
C-3 Phenanthrenes/Anthracenes	5.82	6.61	4.98	1.256	829
C-4 Benz(a)anthracenes/Chrysenes	7.235	7.38	6.41	0.07062	1,214
C-4 Naphthalenes	5.21	6.27	4.37	4.048	657
C-4 Phenanthrenes/Anthracenes	6.213	6.82	5.38	0.5594	913
Chrysene	5.616	6.50	4.78	2.042	844
Dibenzo(a,h)anthracene	6.599	7.04	5.77	0.2825	1,123
Fluoranthene	4.998	6.16	4.15	7.109	707
Fluorene	4.137	5.68	3.29	39.3	538
Indeno(1,2,3-cd)pyrene	6.608	7.04	5.77	0.275	1,115
Naphthalene	3.299	5.22	2.44	193.55	385
Perylene	6.031	6.72	5.19	0.9008	967
Phenanthrene	4.494	5.88	3.65	19.13	596
Pyrene	4.839	6.07	3.99	10.11	697

Notes:
Values from United States Environmental Protection Agency (2012)
µg/L = micrograms per liter
mg/kg = milligrams per kilogram
BC = black carbon
D = dissolved
DOC = dissolved organic carbon
OC = organic carbon
FCV = final chronic value
K_x = partition coefficient between carbon component x and water

Table G-2a
Selected Surface Water Screening Level Values for the Evaluation of Potential Risk to Fish
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	Screening Level Value (µg/L)	Source[1]	DEQ Level II SLV?[2]
PAHs			
1-Methylnaphthalene	2.1	Tier II SCV Surface Water Screening Benchmark	Yes
2-Methylnaphthalene	130	EPA Region 6 FW Surface Water Screening Benchmark	No
Acenaphthene	74	LCV Fish Surface Water Screening Benchmark	No
Acenaphthylene	4,840	EPA Region 5 ESL Surface Water Screening Benchmark	No
Anthracene	0.09	LCV Fish Surface Water Screening Benchmark	No
Benz[a]anthracene	0.027	Tier II SCV Surface Water Screening Benchmark	Yes
Benzo[a]pyrene	0.014	Tier II SCV Surface Water Screening Benchmark	Yes
Benzo[b]fluoranthene	9.07	EPA Region 5 ESL Surface Water Screening Benchmark	No
Benzo[g,h,i]perylene	7.64	EPA Region 5 ESL Surface Water Screening Benchmark	No
Benzo[k]fluoranthene	9.07	Based on benzo(b)fluoranthene	No
Chrysene	7.0	EPA Region 6 FW Surface Water Screening Benchmark	No
Dibenz[a,h]anthracene	5.0	EPA Region 6 FW Surface Water Screening Benchmark	No
Fluoranthene	30	LCV Fish Surface Water Screening Benchmark	No
Fluorene	3.9	OSWER Tier II Secondary Surface Water Screening Benchmark	Yes
Indeno[1,2,3-cd]pyrene	4.31	EPA Region 5 ESL Surface Water Screening Benchmark	No
Naphthalene	620	LCV Fish Surface Water Screening Benchmark	Yes
Phenanthrene	6.3	OSWER Ambient Water Quality Criteria	Yes
Pyrene	0.3	EPA Region 5 ESL Surface Water Screening Benchmark	No

Abbreviations:
µg/L = micrograms per liter
DEQ = Oregon Department of Environmental Quality
EPA = United States Environmental Protection Agency
ESL = ecological screening level
FW = freshwater
LCV = lowest chronic value
OSWER = Office of Solid Waste and Emergency Response
SCV = secondary chronic value
SLV = screening level value
EC = equivalent carbon
NA = not applicable or not available

Notes:
[1] Based on the Oak Ridge National Laboratory Risk Assessment Information System database (ORNL, 2014).
[2] Is the selected SLV equal to the DEQ SLV as per DEQ (2001)?

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Table G-2b
Selected Sediment Screening Level Values for the Evaluation of Potential Risk to Ecological Receptors
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	Screening Level Value (µg/L)	Source[1]
TPH		
Aliphatics		
EC5-EC6	1,210	Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015
EC>6-EC8	2,140	
EC>8-EC10	6,050	
EC>10-EC12	20,900	
EC>12-EC16	560,000	
EC16>EC21	NA	
EC>21-EC34	NA	
Aromatics		
EC>8-EC10	1,900	Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015
EC>10-EC12	1,250	
EC>12-EC16	1,260	
EC16>EC21	600	
EC>21-EC34	19,000	

Abbreviations:
µg/L = micrograms per liter
DEQ = Oregon Department of Environmental Quality
EPA = United States Environmental Protection Agency
ESL = ecological screening level
FW = freshwater
LCV = lowest chronic value
OSWER = Office of Solid Waste and Emergency Response
SCV = secondary chronic value
SLV = screening level value

Note:
[1] Based on the Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015.

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Table G-2c
Selected Porewater Screening Level Values for the Evaluation of Potential Risk to Ecological Receptors
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	Screening Level Value (µg/L)	Source[1]
TPH		
Aliphatics		
EC5-EC6	121	Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015
EC>6-EC8	54	
EC>8-EC10	NA	
EC>10-EC12	2.6	
EC>12-EC16	240	
EC16>EC21	NA	
EC>21-EC34	NA	
Aromatics		
EC>8-EC10	240	Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015
EC>10-EC12	79	
EC>12-EC16	20	
EC16>EC21	4	
EC>21-EC34	15	

Abbreviations:
µg/L = micrograms per liter
DEQ = Oregon Department of Environmental Quality
EPA = United States Environmental Protection Agency
ESL = ecological screening level
FW = freshwater
LCV = lowest chronic value
OSWER = Office of Solid Waste and Emergency Response
SCV = secondary chronic value
SLV = screening level value

Note:
[1] Based on the Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015

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Table G-3
Narcosis Risk to Benthic Organisms Based on ΣESBTUs Calculated from Historical (Pre-2011) Sediment PAH Concentrations and Compared to Bioassay Test Results
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample Date	No. of PAH Analytes Included	Total Organic Carbon (%)	ΣESBTU[1]		Bioassay?	Bioassay Results
				EPA UF[2]	Site-Specific UF[3]		
Milton Creek Exposure Area							
SD-MC-A	6/1/2004	17	2.0	**3.5**	**1.7**	Yes	Fail (no significant toxic effect)
SD-MC-B	6/1/2004	17	0.92	0.26	0.12	No	NA
SD-MC-C	6/1/2004	17	1.6	0.65	0.31	No	NA
SD-MC-D	6/1/2004	17	2.8	0.16	0.08	No	NA
SD-MC-E	6/1/2004	17	2.9	0.87	0.42	No	NA
Scappoose Bay Exposure Area							
SD-100	12/1/2003	17	2.2	0.42	0.20	No	NA
SD-101	12/1/2003	17	2.2	0.66	0.32	No	NA
SD-102	12/1/2003	17	2.5	0.42	0.20	No	NA
SD-103	12/1/2003	17	2.1	**1.4**	0.65	No	NA
SD-103-A	6/1/2004	17	2.9	**4.3**	**2.0**	No	NA
SD-103-B	6/1/2004	17	2.4	0.55	0.26	No	NA
SD-103-C	6/1/2004	17	2.6	**1.3**	0.64	No	NA
SD-104	12/1/2003	17	1.8	**2.4**	**1.1**	No	NA
SD-104-A	6/1/2004	17	2.3	0.24	0.12	No	NA
SD-104-B	6/1/2004	17	2.5	0.24	0.12	No	NA
SD-104-C	6/1/2004	17	2.3	0.25	0.12	No	NA
SD-105	12/1/2003	17	2.2	**1.1**	0.51	No	NA
SD-105-A	6/1/2004	17	2.7	0.41	0.20	Yes	Fail (no significant toxic effect)
SD-105-B	6/1/2004	17	2.6	**1.7**	0.83	Yes	Fail (no significant toxic effect)
SD-105-C	6/1/2004	17	2.6	0.21	0.10	No	NA
SD-106	12/1/2003	17	2.1	0.88	0.42	No	NA
SD-108	12/1/2003	17	1.4	**14**	**6.5**	No	NA
SD-110	12/1/2003	17	1.8	**6.6**	**3.2**	No	NA
SD-112	12/1/2003	17	1.0	**4.6**	**2.2**	No	NA
SD-112-A	6/1/2004	17	1.5	**2.3**	**1.1**	Yes	Fail (no significant toxic effect)
SD-112-B	6/1/2004	17	3.3	**3.0**	**1.5**	No	NA
SD-112-C	6/1/2004	17	2.6	**2.9**	**1.4**	Yes	Fail (no significant toxic effect)
SD-113	12/1/2003	17	0.22	0.60	0.29	No	NA
SD-114	12/1/2003	17	1.7	0.31	0.15	No	NA
SD-115	12/1/2003	17	0.69	0.19	0.09	No	NA
SD-116	12/1/2003	17	1.0	0.41	0.20	No	NA

Please see notes at end of table.

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Table G-3
Narcosis Risk to Benthic Organisms Based on ΣESBTUs Calculated from Historical (Pre-2011) Sediment PAH Concentrations and Compared to Bioassay Test Results
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample Date	No. of PAH Analytes Included	Total Organic Carbon (%)	ΣESBTU[1]		Bioassay?	Bioassay Results
				EPA UF[2]	Site-Specific UF[3]		
SD-117	12/1/2003	17	1.1	**2.1**	0.99	No	NA
SD-117-A	6/1/2004	17	0.18	0.51	0.25	No	NA
SD-117-B	6/1/2004	17	0.30	0.54	0.26	No	NA
SD-117-C	6/1/2004	17	0.76	**1.2**	0.56	Yes	Fail (no significant toxic effect)
SD-119	12/1/2003	17	1.1	**1.1**	0.50	No	NA
SD-119-A	6/1/2004	17	1.7	**1.5**	0.70	No	NA
SD-119-B	6/1/2004	17	2.1	0.99	0.47	Yes	Fail (no significant toxic effect)
SD-119-C	6/1/2004	17	3.0	0.74	0.36	Yes	Fail (no significant toxic effect)
SD-120	12/1/2003	17	0.19	0.53	0.26	No	NA
SD-121	6/1/2004	17	1.8	0.36	0.17	No	NA
SD-122	6/1/2004	17	1.7	**1.8**	0.86	No	NA
SD-123	6/1/2004	17	1.7	**1.5**	0.72	No	NA
SD-124	6/1/2004	17	1.2	0.39	0.19	No	NA
SD-125	4/1/2005	17	2.4	**3.4**	**1.6**	No	NA
SD-126	4/1/2005	17	3.1	**2.6**	**1.3**	No	NA
SD-127	4/1/2005	17	4.3	**4.2**	**2.0**	Yes	Fail (no significant toxic effect)
SD-128	4/1/2005	17	4.7	**2.9**	**1.4**	No	NA
SD-130	4/1/2005	17	4.0	1.0	0.48	No	NA
SD-131	4/1/2005	17	3.2	**22**	**10**	Yes	Fail (no significant toxic effect)
SD-132	4/1/2005	17	3.7	**2.8**	**1.4**	Yes	Fail (no significant toxic effect)
SD-133	4/1/2005	17	2.0	0.79	0.38	No	NA
SD-134	4/1/2005	17	0.62	**8.6**	**4.1**	No	NA
SD-135	4/1/2005	17	6.5	**6.3**	**3.0**	Yes	Fail (no significant toxic effect)
SD-135 (FD)	4/1/2005	17	6.5	**4.4**	**2.1**	No	NA
SD-136	4/1/2005	17	1.5	**6.7**	**3.2**	Yes	Fail (no significant toxic effect)

Please see notes at end of table.

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Table G-3
Narcosis Risk to Benthic Organisms Based on ΣESBTUs Calculated from Historical (Pre-2011) Sediment PAH Concentrations and Compared to Bioassay Test Results
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample Date	No. of PAH Analytes Included	Total Organic Carbon (%)	ΣESBTU[1]		Bioassay?	Bioassay Results
				EPA UF[2]	Site-Specific UF[3]		
SD-137	4/1/2005	17	0.97	0.17	0.08	No	NA
SD-139	4/1/2005	17	3.7	0.32	0.15	No	NA
SD-140	4/1/2005	17	1.2	0.83	0.40	No	NA
SD-141	4/1/2005	17	1.2	0.20	0.10	No	NA
SHID6	11/1/1996	15	2.5	0.81	NC	No	NA
SHID1	10/1/1996	15	3.9	0.46	NC	No	NA
SHID2	10/1/1996	15	0.40	0.51	NC	No	NA

Abbreviations:
EPA = United States Environmental Protection Agency
Eq-P = equilibrium partitioning
NA = Not applicable
NC = not calculated
PAH = polycyclic aromatic hydrocarbon
UF = uncertainty factor
ΣESBTU = sum of Eq-P-based sediment benchmark toxic units

Notes:
[1] Sum of Eq-P-based sediment benchmark toxic units. Calculations are presented in Appendix G-B. Individual toxic unit values based on one-carbon partitioning model for estimating dissolved fraction. Values shown in **BOLD** are greater than 1.
[2] Uncertainty factor of 6.42 (based on UFs presented in EPA [2003] for 90% confidence) used to adjust ΣESBTUs for 17 analytes. UF of 7.43 (based on EPA [2003]) used for samples with 15 analytes (1996 dataset).
[3] Uncertainty factor of 3.24 (based on UF calculated from 2012 Site data for 90% confidence) used to adjust ΣESBTUs for samples with 17 analytes. UF from 2012 Site data not determined for 1996 data (15 analytes).

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Table G-4
Narcosis Risk to Benthic Organisms Based on ΣESBTUs Calculated from 2011 Sediment PAH Concentra
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample Date	No. of PAH Analytes Included	Total Organic Carbon (%)	ΣESBTU[1]	
				EPA UF[2]	Site-Specific UF[3]
Milton Creek Exposure Area					
MC03	7/12/2011	34	0.88	0.23	0.23
MC04	7/12/2011	16	1.4	0.82	0.38
Scappoose Bay Exposure Area					
SB01	7/14/2011	16	2.4	0.38	0.18
SB02	7/14/2011	34	2.4	0.15	0.15
SB03	7/14/2011	16	2.3	0.27	0.13
SB04	7/14/2011	16	2.1	**1.1**	0.49
SB06	7/14/2011	16	2.2	0.89	0.41
SB07	7/13/2011	16	1.5	0.11	0.05
SB08	7/13/2011	34	2.9	0.17	0.17
SB09	7/14/2011	34	2.8	**5.4**	**5.4**
SB12	7/14/2011	16	2.6	**3.4**	**1.6**
SB13	7/14/2011	16	3.3	**1.9**	0.89
SB17	7/15/2011	16	2.7	**4.3**	**2.0**
SB19	7/15/2011	16	1.4	**2.4**	**1.1**
SB20	7/15/2011	16	2.1	**2.7**	**1.3**
SB21	7/15/2011	16	2.9	**1.7**	0.81
SB24	7/16/2011	16	4.4	**13**	**6.0**
SB26	7/16/2011	16	2.9	**8.4**	**3.9**
SB27	7/16/2011	16	2.7	**39**	**18**
SB28	7/16/2011	34	2.7	**11**	**11**

Abbreviations:
EPA = United States Environmental Protection Agency
Eq-P = equilibrium partitioning
PAH = polycyclic aromatic hydrocarbon
UF = uncertainty factor
ΣESBTU = sum of Eq-P-based sediment benchmark toxic units

Notes:
[1] Sum of Eq-P-based sediment benchmark toxic units. Calculations are presented in Appendix G-B. Individual toxic unit values based on one-carbon partitioning model for estimating dissolved fraction. Values shown in **BOLD** are greater than 1.
[2] Uncertainty factor of 6.93 (based on UFs presented in EPA [2003] for 90% confidence) used to adjust ΣESBTUs when data for only 16 analytes were available.
[3] Uncertainty factor of 3.24 (based on UF calculated from 2012 Site data for 90% confidence) used to adjust ΣESBTUs when data for only 16 analytes were available.

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Table G-5
Narcosis Risk to Benthic Organisms Based on ΣIWTUs Calculated from 2012 Sediment PAH Concentrations
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Depth Interval (inches)	Sample Date	Total Organic Carbon (%)	Black Carbon (%)	ΣIWTU[1]
Milton Creek Exposure Area					
PWS-27	8-11	7/13/2012	1.8	0.13	**0.015**
PWS-17	4-7	10/10/2012	0.95	0.12	0.017
PWS-27	8-11	10/9/2012	1.7	0.17	0.012
PWS-30	8-11	10/12/2012	1.1	0.13	0.0047
Scappoose Bay Exposure Area					
PWS-01	8-9	7/10/2012	0.63	0.10	0.16
PWS-03	8-11	7/12/2012	2.8	0.17	**3.5**
PWS-04	1-4	7/10/2012	1.2	0.13	0.28
PWS-04	8-11	7/10/2012	1.0	0.10	0.97
PWS-05	8-11	7/12/2012	1.8	0.14	**1.1**
PWS-06	8-11	7/12/2012	2.3	0.23	**4.1**
PWS-07	8-11	7/10/2012	2.8	0.17	**1.3**
PWS-08	8-11	7/12/2012	2.1	0.20	0.63
PWS-09	8-11	7/12/2012	2.0	0.17	0.20
PWS-12	8-11	7/12/2012	1.8	0.16	0.057
PWS-12 (FD)[2]	8-11	7/12/2012	1.8	0.15	0.036
PWS-13	1-4	7/11/2012	2.7	0.16	0.068
PWS-13	8-11	7/11/2012	2.0	0.15	0.061
PWS-15	8-11	7/12/2012	1.5	0.10	0.015
PWS-16	8-11	7/9/2012	2.0	0.15	**1.5**
PWS-16B	8-11	7/13/2012	2.2	0.17	0.18
PWS-22	8-11	7/12/2012	2.0	0.16	0.04
PWS-25	8-11	7/13/2012	1.6	0.15	0.63
PWS-26	8-11	7/13/2012	1.2	0.16	0.39
LSI-01	8-11	10/16/2012	0.19	0.21[3]	0.0074
LSI-02	8-11	10/9/2012	1.6	0.21[3]	0.019
LSI-20	8-11	10/10/2012	0.33	0.21[3]	0.15
LSI-24	8-11	10/12/2012	0.91	0.21[3]	0.024
PWS-01	8-10	10/10/2012	0.56	0.05	0.15
PWS-03	8-11	10/10/2012	2.6	0.28	0.77
PWS-04	8-11	10/10/2012	0.69	0.12	0.70
PWS-05	8-11	10/10/2012	1.2	0.19	0.19
PWS-06	8-11	10/10/2012	1.5	0.26	0.38
PWS-07	8-10	10/11/2012	1.7	0.22	0.90
PWS-07 (FD)	8-10	10/11/2012	1.7	0.23	0.70
PWS-08	8-11	10/9/2012	1.5	0.25	0.11
PWS-09	8-11	10/9/2012	1.8	0.23	0.010
PWS-12	8-11	10/9/2012	1.5	0.20	0.0027
PWS-13	8-11	10/9/2012	2.2	0.24	0.97
PWS-13 (FD1)[4]	8-11	10/9/2012	2.2	0.24	**1.1**
PWS-13 (FD2)[4]	8-11	10/9/2012	2.2	0.24	0.60
PWS-15	8-11	10/11/2012	0.81	0.12	0.0057
PWS-16	8-11	10/9/2012	1.6	0.23	0.023
PWS-25	4-8	10/11/2012	0.98	0.14	0.48
PWS-26	8-11	10/11/2012	1.0	0.21	0.25
PWS-26 (FD)	8-11	10/11/2012	1.4	0.23	0.27
PWS-28	8-11	10/10/2012	1.1	0.17	0.0069

Abbreviations:
PAH = polycyclic aromatic hydrocarbon
ΣIWTU = sum of interstitial water toxic units

Notes:
[1] Sum of interstitial water toxic units. Calculations are presented in Appendix G-B.
Individual toxic unit values based on two-carbon method of estimating dissolved fraction.
All based on 34 PAH analytes. Values shown in **BOLD** are greater than 1.
Calculated using the full detection limit for analytes not detected.

[2] (FD) indicates the sample is a field duplicate of the previous sample.

[3] Black carbon estimated as the average of Scappoose Bay samples from October 2012.

[4] Two field duplicates collected at PWS-13 in October.

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Table G-6a
Narcosis Risk to Benthic Organisms Based on ΣIWTUs Calculated from Porewater PAH Concentra
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Depth Interval (inches)	Sample Date	No. of PAH Analytes Detected[1]	ΣIWTU (1/2 DL)[2]	ΣIWTU (full DL)[3]
Milton Creek Exposure Area					
PWS-27	8-11	7/13/2012	0	0.077	**1.53**
PWS-17	4-7	10/10/2012	8	0.34	**1.43**
PWS-27	8-11	10/9/2012	2	0.10	**1.33**
PWS-30	8-11	10/12/2012	0	0.28	**1.32**
PWS-2	3-8	9/6/17 - 9/26/17	25	--	**16.2**
PWS-2	24-29	9/6/17 - 9/26/17	20	--	**1.9**
Scappoose Bay Exposure Area					
PWS-01	8-9	7/10/2012	8	0.85	**1.84**
PWS-03	8-11	7/12/2012	10	0.74	**1.72**
PWS-04	8-11	7/10/2012	3	0.54	**1.55**
PWS-05	8-11	7/12/2012	7	0.57	**1.56**
PWS-06	8-11	7/12/2012	3	0.45	**1.55**
PWS-07	8-11	7/10/2012	10	0.69	**1.67**
PWS-08	8-11	7/12/2012	10	0.69	**1.67**
PWS-09	8-11	7/12/2012	1	0.42	**1.53**
PWS-12	8-11	7/12/2012	1	0.51	**1.53**
PWS-12 (FD)[4]	8-11	7/12/2012	1	0.39	**1.53**
PWS-13	1-4	7/11/2012	0	0.40	**1.53**
PWS-13	8-11	7/11/2012	0	0.42	**1.53**
PWS-15	8-11	7/12/2012	0	0.076	**1.53**
PWS-16	8-11	7/9/2012	1	0.17	**1.53**
PWS-16B	8-11	7/13/2012	2	0.53	**1.55**
PWS-25	8-11	7/13/2012	7	0.68	**1.67**
PWS-26	8-11	7/13/2012	4	0.42	**1.55**
LSI-01	8-11	10/16/2012	1	0.16	**1.53**
LSI-02	8-11	10/9/2012	6	0.21	**1.56**
LSI-20	8-11	10/10/2012	5	0.22	**1.58**
LSI-24	8-11	10/12/2012	6	0.21	**1.57**
PWS-01	8-10	10/10/2012	8	0.62	**1.47**
PWS-03	8-11	10/10/2012	9	0.40	**1.41**
PWS-04	8-11	10/10/2012	5	0.47	**1.34**
PWS-05	8-11	10/10/2012	5	0.22	**1.35**
PWS-06	8-11	10/10/2012	9	0.28	**1.47**
PWS-07	8-10	10/11/2012	10	0.52	**2.52**
PWS-07 (FD)	8-10	10/11/2012	13	**1.4**	**1.61**
PWS-08	8-11	10/9/2012	9	0.37	**1.39**
PWS-09	8-11	10/9/2012	5	0.23	**1.34**
PWS-12	8-11	10/9/2012	2	0.11	**1.33**
PWS-13	8-11	10/9/2012	18	**2.8**	**6.92**
PWS-15	8-11	10/11/2012	3	0.25	**1.33**
PWS-16	8-11	10/9/2012	9	0.16	**1.41**
PWS-25	4-8	10/11/2012	6	0.35	**1.39**
PWS-26	8-11	10/11/2012	5	0.24	**1.35**
PWS-26 (FD)	8-11	10/11/2012	7	0.48	**1.35**
PWS-28	8-11	10/10/2012	0	0.29	**1.32**

Please see notes at end of table

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Table G-6a
Narcosis Risk to Benthic Organisms Based on ΣIWTUs Calculated from Porewater PAH Concentra
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Depth Interval (inches)	Sample Date	No. of PAH Analytes Detected[1]	ΣIWTU (1/2 DL)[2]	ΣIWTU (full DL)[3]
PWS-1	3-8	9/6/17 - 9/26/17	24	--	0.08
PWS-1	24-29	9/6/17 - 9/26/17	29	--	**3.42**
PWS-3	3-8	9/5/17 - 9/26/17	15	--	0.02
PWS-3	24-29	9/5/17 - 9/26/17	14	--	0.03
PWS-4	3-8	9/5/17 - 9/26/17	22	--	0.05
PWS-4	24-29	9/5/17 - 9/26/17	21	--	0.59
PWS-5	3-8	9/5/17 - 9/26/17	24	--	0.19
PWS-5	24-29	9/5/17 - 9/26/17	25	--	**20.3**
PWS-6	3-8	9/5/17 - 9/26/17	24	--	0.04
PWS-6	24-29	9/5/17 - 9/26/17	22	--	0.05
PWS-7	3-8	9/5/17 - 9/26/17	24	--	0.04
PWS-7	24-29	9/5/17 - 9/26/17	20	--	0.02
PWS-8	3-8	9/5/17 - 9/26/17	25	--	0.09
PWS-8	24-29	9/5/17 - 9/26/17	25	--	0.04
PWS-9	3-8	9/5/17 - 9/26/17	25	--	0.05
PWS-9	24-29	9/5/17 - 9/26/17	25	--	0.10
PWS-10	3-8	9/5/17 - 9/26/17	26	--	0.13
PWS-11	24-29	9/5/17 - 9/26/17	27	--	**0.00**
PWS-11	3-8	9/5/17 - 9/26/17	27	--	0.08
PWS-12	24-29	9/6/17 - 9/26/17	30	--	0.04
PWS-12	3-8	9/6/17 - 9/26/17	29	--	0.33
PWS-13	24-29	9/6/17 - 9/26/17	30	--	0.47
PWS-13	3-8	9/6/17 - 9/26/17	29	--	0.14
PWS-14	24-29	9/5/17 - 9/26/17	26	--	**0.74**
PWS-14	3-8	9/5/17 - 9/26/17	29	--	0.06
PWS-15	24-29	9/6/17 - 9/26/17	27	--	**1.5**
PWS-15	3-8	9/6/17 - 9/26/17	27	--	4.51

Abbreviations:
PAH = polycyclic aromatic hydrocarbon
ΣIWTU = sum of interstitial water toxic units

Notes:
[1] Number of PAH analytes (out of 34) that were detected in the sample.
[2] Sum of interstitial water toxic units, using one-half the detection limit for non-detect values.
[3] Sum of interstitial water toxic units, using the full detection limit for non-detect values.
[4] (FD) indicates the sample is a field duplicate of the previous sample.
Individual toxic unit values based on freely dissolved concentrations.
Values shown in **BOLD** are greater than 1.

Table G-6b
Narcosis Risk to Benthic Organisms Based on ΣSWTUs Calculated from Surface Water PAH Concentrations
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Period	No. of PAH Analytes Detected[1]	ΣSWTU (1/2 DL)[2]	ΣSWTU (full DL)[3]
Milton Creek Exposure Area					
PWS-2	Surface Water Site 2	9/6/17 - 9/26/17	30	0.340	0.340
Scappoose Bay Exposure Area					
PWS-03	Surface Water Site 3	9/5/17 - 9/26/17	30	0.607	0.607
PWS-04	Surface Water Site 4	9/5/17 - 9/26/17	30	0.814	0.814
PWS-09	Surface Water Site 9	9/5/17 - 9/26/17	32	**1.07**	**1.07**
PWS-10	Surface Water Site 10-1	9/5/17 - 9/26/17	32	**1.07**	**1.07**
PWS-10	Surface Water Site 10-3	9/5/17 - 9/26/17	30	0.989	0.989
PWS-12	Surface Water Site 12	9/6/17 - 9/26/17	31	**1.04**	**1.04**
PWS-13	Surface Water Site 13	9/6/17 - 9/26/17	31	**1.04**	**1.04**
PWS-14	Surface Water Site 14	9/5/17 - 9/26/17	31	0.467	0.467

Abbreviations:
PAH = polycyclic aromatic hydrocarbon
ΣSWTU = sum of surface water toxic units

Notes:
[1] Number of PAH analytes (out of 34) that were detected in the sample
[2] Sum of surface water toxic units using 1/2 the detection limit for non-detect values
[3] Sum of surface water toxic units using the full detection limit for non-detect values
Values shown in **BOLD** are greater than 1

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Table G-7
Summary of 2012 Porewater Data and Comparison to Surface Water Screening Level Values for the Milton Creek Exposure Area
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	No. of Samples	No. of Detections	FOD	Range of Detection Limits[1] (µg/L)	Range of Detections[2] (µg/L)	Location/ Depth of Maximum Sample[3]	Date of Maximum Sample	EPC[4] (µg/L)	SLV (µg/L)	EPC/ SLV[5]
1-Methylnaphthalene	4	1	25.0%	0.299 - 0.319	0.984 - 0.984	PWS-17 / 4-7	10/10/2012	0.984	2.1	4.7E-1
2-Methylnaphthalene	4	0	0.0%	0.252 - 0.269	--	--	--	<0.269	130	<2.1E-3
Acenaphthene	4	1	25.0%	0.135 - 0.149	2.69 - 2.69	PWS-17 / 4-7	10/10/2012	2.69	74	3.6E-2
Acenaphthylene	4	1	25.0%	0.118 - 0.120	0.230 - 0.230	PWS-17 / 4-7	10/10/2012	0.230	4,840	4.7E-5
Anthracene	4	2	50.0%	0.0117 - 0.0158	0.0291 - 0.0698	PWS-27 / 8-11	10/9/2012	0.0698	0.09	7.8E-1
Benzo(a)anthracene	4	0	0.0%	0.00175 - 0.00863	--	--	--	<0.00863	0.027	<3.2E-1
Benzo(a)pyrene	4	0	0.0%	0.00359 - 0.0243	--	--	--	<0.0243	0.014	**<1.7E+0**
Benzo(b)fluoranthene	4	0	0.0%	0.00259 - 0.0209	--	--	--	<0.0209	9.07	<2.3E-3
Benzo(e)pyrene	4	0	0.0%	0.00344 - 0.0239	--	--	--	<0.0239	NA	NA
Benzo(g,h,i)perylene	4	0	0.0%	0.00152 - 0.0155	--	--	--	<0.0155	7.64	<2.0E-3
Benzo(k)fluoranthene	4	0	0.0%	0.00243 - 0.0202	--	--	--	<0.0202	9.07	<2.2E-3
C-1 Benz(a)anthracenes/Chrysenes	4	0	0.0%	0.00041 - 0.00381	--	--	--	<0.00381	NA	NA
C-1 Fluoranthrenes/Pyrenes	4	0	0.0%	0.0370 - 0.104	--	--	--	<0.104	NA	NA
C-1 Fluorenes	4	1	25.0%	0.174 - 0.267	0.311 - 0.311	PWS-17 / 4-7	10/10/2012	0.311	NA	NA
C-1 Naphthalenes	4	1	25.0%	0.551 - 0.588	1.12 - 1.12	PWS-17 / 4-7	10/10/2012	1.12	2.1	5.3E-1
C-1 Phenanthrenes/Anthracenes	4	0	0.0%	0.120 - 0.249	--	--	--	<0.249	NA	NA
C-2 Benz(a)anthracenes/Chrysenes	4	0	0.0%	0.00043 - 0.0054	--	--	--	<0.00540	NA	NA
C-2 Fluorenes	4	0	0.0%	0.124 - 0.314	--	--	--	<0.314	NA	NA
C-2 Naphthalenes	4	0	0.0%	0.636 - 0.770	--	--	--	<0.770	NA	NA
C-2 Phenanthrenes/Anthracenes	4	0	0.0%	0.00089 - 0.00323	--	--	--	<0.00323	NA	NA
C-3 Benz(a)anthracenes/Chrysenes	4	0	0.0%	0.00002 - 0.00035	--	--	--	<0.00035	NA	NA
C-3 Fluorenes	4	0	0.0%	0.00949 - 0.0482	--	--	--	<0.0482	NA	NA
C-3 Naphthalenes	4	1	25.0%	0.00195 - 0.00319	0.349 - 0.349	PWS-17 / 4-7	10/10/2012	0.349	NA	NA
C-3 Phenanthrenes/Anthracenes	4	0	0.0%	0.000517 - 0.00361	--	--	--	<0.00361	NA	NA
C-4 Benz(a)anthracenes/Chrysenes	4	0	0.0%	0.000106 - 0.00209	--	--	--	<0.00209	NA	NA
C-4 Naphthalenes	4	0	0.0%	0.00144 - 0.00416	--	--	--	<0.00416	NA	NA
C-4 Phenanthrenes/Anthracenes	4	0	0.0%	0.000742 - 0.00846	--	--	--	<0.00846	NA	NA
Chrysene	4	1	25.0%	0.000606 - 0.00317	0.00159 - 0.00159	PWS-27 / 8-11	10/9/2012	0.00159	7.0	2.3E-4
Dibenzo(a,h)anthracene	4	0	0.0%	0.00095 - 0.0112	--	--	--	<0.0112	5.0	<2.2E-3
Fluoranthene	4	0	0.0%	0.0251 - 0.0547	--	--	--	<0.0547	30	<1.8E-3

Please see note at end of table.

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Table G-7
Summary of 2012 Porewater Data and Comparison to Surface Water Screening Level Values for the Milton Creek Exposure Area
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	No. of Samples	No. of Detections	FOD	Range of Detection Limits[1] (µg/L)	Range of Detections[2] (µg/L)	Location/ Depth of Maximum Sample[3]	Date of Maximum Sample	EPC[4] (µg/L)	SLV (µg/L)	EPC/ SLV[5]
Fluorene	4	1	25.0%	0.169 - 0.198	0.453 - 0.453	PWS-17 / 4-7	10/10/2012	0.453	3.9	1.2E-1
Indeno(1,2,3-cd)pyrene	4	0	0.0%	0.00095 - 0.0112	--	--	--	<0.0112	4.31	<2.6E-3
Naphthalene	4	0	0.0%	1.09 - 1.12	--	--	--	<1.12	620	<1.8E-3
Perylene	4	0	0.0%	0.00344 - 0.0239	--	--	--	<0.0239	NA	NA
Phenanthrene	4	1	25.0%	0.106 - 0.147	0.270 - 0.270	PWS-17 / 4-7	10/10/2012	0.270	6.3	4.3E-2
Pyrene	4	0	0.0%	0.0258 - 0.0473	--	--	--	<0.0473	0.3	<1.6E-1

Abbreviations:
EPC = exposure point concentration
µg/L = micrograms per liter
FOD = frequency of detection
NA = not available
SLV = screening level value

Notes:
[1] Detection limits are method detection limits (MDLs) converted to freely dissolved concentration.
[2] Detections expressed as freely dissolved concentrations.
[3] Depths in inches below sediment surface where sample with the maximum concentration was detected.
[4] Exposure point concentrations are the maximum detected concentration or maximum MDL (preceded with "<").
[5] Ratios based on maximum MDLs preceded with "<".

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Table G-8
Summary of 2012 Porewater Data and Comparison to Surface Water Screening Level Values for the Scappoose Bay Exposure Area
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	No. of Samples	No. of Detections	FOD	Range of Detection Limits[1] (µg/L)	Range of Detections[2] (µg/L)	Location/Depth of Maximum Sample[3]	Date of Maximum Sample	Statistical Evaluation				EPC[4] (µg/L)	SLV (µg/L)	EPC/SLV[5]
								Data Sufficiency/ Distribution	Arithmetic Mean (µg/L)	90% UCL (µg/L)	Basis of 90% UCL			
1-Methylnaphthalene	34	1	2.9%	0.296 - 0.320	1.36 - 1.36	PWS-01 / 8-9	7/10/2012	Insufficient detections	--	--	--	1.36	2.1	6.5E-1
2-Methylnaphthalene	34	0	0.0%	0.249 - 0.270	--	--	--	Not detected	--	--	--	<0.270	130	<2.1E-3
Acenaphthene	34	30	88.2%	0.134 - 0.150	0.174 - 9.30	PWS-01 / 8-9	7/10/2012	Lognormal	1.10	1.66	BCA bootstrap using ROS	1.66	74	2.2E-2
Acenaphthylene	34	8	23.5%	0.117 - 0.120	0.121 - 0.902	PWS-01 / 8-9	7/10/2012	Low FOD[6]	0.164	0.246	KM Chebyshev (90% UCL)	0.246	4,840	5.1E-5
Anthracene	34	12	35.3%	0.0116 - 0.0160	0.0162 - 0.834	PWS-7 / 8-10	10/11/2012	Lognormal[7]	0.0388	0.0915	KM (BCA)	0.0915	0.09	1.0E+0
Benzo(a)anthracene	34	5	14.7%	0.00153 - 0.0506	0.00316 -- 0.0192	PWS-25 / 4-8	10/11/2012	Low FOD	0.00350	0.00612	KM Chebyshev (90% UCL)	0.00612	0.027	<2.3E-1
Benzo(a)pyrene	34	0	0.0%	0.00234 - 0.0462	--	--	--	Not detected	--	--	--	<0.0462	0.014	**<3.3E+0**
Benzo(b)fluoranthene	34	0	0.0%	0.00168 - 0.0438	--	--	--	Not detected	--	--	--	<0.0438	9.07	<4.8E-3
Benzo(e)pyrene	34	0	0.0%	0.00224 - 0.0459	--	--	--	Not detected	--	--	--	<0.0459	NA	NA
Benzo(g,h,i)perylene	34	0	0.0%	0.00099 - 0.0389	--	--	--	Not detected	--	--	--	<0.0389	7.64	<5.1E-3
Benzo(k)fluoranthene	34	0	0.0%	0.00157 - 0.0433	--	--	--	Not detected	--	--	--	<0.0433	9.07	<4.8E-3
C-1 Benz(a)anthracenes/Chrysenes	34	0	0.0%	0.00035 - 0.00557	--	--	--	Not detected	--	--	--	<0.00557	NA	NA
C-1 Fluoranthrenes/Pyrenes	34	2	5.9%	0.0331 - 0.112	0.0575 -- 0.191	PWS-7 / 8-10	10/11/2012	Insufficient detections	--	--	--	0.191	NA	NA
C-1 Fluorenes	34	13	38.2%	0.174 - 0.272	0.214 - 1.26	PWS-13 / 8-11	10/9/2012	Lognormal[7]	0.256	0.364	KM (BCA)	0.364	NA	NA
C-1 Naphthalenes	34	1	2.9%	0.545 - 0.590	1.49 - 1.49	PWS-01 / 8-9	7/10/2012	Insufficient detections	--	--	--	1.49	2.1	7.1E-1
C-1 Phenanthrenes/Anthracenes	34	6	17.7%	0.109 - 0.260	0.295 -- 1.38	PWS-13 / 8-11	10/9/2012	Low FOD	0.135	0.338	KM Chebyshev (90% UCL)	0.338	NA	NA
C-2 Benz(a)anthracenes/Chrysenes	34	0	0.0%	0.00037 - 0.00960	--	--	--	Not detected	--	--	--	<0.00960	NA	NA
C-2 Fluorenes	34	1	2.9%	0.112 - 0.333	0.738 -- 0.738	PWS-13 / 8-11	10/9/2012	Insufficient detections	--	--	--	0.738	NA	NA
C-2 Naphthalenes	34	6	17.7%	0.635 - 0.776	0.816 -- 11.2	PWS-13 / 8-11	10/9/2012	Low FOD	1.07	2.10	KM Chebyshev (90% UCL)	2.097	NA	NA
C-2 Phenanthrenes/Anthracenes	34	7	20.6%	0.00079 - 0.00359	0.0560 -- 0.518	PWS-13 / 8-11	10/9/2012	Low FOD	0.0517	0.117	KM Chebyshev (90% UCL)	0.117	NA	NA
C-3 Benz(a)anthracenes/Chrysenes	34	0	0.0%	0.00002 - 0.00093	--	--	--	Not detected	--	--	--	<0.00093	NA	NA
C-3 Fluorenes	34	0	0.0%	0.00829 - 0.0570	--	--	--	Not detected	--	--	--	<0.0570	NA	NA
C-3 Naphthalenes	34	5	14.7%	0.00182 - 0.00327	0.231 - 15.0	PWS-13 / 8-11	10/9/2012	Low FOD	0.556	2.02	KM Chebyshev (90% UCL)	2.019	NA	NA
C-3 Phenanthrenes/Anthracenes	34	1	2.9%	0.00045 - 0.00466	0.042 -- 0.0422	PWS-13 / 8-11	10/9/2012	Insufficient detections	--	--	--	0.0422	NA	NA
C-4 Benz(a)anthracenes/Chrysenes	34	0	0.0%	0.00009 - 0.00714	--	--	--	Not detected	--	--	--	<0.00714	NA	NA
C-4 Naphthalenes	34	1	2.9%	0.00129 - 0.00448	1.21 -- 1.21	PWS-13 / 8-11	10/9/2012	Insufficient detections	--	--	--	1.21	NA	NA
C-4 Phenanthrenes/Anthracenes	34	0	0.0%	0.00064 - 0.01395	--	--	--	Not detected	--	--	--	<0.01395	NA	NA
Chrysene	34	14	41.2%	0.00060 - 0.03630	0.00064 - 0.0203	PWS-03 / 8-11	7/12/2012	Normal	0.00367	0.00501	KM (BCA)	0.00501	7.0	7.2E-4
Dibenzo(a,h)anthracene	34	0	0.0%	0.00061 - 0.0334	--	--	--	Not detected	--	--	--	<0.0334	5.0	<6.7E-3
Fluoranthene	34	24	70.6%	0.0250 - 0.0573	0.0597 -- 1.04	PWS-7 / 8-10	10/11/2012	Lognormal[7]	0.144	0.202	BCA bootstrap using ROS	0.202	30	6.7E-3
Fluorene	34	17	50.0%	0.169 - 0.200	0.215 - 2.76	PWS-7 / 8-10	10/11/2012	Gamma	0.333	0.505	Gamma using ROS (adjusted)	0.505	3.9	1.3E-1
Indeno(1,2,3-cd)pyrene	34	0	0.0%	0.00061 - 0.0334	--	--	--	Not detected	--	--	--	<0.0334	4.31	<7.7E-3
Naphthalene	34	0	0.0%	1.09 - 1.12	--	--	--	Not detected	--	--	--	<1.12	620	<1.8E-3
Perylene	34	0	0.0%	0.00224 - 0.0459	--	--	--	Not detected	--	--	--	<0.0459	NA	NA
Phenanthrene	34	18	52.9%	0.106 - 0.149	0.147 - 3.15	PWS-7 / 8-10	10/11/2012	Not discernible	0.293	0.576	KM Chebyshev (90% UCL)	0.576	6.3	9.1E-2
Pyrene	34	22	64.7%	0.0257 - 0.0488	0.0413 -- 0.591	PWS-7 / 8-10	10/11/2012	Lognormal	0.0912	0.123	BCA bootstrap using ROS	0.123	0.3	4.1E-1

Abbreviations:
BCA = bias-corrected accelerated
EPC = exposure point concentration
µg/L = micrograms per liter
FOD = frequency of detection
KM = Kaplan Meier
NA = not available
ROS = regression on order statistic
SLV = screening level value
UCL = upper confidence level

Notes:
[1] Detection limits are method detection limits (MDLs) converted to freely dissolved concentration.
[2] Detections expressed as freely dissolved concentrations.
[3] Depths in inches below sediment surface where sample with the maximum concentration was detected..
[4] Exposure point concentrations are selected from the following (in this order): the 90% UCL, the maximum detected concentration, the maximum MDL (shown preceded with "<").
[5] Ratios based on maximum MDLs preceded with "<".
[6] Number of detections insufficient to identify statistical distribution. UCL based on the nonparametric Chebyshev Inequality using the Kaplan-Meier method for non-detections.
[7] Distribution found to fit lognormal by Lilliefors test (5% significance level), but not by Shapiro Wilk test (5% significance level).

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Table G-9
Summary of Sediment Data for Fluoranthene and Pyrene and Comparison to Bioaccumulation Screening Level Values for the Milton Creek and Scappoose Bay Exposure Areas
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	No. of Samples	No. of Detections	FOD	Range of Detection Limits (mg/kg)	Range of Detections (mg/kg)	Location/Depth of Maximum Sample[1]	Date of Maximum Sample	Statistical Evaluation				EPC (mg/kg)	SLV (mg/kg)	EPC/ SLV
								Data Sufficiency/ Distribution	Arithmetic Mean	90% UCL (mg/kg)	Basis of 90% UCL			
Milton Creek Exposure Area														
Fluoranthene	11	9	81.8%	0.009 - 0.027	0.02 - 1.20	SD-MC-A 0-0.3	6/1/2004	Gamma	0.206	0.439	Gamma using ROS (adjusted)	0.439	37	1.2E-2
Pyrene	11	9	81.8%	0.009 - 0.027	0.017 - 1.20	SD-MC-A 0-0.3	6/1/2004	Gamma	0.199	0.431	Gamma using ROS (adjusted)	0.431	1.9	2.3E-1
Scappoose Bay Exposure Area														
Fluoranthene	112	111	99.1%	0.013 - 0.013	0.009 - 20	SD-131 0-0.3	4/1/2005	Lognormal	2.035	2.56	BCA bootstrap using ROS	2.56	37	6.9E-2
Pyrene	112	110	98.2%	0.013 - 0.383	0.015 - 15	SD-131 0-0.3	4/1/2005	Lognormal	1.44	1.81	BCA bootstrap using ROS	1.81	1.9	9.5E-1

Abbreviations:
BCA = bias -corrected accelerated
EPC = exposure point concentration
FOD = frequency of detection
mg/kg = milligrams per kilogram
ROS = regression on order statistic
SLV = screening level value
UCL = upper confidence level

Note:
[1] Depths in inches below sediment surface where sample with the maximum concentration was detected.

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Table G-10
Summary of 2017 Sediment Concentrations and Comparison to SLVs
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	Total PAHs	VPH						
							$C_{>5}$-C_6	$C_{>6}$-C_8	$C_{>8}$-C_{10}	$C_{>10}$-C_{12}	$C_{>8}$-C_{10}	$C_{>10}$-C_{12}	$C_{>12}$-C_{13}
							Concentrations in mg/kg						
SB	PWS-090617-1	09/06/2017	P	0	1	**10.0**	27.3 U	27.3 U	27.3 U	27.3 U	27.3 U	27.3 U	27.3 U
MC	PWS-090617-2	09/06/2017	P	0	1	**3.64**	33.8 U	33.8 U	33.8 U	33.8 U	33.8 U	33.8 U	33.8 U
SB	PWS-090517-3	09/05/2017	P	0	1	**4.57**	34.2 U	34.2 U	34.2 U	34.2 U	34.2 U	34.2 U	34.2 U
SB	PWS-090517-4	09/05/2017	P	0	1	**8.11**	28.7 U	28.7 U	28.7 U	28.7 U	28.7 U	28.7 U	28.7 U
SB	PWS-090517-5	09/05/2017	P	0	1	**3.39**	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U
SB	PWS-090517-6	09/05/2017	P	0	1	**1.58**	30.8 U	30.8 U	30.8 U	30.8 U	30.8 U	30.8 U	30.8 U
SB	PWS-090517-7	09/05/2017	P	0	1	**3.50**	28.1 U	28.1 U	28.1 U	28.1 U	28.1 U	28.1 U	28.1 U
SB	PWS-090517-8	09/05/2017	P	0	1	**4.56**	30.7 U	30.7 U	30.7 U	30.7 U	30.7 U	30.7 U	30.7 U
SB	PWS-090517-9	09/05/2017	P	0	1	**53.5**	31.5 U	31.5 U	31.5 U	31.5 U	31.5 U	31.5 U	31.5 U
SB	PWS-090517-10	09/05/2017	P	0	1	**11.3**	45.3 U	45.3 U	45.3 U	45.3 U	45.3 U	45.3 U	45.3 U
SB	PWS-090517-DUP	09/05/2017	FD	0	1	**9.68**	34.0 U	34.0 U	34.0 U	34.0 U	34.0 U	34.0 U	34.0 U
SB	PWS-090517-11	09/05/2017	P	0	1	**8.83**	29.1 U	29.1 U	29.1 U	29.1 U	29.1 U	29.1 U	29.1 U
SB	PWS-090617-12	09/06/2017	P	0	1	**22.7**	18.6 U	18.6 U	18.6 U	18.6 U	18.6 U	18.6 U	18.6 U
SB	PWS-090617-13	09/06/2017	P	0	1	**42.0**	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U
SB	PWS-090517-14	09/05/2017	P	0	1	**14.6**	19.2 U	19.2 U	19.2 U	19.2 U	19.2 U	19.2 U	19.2 U
SB	PWS-090617-15	09/06/2017	P	0	1	**3.15**	25.9 U	25.9 U	25.9 U	25.9 U	25.9 U	25.9 U	25.9 U
Probable Effects Concentration (PEC)						22.8	--	--	--	--	--	--	--
Threshold Effects Concentration (TEC)						1.6	--	--	--	--	--	--	--
Portland Harbor ERA SLV						--	1.21	2.14	6.05	20.9	1.9	1.25	1.26

Please see notes at end of table.

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Table G-10
Summary of 2017 Sediment Concentrations and Comparison to SLVs
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	EPH									
						$C_{>8}$-C_{10}	$C_{>10}$-C_{12}	$C_{>12}$-C_{16}	$C_{>16}$-C_{21}	$C_{>21}$-C_{34}	$C_{>8}$-C_{10}	$C_{>10}$-C_{12}	$C_{>12}$-C_{16}	$C_{>16}$-C_{21}	$C_{>21}$-C_{34}
						Concentrations in mg/kg									
SB	PWS-090617-1	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
MC	PWS-090617-2	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
SB	PWS-090517-3	09/05/2017	P	0	1	4.58 H, U	4.58 H, U	**8.15** H	**21.5** H	**72.8** H	4.58 H, U	4.58 H, U	4.58 H, U	**22.0** H	**56.4** H
SB	PWS-090517-4	09/05/2017	P	0	1	4.04 H, U	4.04 H, U	4.04 H, U	**12.4** H	**42.2** H	4.04 H, U	4.04 H, U	4.04 H, U	**27.1** H	**45.9** H
SB	PWS-090517-5	09/05/2017	P	0	1	3.24 H, U	3.24 H, U	3.24 H, U	**18.6** H	**11.0** H	3.24 H, U	3.24 H, U	3.24 H, U	**4.84** H	**54.6** H
SB	PWS-090517-6	09/05/2017	P	0	1	4.17 H, U	4.17 H, U	**8.25** H	**19.0** H	**66.8** H	4.17 H, U	4.17 H, U	**7.90** H	**42.9** H	**52.4** H
SB	PWS-090517-7	09/05/2017	P	0	1	4.05 H, U	4.05 H, U	**8.59** H	**22.1** H	**87.6** H	4.05 H, U	4.05 H, U	4.05 H, U	**24.6** H	**54.5** H
SB	PWS-090517-8	09/05/2017	P	0	1	4.46 H, U	4.46 H, U	4.46 H, U	**11.9** H	**66.3** H	4.46 H, U	4.46 H, U	4.46 H, U	**11.2** H	**44.7** H
SB	PWS-090517-9	09/05/2017	P	0	1	4.13 H, U	12.90 H	**53.4** H	**71.8** H	**191** H	4.13 H, U	**4.44** H	**39.6** H	**236** H	**176** H
SB	PWS-090517-10	09/05/2017	P	0	1	4.32 H, U	4.32 H, U	**12.3** H	**40.3** H	**68.6** H	4.32 H, U	4.32 H, U	**7.87** H	**54.3** H	**139** H
SB	PWS-090517-DUP	09/05/2017	FD	0	1	4.33 H, U	4.33 H, U	**10.3** H	**26.5** H	**117** H	4.33 H, U	4.33 H, U	**8.65** H	**64.9** H	**108** H
SB	PWS-090517-11	09/05/2017	P	0	1	4.32 H, U	4.32 H, U	4.32 H, U	**7.24** H	**39.8** H	4.32 H, U	4.32 H, U	4.32 H, U	**17.0** H	**50.7** H
SB	PWS-090617-12	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
SB	PWS-090617-13	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
SB	PWS-090517-14	09/05/2017	P	0	1	3.09 H, U	3.09 H, U	3.09 H, U	**49.8** H	**23.0** H	3.09 H, U	**3.73** H	**7.05** H	**36.4** H	**77.8** H
SB	PWS-090617-15	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
Probable Effects Concentration (PEC)						--	--	--	--	--	--	--	--	--	--
Threshold Effects Concentration (TEC)						--	--	--	--	--	--	--	--	--	--
Portland Harbor ERA SLV						6.05	20.9	560	--	--	1.9	1.25	1.26	0.6	19

Notes:
Exposure Areas: MC = Milton Creek; SB = Scappoose Bay
Sample Type: P = primary; FD = field duplicate
Portland Harbor Ecological Risk Assessment (ERA) Screening Level Value (SLV) corrected for solubility error (March, 2015)
PAHs = polycyclic aromatic hydrocarbons
Total PAHs were calculated by summing the detected concentrations of Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene.
If an analyte was not detected, 1/2 the reporting or detection limit (as applicable) was included in the sum.
PAHs were analyzed using EPA Methods 8270D and 8270D-SIM
Total PAH values BOLD if greater than TEC and shaded if higher than PEC
VPH = volatile petroleum hydrocarbons
EPH = extractable petroleum hydrocarbons
TPH were analyzed using method NWTPH-Dx
VPH/EPH data **BOLDED** if higher than the detection limit and shaded if higher than the Portland Harbor ERA SLV
FD = field duplicate
U = not detected at or above the stated level
mg/kg = milligrams per kilogram

Table G-11a
Summary of 2017 Porewater Concentrations and IWTUs
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Total OPAHs (µg/L)	Total PAHs (µg/L)	ΣIWTU
PWS-1	Shallow Porewater Site 1	9/6/17 - 9/26/17	P	0.458	1.34	0.08
PWS-1	Deep Porewater Site 1	9/6/17 - 9/26/17	P	0.0	34.2	**3.42**
PWS-2	Shallow Porewater Site 2	9/6/17 - 9/26/17	P	0.0102	116	**16.2**
PWS-2	Deep Porewater Site 2	9/6/17 - 9/26/17	P	0.0018	18.5	**1.89**
PWS-3	Shallow Porewater Site 3	9/5/17 - 9/26/17	P	0.0004	0.26	0.02
PWS-3	Deep Porewater Site 3	9/5/17 - 9/26/17	P	0.0	0.34	0.03
PWS-4	Shallow Porewater Site 4	9/5/17 - 9/26/17	P	0.0010	0.44	0.05
PWS-4	Deep Porewater Site 4	9/5/17 - 9/26/17	P	0.0002	4.51	0.59
PWS-5	Shallow Porewater Site 5	9/5/17 - 9/26/17	P	0.0	1.31	0.19
PWS-5	Deep Porewater Site 5	9/5/17 - 9/26/17	P	0.0005	111	**20.26**
PWS-6	Shallow Porewater Site 6	9/5/17 - 9/26/17	P	0.0002	0.36	0.04
PWS-6	Deep Porewater Site 6	9/5/17 - 9/26/17	P	0.0026	0.52	0.05
PWS-7	Shallow Porewater Site 7	9/5/17 - 9/26/17	P	0.0	0.38	0.04
PWS-7	Deep Porewater Site 7	9/5/17 - 9/26/17	P	0.0	0.26	0.02
PWS-8	Shallow Porewater Site 8	9/5/17 - 9/26/17	P	0.0007	0.64	0.09
PWS-8	Deep Porewater Site 8	9/5/17 - 9/26/17	P	0.0	0.38	0.04
PWS-9	Shallow Porewater Site 9	9/5/17 - 9/26/17	P	0.0011	0.41	0.05
PWS-9	Deep Porewater Site 9	9/5/17 - 9/26/17	P	0.0032	0.77	0.10
PWS-10	Shallow Porewater Site 10	9/5/17 - 9/26/17	P	0.0	0.81	0.13
PWS-11	Shallow Porewater Site 11	9/5/17 - 9/26/17	P	0.0006	0.57	0.08
PWS-11	Deep Porewater Site 11	9/5/17 - 9/26/17	P	0.0005	0.38	0.04
PWS-12	Shallow Porewater Site 12	9/6/17 - 9/26/17	P	0.630	3.29	0.33
PWS-12	Deep Porewater Site 12	9/6/17 - 9/26/17	P	0.570	3.37	0.47
PWS-13	Shallow Porewater Site 13	9/6/17 - 9/26/17	P	0.0117	0.80	0.14
PWS-13	Deep Porewater Site 13	9/6/17 - 9/26/17	P	0.0342	5.41	0.74
PWS-14	Shallow Porewater Site 14	9/5/17 - 9/26/17	P	0.0	0.54	0.06
PWS-14	Deep Porewater Site 14	9/5/17 - 9/26/17	P	0.0333	11.2	**1.49**
PWS-15	Shallow Porewater Site 15	9/6/17 - 9/26/17	P	0.0	0.51	0.07
PWS-15	Deep Porewater Site 15	9/6/17 - 9/26/17	P	0.0001	48.1	**4.51**

Notes:
Sample Type: P = primary; FD = field duplicate
IWTU = interstitial water toxic units. Calculated using final chronic values based on narcotic effects in benthic organisms.
ΣIWTU = sum of interstitial water toxic units. Calculated using the full detection limit (DL) for non-detect values.
ΣIWTU values greater than 1 are in **BOLD**
PAHs = polycyclic aromatic hydrocarbons
PAHs calculated using SOP 427.00 – Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS
OPAHs = oxygenated polycyclic aromatic hydrocarbons
OPAHs calculated using SOP 414.00 – Determination of Oxygenated PAHs (OPAHs) (a total of 22 analytes) using GC/MS
µg/L - micrograms per liter

Table G-11b
Summary of 2017 Porewater VPH Concentrations and Comparison to SLVs
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sediment Porewater Sample ID	Sample Date	VPH						
		$C_{>5}$-C_6 Aliphatics	$C_{>6}$-C_8 Aliphatics	$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{13} Aromatics
		Concentrations in µg/L						
PDB-92617-1	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-2	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-4	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-5	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-6	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-7	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-8	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-9	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-10	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-DUP	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-11	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-92617-12	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-92617-13	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-92617-14	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-92617-15	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Portland Harbor ERA SLV		121	54	--	2.6	240	79	--*

Notes:
VPH = Volatile Petroleum Hydrocarbons using the Washington Ecology method where volatile aliphatic and aromatic hydrocarbons are collectively quantified within the ranges listed above by gas chromatography using a photo-ionization detector and flame ionization detector
Passive samplers PWS-3, PWS-4, PWS-5, PWS-6, PWS-7, PWS-8, PWS-9, PWS-10, PWS-11, PWS-14 were deployed on September 5, 2017.
Passive samplers PWS-1, PWS-2, PWS-12, PWS-13, and PWS-15 were deployed on September 6, 2017.
All passive samplers were removed on September 26, 2017.
DUP = Field duplicate sample collected from Phase 3 sampling location PWS-10
µg/L = micrograms per liter
U = The analyte was not detected above the applicable reporting or detection limit
*No Portland Harbor ERA SLV for C>12-C13 aromatics. Portland Harbor ERA SLV for C>12-C16 aromatics = 20 µg/L

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Table G-12a
Summary of 2017 Surface Water OPAH Concentrations and SWTU Calculations from Direct Measurements of 34 PAHs
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

NAPL or non-NAPL Area	Sampling Period	Exposure Area	Passive Sampler Location	Sample ID	Sample Type	Total OPAHs (µg/L)	ΣSWTU
Non-NAPL Areas	September 2017	MC	PWS-2	Surface Water Site 2	N	0.0001	0.340
		SB	PWS-3	Surface Water Site 3	N	0.0008	0.607
		SB	PWS-4	Surface Water Site 4	N	0.026	0.814
		SB	PWS-9	Surface Water Site 9	N	0.0017	**1.07**
		SB	PWS-10	Surface Water Site 10-1	N	0.0018	**1.07**
		SB	PWS-10	Surface Water Site 10-3	FD	0.438	0.989
		SB	PWS-12	Surface Water Site 12	N	0.414	**1.04**
		SB	PWS-13	Surface Water Site 13	N	0.391	**1.04**
		SB	PWS-14	Surface Water Site 14	N	0.0008	0.467

Notes:
Exposure Areas: MC = Milton Creek; SB = Scappoose Bay
Sample Type: N = normal; FD = field duplicate
SWTU = surface water toxic units. Calculated using final chronic values based on narcotic effects in benthic organisms.
ΣSWTU = sum of surface water toxic units. Calculated using the full detection limit (DL) for non-detect values.
ΣSWTU values greater than 1 are in **BOLD.**
PAHs calculated using SOP 427.00 – Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.
OPAHs = oxygenated polycyclic aromatic hydrocarbons
OPAHs calculated using SOP 414.00 – Determination of Oxygenated PAHs (OPAHs) (a total of 22 analytes) using GC/MS.
µg/L - micrograms per liter

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Table G-12b
Comparison of 2017 Surface Water PAH Concentrations to SLVs
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

						Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [2]																		
Sample ID	**Passive Sampler Location** [1]	**Exposure Area** [1]	**No. of Detected Analytes**	**Fl/Py Ratio**	**Total PAHs**	**Naphthalene**	**C-1 Naphthalenes**	**C-2 Naphthalenes**	**C-3 Naphthalenes**	**C-4 Naphthalenes**	**Acenaphthylene**	**Acenaphthene**	**Fluorene**	**C-1 Fluorenes**	**C-2 Fluorenes**	**C-3 Fluorenes**	**Phenanthrene**	**Anthracene**	**C-1 Phenanthrenes/ Anthracenes**	**C-2 Phenanthrenes/ Anthracenes**	**C-3 Phenanthrenes/ Anthracenes**	**C-4 Phenanthrenes/ Anthracenes**	**Fluoranthene**	**Pyrene**
						Concentrations in µg/L																		
Surface Water Site 2	PWS-2	MC	29	0.80	0.0518	**0.0107** B	**0.0396** B	**0.132** B	**0.46** B	**0.996** B	**0.0004**	**0.00952**	**0.00412**	**0.0109** B	**0.0359** B	**0.0321**	**0.0055**	**0.00058**	**0.00599** B	**0.0135**	**0.0191**	0.00028 U	**0.00363**	**0.00451**
Surface Water Site 3	PWS-3	SB	30	0.72	0.0192	**0.00223** B	**0.00758** B	**0.043** B	**0.454** B	**1.94** B	**0.0003**	**0.00267**	**0.00196**	**0.00726** B	**0.047** B	**0.0474**	**0.00135**	**0.00052**	**0.00483** B	**0.0207**	**0.0309**	**0.00951** B	**0.0025**	**0.00347**
Surface Water Site 4	PWS-4	SB	30	0.68	0.0260	**0.0034** B	**0.0102** B	**0.0618** B	**0.515** B	**2.62** B	**0.00029**	**0.00351**	**0.0022**	**0.00868** B	**0.0707** B	**0.08**	**0.00169**	**0.00056**	**0.00562** B	**0.0294**	**0.0424**	**0.00924** B	**0.00335**	**0.00494**
Surface Water Site 9	PWS-9	SB	32	0.80	0.0634	**0.00426** B	**0.0194** B	**0.105** B	**0.832** B	**3.25** B	**0.00085**	**0.0159**	**0.00683**	**0.0198** B	**0.112** B	**0.102**	**0.00627**	**0.00202**	**0.0126** B	**0.0466**	**0.0625**	**0.0244** B	**0.00694**	**0.00871**
Surface Water Site 10-1	PWS-10	SB	32	0.75	0.0797	**0.0108** B	**0.0318** B	**0.12** B	**0.815** B	**3.33** B	**0.00083**	**0.022**	**0.00805**	**0.0178** B	**0.0998** B	**0.0945**	**0.00671**	**0.00174**	**0.012** B	**0.0452**	**0.0576**	**0.0173** B	**0.00642**	**0.00856**
Surface Water Site 10-3	PWS-10	SB	30	0.73	0.0657	**0.00861** B	**0.0264** B	**0.106** B	**0.712** B	**3.23** B	**0.00088**	**0.0173**	**0.00683**	**0.0158** B	**0.0916** B	**0.0906**	**0.00556**	**0.00144**	**0.0102** B	**0.0388**	**0.0501**	0.00028 U	**0.00553**	**0.00758**
Surface Water Site 12	PWS-12	SB	31	0.72	0.0709	**0.00586** B	**0.0201** B	**0.0854** B	**0.586** B	**3.24** B	**0.00094**	**0.0128**	**0.00552**	**0.0114** B	**0.0887** B	**0.096**	**0.00563**	**0.00172**	**0.0111** B	**0.0455**	**0.0614**	**0.0236** B	**0.00665**	**0.00922**
Surface Water Site 13	PWS-13	SB	31	0.76	0.0793	**0.00942** B	**0.0277** B	**0.0968** B	**0.672** B	**3.03** B	**0.00138**	**0.0157**	**0.00669**	**0.0155** B	**0.092** B	**0.0916**	**0.00576**	**0.00268**	**0.0126** B	**0.053**	**0.0826**	**0.0393** B	**0.0102**	**0.0134**
Surface Water Site 14	PWS-14	SB	31	0.72	0.0327	**0.00475** B	**0.0093** B	**0.044** B	**0.38** B	**1.43** B	**0.00047**	**0.0093**	**0.00388**	**0.01** B	**0.0467** B	**0.0428**	**0.00241**	**0.00087**	**0.00456** B	**0.0175**	**0.0252**	**0.00987** B	**0.00259**	**0.00361**
Screening Level Value (SLV) [8]				--	--	620 [3]	--	--	--	--	4,840 [4]	74 [3]	3.9 [5]	--	--	--	6.3 [5]	0.09 [3]	--	--	--	--	30 [3]	0.3 [4]

Please see notes at end of table.

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Table G-12b
Comparison of 2017 Surface Water PAH Concentrations to SLVs
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

			Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [2]																
Sample ID	**Passive Sampler Location [1]**	**No. of Detected Analytes**	**Total PAHs**	**Fluoranthene**	**Pyrene**	**C-1 Fluoranthrenes/ Pyrenes**	**Benzo(a)anthracene**	**Chrysene**	**C-1 Benz(a)anth/ Chrysenes**	**C-2 Benz(a)anth/ Chrysenes**	**C-3 Benz(a)anth/ Chrysenes**	**C-4 Benz(a)anth/ Chrysenes**	**Benzo(b)fluoranthene**	**Benzo(k)fluoranthene**	**Benzo(e)pyrene**	**Benzo(a)pyrene**	**Perylene**	**Indeno(1,2,3-cd)pyrene**	**Dibenzo(a,h)anthracene**	**Benzo(g,h,i)perylene**
			Concentrations in µg/L																
Surface Water Site 2	PWS-2	29	0.0518	**0.00363**	**0.00451**	**0.00146**	**0.000162**	**0.000168**	**0.000152**	**0.00000542**	0.000000252 U	0.000000252 U	**0.0000447**	**0.00002**	**0.0000408**	**0.0000161**	**0.0000425**	0.000000089 U	0.000000358 U	**0.00000534**
Surface Water Site 3	PWS-3	30	0.0192	**0.0025**	**0.00347**	**0.00345**	**0.000118**	**0.000137**	**0.000429**	**0.0000239**	0.000000899 U	0.000000899 U	**0.0000493**	**0.0000191**	**0.0000608**	**0.0000226**	**0.000129**	0.000000081 U	0.000000326 U	**0.0000106**
Surface Water Site 4	PWS-4	30	0.0260	**0.00335**	**0.00494**	**0.00208**	**0.00018**	**0.000207**	**0.000144**	**0.00000802**	0.000000246 U	0.000000246 U	**0.0000651**	**0.0000276**	**0.0000802**	**0.0000298**	**0.00015**	0.000000086 U	0.000000348 U	**0.0000123**
Surface Water Site 9	PWS-9	32	0.0634	**0.00694**	**0.00871**	**0.00382**	**0.000307**	**0.000315**	**0.000219**	**0.00001**	0.000000185 U	0.000000185 U	**0.000111**	**0.0000363**	**0.000119**	**0.0000549**	**0.000139**	**0.000013**	**0.00000346**	**0.0000166**
Surface Water Site 10-1	PWS-10	32	0.0797	**0.00642**	**0.00856**	**0.00357**	**0.000293**	**0.000288**	**0.000192**	**0.00000827**	0.00000018 U	0.00000018 U	**0.0000928**	**0.0000394**	**0.0000965**	**0.0000478**	**0.000104**	**0.0000104**	**0.00000277**	**0.0000135**
Surface Water Site 10-3	PWS-10	30	0.0657	**0.00553**	**0.00758**	**0.00315**	**0.000225**	**0.000247**	**0.000158**	**0.00000831**	0.000000171 U	0.000000171 U	**0.0000729**	**0.0000298**	**0.0000765**	**0.0000408**	**0.000102**	**0.00000881**	0.000000229 U	**0.0000111**
Surface Water Site 12	PWS-12	31	0.0709	**0.00665**	**0.00922**	**0.00447**	**0.000353**	**0.000328**	**0.000222**	**0.0000104**	0.00000017 U	0.00000017 U	**0.000118**	**0.0000491**	**0.000116**	**0.0000664**	**0.0000969**	**0.0000116**	0.000000228 U	**0.0000156**
Surface Water Site 13	PWS-13	31	0.0793	**0.0102**	**0.0134**	**0.00689**	**0.000619**	**0.000566**	**0.000372**	**0.0000155**	0.00000019 U	0.00000019 U	**0.000208**	**0.0000908**	**0.000204**	**0.000123**	**0.000126**	**0.000017**	0.000000259 U	**0.0000232**
Surface Water Site 14	PWS-14	31	0.0327	**0.00259**	**0.00361**	**0.0012**	**0.0000801**	**0.0000956**	**0.0000734**	**0.00000412**	0.000000155 U	0.000000155 U	**0.0000337**	**0.0000129**	**0.000037**	**0.0000192**	**0.0000634**	**0.00000472**	0.000000205 U	**0.00000738**
Screening Level Value (SLV) [8]			--	30[3]	0.3[4]	--	0.027[7]	7[6]	--	--	--	--	9.07[4]	9.07[4]	--	0.014[7]	--	4.31[4]	5.0[6]	7.64[4]

Notes:

[1] The term "passive sampler" refers to the sampling hardware (surface water cages) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU SOPs to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These *in situ* passive samplers are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in surface water.

[2] SOP 427.00 = Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.

[3] LCV Fish Surface Water Screening Benchmark.

[4] EPA Region 5 ESL Surface Water Screening Benchmark.

[5] OSWER Ambient Water Quality Criteria.

[6] EPA Region 6 FW Surface Water Screening Benchmark.

[7] Tier II SCV Surface Water Screening Benchmark.

[8] SLVs based on the Oak Ridge National Laboratory Risk Assessment Information System database (ORNL, 2014).

Passive samplers PWS-3, PWS-4, PWS-5, PWS-6, PWS-7, PWS-8, PWS-9, PWS-10, PWS-11, PWS-14 were deployed on September 5, 2017.
Passive samplers PWS-1, PWS-2, PWS-12, PWS-13, and PWS-15 were deployed on September 6, 2017.
All passive samplers were removed on September 26, 2017.
Total PAHs represent sum of all 63 freely dissolved concentrations (Cfree ∑63) measured on the passive sampler's media.
Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS).
PAHs = polycyclic aromatic hydrocarbons.
µg/L = micrograms per liter.
Bold indicates analyte was detected at or above the method detection limit.
J = estimated value.
U = The analyte was not detected above the applicable reporting or detection limit.
B = Sample was background corrected.
OSU FSES = Oregon State University Food Safety and Environmental Stewardship Program.
SOP = Standard Operating Procedure.
Fl/Py = fluoranthene/pyrene.
LDPE = low density polyethylene.

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Table G-13
Summary of Groundwater TPH and PAH Concentrations and GWTUs
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	TPH			PAHs																		
				Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Gasoline-Range Hydrocarbons	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Total PAH	ΣGWTU
				Concentrations in mg/L			Concentrations in µg/L																		
MW-3A	MW-3A-20100908-N	9/8/2010	P	**374 N**	**103 N**	**28.5 N**	**740**	19.5 U	**207**	**78.0**	19.5 U	NR	19.5 U	NR	**44.6**	**68.7**	19.5 U	**565**	**601**	19.5 U	**22800**	**1340**	**323**	**26,816**	**509**
MW-3A	MW-3A	8/9/2011	P	**57.1 N**	10.1 U	NT	**560**	**10.7**	**113**	**56.8**	**14.4**	NR	**3.10**	NR	**31.3**	**45.0**	**1.14**	**422**	**417**	**3.97**	**9470**	**898**	**218**	**12,264**	**291**
MW-3A	MW-3A_022112	2/21/2012	P	**49.1 N**	**3.26 N**	NT	**661**	37.4 U	**127**	**56.2**	37.4 U	NR	37.4 U	NR	74.8 U	**41.6**	37.4 U	**332**	**431**	37.4 U	**13000 J**	**916**	**199**	**15,895**	**452**
MW-3A	MW-3A_050412	5/4/2012	P	**113 N**	15 U	NT	**972**	**19.3**	**276**	**118**	**32.4**	NR	**7.42**	NR	**72.2**	**102**	**2.96**	**820**	**799**	**9.55**	**14700**	**1990**	**490**	**20,411**	**594**
MW-3A	MW-3A_081512	8/15/2012	P	**116 N**	3.02 U	NT	**804**	37.7 U	**204**	**91**	37.7 U	NR	37.7 U	NR	75.5 U	**73.1**	37.7 U	**591**	**621**	37.7 U	**12400**	**1500**	**347**	**16,763**	**575**
MW-3B	MW-3B-20100908-N	9/8/2010	P	**1.72 N**	0.467 U	**0.789 N**	**0.974**	0.777 U	**0.898**	**0.828**	**0.284**	NR	**0.0851**	NR	**0.526**	**0.735**	0.0388 U	**2.76**	0.777 U	**0.114**	**67.2**	**2.24**	**1.84**	**79.3**	**2.81**
MW-3B	MW-3B	8/9/2011	P	0.236 U	0.472 U	NT	**0.247 J**	0.0377 UJ	**0.422 J**	**0.111 J**	**0.0473 J**	NR	0.0377 UJ	NR	**0.0819 J**	**0.0900 J**	0.0377 UJ	**0.422 J**	**0.178 J**	0.0377 UJ	**6.83 J**	**0.436 J**	**0.268 J**	**9.21**	0.495
MW-3B	MW-3B_022112	2/21/2012	P	**0.349 N**	0.377 U	NT	**0.344**	0.189 U	**0.715**	**0.242**	0.189 U	NR	0.189 U	NR	0.377 U	0.189 U	0.189 U	**1.34**	**0.273**	0.189 U	**10.5 J**	**1.37**	**0.789**	**16.3**	**1.59**
MW-3B	MW-3B_050412	5/4/2012	P	0.187 U	**0.394**	NT	**1.37**	0.187 U	**0.567**	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	NR	0.187 U	0.187 U	**1.13**	**1.09**	0.187 U	**2.99**	**2.59**	**0.766**	**11.3**	**1.82**
MW-3B	MW-3B_081512	8/15/2012	P	**0.732**	0.374 U	NT	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	NR	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	**0.515**	0.187 U	0.187 U	**1.92**	**1.39**
MW-6A	MW-6A-20100908-N	9/8/2010	P	**4.11 N**	4.67 U	**4.79 N**	**90.2**	**1.00**	**3.59**	**0.228**	**0.0621**	NR	0.0421 U	NR	0.0947 U	**0.173**	0.0421 U	**4.24**	**43.7**	0.0421 U	**46.1**	**28.9**	**2.10**	**220**	**5.91**
MW-6A	MW-6A	8/9/2011	P	**4.28 N**	2.55 U	NT	**114 J**	**1.05 J**	**6.71 J**	**0.115 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	NR	**0.116 J**	0.0400 UJ	**4.92 J**	**69.8 J**	0.0400 UJ	**194 J**	**62.3 J**	**2.65 J**	**456**	**9.74**
MW-6A	MW-6A_022112	2/21/2012	P	**7.69 N**	0.755 U	NT	**244**	3.77 U	**8.63**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	**5.18**	**106**	3.77 U	**331 J**	**72.3**	3.77 U	**786**	**41.2**
MW-6A	MW-6A_050312	5/3/2012	P	**8.3 N**	**0.723 NJ**	NT	**195**	3.74 U	**6.63**	3.74 U	3.74 U	3.74 U	3.74 U	3.74 U	NR	3.74 U	3.74 U	**4.16**	**88**	3.74 U	**305**	**53.1**	3.74 U	**671**	**38.2**
MW-6A	MW-6A_08142012	8/14/2012	P	**8.45 N**	**0.868 N**	NT	**158**	3.77 U	**7.01**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	**5.3**	**84.5**	3.77 U	**175**	**59.2**	3.77 U	**508**	**37.5**
MW-7	MW-7_050312	5/3/2012	P	0.19 U	0.381 U	NT	**0.548**	0.0381 U	**0.312**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	0.0381 U	**0.1**	0.0381 U	**1.95**	0.0381 U	0.0381 U	**3.14**	0.319
MW-10	MW-10-20100907-N	9/7/2010	P	**0.288 N**	0.476 U	0.100 U	**10.0**	**0.121**	**2.11**	**1.73**	**0.350**	NR	**0.0942**	NR	**0.683**	**1.27**	0.0377 U	**13.5**	**5.52**	**0.113**	**0.0773 J**	**4.60**	**8.96**	**49.1**	**5.90**
MW-10	MW-10	8/8/2011	P	**0.730 N**	0.467 U	NT	**66.7**	**0.375**	**2.77**	**0.308**	**0.0492**	NR	0.0374 U	NR	**0.0930**	**0.214**	0.0374 U	**5.79**	**32.7**	0.0374 U	**0.444**	**16.8**	**3.19**	**129**	**4.64**
MW-10	MW-10_022012	2/20/2012	P	**0.771 N**	0.374 U	NT	**65.7**	0.374 U	**2.88**	**0.427**	0.374 U	0.374 U	0.374 U	0.374 U	NR	0.374 U	0.374 U	**7.09**	**27**	0.374 U	**0.906 J**	**10.9**	**4.07**	**120**	**6.79**
MW-10	MW-10_050312	5/3/2012	P	**1.45 N**	0.381 U	NT	**146**	**1.06**	**4.51**	0.762 U	0.762 U	0.762 U	0.762 U	0.762 U	NR	0.762 U	0.762 U	**9.35**	**72.4**	0.762 U	1.52 U	**34.8**	**5.15**	**277**	**13.8**
MW-10	MW-10_08142012	8/14/2012	P	**1.03 N**	0.385 U	NT	**86.8**	0.755 U	**4.25**	0.755 U	0.755 U	0.755 U	0.755 U	0.755 U	NR	0.755 U	0.755 U	**9.13**	**47**	0.755 U	**2.38**	**25.3**	**5.26**	**184**	**11.6**
MW-19	MW-19	8/8/2011	P	**12.5 N**	10.1 U	NT	**128 J**	**2.95 J**	**8.51 J**	**2.07 J**	**0.447 J**	NR	**0.0906 J**	NR	**1.00 J**	**1.69 J**	0.0408 UJ	**16.0 J**	**83.1 J**	**0.119 J**	**4710 J**	**102 J**	**7.58 J**	**5,064**	**40.4**
MW-19	MW-19_022112	2/21/2012	P	**3.66 N**	0.755 U	NT	**108**	**2.21**	**8.22**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**9.55**	**71.1**	1.89 U	**864 J**	**82.3**	**4.77**	**1,158**	**28.4**
MW-19	MW-19_050412	5/4/2012	P	**7.64 N**	0.784 U	NT	**166**	7.84 U	**9.68**	7.84 U	7.84 U	7.84 U	7.84 U	7.84 U	NR	7.84 U	7.84 U	**8.69**	**96.6**	7.84 U	**2300**	**98.1**	7.84 U	**2,718**	**81.3**
MW-19	MW-19_081412	8/14/2012	P	**7.49 N**	0.377 U	NT	**175**	7.48 U	**11.5**	7.48 U	7.48 U	7.48 U	7.48 U	7.48 U	NR	7.48 U	7.48 U	**7.95**	**105**	7.48 U	**1710**	**88.6**	7.48 U	**2,135**	**75.5**
MW-25	MW-25	8/9/2011	P	**4.04 N**	0.510 U	NT	**92.5 J**	**1.38 J**	**8.09 J**	**0.417 J**	**0.112 J**	NR	0.0404 UJ	NR	**0.208 J**	**0.353 J**	0.0404 UJ	**8.52 J**	**66.4 J**	0.0404 UJ	**651 J**	**95.2 J**	**4.10 J**	**928**	**14.4**
MW-25	MW-25_022112	2/21/2012	P	**10.1 N**	1.55 U	NT	**188**	**10.3**	**13.8**	3.88 U	3.88 U	3.88 U	3.88 U	3.88 U	NR	3.88 U	3.88 U	**28.7**	**114**	3.88 U	**1220 J**	**143**	**15.5**	**1,749**	**54.4**
MW-25	MW-25_050312	5/3/2012	P	**7.91 N**	**0.907 NJ**	NT	**96.3**	7.77 U	**9.96**	**8.44**	7.77 U	7.77 U	7.77 U	7.77 U	NR	7.77 U	7.77 U	**53.7**	**61**	7.77 U	**811**	**87.8**	**31.2**	**1,191**	**81.5**
MW-25	MW-25_08142012	8/14/2012	P	**9.51**	**0.554**	NT	**79.4**	7.55 U	**7.61**	7.55 U	7.55 U	7.55 U	7.55 U	7.55 U	NR	7.55 U	7.55 U	**20.2**	**51.6**	7.55 U	**1350**	**52.9**	**11.7**	**1,607**	**71.5**
Freshwater Ecotox Aquatic Habitat Goal Levels[1]				0.640	--	0.443	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DEQ Level II SLVs[2]				--	--	--	520	--	13	0.027	0.014	--	--	--	--	--	--	6.16	3.9	--	620	6.3	--	--	--

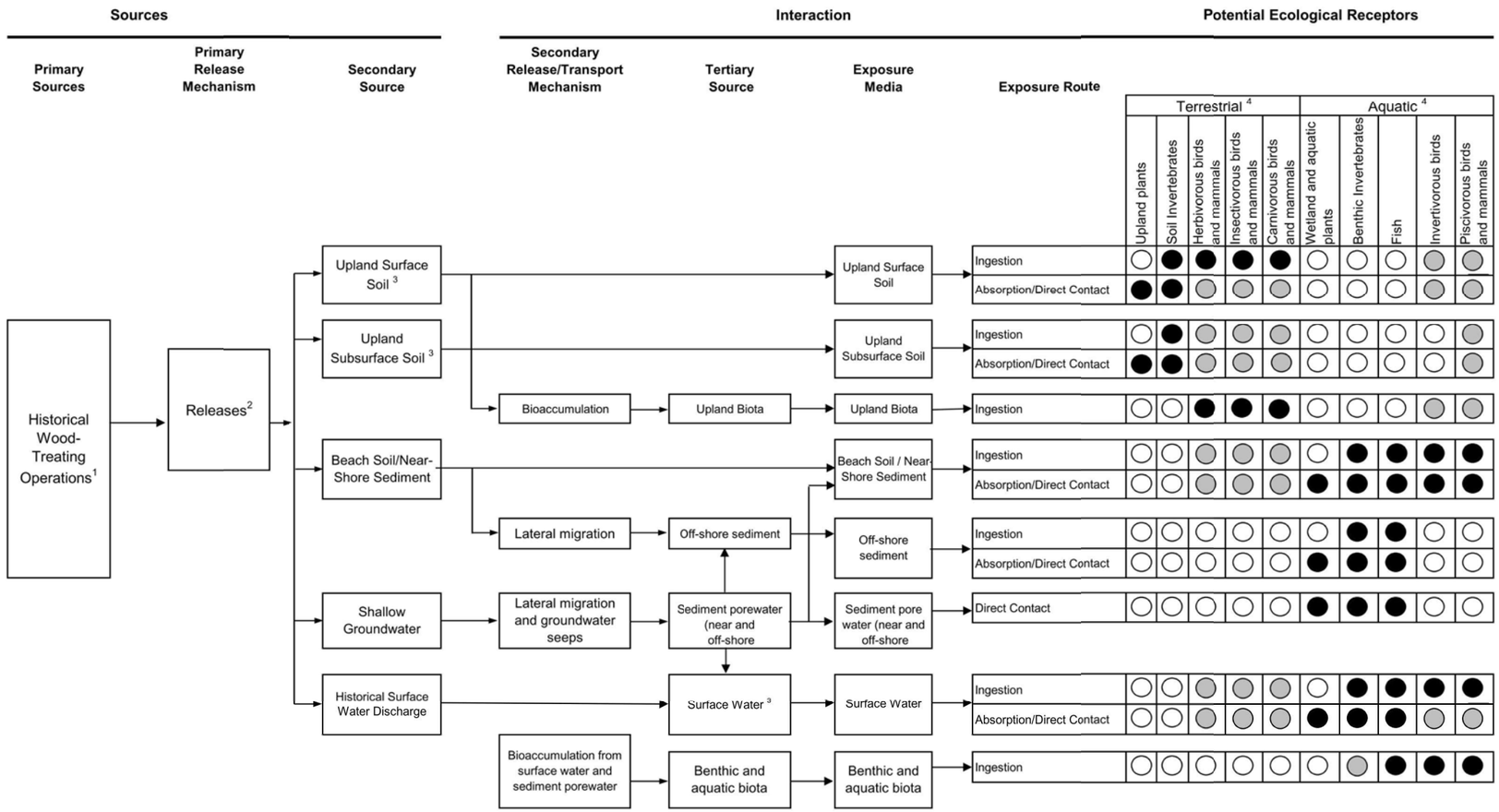
Notes:
BOLD indicates analyte was detected at or above the reporting limit.
Only nearshore monitoring well results are reported.
Data reported to reporting limit.
TPH was analyzed using methods NWTPH-Dx and NWTPH-Gx.
PAHs were analyzed using EPA Method 8270C-SIM or 8270D-SIM.
Total PAHs were calculated by summing the detected concentrations.
If an analyte was not detected, 1/2 the reporting limit was included in the sum.
[1]Freshwater Ecotox Aquatic Habitat Goal Levels from San Francisco Bay Regional Water Quality Control Board (Rev. 2, 2019).
[2]DEQ Level II Screening Level Values (SLVs) from Oregon Department of Environmental Quality (DEQ), 2007. Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment.
Shaded values indicate an exceedance of the associated screening level.
GWTU = groundwater toxic units. Calculated using final chronic values based on narcotic effects in benthic organisms.
ΣGWTU = sum of groundwater water toxic units. Calculated using half the detection limit (DL) for non-detect values.
ΣGWTU calculated using either 14 or 16 parent PAHs and may be biased low as a result.
ΣGWTU values greater than 1 are in **BOLD.**

Acronyms/Abbreviations:
µg/L = micrograms per liter
mg/L = milligrams per liter
EPA = United States Environmental Protection Agency
N = presumptively identified result
NJ = presumptively identified and estimated result
NT = not tested
P = primary sample
FD = field duplicate sample
TPH = total petroleum hydrocarbons
PAH - polycyclic aromatic hydrocarbons
U = not detected at or above the stated level
J = estimated value
-- = not analyzed or not established
NR = not reported

Cascadia Associates, LLC

FIGURES

ECOLOGICAL RISK ASSESSMENT (ERA) CONCEPTUAL SITE MODEL



Notes:

[1] The former wood-treating operations resulted in releases of contaminants of interest (mainly PAHs derived from creosote) and wastes to the historical (1919 through 1959) ground surface within Area 1.

[2] Specific releases are not documented; for the purpose of the RI, sources are defined based on knowledge of historical operations and investigation results that are indicative of creosote releases to the former ground surface (i.e., contamination near the Fill Zone/Native Soil contact). The main upland source area at the Site includes the former wood-treatment plant (i.e., retort pump house and retorts) and former creosote and fuel oil storage tanks located west of the wood treatment plant; collectively these are referred to as the "Former Operations Area" for the purposes of this report (Figure 1-2). This area generally is encompassed by the extent of DNAPL as defined through RI activities. Other ancillary operations immediately adjacent to Area 1 appear to have contributed to more localized shoreline and in-water areas of surface and/or near-surface sediment contamination, such as the historical wastewater discharge pipe, former hog fuel loading dock and hopper, and former transfer table dock.

[3] There have been no significant changes to the surface soil and subsurface soil data used in the 2006 ERA. Therefore, no revision to the ERA CSM for those exposure media has been completed.

[4] See the 2006 ERA for representative receptors.

- Complete Pathway
- Potentially Complete Pathway
- Incomplete Pathway

ECOLOGICAL RISK ASSESSMENT CONCEPTUAL SITE MODEL

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

NOVEMBER 2019

FIGURE **G-1**

DRAWN BY: BRJ/SO CHECKED BY: -

K:\11000\11200\11220\112203\dwg_SRI_Report_2019\10-2 - Ecological Risk Assessment Concept. Site Model.dwg - - - Jun 12, 2019 10:55am - brian.johnson

Observations:

- Biogenic Sheen
- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy
- NAPL
- Area of Surface Petroleum Sheen - Slight
- Area of Surface Petroleum Sheen - Moderate to Heavy
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

INSET MAP

SEE INSET

Upper Milton Creek

Lower Milton Creek

Cove Area

Area 1 Dock

Area 2 Dock

Milton Creek

Scappoose Bay

0 50 100 Feet

N

0 100 200 Feet

NOTE:
Points labelled A & B are from visible sheen observed in surface sediment in October 2010.
2018 Imagery provided by Oregon Geospatial Enterprise Office.

SURFACE SEDIMENT EXHIBITING CREOSOTE SHEEN

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE G-2

DRAWN BY: PM CHECKED BY: JKH

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LEGEND:

- E&E Sediment Sample
- E&E Seep Solids Sample
- E&E Subsurface Soil Sample
- E&E Surface Soil Sample
- E&E Surface Water Sample
- HLA Borehole
- HLA Seep Solid Sample
- HLA Surface Soil Sample
- Near-Surface Soil Sample
- Phase II Hand-Augered Boring
- Phase II Rock Core Boring
- Phase II Soil Boring
- Phase II Surface Soil Sample
- Seep Water Sample obtained by Striplin Environmental Associates
- Surface Water Level Measurement Station
- Direct-Push Boring
- Sediment Sample (2002-2005)
- Composite Sediment Sample
- Existing Monitoring Well
- Former Site Feature
- Approximate Site Boundary

MW-16, MW-17A, SS-2, GP-01, SS-1, SS-3, BH-32, MW-15, SHI01B, BH-31, SS-6, GB-9, GB-5, GB-6, BH-29A, GB-7, GP-02, SP-1, BH-29, SS-4, SW-1, SD-1, SD-117, BH-27, BH-27A, BH-33, SHI01S, SS-7, HA-1, GP-09, MW-13A, MW-13B, SE-34, SD-119, SD-120, MW-8, MW-14, GB-8, GP-03, SHI02B, SS-9, MW-11, SS-35, SB-3, SS-8, BH-30, SS-1, SS-19, BH-23, SB-2, SS-5, SD-116, BH-24, GB-2, SS-11, GB-3, GP-07, GB-4, SS-36, MW-5, BH-26, SS-12, BH-28, GP-18, SB-1, GP-06, AREA 2, AREA 1, BH-19, BH-20, BH-22, SS-10, MW-9, GP-04, MW-18, MW-4A, GP-17, BH-21, SS-20, GB-1, BH-16, SS-13, MW-12B, MW-12A, SHI03B, MW-4B, RCB-2, BH-25, SS-17, GP-08, SD-113, SS-14, GP-05, SD-115, SS-21, BH-15, GP-20, SHI04B, GP-25, BH-13, SD-114, GP-19, SS-15, SEEP-3, SS-23, BH-17, BH-14, GP-10, SS-16, BH-18, SB-4/5, GP-26, RCB-3, MW-10, SP-2, GP-16, SS-22, BH-12, GP-11, BH-08, BH-10, SHI12B, SHI05B, MW-1, GP-24, SB-7/8/9, GP-21, BH-11, SS-18, SD-2, SW-2, BH-09, BH-07, SD-111, SD-139, MW-2, SS-24, BANK-1, BH-05A, SB-6, GP-13, BH-06, MW-7, SD-138, S-2, MW-3B, BH-04, SS-1, GP-12, SD-140, GP-15, BH-01, BH-02, BH-03, BH-05, SD-135, SD-144, SD-MC-A, SP-5, SP-3, MW-3A, MW-6A|B, SS-2, SD-112, RCB-1, SHI-06B-SEEP, SHI06B, GP-23, SP-4, GP-22, SD-136, SD-141, GP-14, SEEP-2, SHI07B, SD-134, SD-4, SW-4, SD-3, SW-3, SD-137, SD-131, SD-109, SD-118, SD-124, SD-MC-B, SD-129, SD-110, SD-103, SD-105, SD-107, SD-108, SHI09B, SD-125, S-1, SD-123, SD-6, SHI08B, SD-102, SD-128, SD-132, SD-133, SHI11B, SD-101, SD-127, SD-MC-C, SD-106, SD-126, SD-130, SD-104, SD-122, SD-MC-D, SHI10B, SD-143, SD-121, SD-MC-E, SD-100

Milton Creek

Pope & Talbot Bay

NOTE:
The locations of all features shown are approximate.
Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000).
2018 Imagery provided by Oregon Geospatial Enterprise Office.
Sample locations are from various sampling events described in the following reports:
- RI Report (GeoEngineers, 2000)
- Level II ERA (Bridgewater Group, 2003)
- ERA Summary Report (Bridgewater Group & Kennedy/Jenks Consultants, 2006)
- HHRA (Kennedy/Jenks Consultants, 2006)

Please see these reports for details regarding the sampling events and data from these sampling locations.
E&E: Ecology & Environment
HLA: Hardig Lawson Associates

N

0 100 200 Feet

RI SAMPLING LOCATIONS BEFORE INITIATING THE SUPPLEMENTAL RI IN 2010

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		G-3

C:\DATA\POCC_0034_001\Projects\ECO_RA\Fig_G_3_RI_Sampling_Locations.mxd - ErikStrandhagen - 12/12/2019 - 1:45:22 PM

LEGEND:

- Existing Monitoring Well
- Direct-Push Boring
- Seep
- RI Sample Location
- Surface Water Level Measurement Station
- October 2011 Shoreline Observation:
- March 2011 Phase 1 TarGOST Boring
- July 2011 Phase 2 Sediment Boring

July/October 2012 Sampling Event:

- Sediment Porewater Sample Location
- Limited Sediment Investigation (LSI) Sample Location

October 2013 Dock Area Investigation:

- Hand Auger
- Pothole
- DAI Boring

September 2017 Sampling Event:

- Phase 3 Data Gap Investigation Location
- Former Site Feature
- Approximate Upland Site Boundary

Milton Creek

AREA 2
AREA 1

Scappoose Bay

NOTE:
2018 Imagery provided by Oregon Geospatial Enterprise Office.

N

0 75 150
Feet

SUPPLEMENTAL RI SAMPLING LOCATIONS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		G-4

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LEGEND:

- Existing Monitoring Well
- Nearshore Monitoring Well
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Subsurface DNAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Site Boundary
- Average Total PAH Concentration Isocontour (µg/L)* (darker shading indicates higher concentration)

Milton Creek

AREA 2
AREA 1

MW-5	
8/8/2011	0.493
2/21/2012	2.34
5/4/2012	3.96
8/15/2012	2.51

MW-22	
8/9/2011	9,924
2/20/2012	22,544
5/4/2012	13,682
8/15/2012	10,280

MW-9	
8/8/2011	245
2/20/2012	300
5/3/2012	233
8/14/2012	222

MW-18	
8/8/2011	0.541
2/20/2012	0.528
5/3/2012	0.460
8/14/2012	0.532

MW-4A	
8/8/2011	9.12
2/21/2012	24.3
5/4/2012	16.6
8/15/2012	15.1

MW-4B	
8/8/2011	1.73
2/21/2012	2.21
5/4/2012	0.62
8/15/2012	1.64

MW-21	
8/9/2011	289
2/21/2012	294
5/4/2012	356
8/15/2012	195

MW-23		
8/9/2011	267	
2/20/2012	334	
5/3/2012	255	
8/14/2012	265	

MW-10		
8/8/2011	129	**4.64**
2/20/2012	120	**6.79**
5/3/2012	277	**13.8**
8/14/2012	184	**11.6**

MW-20	
8/8/2011	84.2
2/21/2012	144
5/4/2012	266
8/15/2012	31.1

MW-1	
8/9/2011	438
2/20/2012	459
5/4/2012	635
8/14/2012	567

MW-24	
8/9/2011	5,745
2/21/2012	9,520
5/3/2012	4,628
8/14/2012	3,659

MW-7		
5/3/2012	3.14	0.319

MW-6A		
8/9/2011	456	**9.74**
2/21/2012	786	**41.2**
5/3/2012	671	**38.2**
8/14/2012	508	**37.5**

MW-19		
8/8/2011	5,064	**40.4**
2/21/2012	1,158	**28.4**
5/4/2012	2,718	**81.3**
8/14/2012	2,135	**75.5**

MW-2A	
8/9/2011	6,438
2/21/2012	11,401
5/3/2012	6,894
8/15/2012	6,672

MW-25		
8/9/2011	928	**14.4**
2/21/2012	1,749	**54.4**
5/3/2012	1,191	**81.5**
8/14/2012	1,607	**71.5**

MW-3B		
8/9/2011	9.21	0.495
2/21/2012	16.3	**1.59**
5/4/2012	11.3	**1.82**
8/15/2012	1.92	**1.39**

MW-3A		
8/9/2011	12,264	**291**
2/21/2012	15,895	**452**
5/4/2012	20,411	**594**
8/15/2012	16,763	**575**

MW-8, MW-11, MW-13A, MW-13B, MW-12B, MW-12A

1, 10, 100, 1,000, 10,000

N

0 75 150 Feet

*Isocontours estimated using average detected concentration at each well. Shallower interval "B" wells excluded from contouring.

Sample Date	Total PAH (µg/L)	ΣGWTU
8/9/2011	928	**14.4**
2/21/2012	1,749	**54.4**
5/3/2012	1,191	**81.5**
8/14/2012	1,607	**71.5**

NOTE:
Nearshore monitoring wells used to assess potential risk from discharge of groundwater to surface water.

Total PAHs were calculated by summing the detected concentrations. If an analyte was not detected, 1/2 the reporting limit was included in the sum.

GWTU = groundwater toxic units. Calculated using final chronic values based on narcotic effects in benthic organisms.

ΣGWTU = sum of groundwater water toxic units. Calculated using half the detection limit (DL) for non-detect values.

ΣGWTU calculated using either 14 or 16 parent PAHs and may be biased low as a result.

ΣGWTU values greater than 1 are in BOLD.

µg/L = micrograms per liter

2018 Imagery provided by Oregon Geospatial Enterprise Office.

Dioxin Source Area

DRAFT

TOTAL PAH DETECTED AND ΣGWTU IN GROUNDWATER 2011-2012

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-006

DECEMBER 2019

FIGURE G-5

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LEGEND:

- Existing Monitoring Well
- Nearshore Monitoring Well
- Former Site Feature
- Average Diesel Range Hydrocarbon Concentration Isocontour (mg/L)* (darker shading indicates higher concentration)
- Approximate Site Boundary
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps

Milton Creek

AREA 1
AREA 2

MW-4A

8/8/2011	0.236 U	0.472 U
2/21/2012	**0.287 N**	**0.391 N**
5/4/2012	**0.238 N**	**0.53**
8/15/2012	**0.191 N**	0.374 U

MW-5

8/8/2011	0.238 U	0.476 U
2/21/2012	0.187 U	0.374 U
5/4/2012	0.19 U	**0.477**
8/15/2012	0.187 U	0.374 U

MW-4B

8/8/2011	0.236 U	0.472 U
2/21/2012	0.189 U	0.377 U
5/4/2012	0.187 U	0.374 U
8/15/2012	0.196 U	0.392 U

MW-21

8/9/2011	**3.65 N**	0.467 U
2/21/2012	**1.38 N**	0.377 U
5/4/2012	**1.69 N**	0.374 U
8/15/2012	**3.03 N**	0.377 U

MW-20

8/8/2011	**0.870 N**	0.495 U
2/21/2012	**0.657 N**	0.377 U
5/4/2012	**1.18 N**	0.762 U
8/15/2012	**0.385 N**	0.377 U

MW-1

8/9/2011	**4.48 N**	0.472 U
2/20/2012	**4.56 N**	**0.519 N**
5/4/2012	**5.37 N**	0.755 U
8/14/2012	**8.49 N**	**0.503 N**

MW-2A

8/9/2011	**26.1 N**	9.90 U
2/21/2012	**76.3 N**	2.99 U
5/3/2012	**81.1 N**	**3.81 N**
8/15/2012	**89.9 N**	1.51 U

MW-19

8/8/2011	**12.5 N**	10.1 U
2/21/2012	**3.66 N**	0.755 U
5/4/2012	**7.64 N**	0.784 U
8/14/2012	**7.49 N**	0.377 U

MW-3B

8/9/2011	0.236 U	0.472 U
2/21/2012	**0.349 N**	0.377 U
5/4/2012	0.187 U	**0.394**
8/15/2012	**0.732**	0.374 U

MW-3A

8/9/2011	**57.1 N**	10.1 U
2/21/2012	**49.1 N**	**3.26 N**
5/4/2012	**113 N**	15 U
8/15/2012	**116 N**	3.02 U

MW-8

MW-11

MW-9

8/8/2011	**1.52 N**	0.467 U
2/20/2012	**2.55 N**	0.755 U
5/3/2012	**2.18 N**	0.374 U
8/14/2012	**2.34 N**	0.374 U

MW-13A **MW-13B**

MW-18

8/8/2011	0.234 U	0.467 U
2/20/2012	0.187 U	0.374 U
5/3/2012	0.187 U	0.374 U
8/14/2012	0.187 U	0.374 U

MW-12B **MW-12A**

MW-23

8/9/2011	**0.949 N**	0.472 U
2/20/2012	**1.1 N**	0.748 U
5/3/2012	**1.19 N**	**0.459 NJ**
8/14/2012	**1.15**	0.374 U

MW-22

8/9/2011	**23.8 N**	9.35 U
2/20/2012	**40.9 N**	1.51 U
5/4/2012	**44.6 N**	3.05 U
8/15/2012	**41.1 N**	1.51 U

MW-10

8/8/2011	**0.730 N**	0.467 U
2/20/2012	**0.771 N**	0.374 U
5/3/2012	**1.45 N**	0.381 U
8/14/2012	**1.03 N**	0.385 U

MW-24

8/9/2011	**11.5 N**	2.34 U
2/21/2012	**12.4 N**	1.5 U
5/3/2012	**10.8 N**	**0.673 NJ**
8/14/2012	**10.9**	**0.902**

MW-7

5/3/2012	0.19 U	0.381 U

MW-6A

8/9/2011	**4.28 N**	2.55 U
2/21/2012	**7.69 N**	0.755 U
5/3/2012	**8.3 N**	**0.723 NJ**
8/14/2012	**8.45 N**	**0.868 N**

MW-25

8/9/2011	**4.04 N**	0.510 U
2/21/2012	**10.1 N**	1.55 U
5/3/2012	**7.91 N**	**0.907 NJ**
8/14/2012	**9.51**	**0.554**

1

10

Scappoose Bay

*Isocontours estimated using average detected concentration at each well. Shallower interval "B" wells excluded from contouring.

Sample Date	Diesel-Range Hydrocarbons (mg/L)	Oil-Range Hydrocarbons (mg/L)
8/9/2011	**4.48 N**	0.472 U
2/20/2012	**4.56 N**	**0.519 N**
5/4/2012	**5.37 N**	0.755 U
8/14/2012	**8.49 N**	**0.503 N**

NOTE:
BOLD indicates analyte was detected at or above the reporting limit
Shading indicates an exceedance of the Freshwater Ecotox Habitat Goal Level (HGL) for diesel-range hydrocarbons (0.64 mg/L). HGL from San Francisco Bay Regional Water Quality Board (Rev. 2, 2019).
Nearshore monitoring wells used to assess potential risk from discharge of groundwater to surface water

mg/L = milligrams per liter
U = not detected at or above the stated level
N = Presumptively identified result
NJ = Presumptively identified and estimated result

2018 Imagery provided by
Oregon Geospatial Enterprise Office.

N

0 75 150
Feet

DRAWN BY: PM CHECKED BY: JKH

DRAFT

TOTAL PETROLEUM HYDROCARBONS DETECTED IN GROUNDWATER 2011-2012

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE G-6

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LEGEND:

- October 2012 Sediment Porewater Sample Location
- July 2012 Sediment Porewater Sample Location
- Sediment Porewater Attempted Sample Location
- October 2012 Limited Sediment Investigation (LSI) Sample Location
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Upper Milton Creek

Lower Milton Creek

Milton Creek

Area 1 Dock

Cove Area

Scappoose Bay

PWS-17	Jul 12	Oct 12
	-	-
	-	0.34
	-	-

PWS-14	Jul 12	Oct 12
	-	-
	-	-
	-	9.7

PWS-29	Jul 12	Oct 12
	-	-
	-	-
	-	27

PWS-30	Jul 12	Oct 12
	-	-
	-	-
	-	0.28

PWS-11B	Jul 12	Oct 12
	-	-
	-	-
	0.60	-

PWS-11	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.24

PWS-07	Jul 12	Oct 12
	-	-
	-	-
	0.69	1.4

LSI-07B / LSI-09	Oct 12
	-
	-
	1.8

PWS-16	Jul 12	Oct 12
	-	-
	-	-
	0.17	0.16

PWS-16B	Jul 12	Oct 12
	-	-
	-	-
	0.53	-

PWS-10	Jul 12	Oct 12
	-	-
	-	-
	0.60	0.40

PWS-12	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.11

LSI-01	Oct 12
	-
	-
	0.16

PWS-09	Jul 12	Oct 12
	-	-
	-	-
	0.42	0.23

PWS-08	Jul 12	Oct 12
	-	-
	-	-
	0.69	0.37

LSI-02	Oct 12
	-
	-
	0.21

PWS-06	Jul 12	Oct 12
	-	-
	-	-
	0.45	0.28

LSI-11	Oct 12
	-
	-
	3.9

PWS-22	Jul 12	Oct 12
	-	-
	-	-
	0.40	-
	-	-
	0.42	2.8

PWS-23	Jul 12	Oct 12
	-	-
	-	-
	0.077	0.10

PWS-02	Jul 12	Oct 12
	0.40	-
	-	-
	109	60

LSI 24	Oct 12
	-
	-
	0.21

PWS-01	Jul 12	Oct 12
	-	-
	-	-
	0.85	0.62

PWS-28	Jul 12	Oct 12
	-	-
	-	-
	-	0.29

PWS-15	Jul 12	Oct 12
	-	-
	-	-
	0.076	0.25

PWS-26	Jul 12	Oct 12
	-	-
	-	-
	0.42	0.48

PWS-25	Jul 12	Oct 12
	-	-
	-	0.35
	0.68	-

PWS-03	Jul 12	Oct 12
	-	-
	-	-
	0.74	0.77

LSI-20	Oct 12
	-
	-
	0.22

PWS-04	Jul 12	Oct 12
	-	-
	-	-
	0.54	0.47

PWS-05	Jul 12	Oct 12
	-	-
	-	-
	0.57	0.22

PWS-21

PWS-20	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.33

PWS-18	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.44

PWS-19	Jul 12	Oct 12
	-	-
	-	-
	0.33	0.31

PWS-20	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.33

0 500 1,000 Feet

0 75 150 Feet

N

SUM OF INTERSTITIAL WATER TOXIC UNITS (ΣIWTU) RESULTS

DEPTH INTERVAL (INCHES BELOW MUDLINE)	SAMPLING EVENT Jul 12	Oct 12
1" - 4"	0.76	-
4" - 8"	-	-
8" - 11"	0.76	**6.1**

BOLD = ΣIWTU > 1

NOTE:
The locations of all features shown are approximate. Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000). 2016 Imagery from live web service provided by ESRI online mapping system.

DRAFT

JULY & OCTOBER 2012 ΣIWTU RESULTS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE **G-8**

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Area 1 Dock

Upper Milton Creek

Cove Area

Milton Creek

Lower Milton Creek

Scappoose Bay

PWS-090517-7	
ΣIWTU	0.04

PWS-090517-8	
ΣIWTU	0.09

PWS-090517-9	
ΣIWTU	0.05
ΣSWTU	**1.07**

PWS-090517-10	
ΣIWTU	0.13
ΣSWTU	**1.07**

PWS-090517-11	
ΣIWTU	0.08

PWS-090617-12	
ΣIWTU	0.33
ΣSWTU	**1.04**

PWS-090617-13	
ΣIWTU	0.14
ΣSWTU	**1.04**

PWS-090617-14	
ΣIWTU	0.06
ΣSWTU	0.467

PWS-090617-15	
ΣIWTU	0.07

PWS-090517-6	
ΣIWTU	0.04

PWS-090617-2	
ΣIWTU	**16.2**
ΣSWTU	0.340

PWS-090517-1	
ΣIWTU	0.08

PWS-090517-5	
ΣIWTU	0.19

PWS-090517-4	
ΣIWTU	0.05
ΣSWTU	0.814

PWS-090517-3	
ΣIWTU	0.02
ΣSWTU	0.607

N

0 75 150

Feet

DRAWN BY: PM CHECKED BY: JKH

DRAFT

LEGEND:

- Phase 3 Data Gap Investigation Location
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Former Transfer Table Dock
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Depth in Ft.: 10, 5, 0, -5, -10

NOTES:
All values are in toxic units (TU) based on narcotic effects in benthic organisms.
ΣIWTU = Summation of Interstitial Water Toxic Units
ΣSWTU = Summation of Surface Water Toxic Units
Values in **bold** are greater than 1.
ΣIWTU calculations are for measured concentrations within the biologically active zone 3"-8" below mudline.
ΣSWTU are for water 12" above the mudline.
The ΣIWTU and ΣSWTU are based on direct measurements of 34 PAHs in sediment porewater and surface water samples.
Regarding non-detected analytes, the full detection limits were used in the ΣIWTU and ΣSWTU calculations.

SEPTEMBER 2017 ΣIWTU & ΣSWTU RESULTS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE G-9

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LEGEND:

Total PAHs including Homologues (mg/kg):

- < 1.6
- 1.7 - 10.0 (Below TEC)
- 10.1 - 50.0 (Above PEC)
- >50.1

Measured Porewater (Toxic Units):

- <1
- >1
- Surface Porewater Sample
- Area of Surface Petroleum Sheen - Slight
- Area of Surface Petroleum Sheen - Moderate to Heavy
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Milton Creek

Upper Milton Creek

Area 1 Dock

Cove Area

Lower Milton Creek

Scappoose Bay

PWS-090517-3
PWS-090517-4
PWS-090517-5
PWS-090517-6
PWS-090517-7
PWS-090517-8
PWS-090517-9
PWS-090517-10
PWS-090517-11
PWS-090517-12
PWS-090517-14
PWS-090617-1
PWS-090617-2
PWS-090617-12
PWS-090617-13
PWS-090617-15

N

0 75 150 Feet

NOTE:
TEC = Threshold Effects Concentration
PEC = Probable Effects Concentration
mg/kg = milligrams per kilogram
PAHs = Polycyclic Aromatic Hydrocarbons
Total PAHs = Sum of 64 parent and alkylated homologues in mg/kg. Non-detects are included in the sum at the laboratory reported limit.
Porewater PAH IWTUs are in surface and subsurface.
Total PAHs in bulk sediment in surface include 34 parent and alkylated PAHs.
ΣIWTU = Summation of Interstitial Water Toxic Units
ΣSWTU = Summation of Surface Water Toxic Units
2018 Imagery provided by Oregon Geospatial Enterprise Office.

2017 DATA GAP INVESTIGATION RESULTS

COLLOCATION OF TOTAL PAHs IN SEDIMENT, ΣIWTU, ΣSWTU, AND PETROLEUM SHEEN IN SURFACE SEDIMENT

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		G-10

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ATTACHMENT A

Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for 2012 Sediment Data Based on One-Carbon Partitioning Model

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes[4]
							Historical Data (1996 - 2005)														
SD-MC-A _20040601	SD-MC-A	MC	6/1/2004	N	0	4	0.0198	8.60	0.026 U	0.086	0.15	0.48	0.9	0.58	NT	0.91	0.54	NT	NT	NT	0.026 U
SD-MC-B _20040601	SD-MC-B	MC	6/1/2004	N	0	4	0.0092	0.22	0.012	0.005 U	0.005 U	0.0052	0.0095	0.0096	NT	0.014	0.0063	NT	NT	NT	0.012
SD-MC-C _20040601	SD-MC-C	MC	6/1/2004	N	0	4	0.0156	1.13	0.052	0.011	0.035	0.049	0.066	0.053	NT	0.082	0.036	NT	NT	NT	0.015
SD-MC-D _20040601	SD-MC-D	MC	6/1/2004	N	0	4	0.028	0.50	0.016	0.0055 U	0.015	0.033	0.026	0.025	NT	0.02	0.019	NT	NT	NT	0.0075
SD-MC-E _20040601	SD-MC-E	MC	6/1/2004	N	0	4	0.0285	2.98	0.041	0.037	0.27	0.15	0.31	0.3	NT	0.2	0.17	NT	NT	NT	0.02
SD-100 _20031201	SD-100	SB	12/1/2003	N	0	4	0.0217	1.06	0.013	0.0056 U	0.037	0.079	0.068	0.075	NT	0.052	0.053	NT	NT	NT	0.013
SD-101 _20031201	SD-101	SB	12/1/2003	N	0	4	0.0218	1.51	0.036	0.0067 U	0.048	0.087	0.078	0.086	NT	0.059	0.059	NT	NT	NT	0.05
SD-102 _20031201	SD-102	SB	12/1/2003	N	0	4	0.0254	1.29	0.0093	0.0078 U	0.029	0.086	0.081	0.11	NT	0.056	0.082	NT	NT	NT	0.0095
SD-103 _20031201	SD-103	SB	12/1/2003	N	0	4	0.0212	3.45	0.055	0.017	0.093	0.3	0.24	0.36	NT	0.097	0.27	NT	NT	NT	0.048
SD-103-A _20040601	SD-103-A	SB	6/1/2004	N	0	4	0.0287	12.24	0.37	0.021	0.71	0.42	0.11	0.18	NT	0.062	0.16	NT	NT	NT	0.36
SD-103-B. _20040601	SD-103-B	SB	6/1/2004	N	0	4	0.0243	1.48	0.025	0.011	0.065	0.087	0.074	0.09	NT	0.066	0.08	NT	NT	NT	0.034
SD-103-C _20040601	SD-103-C	SB	6/1/2004	N	0	4	0.0262	3.76	0.069	0.02	0.2	0.25	0.17	0.25	NT	0.096	0.2	NT	NT	NT	0.11
SD-104_20031201	SD-104	SB	12/1/2003	N	0	4	0.0176	4.48	0.092	0.017	0.21	0.25	0.17	0.23	NT	0.11	0.16	NT	NT	NT	0.14
SD-104-A _20040601	SD-104-A	SB	6/1/2004	N	0	4	0.0232	0.66	0.0075	0.0064 U	0.026	0.043	0.042	0.051	NT	0.038	0.043	NT	NT	NT	0.0093
SD-104-B _20040601	SD-104-B	SB	6/1/2004	N	0	4	0.0247	0.69	0.0087	0.0067 U	0.026	0.044	0.036	0.05	NT	0.031	0.037	NT	NT	NT	0.01
SD-104-C _20040601	SD-104-C	SB	6/1/2004	N	0	4	0.0232	0.67	0.0078	0.0066 U	0.03	0.044	0.037	0.049	NT	0.033	0.037	NT	NT	NT	0.0095
SD-105_20031201	SD-105	SB	12/1/2003	N	0	4	0.0216	2.41	0.083	0.01	0.11	0.14	0.12	0.13	NT	0.089	0.098	NT	NT	NT	0.07
SD-105-A _20040601	SD-105-A	SB	6/1/2004	N	0	4	0.0267	1.19	0.02	0.0097	0.06	0.075	0.054	0.077	NT	0.044	0.058	NT	NT	NT	0.024
SD-105-B _20040601	SD-105-B	SB	6/1/2004	N	0	4	0.026	4.08	0.93	0.022	0.29	0.052	0.036	0.05	NT	0.026	0.045	NT	NT	NT	0.02
SD-105-C _20040601	SD-105-C	SB	6/1/2004	N	0	4	0.026	0.60	0.011	0.0066 U	0.027	0.035	0.027	0.038	NT	0.022	0.031	NT	NT	NT	0.01
SD-106 _20031201	SD-106	SB	12/1/2003	N	0	4	0.021	2.17	0.027	0.0085	0.085	0.16	0.16	0.17	NT	0.099	0.13	NT	NT	NT	0.032
SD-108 _20031201	SD-108	SB	12/1/2003	N	0	4	0.0137	18.51	0.78	0.038	1.1	0.85	0.51	0.64	NT	0.24	0.45	NT	NT	NT	0.7
SD-110_20031201	SD-110	SB	12/1/2003	N	0	4	0.0175	12.43	0.56	0.029	0.52	0.75	0.56	0.73	NT	0.22	0.5	NT	NT	NT	0.22
SD-112 _20031201	SD-112	SB	12/1/2003	N	0	4	0.0103	5.10	0.15	0.017	0.23	0.27	0.26	0.31	NT	0.16	0.21	NT	NT	NT	0.11
SD-112-A _20040601	SD-112-A	SB	6/1/2004	N	0	4	0.0152	4.00	0.063	0.025	0.19	0.15	0.26	0.32	NT	0.17	0.24	NT	NT	NT	0.069
SD-112-B _20040601	SD-112-B	SB	6/1/2004	N	0	4	0.0334	12.01	0.18	0.065	0.45	0.86	0.89	1.2	NT	0.42	1	NT	NT	NT	0.19
SD-112-C _20040601	SD-112-C	SB	6/1/2004	N	0	4	0.0256	8.87	0.1	0.049	0.31	0.61	0.63	0.83	NT	0.36	0.62	NT	NT	NT	0.069
SD-113 _20031201	SD-113	SB	12/1/2003	N	0	4	0.0022	0.17	0.005 U	0.005 U	0.005 U	0.015	0.018	0.012	NT	0.012	0.012	NT	NT	NT	0.005 U
SD-114 _20031201	SD-114	SB	12/1/2003	N	0	4	0.0168	0.63	0.0063	0.0059 U	0.022	0.039	0.058	0.049	NT	0.045	0.04	NT	NT	NT	0.006
SD-115_20031201	SD-115	SB	12/1/2003	N	0	4	0.0069	0.15	0.008 U	0.007 U	0.005 U	0.009	0.012	0.011	NT	0.0091	0.0088	NT	NT	NT	0.006 U
SD-116 _20031201	SD-116	SB	12/1/2003	N	0	4	0.01	0.51	0.0053	0.0049 U	0.0079	0.031	0.059	0.039	NT	0.052	0.033	NT	NT	NT	0.0049 U
SD-117 _20031201	SD-117	SB	12/1/2003	N	0	4	0.0107	2.67	0.034	0.014	0.078	0.2	0.25	0.18	NT	0.18	0.15	NT	NT	NT	0.035
SD-117-A _20040601	SD-117-A	SB	6/1/2004	N	0	4	0.0018	0.11	0.005 U	0.005 U	0.005 U	0.0082	0.009	0.0087	NT	0.0071	0.0083	NT	NT	NT	0.005 U
SD-117-B _20040601	SD-117-B	SB	6/1/2004	N	0	4	0.003	0.16	0.0082	0.0037 U	0.0064	0.0063	0.0077	0.0091	NT	0.0071	0.006	NT	NT	NT	0.0068
SD-117-C _20040601	SD-117-C	SB	6/1/2004	N	0	4	0.0076	1.00	0.015	0.0073	0.029	0.055	0.07	0.079	NT	0.054	0.066	NT	NT	NT	0.02
SD-119_20031201	SD-119	SB	12/1/2003	N	0	4	0.011	1.40	0.017	0.0096	0.029	0.088	0.15	0.12	NT	0.11	0.099	NT	NT	NT	0.019
SD-119-A _20040601	SD-119-A	SB	6/1/2004	N	0	4	0.0169	2.38	0.27	0.0076	0.096	0.083	0.038	0.046	NT	0.021	0.035	NT	NT	NT	0.054
SD-119-B _20040601	SD-119-B	SB	6/1/2004	N	0	4	0.0207	1.95	0.089	0.017	0.064	0.084	0.079	0.066	NT	0.057	0.059	NT	NT	NT	0.094
SD-119-C _20040601	SD-119-C	SB	6/1/2004	N	0	4	0.0303	2.05	0.12	0.023	0.087	0.05	0.031	0.029	NT	0.028	0.026	NT	NT	NT	0.1
SD-120 _20031201	SD-120	SB	12/1/2003	N	0	4	0.0019	0.13	0.005 U	0.005 U	0.005 U	0.0094	0.015	0.0091	NT	0.013	0.0096	NT	NT	NT	0.005 U
SD-121 _20040601	SD-121	SB	6/1/2004	N	0	4	0.018	0.75	0.01	0.005	0.022	0.052	0.062	0.061	NT	0.041	0.05	NT	NT	NT	0.014
SD-122 _20040601	SD-122	SB	6/1/2004	N	0	4	0.0171	3.22	0.1	0.0099	0.15	0.16	0.096	0.11	NT	0.058	0.099	NT	NT	NT	0.077

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
							Historical Data (1996 - 2005)												
SD-MC-A _20040601	SD-MC-A	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.71
SD-MC-B _20040601	SD-MC-B	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0081
SD-MC-C _20040601	SD-MC-C	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.073
SD-MC-D _20040601	SD-MC-D	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.05
SD-MC-E _20040601	SD-MC-E	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.26
SD-100_20031201	SD-100	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.14
SD-101 _20031201	SD-101	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.13
SD-102 _20031201	SD-102	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.14
SD-103 _20031201	SD-103	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.59
SD-103-A _20040601	SD-103-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.46
SD-103-B. _20040601	SD-103-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.13
SD-103-C _20040601	SD-103-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.47
SD-104_20031201	SD-104	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.3
SD-104-A _20040601	SD-104-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.081
SD-104-B _20040601	SD-104-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.072
SD-104-C _20040601	SD-104-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.087
SD-105_20031201	SD-105	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.19
SD-105-A _20040601	SD-105-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.13
SD-105-B _20040601	SD-105-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.097
SD-105-C _20040601	SD-105-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.058
SD-106 _20031201	SD-106	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.28
SD-108 _20031201	SD-108	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.2
SD-110_20031201	SD-110	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.1
SD-112 _20031201	SD-112	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.42
SD-112-A _20040601	SD-112-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.38
SD-112-B _20040601	SD-112-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.5
SD-112-C _20040601	SD-112-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.91
SD-113 _20031201	SD-113	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.019
SD-114 _20031201	SD-114	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.072
SD-115_20031201	SD-115	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.013
SD-116 _20031201	SD-116	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.041
SD-117 _20031201	SD-117	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.36
SD-117-A _20040601	SD-117-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0092
SD-117-B _20040601	SD-117-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.01
SD-117-C _20040601	SD-117-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.14
SD-119_20031201	SD-119	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.14
SD-119-A _20040601	SD-119-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.099
SD-119-B _20040601	SD-119-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.12
SD-119-C _20040601	SD-119-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.068
SD-120 _20031201	SD-120	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.013
SD-121 _20040601	SD-121	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.056
SD-122 _20040601	SD-122	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.29

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
							Historical Data (1996 - 2005)									
SD-MC-A _20040601	SD-MC-A	MC	6/1/2004	N	0	4	0.05	1.2	0.056	0.7	0.026 U	NT	1.0	1.2	NT	0.026 U
SD-MC-B _20040601	SD-MC-B	MC	6/1/2004	N	0	4	0.005 U	0.02	0.011	0.012	0.051	NT	0.023	0.017	NT	0.012
SD-MC-C _20040601	SD-MC-C	MC	6/1/2004	N	0	4	0.007	0.17	0.049	0.064	0.013	NT	0.19	0.16	NT	0.015
SD-MC-D _20040601	SD-MC-D	MC	6/1/2004	N	0	4	0.0055 U	0.073	0.019	0.016	0.014	NT	0.077	0.085	NT	0.0075
SD-MC-E _20040601	SD-MC-E	MC	6/1/2004	N	0	4	0.037	0.36	0.055	0.23	0.056	NT	0.17	0.31	NT	0.02
SD-100_20031201	SD-100	SB	12/1/2003	N	0	4	0.0076	0.17	0.019	0.062	0.03	NT	0.085	0.15	NT	0.013
SD-101 _20031201	SD-101	SB	12/1/2003	N	0	4	0.0082	0.23	0.048	0.07	0.14	NT	0.18	0.2	NT	0.05
SD-102 _20031201	SD-102	SB	12/1/2003	N	0	4	0.0085	0.24	0.013	0.067	0.02	NT	0.081	0.25	NT	0.0095
SD-103 _20031201	SD-103	SB	12/1/2003	N	0	4	0.02	0.41	0.063	0.14	0.044	NT	0.28	0.42	NT	0.048
SD-103-A _20040601	SD-103-A	SB	6/1/2004	N	0	4	0.012	3.5	0.48	0.065	0.33	NT	2.9	2.1	NT	0.36
SD-103-B. _20040601	SD-103-B	SB	6/1/2004	N	0	4	0.0091	0.26	0.039	0.059	0.07	NT	0.17	0.21	NT	0.034
SD-103-C _20040601	SD-103-C	SB	6/1/2004	N	0	4	0.02	0.6	0.11	0.11	0.23	NT	0.42	0.43	NT	0.11
SD-104_20031201	SD-104	SB	12/1/2003	N	0	4	0.022	0.99	0.098	0.16	0.22	NT	0.55	0.76	NT	0.14
SD-104-A _20040601	SD-104-A	SB	6/1/2004	N	0	4	0.0064 U	0.1	0.011	0.034	0.02	NT	0.056	0.09	NT	0.0093
SD-104-B _20040601	SD-104-B	SB	6/1/2004	N	0	4	0.0067 U	0.14	0.012	0.026	0.022	NT	0.058	0.11	NT	0.01
SD-104-C _20040601	SD-104-C	SB	6/1/2004	N	0	4	0.0066 U	0.11	0.012	0.028	0.02	NT	0.058	0.099	NT	0.0095
SD-105_20031201	SD-105	SB	12/1/2003	N	0	4	0.014	0.39	0.084	0.11	0.17	NT	0.31	0.29	NT	0.07
SD-105-A _20040601	SD-105-A	SB	6/1/2004	N	0	4	0.0067 U	0.22	0.03	0.038	0.061	NT	0.12	0.17	NT	0.024
SD-105-B _20040601	SD-105-B	SB	6/1/2004	N	0	4	0.0065 U	0.38	0.74	0.025	0.041	NT	1.1	0.22	NT	0.02
SD-105-C _20040601	SD-105-C	SB	6/1/2004	N	0	4	0.0064 U	0.12	0.014	0.021	0.022	NT	0.067	0.09	NT	0.01
SD-106 _20031201	SD-106	SB	12/1/2003	N	0	4	0.016	0.33	0.037	0.13	0.067	NT	0.16	0.28	NT	0.032
SD-108 _20031201	SD-108	SB	12/1/2003	N	0	4	0.05	3.5	1.1	0.35	1.3	NT	3.3	2.4	NT	0.7
SD-110_20031201	SD-110	SB	12/1/2003	N	0	4	0.055	2.5	0.59	0.34	0.36	NT	1.7	1.7	NT	0.22
SD-112 _20031201	SD-112	SB	12/1/2003	N	0	4	0.028	0.87	0.2	0.22	0.2	NT	0.76	0.68	NT	0.11
SD-112-A _20040601	SD-112-A	SB	6/1/2004	N	0	4	0.034	0.69	0.092	0.2	0.16	NT	0.47	0.49	NT	0.069
SD-112-B _20040601	SD-112-B	SB	6/1/2004	N	0	4	0.11	2.2	0.28	0.54	0.3	NT	0.85	0.97	NT	0.19
SD-112-C _20040601	SD-112-C	SB	6/1/2004	N	0	4	0.083	1.8	0.16	0.43	0.12	NT	0.83	0.96	NT	0.069
SD-113 _20031201	SD-113	SB	12/1/2003	N	0	4	0.005 U	0.02	0.005 U	0.015	0.005 U	NT	0.005 U	0.022	NT	0.005 U
SD-114 _20031201	SD-114	SB	12/1/2003	N	0	4	0.0059 U	0.081	0.0085	0.05	0.016	NT	0.039	0.091	NT	0.006
SD-115_20031201	SD-115	SB	12/1/2003	N	0	4	0.005 U	0.023	0.01 U	0.011	0.005 U	NT	0.0086	0.024	NT	0.006 U
SD-116 _20031201	SD-116	SB	12/1/2003	N	0	4	0.0061	0.057	0.0062	0.056	0.012	NT	0.033	0.07	NT	0.0049 U
SD-117 _20031201	SD-117	SB	12/1/2003	N	0	4	0.023	0.31	0.046	0.22	0.085	NT	0.2	0.3	NT	0.035
SD-117-A _20040601	SD-117-A	SB	6/1/2004	N	0	4	0.005 U	0.018	0.005 U	0.0062	0.005 U	NT	0.005 U	0.015	NT	0.005 U
SD-117-B _20040601	SD-117-B	SB	6/1/2004	N	0	4	0.0037 U	0.019	0.0094	0.0068	0.013	NT	0.029	0.016	NT	0.0068
SD-117-C _20040601	SD-117-C	SB	6/1/2004	N	0	4	0.0076	0.12	0.021	0.051	0.065	NT	0.1	0.1	NT	0.02
SD-119_20031201	SD-119	SB	12/1/2003	N	0	4	0.013	0.15	0.022	0.12	0.049	NT	0.095	0.17	NT	0.019
SD-119-A _20040601	SD-119-A	SB	6/1/2004	N	0	4	0.0044	0.51	0.14	0.022	0.14	NT	0.46	0.35	NT	0.054
SD-119-B _20040601	SD-119-B	SB	6/1/2004	N	0	4	0.0099	0.28	0.093	0.056	0.28	NT	0.27	0.23	NT	0.094
SD-119-C _20040601	SD-119-C	SB	6/1/2004	N	0	4	0.005 U	0.34	0.15	0.022	0.27	NT	0.44	0.26	NT	0.1
SD-120 _20031201	SD-120	SB	12/1/2003	N	0	4	0.005 U	0.0089	0.005 U	0.013	0.005 U	NT	0.005 U	0.016	NT	0.005 U
SD-121 _20040601	SD-121	SB	6/1/2004	N	0	4	0.0066	0.11	0.017	0.04	0.027	NT	0.091	0.088	NT	0.014
SD-122 _20040601	SD-122	SB	6/1/2004	N	0	4	0.0099	0.71	0.15	0.059	0.12	NT	0.56	0.46	NT	0.077

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes[4]
Historical Data (1996 - 2005)																					
SD-123 _20040601	SD-123	SB	6/1/2004	N	0	4	0.0166	3.00	0.04	0.013	0.12	0.31	0.22	0.21	NT	0.11	0.23	NT	NT	NT	0.026
SD-124 _20040601	SD-124	SB	6/1/2004	N	0	4	0.012	0.56	0.0049 U	0.0049 U	0.012	0.05	0.039	0.043	NT	0.025	0.038	NT	NT	NT	0.0049 U
SD-125 _20050401	SD-125	SB	4/1/2005	N	0	4	0.024	8.26	0.36	0.033 J	0.39	0.42	0.17	0.29	NT	0.07	0.11	NT	NT	NT	0.13
SD-126_20050401	SD-126	SB	4/1/2005	N	0	4	0.0314	8.93	0.3	0.062 J	0.35	0.62	0.33	0.55	NT	0.15	0.2	NT	NT	NT	0.051 J
SD-127 _20050401	SD-127	SB	4/1/2005	N	0	4	0.0427	18.07	0.93	0.068	0.92	0.83	0.31	0.59	NT	0.13	0.18	NT	NT	NT	0.26
SD-128 _20050401	SD-128	SB	4/1/2005	N	0	4	0.0466	12.68	1.1	0.03 J	0.54	0.32	0.11	0.2	NT	0.054	0.068	NT	NT	NT	0.28
SD-130 _20050401	SD-130	SB	4/1/2005	N	0	4	0.0395	4.33	0.1	0.039 J	0.2	0.27	0.17	0.37	NT	0.11	0.11	NT	NT	NT	0.072
SD-131 _20050401	SD-131	SB	4/1/2005	N	0	4	0.0317	79.88	0.69	0.32	3.5	7	3.6	6.3	NT	1.5	2.3	NT	NT	NT	0.2 J
SD-132 _20050401	SD-132	SB	4/1/2005	N	0	4	0.0374	11.45	0.24	0.078	0.29	0.39	0.25	0.58	NT	0.16	0.2	NT	NT	NT	0.066
SD-133 _20050401	SD-133	SB	4/1/2005	N	0	4	0.0203	1.93	0.012	0.02	0.039	0.1	0.12	0.21	NT	0.086	0.073	NT	NT	NT	0.0088 J
SD-134_20050401	SD-134	SB	4/1/2005	N	0	4	0.0062	6.07	0.1	0.05	0.51	0.42	0.26	0.56	NT	0.12	0.2	NT	NT	NT	0.015 J
SD-135 _20050401	SD-135	SB	4/1/2005	N	0	4	0.0647	47.66	0.32	0.31	1.4	2.3	1.9	5.2	NT	1.3	1.5	NT	NT	NT	0.16
SD-135_DUP_20050401	SD-135	SB	4/1/2005	FD	0	4	0.0647	33.99	0.24	0.25	0.74	2.3	1.8	4.2	NT	1.1	1.4	NT	NT	NT	0.11 J
SD-136 _20050401	SD-136	SB	4/1/2005	N	0	4	0.0147	12.61	0.054	0.07	0.25	1.2	1.1	2.2	NT	0.48	0.67	NT	NT	NT	0.017 J
SD-137 _20050401	SD-137	SB	4/1/2005	N	0	4	0.0097	0.21	0.0018 U	0.0036 J	0.0059 J	0.012	0.026	0.039	NT	0.02	0.01	NT	NT	NT	0.0022 U
SD-139 _20050401	SD-139	SB	4/1/2005	N	0	4	0.0367	1.24	0.12	0.018	0.052	0.051	0.07	0.1	NT	0.052	0.035	NT	NT	NT	0.017
SD-140_20050401	SD-140	SB	4/1/2005	N	0	4	0.0117	1.17	0.0072 J	0.013	0.03	0.091	0.078	0.12	NT	0.057	0.038	NT	NT	NT	0.0039 J
SD-141_20050401	SD-141	SB	4/1/2005	N	0	4	0.0118	0.30	0.0034 J	0.0048 J	0.012	0.024	0.026	0.038	NT	0.017	0.017	NT	NT	NT	0.0023 U
SHI6D_19961101	SHID6	SB	11/1/1996	N	0	4	0.025	2.01	0.028	0.022	0.13	0.14	0.1	0.27	NT	NT	0.069	NT	NT	NT	0.019 U
SHID1_19961001	SHID1	SB	10/1/1996	N	0	4	0.039	1.96	0.02 U	0.02 U	0.025	0.13	0.23	0.29	NT	NT	0.14	NT	NT	NT	0.02 U
SHID2 _19961001	SHID2	SB	10/1/1996	N	0	4	0.004	0.18	0.019 U	0.019 U	0.019 U	0.019 U	0.019	0.019 U	NT	NT	0.019 U	NT	NT	NT	0.019 U
2011 Sediment Data																					
MCO3-0-0.3	MC03	MC	7/12/2011	N	0	4	0.0088	0.31	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ
MC04-0-0.3	MC04	MC	7/12/2011	N	0	4	0.014	0.89	0.268	0.0135 U	0.0303	0.0135 U	0.0135 U	0.0135 U	NT	0.0135 U	0.0135 U	NT	NT	NT	NT
SB01-0-0.3	SB01	SB	7/14/2011	N	0	4	0.024	0.99	0.0458 U	0.0458 U	0.0474	0.0659	0.063	NT	NT	0.063	NT	NT	NT	NT	NT
SB02-0.0.3	SB02	SB	7/14/2011	N	0	4	0.024	0.99	0.0366 U	0.0366 U	0.0492	0.0557	0.0436	NT	0.039	0.0367	NT	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ
SB03_0-0.3	SB03	SB	7/14/2011	N	0	4	0.023	0.65	0.0214 U	0.0214 U	0.0386	0.0403	0.0326	NT	NT	0.0339	NT	NT	NT	NT	NT
SB04-0-0.3	SB04	SB	7/14/2011	N	0	4	0.021	2.23	0.0577 J	0.037 U	0.134 J	0.116	0.0996	NT	NT	0.0956	NT	NT	NT	NT	NT
SB06-0-0.3	SB06	SB	7/14/2011	N	0	4	0.022	2.13	0.0398 U	0.0398 U	0.119	0.157	0.131	NT	NT	0.106	NT	NT	NT	NT	NT
SB07-0-0.3	SB07	SB	7/13/2011	N	0	4	0.015	0.14	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	NT	0.0129 U	0.0129 U	NT	NT	NT	NT
SB08-0-0.3	SB08	SB	7/13/2011	N	0	4	0.029	1.79	0.0444	0.0422 U	0.0833	0.107	0.0962	NT	0.0819	0.0728	NT	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ
SB09-0-0.3	SB09	SB	7/14/2011	N	0	4	0.028	56.12	5.4	0.196 U	1.74	0.832	0.339	NT	0.265	0.215	NT	0.98 UJ	1.88 J	1.38 J	4.37 J
SB12-0-0.3	SB12	SB	7/14/2011	N	0	4	0.026	8.89	0.414 U	0.414 U	0.429	0.588	0.414 U	NT	NT	0.414 U	NT	NT	NT	NT	NT
SB13-0-0.3	SB13	SB	7/14/2011	N	0	4	0.033	5.97	0.391	0.191 U	0.275	0.338	0.191 U	NT	NT	0.191 U	NT	NT	NT	NT	NT
SB17-0-0.3	SB17	SB	7/15/2011	N	0	4	0.027	12.05	0.586 U	0.586 U	0.586 U	0.799	0.586 U	NT	NT	0.586 U	NT	NT	NT	NT	NT
SB19-0-0.3	SB19	SB	7/15/2011	N	0	4	0.014	3.31	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	NT	0.383 U	0.383 U	NT	NT	NT	NT
SB20-0-0.3	SB20	SB	7/15/2011	N	0	4	0.021	5.69	0.291	0.165 U	0.214	0.325	0.223	NT	NT	0.177	NT	NT	NT	NT	NT
SB21-0-0.3	SB21	SB	7/15/2011	N	0	4	0.029	5.49	0.27 U	0.27 U	0.27 U	0.462	0.428	NT	NT	0.27 U	NT	NT	NT	NT	NT
SB24-0-0.3	SB24	SB	7/16/2011	N	0	4	0.044	51.98	2.79	1.73 U	1.73 U	2.18	1.73 U	NT	NT	1.73 U	NT	NT	NT	NT	NT
SB26-0-0.3	SB26	SB	7/16/2011	N	0	4	0.029	21.17	1.19	0.826 U	0.961	0.873	0.826 U	NT	NT	0.826 U	NT	NT	NT	NT	NT
SB27-0-0.3	SB27	SB	7/16/2011	N	0	4	0.027	87.33	16.2	0.758 U	3.64	1.62	0.758 U	NT	NT	0.758 U	NT	NT	NT	NT	NT
SB28-0-0.3	SB28	SB	7/16/2011	N	0	4	0.027	118.16	7.81	0.397	4.95	2.92	1.53	2.95	1.36	0.818	0.899	1.6 J	5.41 J	1.96 J	14 J

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
Historical Data (1996 - 2005)																			
SD-123 _20040601	SD-123	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.61
SD-124 _20040601	SD-124	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.076
SD-125 _20050401	SD-125	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.47
SD-126_20050401	SD-126	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.71
SD-127 _20050401	SD-127	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.94
SD-128 _20050401	SD-128	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.36
SD-130 _20050401	SD-130	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.44
SD-131 _20050401	SD-131	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	11
SD-132 _20050401	SD-132	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.8
SD-133 _20050401	SD-133	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.21
SD-134_20050401	SD-134	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.63
SD-135 _20050401	SD-135	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	5.2
SD-135_DUP_20050401	SD-135	SB	4/1/2005	FD	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	4.5
SD-136 _20050401	SD-136	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	2.3
SD-137 _20050401	SD-137	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.018
SD-139 _20050401	SD-139	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.11
SD-140_20050401	SD-140	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.13
SD-141_20050401	SD-141	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.064
SHI6D_19961101	SHID6	SB	11/1/1996	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.2
SHID1_19961001	SHID1	SB	10/1/1996	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.24
SHID2 _19961001	SHID2	SB	10/1/1996	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.019 U
2011 Sediment Data																			
MCO3-0-0.3	MC03	MC	7/12/2011	N	0	4	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.273 UJ	0.137 UJ	0.273 UJ	0.0273 U
MC04-0-0.3	MC04	MC	7/12/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0135 U
SB01-0-0.3	SB01	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0986
SB02-0.0.3	SB02	SB	7/14/2011	N	0	4	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.366 UJ	0.183 UJ	0.366 UJ	0.0669
SB03_0-0.3	SB03	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0563
SB04-0-0.3	SB04	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.16
SB06-0-0.3	SB06	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.312
SB07-0-0.3	SB07	SB	7/13/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0129 U
SB08-0-0.3	SB08	SB	7/13/2011	N	0	4	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.422 UJ	0.211 UJ	0.422 UJ	0.17
SB09-0-0.3	SB09	SB	7/14/2011	N	0	4	4.24 J	0.98 UJ	0.98 UJ	3.76 J	2.02 J	0.98 UJ	0.98 UJ	2.94 J	0.98 UJ	1.96 UJ	1.34 J	1.96 UJ	0.962
SB12-0-0.3	SB12	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.823
SB13-0-0.3	SB13	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.328
SB17-0-0.3	SB17	SB	7/15/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.14
SB19-0-0.3	SB19	SB	7/15/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.383 U
SB20-0-0.3	SB20	SB	7/15/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.497
SB21-0-0.3	SB21	SB	7/15/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.566
SB24-0-0.3	SB24	SB	7/16/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.87
SB26-0-0.3	SB26	SB	7/16/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.826 U
SB27-0-0.3	SB27	SB	7/16/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.69
SB28-0-0.3	SB28	SB	7/16/2011	N	0	4	7.76 J	0.406 J	0.724 J	7.18 J	3.37 J	0.182 UJ	0.498 J	3.43 J	1.26 J	0.364 UJ	1.31 J	0.433 J	4.8

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
Historical Data (1996 - 2005)																
SD-123 _20040601	SD-123	SB	6/1/2004	N	0	4	0.028	0.32	0.07	0.11	0.049	NT	0.29	0.24	NT	0.026
SD-124 _20040601	SD-124	SB	6/1/2004	N	0	4	0.0049 U	0.11	0.0057	0.023	0.0068	NT	0.034	0.09	NT	0.0049 U
SD-125 _20050401	SD-125	SB	4/1/2005	N	0	4	0.07	1.9	0.45	0.078	0.32	NT	1.6	1.4	NT	0.13
SD-126_20050401	SD-126	SB	4/1/2005	N	0	4	0.041 J	1.9	0.4	0.16	0.11	NT	1.4	1.6	NT	0.051 J
SD-127 _20050401	SD-127	SB	4/1/2005	N	0	4	0.039 J	3.9	1.2	0.15	0.42	NT	4.6	2.6	NT	0.26
SD-128 _20050401	SD-128	SB	4/1/2005	N	0	4	0.022 U	2.1	1.4	0.057	0.35	NT	4.2	1.5	NT	0.28
SD-130 _20050401	SD-130	SB	4/1/2005	N	0	4	0.029 J	0.87	0.13	0.12	0.15	NT	0.51	0.64	NT	0.072
SD-131 _20050401	SD-131	SB	4/1/2005	N	0	4	0.45	20	0.78	1.7	0.44	NT	5.1	15	NT	0.2 J
SD-132 _20050401	SD-132	SB	4/1/2005	N	0	4	0.041 J	3.7	0.24	0.17	0.14	NT	1.9	2.2	NT	0.066
SD-133 _20050401	SD-133	SB	4/1/2005	N	0	4	0.017	0.39	0.016	0.087	0.017	NT	0.14	0.38	NT	0.0088 J
SD-134_20050401	SD-134	SB	4/1/2005	N	0	4	0.034	1.3	0.13	0.14	0.035	NT	0.59	0.98	NT	0.015 J
SD-135 _20050401	SD-135	SB	4/1/2005	N	0	4	0.31	12	0.5	1.5	0.36	NT	5.5	7.9	NT	0.16
SD-135_DUP_20050401	SD-135	SB	4/1/2005	FD	0	4	0.27	7.1	0.33	1.3	0.25	NT	2.2	5.9	NT	0.11 J
SD-136 _20050401	SD-136	SB	4/1/2005	N	0	4	0.14	1.6	0.13	0.56	0.025	NT	0.51	1.3	NT	0.017 J
SD-137 _20050401	SD-137	SB	4/1/2005	N	0	4	0.0041 J	0.018	0.003 U	0.021	0.0033 J	NT	0.0076 J	0.02	NT	0.0022 U
SD-139 _20050401	SD-139	SB	4/1/2005	N	0	4	0.012	0.15	0.084	0.056	0.027	NT	0.15	0.14	NT	0.017
SD-140_20050401	SD-140	SB	4/1/2005	N	0	4	0.012	0.24	0.0098 J	0.054	0.0082 J	NT	0.048	0.23	NT	0.0039 J
SD-141_20050401	SD-141	SB	4/1/2005	N	0	4	0.0041 U	0.023	0.0045 J	0.018	0.0037 J	NT	0.015	0.026	NT	0.0023 U
SHI6D_19961101	SHID6	SB	11/1/1996	N	0	4	NT	0.36	0.038	0.085	0.028	NT	0.19	0.34	NT	0.019 U
SHID1_19961001	SHID1	SB	10/1/1996	N	0	4	NT	0.33	0.02 U	0.16	0.02 U	NT	0.073	0.29	NT	0.02 U
SHID2 _19961001	SHID2	SB	10/1/1996	N	0	4	NT	0.022	0.019 U	0.019 U	0.019 U	NT	0.019 U	0.026	NT	0.019 U
2011 Sediment Data																
MCO3-0-0.3	MC03	MC	7/12/2011	N	0	4	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0787	0.0273 U	0.0273 U	NT	NT
MC04-0-0.3	MC04	MC	7/12/2011	N	0	4	0.0135 U	0.0236	0.168	0.0135 U	0.0866	NT	0.235	0.0177	NT	NT
SB01-0-0.3	SB01	SB	7/14/2011	N	0	4	0.0458 U	0.141	0.0458 U	0.0581	0.0458 U	NT	0.0778	0.133	NT	NT
SB02-0.0.3	SB02	SB	7/14/2011	N	0	4	0.0366 U	0.155	0.0366 U	0.0376	0.0784	0.0404	0.0961	0.128	NT	NT
SB03_0-0.3	SB03	SB	7/14/2011	N	0	4	0.0214 U	0.119	0.0214 U	0.0329	0.0337	NT	0.0514	0.0968	NT	NT
SB04-0-0.3	SB04	SB	7/14/2011	N	0	4	0.037 U	0.432 J	0.075	0.0875	0.0837	NT	0.337 J	0.312 J	NT	NT
SB06-0-0.3	SB06	SB	7/14/2011	N	0	4	0.0398 U	0.329	0.044	0.104	0.0624	NT	0.147	0.269	NT	NT
SB07-0-0.3	SB07	SB	7/13/2011	N	0	4	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0412	NT	0.0129 U	0.0129 U	NT	NT
SB08-0-0.3	SB08	SB	7/13/2011	N	0	4	0.0422 U	0.276	0.0422 U	0.0734	0.142	0.0422 U	0.119	0.213	NT	NT
SB09-0-0.3	SB09	SB	7/14/2011	N	0	4	0.196 U	7.3	5.92	0.216	16.1	0.196 U	11.5	4.23	NT	NT
SB12-0-0.3	SB12	SB	7/14/2011	N	0	4	0.414 U	2.17	0.414 U	0.414 U	0.414 U	NT	1.23	1.58	NT	NT
SB13-0-0.3	SB13	SB	7/14/2011	N	0	4	0.191 U	1.24	0.39	0.191 U	0.191 U	NT	1.39	0.849	NT	NT
SB17-0-0.3	SB17	SB	7/15/2011	N	0	4	0.586 U	2.85	0.586 U	0.586 U	0.586 U	NT	1.23	2.11	NT	NT
SB19-0-0.3	SB19	SB	7/15/2011	N	0	4	0.383 U	0.433	0.383 U	0.383 U	0.383 U	NT	0.383 U	0.383 U	NT	NT
SB20-0-0.3	SB20	SB	7/15/2011	N	0	4	0.165 U	0.977	0.245	0.218	0.212	NT	0.758	0.722	NT	NT
SB21-0-0.3	SB21	SB	7/15/2011	N	0	4	0.27 U	0.78	0.27 U	0.285 J	0.27 U	NT	0.372	0.757	NT	NT
SB24-0-0.3	SB24	SB	7/16/2011	N	0	4	1.73 U	10.8	2.98	1.73 U	2.89	NT	14	7.54	NT	NT
SB26-0-0.3	SB26	SB	7/16/2011	N	0	4	0.826 U	3.39	1.56	0.826 U	2.92	NT	4.68	2.29	NT	NT
SB27-0-0.3	SB27	SB	7/16/2011	N	0	4	0.758 U	13.4	12.2	0.758 U	4.36	NT	23.7	7.86	NT	NT
SB28-0-0.3	SB28	SB	7/16/2011	N	0	4	0.222	17	7.74	0.968	29.6	0.395	23.3	10.5	NT	NT

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes[4]
2012 Sediment Data																					
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.018	1.18	0.00987 J	0.00805 U	0.0179	0.0698	0.102	0.135	0.0711	0.0805 U	0.0458	0.0807	0.0849	0.0805 U	0.02203
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.0063	3.57	0.755	0.0133 J	0.114	0.0895	0.0666	0.145	0.071	0.0329	0.0461	0.0674 U	0.144	0.104	0.1736
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	0.028	92.19	1.37	0.49	2.69	5.57	3.49	7.6	3.8	1.75	2.65	3.7	9	0.763	2.601
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.012	8.63	0.161	0.0514	0.277 J	0.461	0.372	0.75	0.384	0.207	0.248	0.279	0.614	0.103	0.3125
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.01	15.29	0.521	0.0769	0.559	0.668	0.472	0.944	0.507	0.252	0.284	0.39	1.02	0.176	0.715
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	0.018	26.65	0.84	0.139	0.971	1.52	1.03	1.93	1.01	0.489	0.604	0.812	2	0.276	1.087
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	0.023	89.71	3.89	0.235	3.4	2.43	0.975	2.46	1.1	0.35	0.739	1.29	5.37	1.04	7
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	0.028	39.53	1.32	0.216	1.48	1.7	1.36	2.69	1.41	0.707	0.832	1.31	2.27	0.357	2.234
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	0.021	20.71	1.05	0.0713	0.831	0.708	0.372	0.727	0.353	0.167	0.22	0.408	1.18	0.298	1.453
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.02	8.53	0.333	0.0385	0.302	0.361	0.251	0.415	0.216	0.11	0.134	0.196	0.566	0.196	0.392
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.018	4.05	0.0793 J	0.0268	0.111	0.23	0.241 J	0.405	0.222 J	0.153 J	0.144 J	0.152	0.273	0.0979 U	0.0839
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.018	2.66	0.043 J	0.0197	0.0848	0.147	0.142 J	0.244	0.129 J	0.0792 J	0.0742 J	0.105	0.197	0.0933 U	0.0677
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.027	4.64	0.0947	0.0341	0.272	0.192	0.278	0.336	0.192	0.166	0.107	0.13	0.238	0.101 U	0.2029
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.02	3.86	0.0736	0.0238	0.108	0.238	0.25	0.464	0.218	0.126	0.152 J	0.223	0.281	0.0918 U	0.1408
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.015	0.55	0.00906 J	0.00759 U	0.0126 J	0.0179	0.0205 J	0.0265	0.0168 J	0.00759 U	0.0156 J	0.0759 U	0.0759 U	0.0759 U	0.01734
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.022	8.64	0.28	0.0597	0.336	0.439	0.254	0.54	0.283	0.148 J	0.169	0.258	0.609	0.107	0.545
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	0.02	32.15	1.3	0.158	1.55	0.932	0.436	1	0.517	0.2	0.281	0.63	1.58	0.442	3.096
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.02	2.76	0.0986	0.0194	0.0762	0.221 J	0.124 J	0.229 J	0.109 J	0.0516 J	0.0652 J	0.194	0.343	0.0725 U	0.047
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.016	18.23	0.536	0.109	0.509	0.795	0.797	1.53	0.783	0.421	0.522	0.578	1.25	0.173	0.862
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.012	11.58	0.572	0.0506	0.477	0.353	0.29	0.515	0.264	0.183	0.172	0.22	0.581	0.163	0.926
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.0095	1.12	0.149	0.00891 J	0.0238	0.0263	0.0203	0.0471 J	0.0283	0.019	0.0137 J	0.0553 U	0.0553 U	0.0553 U	0.1261
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.0170	1.26	0.0104 J	0.00934 J	0.0264	0.0645	0.0646	0.095	0.058	0.0491	0.0339	0.0697	0.0954	0.0689 U	0.01317
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.0110	0.09	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.0853 U	0.0853 U	0.0853 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0019	1.14	0.034	0.00667 J	0.0478	0.0384	0.0296	0.0497 J	0.0301	0.0243	0.015 J	0.064 U	0.064 U	0.064 U	0.0761
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.0160	2.60	0.0613	0.0182	0.131	0.112	0.0946	0.21 J	0.116	0.0641	0.0699 J	0.0834	0.137	0.0805 U	0.057
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.0033	7.82	0.127	0.0373	0.19	0.436	0.318	0.649	0.319	0.144	0.216	0.327	0.6	0.0681	0.1112
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.0091	3.05	0.114	0.0345	0.0381	0.165	0.234	0.273	0.163	0.173	0.102	0.12	0.198	0.062 U	0.0447
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.0056	1.01	0.0736	0.00625 U	0.019	0.0802	0.0485	0.0757	0.0423	0.0272	0.0286	0.0625 U	0.113	0.0625 U	0.00625 U
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.0260	43.83	0.461	0.29	1.16	2.63	1.98	4.36	2.05	0.739	1.46	1.61	3.64	0.256	0.691
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.0069	17.49	0.102	0.0787	0.868	0.765	1.46	1.99 J	1.26	0.63	0.562 J	0.555	0.987	0.0643 U	0.1345
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.0120	10.31	0.283	0.0563	0.274	0.513	0.456	0.862	0.408	0.205	0.294	0.315	0.584	0.097	0.3092
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	0.0150	17.47	0.977	0.067	0.872	0.606	0.371	0.735	0.36	0.159	0.266	0.352	0.846	0.292	1.24
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.017	34.11	0.878	0.175	2.69 J	1.78	1.49	2.68	1.28	0.45	0.873	1.01	2.06	0.381	0.996
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	0.017	31.01	0.859	0.184	0.981 J	1.38	1.62	2.69 J	1.43	0.588	0.828 J	0.933	1.76	0.338	1.313
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.0150	9.11	0.261	0.0523	0.344	0.414	0.366	0.747	0.363	0.18	0.274	0.299	0.541	0.107	0.385

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
							2012 Sediment Data												
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.0805 U	0.145	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	0.084
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.172	0.0674 U	0.0674 U	0.355	0.0862	0.0674 U	0.0674 U	0.133	0.0674 U	0.135 U	0.0674 U	0.135 U	0.127
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	4.23	1.08	0.751	1.94	3.03	0.872	0.407	1.25	1.68	0.751 U	0.609	0.751 U	9.76
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.414	0.115	0.0837	0.203	0.288	0.129	0.0708 U	0.152	0.146	0.142 U	0.0857	0.142 U	0.626
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.932	0.172	0.192	0.655	0.574	0.163	0.187	0.364	0.322	0.145 U	0.204	0.145 U	1.01
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	1.38	0.334	0.224	0.995	0.915	0.227	0.132	0.582	0.474	0.158 U	0.271	1.26	2.06
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	6.08	0.502	0.96	4.53	3.36	0.333	0.429	2.32	1.28	0.656 U	1.01	4.21	3.72
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	1.87	0.455	0.0807 U	1.42	1.12	0.334	0.397	0.789	0.553	0.161 U	0.403	0.245	2.38
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	1.55	0.191	0.301	1.26	0.824	0.173	0.152	0.745	0.405	0.178 U	0.369	0.361	0.802
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.647	0.0922	0.108	0.363	0.302	0.089 U	0.089 U	0.268	0.146	0.178 U	0.117	0.231	0.409
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.164	0.11	0.0979 U	0.0979 U	0.13	0.0979 U	0.0979 U	0.0979 U	0.0979 U	0.196 U	0.0979 U	0.196 U	0.33
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.134	0.0933 U	0.0933 U	0.0933 U	0.0963	0.0933 U	0.0933 U	0.0933 U	0.0933 U	0.187 U	0.0933 U	0.187 U	0.216
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.257	0.101 U	0.101 U	0.201	0.162	0.101 U	0.101 U	0.184	0.101 U	0.201 U	0.101 U	0.201 U	0.277
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.187	0.094	0.0918 U	0.121	0.126	0.11	0.0918 U	0.1	0.133	0.184 U	0.0918 U	0.184 U	0.314
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0896	0.0759 U	0.152 U	0.0759 U	0.238	0.0248
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.462	0.101	0.102	0.327	0.309	0.113	0.0855 U	0.208	0.221	0.171 U	0.118	0.171 U	0.554
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	2.07	0.223	0.363	1.83	1.01	0.25	0.17	0.964	0.377	0.169 U	0.388	0.232	1.11
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.164	0.13	0.0725 U	0.0725 U	0.219	0.0749	0.0725 U	0.0725 U	0.255	0.145 U	0.0783	0.145 U	0.277
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.953	0.267	0.197	0.523	0.593	0.231	0.108	0.371	0.291	0.164 U	0.207	0.275	1.25
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.752	0.137	0.133	0.556	0.341	0.114	0.0819 U	0.353	0.168	0.164 U	0.158	0.406	0.502
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.0553 U	0.0553 U	0.0553 U	0.0597	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.111 U	0.0553 U	0.111 U	0.0403
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.119	0.0705	0.0689 U	0.0689 U	0.118	0.0994	0.0689 U	0.0689 U	0.0965	0.138 U	0.0689 U	0.138 U	0.0923
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.171 U	0.0853 U	0.171 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.128 U	0.064 U	0.128 U	0.0467
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.136	0.0805 U	0.0805 U	0.0805 U	0.085	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	0.165
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.421	0.139	0.0774	0.0837	0.291	0.129	0.127	0.101	0.203	0.119 U	0.0914	0.119 U	0.593
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.122	0.0664	0.062 U	0.062 U	0.139	0.062 U	0.062 U	0.062 U	0.131	0.124 U	0.062 U	0.124 U	0.211
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.125 U	0.0625 U	1.1	0.164
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	1.96	0.605	0.227	0.522	1.3	0.543	0.618	0.422	0.684	0.26	0.268	0.346	6.36
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.531	0.279	0.0643 U	0.0937	0.296	0.239	0.13	0.081	0.159	0.129 U	0.0643 U	0.129 U	2.03
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.456	0.149	0.0849	0.257	0.318	0.133	0.147	0.217	0.144	0.15 U	0.126	0.211	1.24
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	1.29	0.19	0.179	1.04	0.638	0.184	0.193	0.765	0.294	0.165 U	0.326	1.29	0.693
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	2.01	0.521	0.29	0.915	1.18	0.488	0.551	0.963	0.665	0.167	0.536	0.378	2.07
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	1.55	0.452	0.234	0.877	0.962	0.42	0.424	0.67	0.483	0.15	0.334	0.282	2.56
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.513	0.14	0.0856	0.299	0.355	0.151	0.149	0.21	0.182	0.165 U	0.138	0.616	0.615

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
							2012 Sediment Data									
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.0805 U	0.129	0.0129 J	0.0805 U	0.0665	0.0862	0.0652	0.135	0.00805 U	0.018
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.00772 J	0.433	0.55	0.0357	0.0692	0.0255	0.489	0.321	0.14	0.0336
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	0.443	18.6	1.95	1.92	5.7	0.83	6.48	14.5	0.661	1.94
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.052	1.51	0.221	0.221	0.693	0.12	0.772	1.19	0.0865	0.226
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.0684	2.77	0.571	0.302	1.54	0.153	1.87	2.01	0.216	0.499
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	0.123 J	4.44	0.921	0.506	2.2	0.345	3.14	3.29	0.302	0.785
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	0.107 J	16.9	4.15	0.406	17.3	0.244	13.6	10.7	2.11	4.89
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	0.177	5.72	1.43	0.762	5.35	0.481	4.65	4.63	0.604	1.63
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	0.0492	3.46	1.17	0.186	2.44	0.123	4.01	2.52	0.471	0.982
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.0297	1.43	0.327	0.124	1.16	0.125	1.27	1.1	0.133	0.259
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.035	0.576	0.088	0.169 J	0.17	0.168	0.28	0.536	0.0222	0.0617
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.0191	0.386	0.0664	0.088 J	0.172	0.111	0.238	0.337	0.0168 J	0.0509
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.0275	0.596	0.142	0.162	0.359	0.0946	0.496	0.612	0.0589	0.144
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.0301	0.433	0.0971	0.126	0.255	0.101	0.341	0.37	0.0378	0.103
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.00759 U	0.0976	0.00974 J	0.00778 J	0.0233	0.086	0.0736	0.0789	0.00782 J	0.00952 J
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.0855 U	1.39	0.311	0.176	0.999	0.13	0.895	1.09	0.15	0.395
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	0.0844 U	4.9	1.56	0.229	5.44	0.173	5.75	3.48	0.896	2.2
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.0182	0.292	0.0607	0.0643 J	0.122	0.0428 J	0.277	0.267	0.0137 J	0.0333
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.117 J	2.8	0.643	0.514	1.45	0.217	2.01	2.36	0.237	0.625
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.0819 U	1.6	0.756	0.191	1.35	0.121	1.98	1.24	0.253	0.673
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.00553 U	0.0825	0.0625	0.0172	0.195	0.0162	0.124	0.0568	0.0803	0.0458
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.0103 J	0.186	0.0141	0.0436	0.0228	0.0516	0.103	0.186	0.00689 U	0.00972 J
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0064 U	0.155	0.0386	0.0243	0.188	0.00931 J	0.152	0.103	0.0212	0.0549
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.0157 J	0.388	0.0711	0.069	0.116	0.0355	0.25	0.285	0.0164	0.0406
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.0445	1.47	0.0933	0.162	0.256	0.0873	0.618	1.12	0.0304	0.0808
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.024	0.328	0.0287	0.146	0.0893	0.082	0.139	0.306	0.014	0.0307
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.00626 J	0.1	0.036	0.0292	0.0152	0.0156	0.049	0.0862	0.00625 U	0.00625 U
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.289	5.64	0.629	1.03	1.26	0.43	2.47	4.3	0.208	0.483
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.191	1.34	0.156	0.793	0.339	0.47	0.711	1.15 J	0.0375	0.097
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.0604	1.22	0.277	0.233	0.634	0.124	0.882	0.855	0.0992	0.21
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	0.0534	2.38	0.969	0.184	2.05	0.0937	2.77	1.67	0.4	0.84
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.186	4.43	1.05	0.619	1.99	0.411	3.16	3.5	0.307	0.689 J
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	0.197	3.29	0.962	0.758	2.53	0.463	2.42	2.6	0.381	0.932 J
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.0554	1.12	0.32	0.209	0.593	0.0916	0.962	0.775	0.12	0.265

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes[4]
2012 Sediment Data																					
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.0180	1.64	0.0494	0.00942 U	0.0689	0.0836	0.0548	0.0932	0.0474	0.0329	0.0373	0.0942 U	0.14	0.0942 U	0.0595
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.0150	0.36	0.00804 U	0.00804 U	0.00804 U	0.0198	0.0183	0.0303 J	0.0183	0.0165	0.0105 J	0.0804 U	0.0804 U	0.0804 U	0.00804 U
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.022	7.31	0.247	0.0297	0.215	0.496	0.28	0.271	0.241	0.0856	0.107	1.5	1.96	0.674	0.1538
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.022	11.18	0.347 J	0.0537 J	0.317 J	0.599 J	0.323 J	0.429 J	0.312 J	0.16 J	0.138 J	1.77 J	2.34 J	0.638 J	0.413
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.022	ND	0.187	0.0341	0.159	0.29	0.258	0.302	0.252	0.135	0.0906	1.22	1.33	0.396	0.1955
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.0081	0.42	0.0236	0.00668 U	0.0101 J	0.0214	0.0112 J	0.0207 J	0.0107 J	0.00872 J	0.00782 J	0.0668 U	0.0668 U	0.0668 U	0.01564
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.0160	2.88	0.0817	0.0176	0.106	0.146	0.0809	0.181 J	0.0988	0.0524	0.0553 J	0.101	0.209	0.0711 U	0.1219
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.0098	15.83	0.161	0.0476	0.367	1.33	1.14	1.74	0.836	0.439	0.613	0.578	1.21	0.0922	0.2432
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.010	10.09	0.322	0.0527	0.436	0.392 J	0.399 J	0.736 J	0.357 J	0.206	0.275 J	0.271 J	0.591 J	0.146	0.49
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.014	15.26	0.326	0.0702	0.506	0.886 J	0.776 J	1.34 J	0.631 J	0.324	0.466 J	0.548 J	1.09 J	0.161	0.545
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0110	1.03	0.00603 U	0.0165	0.0106 J	0.0418	0.0853	0.088	0.0683	0.069	0.031	0.0695	0.0603 U	0.0603 U	0.01714

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
							2012 Sediment Data												
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.124	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.188 U	0.0942 U	0.188 U	0.227
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.161 U	0.0804 U	0.161 U	0.0273
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	3.79	1.84	1.41	1.66	5.68	1.41	1.74	5.33	4.6	0.557	3.79	4.37	0.885
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	4.27 J	2.06 J	1.07 J	2.19 J	5.5 J	1.66 J	1.42 J	5.59 J	5.26 J	0.547 J	3.68 J	2.93 J	1.12 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	2.66	1.51	0.73	1.50	3.59	1.06	0.95	4.14	3.70	0.537	2.64	2.18	0.45
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.134 U	0.0668 U	0.134 U	0.0215
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.192	0.0711 U	0.0711 U	0.0916	0.143	0.0934	0.0711 U	0.0814	0.0806	0.142 U	0.0711 U	0.142 U	0.197
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.399	0.197	0.0734 U	0.17	0.3	0.146	0.118	0.113	0.153	0.147 U	0.0734 U	0.299	1.64
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.612	0.132 J	0.0903	0.346	0.356 J	0.113	0.129 J	0.251	0.18	0.149 U	0.13	2.59 J	0.711 J
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.833	0.243 J	0.123	0.361	0.599 J	0.183	0.217 J	0.253	0.297	0.151 U	0.153	0.876 J	1.32 J
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0603 U	0.0682	0.0603 U	0.0603 U	0.0603 U	0.0616	0.0603 U	0.0603 U	0.0603 U	0.121 U	0.0603 U	0.121 U	0.0658

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
							2012 Sediment Data									
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.00942 U	0.203	0.0675	0.0354	0.0943	0.0208	0.179	0.149	0.0193	0.0402
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.00804 U	0.045	0.00804 U	0.017	0.0109 J	0.0113 J	0.0203	0.0421	0.00804 U	0.00804 U
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.044	0.977	0.208	0.0701	0.276	0.0965	1.24	1.01	0.0508	0.103
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.0432 J	1.63 J	0.334 J	0.127 J	0.766 J	0.123 J	1.77 J	1.6 J	0.111 J	0.302 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.0392	0.66	0.169	0.109	0.305	0.088	0.965	0.748	0.0585	0.137
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.00668 U	0.0584	0.015	0.00881 J	0.0329	0.0264	0.0405	0.048	0.00668 U	0.0123 J
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.0148	0.465	0.0989	0.0551	0.187	0.0305	0.316	0.339	0.0375	0.0844
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.14	1.56	0.268	0.516	0.473	0.274	0.667	1.11	0.0732	0.17
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.0554 J	1.22	0.435	0.221 J	0.776	0.095 J	1.09	0.854	0.154	0.336
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.0995 J	1.77	0.428	0.373 J	1	0.175 J	1.2	1.28	0.163	0.382
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0103 J	0.132	0.00635 J	0.056	0.0211	0.0287	0.0605	0.106	0.00614 J	0.011 J

Notes:

[1]All PAH concentrations in mg/kg sediment (dry weight).

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

"C-1 naphthalenes = sum of 1- and 2-methylnaphthalene. Non-detections included as 1/2 the MDL.

J = estimated value

MDL = method detection limit

mg/kg = milligrams per kilogram

ND = not determined

PAH = polycyclic aromatic hydrocarbon

U = not detected

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene		Acenaphthylene		Anthracene		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b) fluoranthene		Benzo(e)pyrene		Benzo(g,h,i)perylene		Benzo(k) fluoranthene		C-1 Benz(a)anth/ Chrysenes		C-1 Fluoranthrenes/ Pyrenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
Historical Data (1996 - 2005)																									
SD-MC-A _20040601	SD-MC-A	MC	N	0.0130	0.657	0.0860	4.34	0.150	7.58	0.480	24.2	0.900	45.5	0.580	29.3			0.910	46.0	0.540	27.3				
SD-MC-B _20040601	SD-MC-B	MC	N	0.0120	1.30	0.00250	0.272	0.00250	0.272	0.00520	0.565	0.00950	1.03	0.00960	1.04			0.0140	1.52	0.00630	0.685				
SD-MC-C _20040601	SD-MC-C	MC	N	0.0520	3.33	0.0110	0.705	0.0350	2.24	0.0490	3.14	0.0660	4.23	0.0530	3.40			0.0820	5.26	0.0360	2.31				
SD-MC-D _20040601	SD-MC-D	MC	N	0.0160	0.571	0.00275	0.0982	0.0150	0.536	0.0330	1.18	0.0260	0.929	0.0250	0.893			0.0200	0.714	0.0190	0.679				
SD-MC-E _20040601	SD-MC-E	MC	N	0.0410	1.44	0.0370	1.30	0.270	9.47	0.150	5.26	0.310	10.9	0.300	10.5			0.200	7.02	0.170	5.96				
SD-100 _20031201	SD-100	SB	N	0.0130	0.599	0.00280	0.129	0.0370	1.71	0.0790	3.64	0.0680	3.13	0.0750	3.46			0.0520	2.40	0.0530	2.44				
SD-101 _20031201	SD-101	SB	N	0.0360	1.65	0.00335	0.154	0.0480	2.20	0.0870	3.99	0.0780	3.58	0.0860	3.94			0.0590	2.71	0.0590	2.71				
SD-102 _20031201	SD-102	SB	N	0.00930	0.366	0.00390	0.154	0.0290	1.14	0.0860	3.39	0.0810	3.19	0.110	4.33			0.0560	2.20	0.0820	3.23				
SD-103 _20031201	SD-103	SB	N	0.0550	2.59	0.0170	0.802	0.0930	4.39	0.300	14.2	0.240	11.3	0.360	17.0			0.0970	4.58	0.270	12.7				
SD-103-A _20040601	SD-103-A	SB	N	0.370	12.9	0.0210	0.732	0.710	24.7	0.420	14.6	0.110	3.83	0.180	6.27			0.0620	2.16	0.160	5.57				
SD-103-B. _20040601	SD-103-B	SB	N	0.0250	1.03	0.0110	0.453	0.0650	2.67	0.0870	3.58	0.0740	3.05	0.0900	3.70			0.0660	2.72	0.0800	3.29				
SD-103-C _20040601	SD-103-C	SB	N	0.0690	2.63	0.0200	0.763	0.200	7.63	0.250	9.54	0.170	6.49	0.250	9.54			0.0960	3.66	0.200	7.63				
SD-104 _20031201	SD-104	SB	N	0.0920	5.23	0.0170	0.966	0.210	11.9	0.250	14.2	0.170	9.66	0.230	13.1			0.110	6.25	0.160	9.09				
SD-104-A _20040601	SD-104-A	SB	N	0.00750	0.323	0.00320	0.138	0.0260	1.12	0.0430	1.85	0.0420	1.81	0.0510	2.20			0.0380	1.64	0.0430	1.85				
SD-104-B _20040601	SD-104-B	SB	N	0.00870	0.352	0.00335	0.136	0.0260	1.05	0.0440	1.78	0.0360	1.46	0.0500	2.02			0.0310	1.26	0.0370	1.50				
SD-104-C _20040601	SD-104-C	SB	N	0.00780	0.336	0.00330	0.142	0.0300	1.29	0.0440	1.90	0.0370	1.59	0.0490	2.11			0.0330	1.42	0.0370	1.59				
SD-105 _20031201	SD-105	SB	N	0.0830	3.84	0.01000	0.463	0.110	5.09	0.140	6.48	0.120	5.56	0.130	6.02			0.0890	4.12	0.0980	4.54				
SD-105-A _20040601	SD-105-A	SB	N	0.0200	0.749	0.00970	0.363	0.0600	2.25	0.0750	2.81	0.0540	2.02	0.0770	2.88			0.0440	1.65	0.0580	2.17				
SD-105-B _20040601	SD-105-B	SB	N	0.930	35.8	0.0220	0.846	0.290	11.2	0.0520	2.00	0.0360	1.38	0.0500	1.92			0.0260	1.00	0.0450	1.73				
SD-105-C _20040601	SD-105-C	SB	N	0.0110	0.423	0.00330	0.127	0.0270	1.04	0.0350	1.35	0.0270	1.04	0.0380	1.46			0.0220	0.846	0.0310	1.19				
SD-106 _20031201	SD-106	SB	N	0.0270	1.29	0.00850	0.405	0.0850	4.05	0.160	7.62	0.160	7.62	0.170	8.10			0.0990	4.71	0.130	6.19				
SD-108 _20031201	SD-108	SB	N	0.780	56.9	0.0380	2.77	1.10	80.3	0.850	62.0	0.510	37.2	0.640	46.7			0.240	17.5	0.450	32.8				
SD-110 _20031201	SD-110	SB	N	0.560	32.0	0.0290	1.66	0.520	29.7	0.750	42.9	0.560	32.0	0.730	41.7			0.220	12.6	0.500	28.6				
SD-112 _20031201	SD-112	SB	N	0.150	14.6	0.0170	1.65	0.230	22.3	0.270	26.2	0.260	25.2	0.310	30.1			0.160	15.5	0.210	20.4				
SD-112-A _20040601	SD-112-A	SB	N	0.0630	4.14	0.0250	1.64	0.190	12.5	0.150	9.87	0.260	17.1	0.320	21.1			0.170	11.2	0.240	15.8				
SD-112-B _20040601	SD-112-B	SB	N	0.180	5.39	0.0650	1.95	0.450	13.5	0.860	25.7	0.890	26.6	1.20	35.9			0.420	12.6	1.00	29.9				
SD-112-C _20040601	SD-112-C	SB	N	0.100	3.91	0.0490	1.91	0.310	12.1	0.610	23.8	0.630	24.6	0.830	32.4			0.360	14.1	0.620	24.2				
SD-113 _20031201	SD-113	SB	N	0.00250	1.14	0.00250	1.14	0.00250	1.14	0.0150	6.82	0.0180	8.18	0.0120	5.45			0.0120	5.45	0.0120	5.45				
SD-114 _20031201	SD-114	SB	N	0.00630	0.375	0.00295	0.176	0.0220	1.31	0.0390	2.32	0.0580	3.45	0.0490	2.92			0.0450	2.68	0.0400	2.38				
SD-115 _20031201	SD-115	SB	N	0.00400	0.580	0.00350	0.507	0.00250	0.362	0.00900	1.30	0.0120	1.74	0.0110	1.59			0.00910	1.32	0.00880	1.28				
SD-116 _20031201	SD-116	SB	N	0.00530	0.530	0.00245	0.245	0.00790	0.790	0.0310	3.10	0.0590	5.90	0.0390	3.90			0.0520	5.20	0.0330	3.30				
SD-117 _20031201	SD-117	SB	N	0.0340	3.18	0.0140	1.31	0.0780	7.29	0.200	18.7	0.250	23.4	0.180	16.8			0.180	16.8	0.150	14.0				
SD-117-A _20040601	SD-117-A	SB	N	0.00250	1.39	0.00250	1.39	0.00250	1.39	0.00820	4.56	0.00900	5.00	0.00870	4.83			0.00710	3.94	0.00830	4.61				
SD-117-B _20040601	SD-117-B	SB	N	0.00820	2.73	0.00185	0.617	0.00640	2.13	0.00630	2.10	0.00770	2.57	0.00910	3.03			0.00710	2.37	0.00600	2.00				
SD-117-C _20040601	SD-117-C	SB	N	0.0150	1.97	0.00730	0.961	0.0290	3.82	0.0550	7.24	0.0700	9.21	0.0790	10.4			0.0540	7.11	0.0660	8.68				
SD-119 _20031201	SD-119	SB	N	0.0170	1.55	0.00960	0.873	0.0290	2.64	0.0880	8.00	0.150	13.6	0.120	10.9			0.110	10.0	0.0990	9.00				
SD-119-A _20040601	SD-119-A	SB	N	0.270	16.0	0.00760	0.450	0.0960	5.68	0.0830	4.91	0.0380	2.25	0.0460	2.72			0.0210	1.24	0.0350	2.07				
SD-119-B _20040601	SD-119-B	SB	N	0.0890	4.30	0.0170	0.821	0.0640	3.09	0.0840	4.06	0.0790	3.82	0.0660	3.19			0.0570	2.75	0.0590	2.85				
SD-119-C _20040601	SD-119-C	SB	N	0.120	3.96	0.0230	0.759	0.0870	2.87	0.0500	1.65	0.0310	1.02	0.0290	0.957			0.0280	0.924	0.0260	0.858				
SD-120 _20031201	SD-120	SB	N	0.00250	1.32	0.00250	1.32	0.00250	1.32	0.00940	4.95	0.0150	7.89	0.00910	4.79			0.0130	6.84	0.00960	5.05				
SD-121 _20040601	SD-121	SB	N	0.01000	0.556	0.00500	0.278	0.0220	1.22	0.0520	2.89	0.0620	3.44	0.0610	3.39			0.0410	2.28	0.0500	2.78				
SD-122 _20040601	SD-122	SB	N	0.100	5.85	0.00990	0.579	0.150	8.77	0.160	9.36	0.0960	5.61	0.110	6.43			0.0580	3.39	0.0990	5.79				
SD-123 _20040601	SD-123	SB	N	0.0400	2.41	0.0130	0.783	0.120	7.23	0.310	18.7	0.220	13.3	0.210	12.7			0.110	6.63	0.230	13.9				
SD-124 _20040601	SD-124	SB	N	0.00245	0.204	0.00245	0.204	0.0120	1.00	0.0500	4.17	0.0390	3.25	0.0430	3.58			0.0250	2.08	0.0380	3.17				
SD-125 _20050401	SD-125	SB	N	0.360	15.0	0.0330	1.38	0.390	16.3	0.420	17.5	0.170	7.08	0.290	12.1			0.0700	2.92	0.110	4.58				
SD-126 _20050401	SD-126	SB	N	0.300	9.55	0.0620	1.97	0.350	11.1	0.620	19.7	0.330	10.5	0.550	17.5			0.150	4.78	0.200	6.37				
SD-127 _20050401	SD-127	SB	N	0.930	21.8	0.0680	1.59	0.920	21.5	0.830	19.4	0.310	7.26	0.590	13.8			0.130	3.04	0.180	4.22				
SD-128 _20050401	SD-128	SB	N	1.10	23.6	0.0300	0.644	0.540	11.6	0.320	6.87	0.110	2.36	0.200	4.29			0.0540	1.16	0.0680	1.46				
SD-130 _20050401	SD-130	SB	N	0.100	2.53	0.0390	0.987	0.200	5.06	0.270	6.84	0.170	4.30	0.370	9.37			0.110	2.78	0.110	2.78				
SD-131 _20050401	SD-131	SB	N	0.690	21.8	0.320	10.1	3.50	110	7.00	221	3.60	114	6.30	199			1.50	47.3	2.30	72.6				
SD-132 _20050401	SD-132	SB	N	0.240	6.42	0.0780	2.09	0.290	7.75	0.390	10.4	0.250	6.68	0.580	15.5			0.160	4.28	0.200	5.35				
SD-133 _20050401	SD-133	SB	N	0.0120	0.591	0.0200	0.985	0.0390	1.92	0.100	4.93	0.120	5.91	0.210	10.3			0.0860	4.24	0.0730	3.60				
SD-134 _20050401	SD-134	SB	N	0.100	16.1	0.0500	8.06	0.510	82.3	0.420	67.7	0.260	41.9	0.560	90.3			0.120	19.4	0.200	32.3				
SD-135 _20050401	SD-135	SB	N	0.320	4.95	0.310	4.79	1.40	21.6	2.30	35.5	1.90	29.4	5.20	80.4			1.30	20.1	1.50	23.2				
SD-135_DUP_20050401	SD-135	SB	FD	0.240	3.71	0.250	3.86	0.740	11.4	2.30	35.5	1.80	27.8	4.20	64.9			1.10	17.0	1.40	21.6				
SD-136 _20050401	SD-136	SB	N	0.0540	3.67	0.0700	4.76	0.250	17.0	1.20	81.6	1.10	74.8	2.20	150			0.480	32.7	0.670	45.6				
SD-137 _20050401	SD-137	SB	N	9.00E-04	0.0928	0.00360	0.371	0.00590	0.608	0.0120	1.24	0.0260	2.68	0.0390	4.02			0.0200	2.06	0.01000	1.03				
SD-139 _20050401	SD-139	SB	N	0.120	3.27	0.0180	0.490	0.0520	1.42	0.0510	1.39	0.0700	1.91	0.100	2.72			0.0520	1.42	0.0350	0.954				
SD-140 _20050401	SD-140	SB	N	0.00720	0.615	0.0130	1.11	0.0300	2.56	0.0910	7.78	0.0780	6.67	0.120	10.3			0.0570	4.87	0.0380	3.25				
SD-141 _20050401	SD-141	SB	N	0.00340	0.288	0.00480	0.407	0.0120	1.02	0.0240	2.03	0.0260	2.20	0.0380	3.22			0.0170	1.44	0.0170	1.44				
SHI6D_19961101	SHID6	SB	N	0.0280	1.12	0.0220	0.880	0.130	5.20	0.140	5.60	0.100	4.00	0.270	10.8					0.0690	2.76				
SHID1_19961001	SHID1	SB	N	0.01000	0.256	0.01000	0.256	0.0250	0.641	0.130	3.33	0.230	5.90	0.290	7.44					0.140	3.59				
SHID2 _19961001	SHID2	SB	N	0.00950	2.38	0.00950	2.38	0.00950	2.38	0.00950	2.38	0.0190	4.75	0.00950	2.38					0.00950	2.38				

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-1 Fluorenes		C-1 Naphthalenes		C-1 Phenanthrenes/ Anthracenes		C-2 Benz(a)anth/ Chrysenes		C-2 Fluorenes		C-2 Naphthalenes		C-2 Phenanthrenes/ Anthracenes		C-3 Benz(a)anth/ Chrysenes		C-3 Fluorenes		C-3 Naphthalenes		C-3 Phenanthrenes/ Anthracenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
Historical Data (1996 - 2005)																									
SD-MC-A _20040601	SD-MC-A	MC	N			0.0130	0.657																		
SD-MC-B _20040601	SD-MC-B	MC	N			0.0120	1.30																		
SD-MC-C _20040601	SD-MC-C	MC	N			0.0150	0.962																		
SD-MC-D _20040601	SD-MC-D	MC	N			0.00750	0.268																		
SD-MC-E _20040601	SD-MC-E	MC	N			0.0200	0.702																		
SD-100_20031201	SD-100	SB	N			0.0130	0.599																		
SD-101 _20031201	SD-101	SB	N			0.0500	2.29																		
SD-102 _20031201	SD-102	SB	N			0.00950	0.374																		
SD-103 _20031201	SD-103	SB	N			0.0480	2.26																		
SD-103-A _20040601	SD-103-A	SB	N			0.360	12.5																		
SD-103-B. _20040601	SD-103-B	SB	N			0.0340	1.40																		
SD-103-C _20040601	SD-103-C	SB	N			0.110	4.20																		
SD-104_20031201	SD-104	SB	N			0.140	7.95																		
SD-104-A _20040601	SD-104-A	SB	N			0.00930	0.401																		
SD-104-B _20040601	SD-104-B	SB	N			0.01000	0.405																		
SD-104-C _20040601	SD-104-C	SB	N			0.00950	0.409																		
SD-105_20031201	SD-105	SB	N			0.0700	3.24																		
SD-105-A _20040601	SD-105-A	SB	N			0.0240	0.899																		
SD-105-B _20040601	SD-105-B	SB	N			0.0200	0.769																		
SD-105-C _20040601	SD-105-C	SB	N			0.01000	0.385																		
SD-106 _20031201	SD-106	SB	N			0.0320	1.52																		
SD-108 _20031201	SD-108	SB	N			0.700	51.1																		
SD-110_20031201	SD-110	SB	N			0.220	12.6																		
SD-112 _20031201	SD-112	SB	N			0.110	10.7																		
SD-112-A _20040601	SD-112-A	SB	N			0.0690	4.54																		
SD-112-B _20040601	SD-112-B	SB	N			0.190	5.69																		
SD-112-C _20040601	SD-112-C	SB	N			0.0690	2.70																		
SD-113 _20031201	SD-113	SB	N			0.00250	1.14																		
SD-114 _20031201	SD-114	SB	N			0.00600	0.357																		
SD-115_20031201	SD-115	SB	N			0.00300	0.435																		
SD-116 _20031201	SD-116	SB	N			0.00245	0.245																		
SD-117 _20031201	SD-117	SB	N			0.0350	3.27																		
SD-117-A _20040601	SD-117-A	SB	N			0.00250	1.39																		
SD-117-B _20040601	SD-117-B	SB	N			0.00680	2.27																		
SD-117-C _20040601	SD-117-C	SB	N			0.0200	2.63																		
SD-119_20031201	SD-119	SB	N			0.0190	1.73																		
SD-119-A _20040601	SD-119-A	SB	N			0.0540	3.20																		
SD-119-B _20040601	SD-119-B	SB	N			0.0940	4.54																		
SD-119-C _20040601	SD-119-C	SB	N			0.100	3.30																		
SD-120 _20031201	SD-120	SB	N			0.00250	1.32																		
SD-121 _20040601	SD-121	SB	N			0.0140	0.778																		
SD-122 _20040601	SD-122	SB	N			0.0770	4.50																		
SD-123 _20040601	SD-123	SB	N			0.0260	1.57																		
SD-124 _20040601	SD-124	SB	N			0.00245	0.204																		
SD-125 _20050401	SD-125	SB	N			0.130	5.42																		
SD-126_20050401	SD-126	SB	N			0.0510	1.62																		
SD-127 _20050401	SD-127	SB	N			0.260	6.09																		
SD-128 _20050401	SD-128	SB	N			0.280	6.01																		
SD-130 _20050401	SD-130	SB	N			0.0720	1.82																		
SD-131 _20050401	SD-131	SB	N			0.200	6.31																		
SD-132 _20050401	SD-132	SB	N			0.0660	1.76																		
SD-133 _20050401	SD-133	SB	N			0.00880	0.433																		
SD-134_20050401	SD-134	SB	N			0.0150	2.42																		
SD-135 _20050401	SD-135	SB	N			0.160	2.47																		
SD-135_DUP_20050401	SD-135	SB	FD			0.110	1.70																		
SD-136 _20050401	SD-136	SB	N			0.0170	1.16																		
SD-137 _20050401	SD-137	SB	N			0.00110	0.113																		
SD-139 _20050401	SD-139	SB	N			0.0170	0.463																		
SD-140_20050401	SD-140	SB	N			0.00390	0.333																		
SD-141_20050401	SD-141	SB	N			0.00115	0.0975																		
SHI6D_19961101	SHID6	SB	N			0.00950	0.380																		
SHID1_19961001	SHID1	SB	N			0.01000	0.256																		
SHID2 _19961001	SHID2	SB	N			0.00950	2.38																		

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-4 Benz(a)anth/ Chrysenes		C-4 Naphthalenes		C-4 Phenanthrenes/ Anthracenes		Chrysene		Dibenzo(a,h) anthracene		Fluoranthene		Fluorene		Indeno(1,2,3-cd) pyrene		Naphthalene		Perylene		Phenanthrene		Pyrene	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
Historical Data (1996 - 2005)																											
SD-MC-A _20040601	SD-MC-A	MC	N							0.710	35.9	0.0500	2.53	1.20	60.6	0.0560	2.83	0.700	35.4	0.0130	0.657			1.00	50.5	1.20	60.6
SD-MC-B _20040601	SD-MC-B	MC	N							0.00810	0.880	0.00250	0.272	0.0200	2.17	0.0110	1.20	0.0120	1.30	0.0510	5.54			0.0230	2.50	0.0170	1.85
SD-MC-C _20040601	SD-MC-C	MC	N							0.0730	4.68	0.00700	0.449	0.170	10.9	0.0490	3.14	0.0640	4.10	0.0130	0.833			0.190	12.2	0.160	10.3
SD-MC-D _20040601	SD-MC-D	MC	N							0.0500	1.79	0.00275	0.0982	0.0730	2.61	0.0190	0.679	0.0160	0.571	0.0140	0.500			0.0770	2.75	0.0850	3.04
SD-MC-E _20040601	SD-MC-E	MC	N							0.260	9.12	0.0370	1.30	0.360	12.6	0.0550	1.93	0.230	8.07	0.0560	1.96			0.170	5.96	0.310	10.9
SD-100_20031201	SD-100	SB	N							0.140	6.45	0.00760	0.350	0.170	7.83	0.0190	0.876	0.0620	2.86	0.0300	1.38			0.0850	3.92	0.150	6.91
SD-101 _20031201	SD-101	SB	N							0.130	5.96	0.00820	0.376	0.230	10.6	0.0480	2.20	0.0700	3.21	0.140	6.42			0.180	8.26	0.200	9.17
SD-102 _20031201	SD-102	SB	N							0.140	5.51	0.00850	0.335	0.240	9.45	0.0130	0.512	0.0670	2.64	0.0200	0.787			0.0810	3.19	0.250	9.84
SD-103 _20031201	SD-103	SB	N							0.590	27.8	0.0200	0.943	0.410	19.3	0.0630	2.97	0.140	6.60	0.0440	2.08			0.280	13.2	0.420	19.8
SD-103-A _20040601	SD-103-A	SB	N							0.460	16.0	0.0120	0.418	3.50	122	0.480	16.7	0.0650	2.26	0.330	11.5			2.90	101	2.10	73.2
SD-103-B. _20040601	SD-103-B	SB	N							0.130	5.35	0.00910	0.374	0.260	10.7	0.0390	1.60	0.0590	2.43	0.0700	2.88			0.170	7.00	0.210	8.64
SD-103-C _20040601	SD-103-C	SB	N							0.470	17.9	0.0200	0.763	0.600	22.9	0.110	4.20	0.110	4.20	0.230	8.78			0.420	16.0	0.430	16.4
SD-104_20031201	SD-104	SB	N							0.300	17.0	0.0220	1.25	0.990	56.3	0.0980	5.57	0.160	9.09	0.220	12.5			0.550	31.3	0.760	43.2
SD-104-A _20040601	SD-104-A	SB	N							0.0810	3.49	0.00320	0.138	0.100	4.31	0.0110	0.474	0.0340	1.47	0.0200	0.862			0.0560	2.41	0.0900	3.88
SD-104-B _20040601	SD-104-B	SB	N							0.0720	2.91	0.00335	0.136	0.140	5.67	0.0120	0.486	0.0260	1.05	0.0220	0.891			0.0580	2.35	0.110	4.45
SD-104-C _20040601	SD-104-C	SB	N							0.0870	3.75	0.00330	0.142	0.110	4.74	0.0120	0.517	0.0280	1.21	0.0200	0.862			0.0580	2.50	0.0990	4.27
SD-105_20031201	SD-105	SB	N							0.190	8.80	0.0140	0.648	0.390	18.1	0.0840	3.89	0.110	5.09	0.170	7.87			0.310	14.4	0.290	13.4
SD-105-A _20040601	SD-105-A	SB	N							0.130	4.87	0.00335	0.125	0.220	8.24	0.0300	1.12	0.0380	1.42	0.0610	2.28			0.120	4.49	0.170	6.37
SD-105-B _20040601	SD-105-B	SB	N							0.0970	3.73	0.00325	0.125	0.380	14.6	0.740	28.5	0.0250	0.962	0.0410	1.58			1.10	42.3	0.220	8.46
SD-105-C _20040601	SD-105-C	SB	N							0.0580	2.23	0.00320	0.123	0.120	4.62	0.0140	0.538	0.0210	0.808	0.0220	0.846			0.0670	2.58	0.0900	3.46
SD-106 _20031201	SD-106	SB	N							0.280	13.3	0.0160	0.762	0.330	15.7	0.0370	1.76	0.130	6.19	0.0670	3.19			0.160	7.62	0.280	13.3
SD-108 _20031201	SD-108	SB	N							1.20	87.6	0.0500	3.65	3.50	255	1.10	80.3	0.350	25.5	1.30	94.9			3.30	241	2.40	175
SD-110_20031201	SD-110	SB	N							1.10	62.9	0.0550	3.14	2.50	143	0.590	33.7	0.340	19.4	0.360	20.6			1.70	97.1	1.70	97.1
SD-112 _20031201	SD-112	SB	N							0.420	40.8	0.0280	2.72	0.870	84.5	0.200	19.4	0.220	21.4	0.200	19.4			0.760	73.8	0.680	66.0
SD-112-A _20040601	SD-112-A	SB	N							0.380	25.0	0.0340	2.24	0.690	45.4	0.0920	6.05	0.200	13.2	0.160	10.5			0.470	30.9	0.490	32.2
SD-112-B _20040601	SD-112-B	SB	N							1.50	44.9	0.110	3.29	2.20	65.9	0.280	8.38	0.540	16.2	0.300	8.98			0.850	25.4	0.970	29.0
SD-112-C _20040601	SD-112-C	SB	N							0.910	35.5	0.0830	3.24	1.80	70.3	0.160	6.25	0.430	16.8	0.120	4.69			0.830	32.4	0.960	37.5
SD-113 _20031201	SD-113	SB	N							0.0190	8.64	0.00250	1.14	0.0200	9.09	0.00250	1.14	0.0150	6.82	0.00250	1.14			0.00250	1.14	0.0220	10.0
SD-114 _20031201	SD-114	SB	N							0.0720	4.29	0.00295	0.176	0.0810	4.82	0.00850	0.506	0.0500	2.98	0.0160	0.952			0.0390	2.32	0.0910	5.42
SD-115_20031201	SD-115	SB	N							0.0130	1.88	0.00250	0.362	0.0230	3.33	0.00500	0.725	0.0110	1.59	0.00250	0.362			0.00860	1.25	0.0240	3.48
SD-116 _20031201	SD-116	SB	N							0.0410	4.10	0.00610	0.610	0.0570	5.70	0.00620	0.620	0.0560	5.60	0.0120	1.20			0.0330	3.30	0.0700	7.00
SD-117 _20031201	SD-117	SB	N							0.360	33.6	0.0230	2.15	0.310	29.0	0.0460	4.30	0.220	20.6	0.0850	7.94			0.200	18.7	0.300	28.0
SD-117-A _20040601	SD-117-A	SB	N							0.00920	5.11	0.00250	1.39	0.0180	10.0	0.00250	1.39	0.00620	3.44	0.00250	1.39			0.00250	1.39	0.0150	8.33
SD-117-B _20040601	SD-117-B	SB	N							0.01000	3.33	0.00185	0.617	0.0190	6.33	0.00940	3.13	0.00680	2.27	0.0130	4.33			0.0290	9.67	0.0160	5.33
SD-117-C _20040601	SD-117-C	SB	N							0.140	18.4	0.00760	1.00	0.120	15.8	0.0210	2.76	0.0510	6.71	0.0650	8.55			0.100	13.2	0.100	13.2
SD-119_20031201	SD-119	SB	N							0.140	12.7	0.0130	1.18	0.150	13.6	0.0220	2.00	0.120	10.9	0.0490	4.45			0.0950	8.64	0.170	15.5
SD-119-A _20040601	SD-119-A	SB	N							0.0990	5.86	0.00440	0.260	0.510	30.2	0.140	8.28	0.0220	1.30	0.140	8.28			0.460	27.2	0.350	20.7
SD-119-B _20040601	SD-119-B	SB	N							0.120	5.80	0.00990	0.478	0.280	13.5	0.0930	4.49	0.0560	2.71	0.280	13.5			0.270	13.0	0.230	11.1
SD-119-C _20040601	SD-119-C	SB	N							0.0680	2.24	0.00250	0.0825	0.340	11.2	0.150	4.95	0.0220	0.726	0.270	8.91			0.440	14.5	0.260	8.58
SD-120 _20031201	SD-120	SB	N							0.0130	6.84	0.00250	1.32	0.00890	4.68	0.00250	1.32	0.0130	6.84	0.00250	1.32			0.00250	1.32	0.0160	8.42
SD-121 _20040601	SD-121	SB	N							0.0560	3.11	0.00660	0.367	0.110	6.11	0.0170	0.944	0.0400	2.22	0.0270	1.50			0.0910	5.06	0.0880	4.89
SD-122 _20040601	SD-122	SB	N							0.290	17.0	0.00990	0.579	0.710	41.5	0.150	8.77	0.0590	3.45	0.120	7.02			0.560	32.7	0.460	26.9
SD-123 _20040601	SD-123	SB	N							0.610	36.7	0.0280	1.69	0.320	19.3	0.0700	4.22	0.110	6.63	0.0490	2.95			0.290	17.5	0.240	14.5
SD-124 _20040601	SD-124	SB	N							0.0760	6.33	0.00245	0.204	0.110	9.17	0.00570	0.475	0.0230	1.92	0.00680	0.567			0.0340	2.83	0.0900	7.50
SD-125 _20050401	SD-125	SB	N							0.470	19.6	0.0700	2.92	1.90	79.2	0.450	18.8	0.0780	3.25	0.320	13.3			1.60	66.7	1.40	58.3
SD-126 _20050401	SD-126	SB	N							0.710	22.6	0.0410	1.31	1.90	60.5	0.400	12.7	0.160	5.10	0.110	3.50			1.40	44.6	1.60	51.0
SD-127 _20050401	SD-127	SB	N							0.940	22.0	0.0390	0.913	3.90	91.3	1.20	28.1	0.150	3.51	0.420	9.84			4.60	108	2.60	60.9
SD-128 _20050401	SD-128	SB	N							0.360	7.73	0.0110	0.236	2.10	45.1	1.40	30.0	0.0570	1.22	0.350	7.51			4.20	90.1	1.50	32.2
SD-130 _20050401	SD-130	SB	N							0.440	11.1	0.0290	0.734	0.870	22.0	0.130	3.29	0.120	3.04	0.150	3.80			0.510	12.9	0.640	16.2
SD-131 _20050401	SD-131	SB	N							11.0	347	0.450	14.2	20.0	631	0.780	24.6	1.70	53.6	0.440	13.9			5.10	161	15.0	473
SD-132 _20050401	SD-132	SB	N							0.800	21.4	0.0410	1.10	3.70	98.9	0.240	6.42	0.170	4.55	0.140	3.74			1.90	50.8	2.20	58.8
SD-133 _20050401	SD-133	SB	N							0.210	10.3	0.0170	0.837	0.390	19.2	0.0160	0.788	0.0870	4.29	0.0170	0.837			0.140	6.90	0.380	18.7
SD-134_20050401	SD-134	SB	N							0.630	102	0.0340	5.48	1.30	210	0.130	21.0	0.140	22.6	0.0350	5.65			0.590	95.2	0.980	158
SD-135 _20050401	SD-135	SB	N							5.20	80.4	0.310	4.79	12.0	185	0.500	7.73	1.50	23.2	0.360	5.56			5.50	85.0	7.90	122
SD-135_DUP_20050401	SD-135	SB	FD							4.50	69.6	0.270	4.17	7.10	110	0.330	5.10	1.30	20.1	0.250	3.86			2.20	34.0	5.90	91.2
SD-136 _20050401	SD-136	SB	N							2.30	156	0.140	9.52	1.60	109	0.130	8.84	0.560	38.1	0.0250	1.70			0.510	34.7	1.30	88.4
SD-137 _20050401	SD-137	SB	N							0.0180	1.86	0.00410	0.423	0.0180	1.86	0.00150	0.155	0.0210	2.16	0.00330	0.340			0.00760	0.784	0.0200	2.06
SD-139 _20050401	SD-139	SB	N							0.110	3.00	0.0120	0.327	0.150	4.09	0.0840	2.29	0.0560	1.53	0.0270	0.736			0.150	4.09	0.140	3.81
SD-140_20050401	SD-140	SB	N							0.130	11.1	0.0120	1.03	0.240	20.5	0.00980	0.838	0.0540	4.62	0.00820	0.701			0.0480	4.10	0.230	19.7
SD-141_20050401	SD-141	SB	N							0.0640	5.42	0.00205	0.174	0.0230	1.95	0.00450	0.381	0.0180	1.53	0.00370	0.314			0.0150	1.27	0.0260	2.20
SHI6D_19961101	SHID6	SB	N							0.200	8.00			0.360	14.4	0.0380	1.52	0.0850	3.40	0.0280	1.12			0.190	7.60	0.340	13.6
SHID1_19961001	SHID1	SB	N							0.240	6.15			0.330	8.46	0.01000	0.256	0.160	4.10	0.01000	0.256			0.0730	1.87	0.290	7.44
SHID2 _19961001	SHID2	SB	N							0.00950	2.38			0.0220	5.50	0.00950	2.38	0.00950	2.38	0.00950	2.38			0.00950	2.38	0.0260	6.50

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene		Acenaphthylene		Anthracene		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b) fluoranthene		Benzo(e)pyrene		Benzo(g,h,i)perylene		Benzo(k) fluoranthene		C-1 Benz(a)anth/ Chrysenes		C-1 Fluoranthrenes/ Pyrenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2011 Sediment Data																									
MCO3-0-0.3	MC03	MC	N	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0685	7.78	0.0685	7.78
MC04-0-0.3	MC04	MC	N	0.268	19.1	0.00675	0.482	0.0303	2.16	0.00675	0.482	0.00675	0.482	0.00675	0.482			0.00675	0.482	0.00675	0.482				
SB01-0-0.3	SB01	SB	N	0.0229	0.954	0.0229	0.954	0.0474	1.98	0.0659	2.75	0.0630	2.63	0.0660	2.75			0.0630	2.63	0.0660	2.75				
SB02-0.0.3	SB02	SB	N	0.0183	0.763	0.0183	0.763	0.0492	2.05	0.0557	2.32	0.0436	1.82	0.0470	1.96	0.0390	1.63	0.0367	1.53	0.0470	1.96	0.0915	3.81	0.0915	3.81
SB03_0-0.3	SB03	SB	N	0.0107	0.465	0.0107	0.465	0.0386	1.68	0.0403	1.75	0.0326	1.42	0.0360	1.57			0.0339	1.47	0.0360	1.57				
SB04-0-0.3	SB04	SB	N	0.0577	2.75	0.0185	0.881	0.134	6.38	0.116	5.52	0.0996	4.74	0.102	4.86			0.0956	4.55	0.102	4.86				
SB06-0-0.3	SB06	SB	N	0.0199	0.905	0.0199	0.905	0.119	5.41	0.157	7.14	0.131	5.95	0.143	6.50			0.106	4.82	0.143	6.50				
SB07-0-0.3	SB07	SB	N	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430			0.00645	0.430	0.00645	0.430				
SB08-0-0.3	SB08	SB	N	0.0444	1.53	0.0211	0.728	0.0833	2.87	0.107	3.69	0.0962	3.32	0.113	3.90	0.0819	2.82	0.0728	2.51	0.113	3.90	0.106	3.64	0.106	3.64
SB09-0-0.3	SB09	SB	N	5.40	193	0.0980	3.50	1.74	62.1	0.832	29.7	0.339	12.1	0.405	14.5	0.265	9.46	0.215	7.68	0.405	14.5	0.490	17.5	1.88	67.1
SB12-0-0.3	SB12	SB	N	0.207	7.96	0.207	7.96	0.429	16.5	0.588	22.6	0.207	7.96	0.207	7.96			0.207	7.96	0.207	7.96				
SB13-0-0.3	SB13	SB	N	0.391	11.8	0.0955	2.89	0.275	8.33	0.338	10.2	0.0955	2.89	0.0958	2.90			0.0955	2.89	0.0958	2.90				
SB17-0-0.3	SB17	SB	N	0.293	10.9	0.293	10.9	0.293	10.9	0.799	29.6	0.293	10.9	0.640	23.7			0.293	10.9	0.640	23.7				
SB19-0-0.3	SB19	SB	N	0.192	13.7	0.192	13.7	0.192	13.7	0.192	13.7	0.192	13.7	0.192	13.7			0.192	13.7	0.192	13.7				
SB20-0-0.3	SB20	SB	N	0.291	13.9	0.0825	3.93	0.214	10.2	0.325	15.5	0.223	10.6	0.333	15.8			0.177	8.43	0.333	15.8				
SB21-0-0.3	SB21	SB	N	0.135	4.66	0.135	4.66	0.135	4.66	0.462	15.9	0.428	14.8	0.428	14.8			0.135	4.66	0.428	14.8				
SB24-0-0.3	SB24	SB	N	2.79	63.4	0.865	19.7	0.865	19.7	2.18	49.5	0.865	19.7	0.868	19.7			0.865	19.7	0.868	19.7				
SB26-0-0.3	SB26	SB	N	1.19	41.0	0.413	14.2	0.961	33.1	0.873	30.1	0.413	14.2	0.413	14.2			0.413	14.2	0.413	14.2				
SB27-0-0.3	SB27	SB	N	16.2	600	0.379	14.0	3.64	135	1.62	60.0	0.379	14.0	0.380	14.1			0.379	14.0	0.380	14.1				
SB28-0-0.3	SB28	SB	N	7.81	289	0.397	14.7	4.95	183	2.92	108	1.53	56.7	2.95	109	1.36	50.4	0.818	30.3	0.899	33.3	1.60	59.3	5.41	200

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-1 Fluorenes		C-1 Naphthalenes		C-1 Phenanthrenes/ Anthracenes		C-2 Benz(a)anth/ Chrysenes		C-2 Fluorenes		C-2 Naphthalenes		C-2 Phenanthrenes/ Anthracenes		C-3 Benz(a)anth/ Chrysenes		C-3 Fluorenes		C-3 Naphthalenes		C-3 Phenanthrenes/ Anthracenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2011 Sediment Data																									
MCO3-0-0.3	MC03	MC	N	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78
MC04-0-0.3	MC04	MC	N																						
SB01-0-0.3	SB01	SB	N																						
SB02-0.0.3	SB02	SB	N	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81
SB03_0-0.3	SB03	SB	N																						
SB04-0-0.3	SB04	SB	N																						
SB06-0-0.3	SB06	SB	N																						
SB07-0-0.3	SB07	SB	N																						
SB08-0-0.3	SB08	SB	N	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64
SB09-0-0.3	SB09	SB	N	1.38	49.3	4.37	156	4.24	151	0.490	17.5	0.490	17.5	3.76	134	2.02	72.1	0.490	17.5	0.490	17.5	2.94	105	0.490	17.5
SB12-0-0.3	SB12	SB	N																						
SB13-0-0.3	SB13	SB	N																						
SB17-0-0.3	SB17	SB	N																						
SB19-0-0.3	SB19	SB	N																						
SB20-0-0.3	SB20	SB	N																						
SB21-0-0.3	SB21	SB	N																						
SB24-0-0.3	SB24	SB	N																						
SB26-0-0.3	SB26	SB	N																						
SB27-0-0.3	SB27	SB	N																						
SB28-0-0.3	SB28	SB	N	1.96	72.6	14.0	519	7.76	287	0.406	15.0	0.724	26.8	7.18	266	3.37	125	0.0910	3.37	0.498	18.4	3.43	127	1.26	46.7

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-4 Benz(a)anth/ Chrysenes		C-4 Naphthalenes		C-4 Phenanthrenes/ Anthracenes		Chrysene		Dibenzo(a,h) anthracene		Fluoranthene		Fluorene		Indeno(1,2,3-cd) pyrene		Naphthalene		Perylene		Phenanthrene		Pyrene	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2011 Sediment Data																											
MCO3-0-0.3	MC03	MC	N	0.137	15.5	0.0685	7.78	0.137	15.5	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0787	8.94	0.0137	1.55	0.0137	1.55
MC04-0-0.3	MC04	MC	N							0.00675	0.482	0.00675	0.482	0.0236	1.69	0.168	12.0	0.00675	0.482	0.0866	6.19			0.235	16.8	0.0177	1.26
SB01-0-0.3	SB01	SB	N							0.0986	4.11	0.0229	0.954	0.141	5.88	0.0229	0.954	0.0581	2.42	0.0229	0.954			0.0778	3.24	0.133	5.54
SB02-0.0.3	SB02	SB	N	0.183	7.63	0.0915	3.81	0.183	7.63	0.0669	2.79	0.0183	0.763	0.155	6.46	0.0183	0.763	0.0376	1.57	0.0784	3.27	0.0404	1.68	0.0961	4.00	0.128	5.33
SB03_0-0.3	SB03	SB	N							0.0563	2.45	0.0107	0.465	0.119	5.17	0.0107	0.465	0.0329	1.43	0.0337	1.47			0.0514	2.23	0.0968	4.21
SB04-0-0.3	SB04	SB	N							0.160	7.62	0.0185	0.881	0.432	20.6	0.0750	3.57	0.0875	4.17	0.0837	3.99			0.337	16.0	0.312	14.9
SB06-0-0.3	SB06	SB	N							0.312	14.2	0.0199	0.905	0.329	15.0	0.0440	2.00	0.104	4.73	0.0624	2.84			0.147	6.68	0.269	12.2
SB07-0-0.3	SB07	SB	N							0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.0412	2.75			0.00645	0.430	0.00645	0.430
SB08-0-0.3	SB08	SB	N	0.211	7.28	0.106	3.64	0.211	7.28	0.170	5.86	0.0211	0.728	0.276	9.52	0.0211	0.728	0.0734	2.53	0.142	4.90	0.0211	0.728	0.119	4.10	0.213	7.34
SB09-0-0.3	SB09	SB	N	0.980	35.0	1.34	47.9	0.980	35.0	0.962	34.4	0.0980	3.50	7.30	261	5.92	211	0.216	7.71	16.1	575	0.0980	3.50	11.5	411	4.23	151
SB12-0-0.3	SB12	SB	N							0.823	31.7	0.207	7.96	2.17	83.5	0.207	7.96	0.207	7.96	0.207	7.96			1.23	47.3	1.58	60.8
SB13-0-0.3	SB13	SB	N							0.328	9.94	0.0955	2.89	1.24	37.6	0.390	11.8	0.0955	2.89	0.0955	2.89			1.39	42.1	0.849	25.7
SB17-0-0.3	SB17	SB	N							1.14	42.2	0.293	10.9	2.85	106	0.293	10.9	0.293	10.9	0.293	10.9			1.23	45.6	2.11	78.1
SB19-0-0.3	SB19	SB	N							0.192	13.7	0.192	13.7	0.433	30.9	0.192	13.7	0.192	13.7	0.192	13.7			0.192	13.7	0.192	13.7
SB20-0-0.3	SB20	SB	N							0.497	23.7	0.0825	3.93	0.977	46.5	0.245	11.7	0.218	10.4	0.212	10.1			0.758	36.1	0.722	34.4
SB21-0-0.3	SB21	SB	N							0.566	19.5	0.135	4.66	0.780	26.9	0.135	4.66	0.285	9.83	0.135	4.66			0.372	12.8	0.757	26.1
SB24-0-0.3	SB24	SB	N							1.87	42.5	0.865	19.7	10.8	245	2.98	67.7	0.865	19.7	2.89	65.7			14.0	318	7.54	171
SB26-0-0.3	SB26	SB	N							0.413	14.2	0.413	14.2	3.39	117	1.56	53.8	0.413	14.2	2.92	101			4.68	161	2.29	79.0
SB27-0-0.3	SB27	SB	N							1.69	62.6	0.379	14.0	13.4	496	12.2	452	0.379	14.0	4.36	161			23.7	878	7.86	291
SB28-0-0.3	SB28	SB	N	0.182	6.74	1.31	48.5	0.433	16.0	4.80	178	0.222	8.22	17.0	630	7.74	287	0.968	35.9	29.6	1096	0.395	14.6	23.3	863	10.5	389

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene		Acenaphthylene		Anthracene		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b) fluoranthene		Benzo(e)pyrene		Benzo(g,h,i)perylene		Benzo(k) fluoranthene		C-1 Benz(a)anth/ Chrysenes		C-1 Fluoranthrenes/ Pyrenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2012 Sediment Data																									
PWS-27_8-11_SE	PWS-27	MC	N	0.00987	0.548	0.00403	0.224	0.0179	0.994	0.0698	3.88	0.102	5.67	0.135	7.50	0.0711	3.95	0.0403	2.24	0.0458	2.54	0.0807	4.48	0.0849	4.72
PWS-01_8-9_SE	PWS-01	SB	N	0.755	120	0.0133	2.11	0.114	18.1	0.0895	14.2	0.0666	10.6	0.145	23.0	0.0710	11.3	0.0329	5.22	0.0461	7.32	0.0337	5.35	0.144	22.9
PWS-03_8-11_SE	PWS-03	SB	N	1.37	48.9	0.490	17.5	2.69	96.1	5.57	199	3.49	125	7.60	271	3.80	136	1.75	62.5	2.65	94.6	3.70	132	9.00	321
PWS-04_1-4_SE	PWS-04	SB	N	0.161	13.4	0.0514	4.28	0.277	23.1	0.461	38.4	0.372	31.0	0.750	62.5	0.384	32.0	0.207	17.3	0.248	20.7	0.279	23.3	0.614	51.2
PWS-04_8-11_SE	PWS-04	SB	N	0.521	52.1	0.0769	7.69	0.559	55.9	0.668	66.8	0.472	47.2	0.944	94.4	0.507	50.7	0.252	25.2	0.284	28.4	0.390	39.0	1.02	102
PWS-05_8-11_SE	PWS-05	SB	N	0.840	46.7	0.139	7.72	0.971	53.9	1.52	84.4	1.03	57.2	1.93	107	1.01	56.1	0.489	27.2	0.604	33.6	0.812	45.1	2.00	111
PWS-06_8-11_SE	PWS-06	SB	N	3.89	169	0.235	10.2	3.40	148	2.43	106	0.975	42.4	2.46	107	1.10	47.8	0.350	15.2	0.739	32.1	1.29	56.1	5.37	233
PWS-07_8-11_SE	PWS-07	SB	N	1.32	47.1	0.216	7.71	1.48	52.9	1.70	60.7	1.36	48.6	2.69	96.1	1.41	50.4	0.707	25.3	0.832	29.7	1.31	46.8	2.27	81.1
PWS-08_8-11_SE	PWS-08	SB	N	1.05	50.0	0.0713	3.40	0.831	39.6	0.708	33.7	0.372	17.7	0.727	34.6	0.353	16.8	0.167	7.95	0.220	10.5	0.408	19.4	1.18	56.2
PWS-09_8-11_SE	PWS-09	SB	N	0.333	16.7	0.0385	1.93	0.302	15.1	0.361	18.1	0.251	12.6	0.415	20.8	0.216	10.8	0.110	5.50	0.134	6.70	0.196	9.80	0.566	28.3
PWS-12_8-11_SE	PWS-12	SB	N	0.0793	4.41	0.0268	1.49	0.111	6.17	0.230	12.8	0.241	13.4	0.405	22.5	0.222	12.3	0.153	8.50	0.144	8.00	0.152	8.44	0.273	15.2
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0430	2.39	0.0197	1.09	0.0848	4.71	0.147	8.17	0.142	7.89	0.244	13.6	0.129	7.17	0.0792	4.40	0.0742	4.12	0.105	5.83	0.197	10.9
PWS-13_1-4_SE	PWS-13	SB	N	0.0947	3.51	0.0341	1.26	0.272	10.1	0.192	7.11	0.278	10.3	0.336	12.4	0.192	7.11	0.166	6.15	0.107	3.96	0.130	4.81	0.238	8.81
PWS-13_8-11_SE	PWS-13	SB	N	0.0736	3.68	0.0238	1.19	0.108	5.40	0.238	11.9	0.250	12.5	0.464	23.2	0.218	10.9	0.126	6.30	0.152	7.60	0.223	11.2	0.281	14.1
PWS-15_8-11_SE	PWS-15	SB	N	0.00906	0.604	0.00380	0.253	0.0126	0.840	0.0179	1.19	0.0205	1.37	0.0265	1.77	0.0168	1.12	0.00380	0.253	0.0156	1.04	0.0380	2.53	0.0380	2.53
PWS-16B_8-11_SE	PWS-16	SB	N	0.280	12.7	0.0597	2.71	0.336	15.3	0.439	20.0	0.254	11.5	0.540	24.5	0.283	12.9	0.148	6.73	0.169	7.68	0.258	11.7	0.609	27.7
PWS-16_8-11_SE	PWS-16	SB	N	1.30	65.0	0.158	7.90	1.55	77.5	0.932	46.6	0.436	21.8	1.00	50.0	0.517	25.9	0.200	10.0	0.281	14.1	0.630	31.5	1.58	79.0
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0986	4.93	0.0194	0.970	0.0762	3.81	0.221	11.1	0.124	6.20	0.229	11.5	0.109	5.45	0.0516	2.58	0.0652	3.26	0.194	9.70	0.343	17.2
PWS-25_8-11_SE	PWS-25	SB	N	0.536	33.5	0.109	6.81	0.509	31.8	0.795	49.7	0.797	49.8	1.53	95.6	0.783	48.9	0.421	26.3	0.522	32.6	0.578	36.1	1.25	78.1
PWS-26_8-11_SE	PWS-26	SB	N	0.572	47.7	0.0506	4.22	0.477	39.8	0.353	29.4	0.290	24.2	0.515	42.9	0.264	22.0	0.183	15.3	0.172	14.3	0.220	18.3	0.581	48.4
PWS-17_4-7	PWS-17	MC	N	0.149	15.7	0.00891	0.938	0.0238	2.51	0.0263	2.77	0.0203	2.14	0.0471	4.96	0.0283	2.98	0.0190	2.00	0.0137	1.44	0.0277	2.91	0.0277	2.91
PWS-27_8-11	PWS-27	MC	N	0.0104	0.612	0.00934	0.549	0.0264	1.55	0.0645	3.79	0.0646	3.80	0.0950	5.59	0.0580	3.41	0.0491	2.89	0.0339	1.99	0.0697	4.10	0.0954	5.61
PWS-30_8-11	PWS-30	MC	N	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.0427	3.88	0.0427	3.88
LSI-01_8-11	LSI-01	SB	N	0.0340	17.9	0.00667	3.51	0.0478	25.2	0.0384	20.2	0.0296	15.6	0.0497	26.2	0.0301	15.8	0.0243	12.8	0.0150	7.89	0.0320	16.8	0.0320	16.8
LSI-02_8-11	LSI-02	SB	N	0.0613	3.83	0.0182	1.14	0.131	8.19	0.112	7.00	0.0946	5.91	0.210	13.1	0.116	7.25	0.0641	4.01	0.0699	4.37	0.0834	5.21	0.137	8.56
LSI-20_8-11	LSI-20	SB	N	0.127	38.5	0.0373	11.3	0.190	57.6	0.436	132	0.318	96.4	0.649	197	0.319	96.7	0.144	43.6	0.216	65.5	0.327	99.1	0.600	182
LSI-24_8-11	LSI-24	SB	N	0.114	12.5	0.0345	3.79	0.0381	4.19	0.165	18.1	0.234	25.7	0.273	30.0	0.163	17.9	0.173	19.0	0.102	11.2	0.120	13.2	0.198	21.8
PWS-1_8-10	PWS-01	SB	N	0.0736	13.1	0.00313	0.558	0.0190	3.39	0.0802	14.3	0.0485	8.66	0.0757	13.5	0.0423	7.55	0.0272	4.86	0.0286	5.11	0.0313	5.58	0.113	20.2
PWS-3_8-11	PWS-03	SB	N	0.461	17.7	0.290	11.2	1.16	44.6	2.63	101	1.98	76.2	4.36	168	2.05	78.8	0.739	28.4	1.46	56.2	1.61	61.9	3.64	140
PWS-4_8-11	PWS-04	SB	N	0.102	14.8	0.0787	11.4	0.868	126	0.765	111	1.46	212	1.99	288	1.26	183	0.630	91.3	0.562	81.4	0.555	80.4	0.987	143
PWS-5_8-11	PWS-05	SB	N	0.283	23.6	0.0563	4.69	0.274	22.8	0.513	42.8	0.456	38.0	0.862	71.8	0.408	34.0	0.205	17.1	0.294	24.5	0.315	26.3	0.584	48.7
PWS-6_8-11	PWS-06	SB	N	0.977	65.1	0.0670	4.47	0.872	58.1	0.606	40.4	0.371	24.7	0.735	49.0	0.360	24.0	0.159	10.6	0.266	17.7	0.352	23.5	0.846	56.4
PWS-7_8-10	PWS-07	SB	N	0.878	51.6	0.175	10.3	2.69	158	1.78	105	1.49	87.6	2.68	158	1.28	75.3	0.450	26.5	0.873	51.4	1.01	59.4	2.06	121
PWS-7_8-10 DUP	PWS-07	SB	FD	0.859	50.5	0.184	10.8	0.981	57.7	1.38	81.2	1.62	95.3	2.69	158	1.43	84.1	0.588	34.6	0.828	48.7	0.933	54.9	1.76	104
PWS-8_8-11	PWS-08	SB	N	0.261	17.4	0.0523	3.49	0.344	22.9	0.414	27.6	0.366	24.4	0.747	49.8	0.363	24.2	0.180	12.0	0.274	18.3	0.299	19.9	0.541	36.1
PWS-9_8-11	PWS-09	SB	N	0.0494	2.74	0.00471	0.262	0.0689	3.83	0.0836	4.64	0.0548	3.04	0.0932	5.18	0.0474	2.63	0.0329	1.83	0.0373	2.07	0.0471	2.62	0.140	7.78
PWS-12_8-11	PWS-12	SB	N	0.00402	0.268	0.00402	0.268	0.00402	0.268	0.0198	1.32	0.0183	1.22	0.0303	2.02	0.0183	1.22	0.0165	1.10	0.0105	0.700	0.0402	2.68	0.0402	2.68
PWS-13_8-11	PWS-13	SB	N	0.247	11.2	0.0297	1.35	0.215	9.77	0.496	22.5	0.280	12.7	0.271	12.3	0.241	11.0	0.0856	3.89	0.107	4.86	1.50	68.2	1.96	89.1
PWS-13_8-11_1	PWS-13	SB	FD	0.347	15.8	0.0537	2.44	0.317	14.4	0.599	27.2	0.323	14.7	0.429	19.5	0.312	14.2	0.160	7.27	0.138	6.27	1.77	80.5	2.34	106
PWS-13_8-11_2	PWS-13	SB	FT	0.187	8.50	0.0341	1.55	0.159	7.23	0.290	13.2	0.258	11.7	0.302	13.7	0.252	11.5	0.135	6.14	0.0906	4.12	1.22	55.5	1.33	60.5
PWS-15_8-11	PWS-15	SB	N	0.0236	2.91	0.00334	0.412	0.0101	1.25	0.0214	2.64	0.0112	1.38	0.0207	2.56	0.0107	1.32	0.00872	1.08	0.00782	0.965	0.0334	4.12	0.0334	4.12
PWS-16_8-11	PWS-16	SB	N	0.0817	5.11	0.0176	1.10	0.106	6.63	0.146	9.13	0.0809	5.06	0.181	11.3	0.0988	6.18	0.0524	3.28	0.0553	3.46	0.101	6.31	0.209	13.1
PWS-25_4-8	PWS-25	SB	N	0.161	16.4	0.0476	4.86	0.367	37.4	1.33	136	1.14	116	1.74	178	0.836	85.3	0.439	44.8	0.613	62.6	0.578	59.0	1.21	123
PWS-26_8-11	PWS-26	SB	N	0.322	32.2	0.0527	5.27	0.436	43.6	0.392	39.2	0.399	39.9	0.736	73.6	0.357	35.7	0.206	20.6	0.275	27.5	0.271	27.1	0.591	59.1
PWS-26_8-11_DUP	PWS-26	SB	FD	0.326	23.3	0.0702	5.01	0.506	36.1	0.886	63.3	0.776	55.4	1.34	95.7	0.631	45.1	0.324	23.1	0.466	33.3	0.548	39.1	1.09	77.9
PWS-28_8-11	PWS-28	SB	N	0.00302	0.274	0.0165	1.50	0.0106	0.964	0.0418	3.80	0.0853	7.75	0.0880	8.00	0.0683	6.21	0.0690	6.27	0.0310	2.82	0.0695	6.32	0.0302	2.74

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-1 Fluorenes		C-1 Naphthalenes		C-1 Phenanthrenes/ Anthracenes		C-2 Benz(a)anth/ Chrysenes		C-2 Fluorenes		C-2 Naphthalenes		C-2 Phenanthrenes/ Anthracenes		C-3 Benz(a)anth/ Chrysenes		C-3 Fluorenes		C-3 Naphthalenes		C-3 Phenanthrenes/ Anthracenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2012 Sediment Data																									
PWS-27_8-11_SE	PWS-27	MC	N	0.0403	2.24	0.0220	1.22	0.0403	2.24	0.145	8.06	0.0403	2.24	0.0403	2.24	0.0403	2.24	0.0403	2.24	0.0403	2.24	0.0403	2.24	0.0403	2.24
PWS-01_8-9_SE	PWS-01	SB	N	0.104	16.5	0.174	27.6	0.172	27.3	0.0337	5.35	0.0337	5.35	0.355	56.3	0.0862	13.7	0.0337	5.35	0.0337	5.35	0.133	21.1	0.0337	5.35
PWS-03_8-11_SE	PWS-03	SB	N	0.763	27.3	2.60	92.9	4.23	151	1.08	38.6	0.751	26.8	1.94	69.3	3.03	108	0.872	31.1	0.407	14.5	1.25	44.6	1.68	60.0
PWS-04_1-4_SE	PWS-04	SB	N	0.103	8.58	0.313	26.0	0.414	34.5	0.115	9.58	0.0837	6.98	0.203	16.9	0.288	24.0	0.129	10.8	0.0354	2.95	0.152	12.7	0.146	12.2
PWS-04_8-11_SE	PWS-04	SB	N	0.176	17.6	0.715	71.5	0.932	93.2	0.172	17.2	0.192	19.2	0.655	65.5	0.574	57.4	0.163	16.3	0.187	18.7	0.364	36.4	0.322	32.2
PWS-05_8-11_SE	PWS-05	SB	N	0.276	15.3	1.09	60.4	1.38	76.7	0.334	18.6	0.224	12.4	0.995	55.3	0.915	50.8	0.227	12.6	0.132	7.33	0.582	32.3	0.474	26.3
PWS-06_8-11_SE	PWS-06	SB	N	1.04	45.2	7.00	304	6.08	264	0.502	21.8	0.960	41.7	4.53	197	3.36	146	0.333	14.5	0.429	18.7	2.32	101	1.28	55.7
PWS-07_8-11_SE	PWS-07	SB	N	0.357	12.8	2.23	79.8	1.87	66.8	0.455	16.3	0.0404	1.44	1.42	50.7	1.12	40.0	0.334	11.9	0.397	14.2	0.789	28.2	0.553	19.8
PWS-08_8-11_SE	PWS-08	SB	N	0.298	14.2	1.45	69.2	1.55	73.8	0.191	9.10	0.301	14.3	1.26	60.0	0.824	39.2	0.173	8.24	0.152	7.24	0.745	35.5	0.405	19.3
PWS-09_8-11_SE	PWS-09	SB	N	0.196	9.80	0.392	19.6	0.647	32.4	0.0922	4.61	0.108	5.40	0.363	18.2	0.302	15.1	0.0445	2.23	0.0445	2.23	0.268	13.4	0.146	7.30
PWS-12_8-11_SE	PWS-12	SB	N	0.0490	2.72	0.0839	4.66	0.164	9.11	0.110	6.11	0.0490	2.72	0.0490	2.72	0.130	7.22	0.0490	2.72	0.0490	2.72	0.0490	2.72	0.0490	2.72
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0467	2.59	0.0677	3.76	0.134	7.44	0.0467	2.59	0.0467	2.59	0.0467	2.59	0.0963	5.35	0.0467	2.59	0.0467	2.59	0.0467	2.59	0.0467	2.59
PWS-13_1-4_SE	PWS-13	SB	N	0.0505	1.87	0.203	7.51	0.257	9.52	0.0505	1.87	0.0505	1.87	0.201	7.44	0.162	6.00	0.0505	1.87	0.0505	1.87	0.184	6.81	0.0505	1.87
PWS-13_8-11_SE	PWS-13	SB	N	0.0459	2.30	0.141	7.04	0.187	9.35	0.0940	4.70	0.0459	2.30	0.121	6.05	0.126	6.30	0.110	5.50	0.0459	2.30	0.100	5.00	0.133	6.65
PWS-15_8-11_SE	PWS-15	SB	N	0.0380	2.53	0.0173	1.16	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0896	5.97	0.0380	2.53
PWS-16B_8-11_SE	PWS-16	SB	N	0.107	4.86	0.545	24.8	0.462	21.0	0.101	4.59	0.102	4.64	0.327	14.9	0.309	14.0	0.113	5.14	0.0428	1.94	0.208	9.45	0.221	10.0
PWS-16_8-11_SE	PWS-16	SB	N	0.442	22.1	3.10	155	2.07	104	0.223	11.2	0.363	18.2	1.83	91.5	1.01	50.5	0.250	12.5	0.170	8.50	0.964	48.2	0.377	18.9
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0363	1.81	0.0470	2.35	0.164	8.20	0.130	6.50	0.0363	1.81	0.0363	1.81	0.219	11.0	0.0749	3.75	0.0363	1.81	0.0363	1.81	0.255	12.8
PWS-25_8-11_SE	PWS-25	SB	N	0.173	10.8	0.862	53.9	0.953	59.6	0.267	16.7	0.197	12.3	0.523	32.7	0.593	37.1	0.231	14.4	0.108	6.75	0.371	23.2	0.291	18.2
PWS-26_8-11_SE	PWS-26	SB	N	0.163	13.6	0.926	77.2	0.752	62.7	0.137	11.4	0.133	11.1	0.556	46.3	0.341	28.4	0.114	9.50	0.0410	3.41	0.353	29.4	0.168	14.0
PWS-17_4-7	PWS-17	MC	N	0.0277	2.91	0.126	13.3	0.0277	2.91	0.0277	2.91	0.0277	2.91	0.0597	6.28	0.0277	2.91	0.0277	2.91	0.0277	2.91	0.0277	2.91	0.0277	2.91
PWS-27_8-11	PWS-27	MC	N	0.0345	2.03	0.0132	0.774	0.119	7.00	0.0705	4.15	0.0345	2.03	0.0345	2.03	0.118	6.94	0.0994	5.85	0.0345	2.03	0.0345	2.03	0.0965	5.68
PWS-30_8-11	PWS-30	MC	N	0.0427	3.88	0.00853	0.775	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88
LSI-01_8-11	LSI-01	SB	N	0.0320	16.8	0.0761	40.1	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8
LSI-02_8-11	LSI-02	SB	N	0.0403	2.52	0.0570	3.56	0.136	8.50	0.0403	2.52	0.0403	2.52	0.0403	2.52	0.0850	5.31	0.0403	2.52	0.0403	2.52	0.0403	2.52	0.0403	2.52
LSI-20_8-11	LSI-20	SB	N	0.0681	20.6	0.111	33.7	0.421	128	0.139	42.1	0.0774	23.5	0.0837	25.4	0.291	88.2	0.129	39.1	0.127	38.5	0.101	30.6	0.203	61.5
LSI-24_8-11	LSI-24	SB	N	0.0310	3.41	0.0447	4.91	0.122	13.4	0.0664	7.30	0.0310	3.41	0.0310	3.41	0.139	15.3	0.0310	3.41	0.0310	3.41	0.0310	3.41	0.131	14.4
PWS-1_8-10	PWS-01	SB	N	0.0313	5.58	0.00625	1.12	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58
PWS-3_8-11	PWS-03	SB	N	0.256	9.85	0.691	26.6	1.96	75.4	0.605	23.3	0.227	8.73	0.522	20.1	1.30	50.0	0.543	20.9	0.618	23.8	0.422	16.2	0.684	26.3
PWS-4_8-11	PWS-04	SB	N	0.0322	4.66	0.135	19.5	0.531	77.0	0.279	40.4	0.0322	4.66	0.0937	13.6	0.296	42.9	0.239	34.6	0.130	18.8	0.0810	11.7	0.159	23.0
PWS-5_8-11	PWS-05	SB	N	0.0970	8.08	0.309	25.8	0.456	38.0	0.149	12.4	0.0849	7.08	0.257	21.4	0.318	26.5	0.133	11.1	0.147	12.3	0.217	18.1	0.144	12.0
PWS-6_8-11	PWS-06	SB	N	0.292	19.5	1.24	82.7	1.29	86.0	0.190	12.7	0.179	11.9	1.04	69.3	0.638	42.5	0.184	12.3	0.193	12.9	0.765	51.0	0.294	19.6
PWS-7_8-10	PWS-07	SB	N	0.381	22.4	0.996	58.6	2.01	118	0.521	30.6	0.290	17.1	0.915	53.8	1.18	69.4	0.488	28.7	0.551	32.4	0.963	56.6	0.665	39.1
PWS-7_8-10 DUP	PWS-07	SB	FD	0.338	19.9	1.31	77.2	1.55	91.2	0.452	26.6	0.234	13.8	0.877	51.6	0.962	56.6	0.420	24.7	0.424	24.9	0.670	39.4	0.483	28.4
PWS-8_8-11	PWS-08	SB	N	0.107	7.13	0.385	25.7	0.513	34.2	0.140	9.33	0.0856	5.71	0.299	19.9	0.355	23.7	0.151	10.1	0.149	9.93	0.210	14.0	0.182	12.1
PWS-9_8-11	PWS-09	SB	N	0.0471	2.62	0.0595	3.31	0.124	6.89	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62
PWS-12_8-11	PWS-12	SB	N	0.0402	2.68	0.00804	0.536	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68
PWS-13_8-11	PWS-13	SB	N	0.674	30.6	0.154	6.99	3.79	172	1.84	83.6	1.41	64.1	1.66	75.5	5.68	258	1.41	64.1	1.74	79.1	5.33	242	4.60	209
PWS-13_8-11_1	PWS-13	SB	FD	0.638	29.0	0.413	18.8	4.27	194	2.06	93.6	1.07	48.6	2.19	99.5	5.50	250	1.66	75.5	1.42	64.5	5.59	254	5.26	239
PWS-13_8-11_2	PWS-13	SB	FT	0.396	18.0	0.196	8.89	2.66	121	1.51	68.6	0.726	33.0	1.50	68.2	3.59	163	1.06	48.2	0.951	43.2	4.14	188	3.70	168
PWS-15_8-11	PWS-15	SB	N	0.0334	4.12	0.0156	1.93	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12
PWS-16_8-11	PWS-16	SB	N	0.0356	2.22	0.122	7.62	0.192	12.0	0.0356	2.22	0.0356	2.22	0.0916	5.73	0.143	8.94	0.0934	5.84	0.0356	2.22	0.0814	5.09	0.0806	5.04
PWS-25_4-8	PWS-25	SB	N	0.0922	9.41	0.243	24.8	0.399	40.7	0.197	20.1	0.0367	3.74	0.170	17.3	0.300	30.6	0.146	14.9	0.118	12.0	0.113	11.5	0.153	15.6
PWS-26_8-11	PWS-26	SB	N	0.146	14.6	0.490	49.0	0.612	61.2	0.132	13.2	0.0903	9.03	0.346	34.6	0.356	35.6	0.113	11.3	0.129	12.9	0.251	25.1	0.180	18.0
PWS-26_8-11_DUP	PWS-26	SB	FD	0.161	11.5	0.545	38.9	0.833	59.5	0.243	17.4	0.123	8.79	0.361	25.8	0.599	42.8	0.183	13.1	0.217	15.5	0.253	18.1	0.297	21.2
PWS-28_8-11	PWS-28	SB	N	0.0302	2.74	0.0171	1.56	0.0302	2.74	0.0682	6.20	0.0302	2.74	0.0302	2.74	0.0302	2.74	0.0616	5.60	0.0302	2.74	0.0302	2.74	0.0302	2.74

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-4 Benz(a)anth/ Chrysenes		C-4 Naphthalenes		C-4 Phenanthrenes/ Anthracenes		Chrysene		Dibenzo(a,h) anthracene		Fluoranthene		Fluorene		Indeno(1,2,3-cd) pyrene		Naphthalene		Perylene		Phenanthrene		Pyrene	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2012 Sediment Data																											
PWS-27_8-11_SE	PWS-27	MC	N	0.0805	4.47	0.0403	2.24	0.0805	4.47	0.0840	4.67	0.0403	2.24	0.129	7.17	0.0129	0.717	0.0403	2.24	0.0665	3.69	0.0862	4.79	0.0652	3.62	0.135	7.50
PWS-01_8-9_SE	PWS-01	SB	N	0.0675	10.7	0.0337	5.35	0.0675	10.7	0.127	20.2	0.00772	1.23	0.433	68.7	0.550	87.3	0.0357	5.67	0.0692	11.0	0.0255	4.05	0.489	77.6	0.321	51.0
PWS-03_8-11_SE	PWS-03	SB	N	0.376	13.4	0.609	21.8	0.376	13.4	9.76	349	0.443	15.8	18.6	664	1.95	69.6	1.92	68.6	5.70	204	0.830	29.6	6.48	231	14.5	518
PWS-04_1-4_SE	PWS-04	SB	N	0.0710	5.92	0.0857	7.14	0.0710	5.92	0.626	52.2	0.0520	4.33	1.51	126	0.221	18.4	0.221	18.4	0.693	57.8	0.120	10.0	0.772	64.3	1.19	99.2
PWS-04_8-11_SE	PWS-04	SB	N	0.0725	7.25	0.204	20.4	0.0725	7.25	1.01	101	0.0684	6.84	2.77	277	0.571	57.1	0.302	30.2	1.54	154	0.153	15.3	1.87	187	2.01	201
PWS-05_8-11_SE	PWS-05	SB	N	0.0790	4.39	0.271	15.1	1.26	70.0	2.06	114	0.123	6.83	4.44	247	0.921	51.2	0.506	28.1	2.20	122	0.345	19.2	3.14	174	3.29	183
PWS-06_8-11_SE	PWS-06	SB	N	0.328	14.3	1.01	43.9	4.21	183	3.72	162	0.107	4.65	16.9	735	4.15	180	0.406	17.7	17.3	752	0.244	10.6	13.6	591	10.7	465
PWS-07_8-11_SE	PWS-07	SB	N	0.0805	2.88	0.403	14.4	0.245	8.75	2.38	85.0	0.177	6.32	5.72	204	1.43	51.1	0.762	27.2	5.35	191	0.481	17.2	4.65	166	4.63	165
PWS-08_8-11_SE	PWS-08	SB	N	0.0890	4.24	0.369	17.6	0.361	17.2	0.802	38.2	0.0492	2.34	3.46	165	1.17	55.7	0.186	8.86	2.44	116	0.123	5.86	4.01	191	2.52	120
PWS-09_8-11_SE	PWS-09	SB	N	0.0890	4.45	0.117	5.85	0.231	11.6	0.409	20.5	0.0297	1.49	1.43	71.5	0.327	16.4	0.124	6.20	1.16	58.0	0.125	6.25	1.27	63.5	1.10	55.0
PWS-12_8-11_SE	PWS-12	SB	N	0.0980	5.44	0.0490	2.72	0.0980	5.44	0.330	18.3	0.0350	1.94	0.576	32.0	0.0880	4.89	0.169	9.39	0.170	9.44	0.168	9.33	0.280	15.6	0.536	29.8
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0935	5.19	0.0467	2.59	0.0935	5.19	0.216	12.0	0.0191	1.06	0.386	21.4	0.0664	3.69	0.0880	4.89	0.172	9.56	0.111	6.17	0.238	13.2	0.337	18.7
PWS-13_1-4_SE	PWS-13	SB	N	0.101	3.72	0.0505	1.87	0.101	3.72	0.277	10.3	0.0275	1.02	0.596	22.1	0.142	5.26	0.162	6.00	0.359	13.3	0.0946	3.50	0.496	18.4	0.612	22.7
PWS-13_8-11_SE	PWS-13	SB	N	0.0920	4.60	0.0459	2.30	0.0920	4.60	0.314	15.7	0.0301	1.51	0.433	21.7	0.0971	4.86	0.126	6.30	0.255	12.8	0.101	5.05	0.341	17.1	0.370	18.5
PWS-15_8-11_SE	PWS-15	SB	N	0.0760	5.07	0.0380	2.53	0.238	15.9	0.0248	1.65	0.00380	0.253	0.0976	6.51	0.00974	0.649	0.00778	0.519	0.0233	1.55	0.0860	5.73	0.0736	4.91	0.0789	5.26
PWS-16B_8-11_SE	PWS-16	SB	N	0.0855	3.89	0.118	5.36	0.0855	3.89	0.554	25.2	0.0428	1.94	1.39	63.2	0.311	14.1	0.176	8.00	0.999	45.4	0.130	5.91	0.895	40.7	1.09	49.5
PWS-16_8-11_SE	PWS-16	SB	N	0.0845	4.23	0.388	19.4	0.232	11.6	1.11	55.5	0.0422	2.11	4.90	245	1.56	78.0	0.229	11.5	5.44	272	0.173	8.65	5.75	288	3.48	174
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0725	3.63	0.0783	3.92	0.0725	3.63	0.277	13.9	0.0182	0.910	0.292	14.6	0.0607	3.04	0.0643	3.22	0.122	6.10	0.0428	2.14	0.277	13.9	0.267	13.4
PWS-25_8-11_SE	PWS-25	SB	N	0.0820	5.13	0.207	12.9	0.275	17.2	1.25	78.1	0.117	7.31	2.80	175	0.643	40.2	0.514	32.1	1.45	90.6	0.217	13.6	2.01	126	2.36	148
PWS-26_8-11_SE	PWS-26	SB	N	0.0820	6.83	0.158	13.2	0.406	33.8	0.502	41.8	0.0410	3.41	1.60	133	0.756	63.0	0.191	15.9	1.35	113	0.121	10.1	1.98	165	1.24	103
PWS-17_4-7	PWS-17	MC	N	0.0555	5.84	0.0277	2.91	0.0555	5.84	0.0403	4.24	0.00277	0.291	0.0825	8.68	0.0625	6.58	0.0172	1.81	0.195	20.5	0.0162	1.71	0.124	13.1	0.0568	5.98
PWS-27_8-11	PWS-27	MC	N	0.0690	4.06	0.0345	2.03	0.0690	4.06	0.0923	5.43	0.0103	0.606	0.186	10.9	0.0141	0.829	0.0436	2.56	0.0228	1.34	0.0516	3.04	0.103	6.06	0.186	10.9
PWS-30_8-11	PWS-30	MC	N	0.0855	7.77	0.0427	3.88	0.0855	7.77	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388
LSI-01_8-11	LSI-01	SB	N	0.0640	33.7	0.0320	16.8	0.0640	33.7	0.0467	24.6	0.00320	1.68	0.155	81.6	0.0386	20.3	0.0243	12.8	0.188	98.9	0.00931	4.90	0.152	80.0	0.103	54.2
LSI-02_8-11	LSI-02	SB	N	0.0805	5.03	0.0403	2.52	0.0805	5.03	0.165	10.3	0.0157	0.981	0.388	24.3	0.0711	4.44	0.0690	4.31	0.116	7.25	0.0355	2.22	0.250	15.6	0.285	17.8
LSI-20_8-11	LSI-20	SB	N	0.0595	18.0	0.0914	27.7	0.0595	18.0	0.593	180	0.0445	13.5	1.47	445	0.0933	28.3	0.162	49.1	0.256	77.6	0.0873	26.5	0.618	187	1.12	339
LSI-24_8-11	LSI-24	SB	N	0.0620	6.81	0.0310	3.41	0.0620	6.81	0.211	23.2	0.0240	2.64	0.328	36.0	0.0287	3.15	0.146	16.0	0.0893	9.81	0.0820	9.01	0.139	15.3	0.306	33.6
PWS-1_8-10	PWS-01	SB	N	0.0625	11.2	0.0313	5.58	1.10	196	0.164	29.3	0.00626	1.12	0.100	17.9	0.0360	6.43	0.0292	5.21	0.0152	2.71	0.0156	2.79	0.0490	8.75	0.0862	15.4
PWS-3_8-11	PWS-03	SB	N	0.260	10.0	0.268	10.3	0.346	13.3	6.36	245	0.289	11.1	5.64	217	0.629	24.2	1.03	39.6	1.26	48.5	0.430	16.5	2.47	95.0	4.30	165
PWS-4_8-11	PWS-04	SB	N	0.0645	9.35	0.0322	4.66	0.0645	9.35	2.03	294	0.191	27.7	1.34	194	0.156	22.6	0.793	115	0.339	49.1	0.470	68.1	0.711	103	1.15	167
PWS-5_8-11	PWS-05	SB	N	0.0750	6.25	0.126	10.5	0.211	17.6	1.24	103	0.0604	5.03	1.22	102	0.277	23.1	0.233	19.4	0.634	52.8	0.124	10.3	0.882	73.5	0.855	71.3
PWS-6_8-11	PWS-06	SB	N	0.0825	5.50	0.326	21.7	1.29	86.0	0.693	46.2	0.0534	3.56	2.38	159	0.969	64.6	0.184	12.3	2.05	137	0.0937	6.25	2.77	185	1.67	111
PWS-7_8-10	PWS-07	SB	N	0.167	9.82	0.536	31.5	0.378	22.2	2.07	122	0.186	10.9	4.43	261	1.05	61.8	0.619	36.4	1.99	117	0.411	24.2	3.16	186	3.50	206
PWS-7_8-10 DUP	PWS-07	SB	FD	0.150	8.82	0.334	19.6	0.282	16.6	2.56	151	0.197	11.6	3.29	194	0.962	56.6	0.758	44.6	2.53	149	0.463	27.2	2.42	142	2.60	153
PWS-8_8-11	PWS-08	SB	N	0.0825	5.50	0.138	9.20	0.616	41.1	0.615	41.0	0.0554	3.69	1.12	74.7	0.320	21.3	0.209	13.9	0.593	39.5	0.0916	6.11	0.962	64.1	0.775	51.7
PWS-9_8-11	PWS-09	SB	N	0.0940	5.22	0.0471	2.62	0.0940	5.22	0.227	12.6	0.00471	0.262	0.203	11.3	0.0675	3.75	0.0354	1.97	0.0943	5.24	0.0208	1.16	0.179	9.94	0.149	8.28
PWS-12_8-11	PWS-12	SB	N	0.0805	5.37	0.0402	2.68	0.0805	5.37	0.0273	1.82	0.00402	0.268	0.0450	3.00	0.00402	0.268	0.0170	1.13	0.0109	0.727	0.0113	0.753	0.0203	1.35	0.0421	2.81
PWS-13_8-11	PWS-13	SB	N	0.557	25.3	3.79	172	4.37	199	0.885	40.2	0.0440	2.00	0.977	44.4	0.208	9.45	0.0701	3.19	0.276	12.5	0.0965	4.39	1.24	56.4	1.01	45.9
PWS-13_8-11_1	PWS-13	SB	FD	0.547	24.9	3.68	167	2.93	133	1.12	50.9	0.0432	1.96	1.63	74.1	0.334	15.2	0.127	5.77	0.766	34.8	0.123	5.59	1.77	80.5	1.60	72.7
PWS-13_8-11_2	PWS-13	SB	FT	0.537	24.4	2.64	120	2.18	99.1	0.449	20.4	0.0392	1.78	0.662	30.1	0.169	7.68	0.109	4.95	0.305	13.9	0.0880	4.00	0.965	43.9	0.748	34.0
PWS-15_8-11	PWS-15	SB	N	0.0670	8.27	0.0334	4.12	0.0670	8.27	0.0215	2.65	0.00334	0.412	0.0584	7.21	0.0150	1.85	0.00881	1.09	0.0329	4.06	0.0264	3.26	0.0405	5.00	0.0480	5.93
PWS-16_8-11	PWS-16	SB	N	0.0710	4.44	0.0356	2.22	0.0710	4.44	0.197	12.3	0.0148	0.925	0.465	29.1	0.0989	6.18	0.0551	3.44	0.187	11.7	0.0305	1.91	0.316	19.8	0.339	21.2
PWS-25_4-8	PWS-25	SB	N	0.0735	7.50	0.0367	3.74	0.299	30.5	1.64	167	0.140	14.3	1.56	159	0.268	27.3	0.516	52.7	0.473	48.3	0.274	28.0	0.667	68.1	1.11	113
PWS-26_8-11	PWS-26	SB	N	0.0745	7.45	0.130	13.0	2.59	259	0.711	71.1	0.0554	5.54	1.22	122	0.435	43.5	0.221	22.1	0.776	77.6	0.0950	9.50	1.09	109	0.854	85.4
PWS-26_8-11_DUP	PWS-26	SB	FD	0.0755	5.39	0.153	10.9	0.876	62.6	1.32	94.3	0.0995	7.11	1.77	126	0.428	30.6	0.373	26.6	1.00	71.4	0.175	12.5	1.20	85.7	1.28	91.4
PWS-28_8-11	PWS-28	SB	N	0.0605	5.50	0.0302	2.74	0.0605	5.50	0.0658	5.98	0.0103	0.936	0.132	12.0	0.00635	0.577	0.0560	5.09	0.0211	1.92	0.0287	2.61	0.0605	5.50	0.106	9.64

Notes:

[1]Normalization based on total organic carbon (TOC).

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

mg/kg = milligrams per kilogram

OC = organic carbon

PAH = polycyclic aromatic hydrocarbon

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracene	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracene	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracene	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracene	Chrysene	Dibenzo(a,h)anthracene
Final Chronic Value (mg/kg OC)				491	452	594	841	965	979	967	1,095	981	929	770	611	444	670	1,008	686	510	746	1,112	769	581	829	1,214	657	913	844	1,123
Historical Data (1996 - 2005)																														
SD-MC-A _20040601	SD-MC-A	MC	N	0.00134	0.00961	0.0128	0.0288	0.0471	0.0299		0.0420	0.0278				0.00148													0.0425	0.00225
SD-MC-B _20040601	SD-MC-B	MC	N	0.00266	6.01E-04	4.57E-04	6.72E-04	0.00107	0.00107		0.00139	6.98E-04				0.00294													0.00104	2.42E-04
SD-MC-C _20040601	SD-MC-C	MC	N	0.00679	0.00156	0.00378	0.00373	0.00438	0.00347		0.00480	0.00235				0.00217													0.00554	4.00E-04
SD-MC-D _20040601	SD-MC-D	MC	N	0.00116	2.17E-04	9.02E-04	0.00140	9.62E-04	9.12E-04		6.52E-04	6.92E-04				6.03E-04													0.00212	8.75E-05
SD-MC-E _20040601	SD-MC-E	MC	N	0.00293	0.00287	0.0159	0.00626	0.0113	0.0108		0.00641	0.00608				0.00158													0.0108	0.00116
SD-100_20031201	SD-100	SB	N	0.00122	2.85E-04	0.00287	0.00433	0.00325	0.00353		0.00219	0.00249				0.00135													0.00764	3.12E-04
SD-101 _20031201	SD-101	SB	N	0.00336	3.40E-04	0.00371	0.00475	0.00371	0.00403		0.00247	0.00276				0.00517													0.00707	3.35E-04
SD-102 _20031201	SD-102	SB	N	7.46E-04	3.40E-04	0.00192	0.00403	0.00330	0.00442		0.00201	0.00329				8.42E-04													0.00653	2.98E-04
SD-103 _20031201	SD-103	SB	N	0.00528	0.00177	0.00739	0.0168	0.0117	0.0173		0.00418	0.0130				0.00510													0.0330	8.40E-04
SD-103-A _20040601	SD-103-A	SB	N	0.0263	0.00162	0.0416	0.0174	0.00397	0.00641		0.00197	0.00568				0.0283													0.0190	3.72E-04
SD-103-B._20040601	SD-103-B	SB	N	0.00210	0.00100	0.00450	0.00426	0.00316	0.00378		0.00248	0.00336				0.00315													0.00634	3.33E-04
SD-103-C _20040601	SD-103-C	SB	N	0.00536	0.00169	0.0129	0.0113	0.00672	0.00975		0.00335	0.00778				0.00946													0.0213	6.80E-04
SD-104_20031201	SD-104	SB	N	0.0106	0.00214	0.0201	0.0169	0.0100	0.0133		0.00571	0.00927				0.0179													0.0202	0.00111
SD-104-A _20040601	SD-104-A	SB	N	6.58E-04	3.05E-04	0.00189	0.00220	0.00188	0.00225		0.00150	0.00189				9.03E-04													0.00414	1.23E-04
SD-104-B _20040601	SD-104-B	SB	N	7.17E-04	3.00E-04	0.00177	0.00212	0.00151	0.00207		0.00115	0.00153				9.12E-04													0.00345	1.21E-04
SD-104-C _20040601	SD-104-C	SB	N	6.85E-04	3.15E-04	0.00218	0.00226	0.00165	0.00216		0.00130	0.00163				9.22E-04													0.00444	1.27E-04
SD-105_20031201	SD-105	SB	N	0.00783	0.00102	0.00857	0.00771	0.00576	0.00615		0.00376	0.00462				0.00730													0.0104	5.77E-04
SD-105-A _20040601	SD-105-A	SB	N	0.00153	8.04E-04	0.00378	0.00334	0.00210	0.00295		0.00150	0.00221				0.00202													0.00577	1.12E-04
SD-105-B _20040601	SD-105-B	SB	N	0.0728	0.00187	0.0188	0.00238	0.00143	0.00196		9.13E-04	0.00176				0.00173													0.00442	1.11E-04
SD-105-C _20040601	SD-105-C	SB	N	8.62E-04	2.81E-04	0.00175	0.00160	0.00108	0.00149		7.73E-04	0.00122				8.66E-04													0.00264	1.10E-04
SD-106 _20031201	SD-106	SB	N	0.00262	8.95E-04	0.00681	0.00906	0.00790	0.00827		0.00431	0.00631				0.00343													0.0158	6.78E-04
SD-108 _20031201	SD-108	SB	N	0.116	0.00614	0.135	0.0738	0.0386	0.0477		0.0160	0.0335				0.115													0.104	0.00325
SD-110_20031201	SD-110	SB	N	0.0652	0.00367	0.0500	0.0510	0.0332	0.0426		0.0115	0.0291				0.0283													0.0745	0.00280
SD-112 _20031201	SD-112	SB	N	0.0297	0.00365	0.0376	0.0312	0.0262	0.0307		0.0142	0.0208				0.0241													0.0483	0.00242
SD-112-A _20040601	SD-112-A	SB	N	0.00844	0.00364	0.0210	0.0117	0.0177	0.0215		0.0102	0.0161				0.0102													0.0296	0.00199
SD-112-B _20040601	SD-112-B	SB	N	0.0110	0.00431	0.0227	0.0306	0.0276	0.0367		0.0115	0.0305				0.0128													0.0532	0.00293
SD-112-C _20040601	SD-112-C	SB	N	0.00796	0.00423	0.0204	0.0283	0.0255	0.0331		0.0128	0.0247				0.00607													0.0421	0.00289
SD-113 _20031201	SD-113	SB	N	0.00231	0.00251	0.00191	0.00811	0.00848	0.00557		0.00498	0.00556				0.00256													0.0102	0.00101
SD-114 _20031201	SD-114	SB	N	7.64E-04	3.88E-04	0.00220	0.00276	0.00358	0.00298		0.00245	0.00243				8.04E-04													0.00508	1.56E-04
SD-115_20031201	SD-115	SB	N	0.00118	0.00112	6.10E-04	0.00155	0.00180	0.00163		0.00120	0.00130				9.79E-04													0.00223	3.23E-04
SD-116 _20031201	SD-116	SB	N	0.00108	5.42E-04	0.00133	0.00369	0.00611	0.00398		0.00475	0.00336				5.52E-04													0.00486	5.43E-04
SD-117 _20031201	SD-117	SB	N	0.00647	0.00289	0.0123	0.0222	0.0242	0.0172		0.0154	0.0143				0.00737													0.0399	0.00191
SD-117-A _20040601	SD-117-A	SB	N	0.00283	0.00307	0.00234	0.00542	0.00518	0.00494		0.00360	0.00470				0.00313													0.00606	0.00124
SD-117-B _20040601	SD-117-B	SB	N	0.00557	0.00136	0.00359	0.00250	0.00266	0.00310		0.00216	0.00204				0.00511													0.00395	5.49E-04
SD-117-C _20040601	SD-117-C	SB	N	0.00402	0.00213	0.00642	0.00861	0.00954	0.0106		0.00649	0.00885				0.00593													0.0218	8.90E-04
SD-119_20031201	SD-119	SB	N	0.00315	0.00193	0.00444	0.00951	0.0141	0.0111		0.00913	0.00917				0.00389													0.0151	0.00105
SD-119-A _20040601	SD-119-A	SB	N	0.0325	9.95E-04	0.00956	0.00584	0.00233	0.00278		0.00113	0.00211				0.00720													0.00694	2.32E-04
SD-119-B _20040601	SD-119-B	SB	N	0.00876	0.00182	0.00521	0.00483	0.00395	0.00326		0.00251	0.00291				0.0102													0.00687	4.26E-04
SD-119-C _20040601	SD-119-C	SB	N	0.00807	0.00168	0.00483	0.00196	0.00106	9.78E-04		8.44E-04	8.75E-04				0.00743													0.00266	7.35E-05
SD-120 _20031201	SD-120	SB	N	0.00268	0.00291	0.00222	0.00588	0.00818	0.00489		0.00625	0.00515				0.00296													0.00811	0.00117
SD-121 _20040601	SD-121	SB	N	0.00113	6.15E-04	0.00206	0.00344	0.00357	0.00346		0.00208	0.00283				0.00175													0.00369	3.27E-04
SD-122 _20040601	SD-122	SB	N	0.0119	0.00128	0.0148	0.0111	0.00582	0.00657		0.00310	0.00590				0.0101													0.0201	5.16E-04
SD-123 _20040601	SD-123	SB	N	0.00491	0.00173	0.0122	0.0222	0.0137	0.0129		0.00605	0.0141				0.00353													0.0435	0.00150
SD-124 _20040601	SD-124	SB	N	4.16E-04	4.52E-04	0.00168	0.00495	0.00337	0.00366		0.00190	0.00323				4.60E-04													0.00750	1.82E-04
SD-125 _20050401	SD-125	SB	N	0.0305	0.00304	0.0274	0.0208	0.00734	0.0123		0.00266	0.00467				0.0122													0.0232	0.00260
SD-126_20050401	SD-126	SB	N	0.0195	0.00437	0.0188	0.0235	0.0109	0.0179		0.00436	0.00649				0.00366													0.0268	0.00116
SD-127 _20050401	SD-127	SB	N	0.0444	0.00352	0.0363	0.0231	0.00752	0.0141		0.00278	0.00430				0.0137													0.0261	8.13E-04
SD-128 _20050401	SD-128	SB	N	0.0481	0.00142	0.0195	0.00817	0.00245	0.00438		0.00106	0.00149				0.0135													0.00915	2.10E-04
SD-130 _20050401	SD-130	SB	N	0.00516	0.00218	0.00852	0.00813	0.00446	0.00957		0.00254	0.00284				0.00411													0.0132	6.54E-04
SD-131 _20050401	SD-131	SB	N	0.0443	0.0223	0.186	0.263	0.118	0.203		0.0432	0.0740				0.0142													0.411	0.0126
SD-132 _20050401	SD-132	SB	N	0.0131	0.00461	0.0131	0.0124	0.00693	0.0158		0.00391	0.00545				0.00397													0.0253	9.76E-04
SD-133 _20050401	SD-133	SB	N	0.00120	0.00218	0.00323	0.00586	0.00613	0.0106		0.00387	0.00367				9.76E-04													0.0123	7.46E-04
SD-134_20050401	SD-134	SB	N	0.0328	0.0178	0.138	0.0805	0.0435	0.0923		0.0177	0.0329				0.00545													0.120	0.00488
SD-135 _20050401	SD-135	SB	N	0.0101	0.0106	0.0364	0.0423	0.0304	0.0821		0.0183	0.0236				0.00557													0.0952	0.00427
SD-135_DUP_20050401	SD-135	SB	FD	0.00755	0.00855	0.0193	0.0423	0.0288	0.0663		0.0155	0.0221				0.00383													0.0824	0.00372
SD-136 _20050401	SD-136	SB	N	0.00748	0.0105	0.0286	0.0971	0.0775	0.153		0.0298	0.0465				0.00260													0.185	0.00848
SD-137 _20050401	SD-137	SB	N	1.89E-04	8.21E-04	0.00102	0.00147	0.00278	0.00411		0.00188	0.00105				2.55E-04													0.00220	3.76E-04
SD-139 _20050401	SD-139	SB	N	0.00666	0.00109	0.00239	0.00165	0.00198	0.00278		0.00129	9.72E-04				0.00104													0.00355	2.91E-04
SD-140_20050401	SD-140	SB	N	0.00125	0.00246	0.00432	0.00925	0.00691	0.0105		0.00445	0.00331				7.51E-04													0.0132	9.13E-04
SD-141_20050401	SD-141	SB	N	5.87E-04	9.00E-04	0.00171	0.00242	0.00228	0.00329		0.00132	0.00147				2.19E-04													0.00643	1.55E-04
SHI6D_19961101	SHID6	SB	N	0.00228	0.00195	0.00875	0.00666	0.00415	0.0110			0.00281				8.56E-04													0.00948	
SHID1_19961001	SHID1	SB	N	5.22E-04	5.67E-04	0.00108	0.00396	0.00611	0.00760			0.00366				5.78E-04													0.00729	
SHID2 _19961001	SHID2	SB	N	0.00484	0.00525	0.00400	0.00282	0.00492	0.00243			0.00242				0.00535													0.00281	

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	No. of PAH analytes available	ΣESBTU	Adjusted ΣESBTU based on UF from USEPA (2003) for fewer than 34 PAH analytes[4]	Adjusted ΣESBTU based on site-specific UF for fewer than 34 PAH analytes[5]	Sample used in bioassay?
Final Chronic Value (mg/kg OC)				707	538	1,115	385	967	596	697	--	--	--	--	--
Historical Data (1996 - 2005)															
SD-MC-A _20040601	SD-MC-A	MC	N	0.0857	0.00526	0.0317	0.00171		0.0847	0.0870	17	0.54	**3.48**	**1.66**	Y
SD-MC-B _20040601	SD-MC-B	MC	N	0.00307	0.00222	0.00117	0.0144		0.00419	0.00265	17	0.04	0.26	0.12	N
SD-MC-C _20040601	SD-MC-C	MC	N	0.0154	0.00584	0.00368	0.00216		0.0204	0.0147	17	0.10	0.65	0.31	N
SD-MC-D _20040601	SD-MC-D	MC	N	0.00369	0.00126	5.12E-04	0.00130		0.00461	0.00436	17	0.03	0.16	0.08	N
SD-MC-E _20040601	SD-MC-E	MC	N	0.0179	0.00359	0.00724	0.00510		0.0100	0.0156	17	0.14	0.87	0.42	N
SD-100_20031201	SD-100	SB	N	0.0111	0.00163	0.00256	0.00359		0.00657	0.00992	17	0.06	0.42	0.20	N
SD-101 _20031201	SD-101	SB	N	0.0149	0.00409	0.00288	0.0167		0.0139	0.0132	17	0.10	0.66	0.32	N
SD-102 _20031201	SD-102	SB	N	0.0134	9.51E-04	0.00237	0.00205		0.00535	0.0141	17	0.07	0.42	0.20	N
SD-103 _20031201	SD-103	SB	N	0.0274	0.00552	0.00592	0.00539		0.0222	0.0284	17	0.21	**1.36**	0.65	N
SD-103-A _20040601	SD-103-A	SB	N	0.172	0.0311	0.00203	0.0299		0.170	0.105	17	0.66	**4.25**	**2.03**	N
SD-103-B _20040601	SD-103-B	SB	N	0.0151	0.00298	0.00218	0.00748		0.0117	0.0124	17	0.09	0.55	0.26	N
SD-103-C _20040601	SD-103-C	SB	N	0.0324	0.00780	0.00377	0.0228		0.0269	0.0235	17	0.21	**1.33**	0.64	N
SD-104_20031201	SD-104	SB	N	0.0796	0.0103	0.00815	0.0325		0.0524	0.0620	17	0.37	**2.39**	**1.14**	N
SD-104-A _20040601	SD-104-A	SB	N	0.00610	8.81E-04	0.00131	0.00224		0.00405	0.00557	17	0.04	0.24	0.12	N
SD-104-B _20040601	SD-104-B	SB	N	0.00802	9.03E-04	9.44E-04	0.00231		0.00394	0.00639	17	0.04	0.24	0.12	N
SD-104-C _20040601	SD-104-C	SB	N	0.00671	9.61E-04	0.00108	0.00224		0.00419	0.00612	17	0.04	0.25	0.12	N
SD-105_20031201	SD-105	SB	N	0.0255	0.00723	0.00457	0.0204		0.0241	0.0193	17	0.16	**1.06**	0.51	N
SD-105-A _20040601	SD-105-A	SB	N	0.0117	0.00209	0.00128	0.00593		0.00754	0.00913	17	0.06	0.41	0.20	Y
SD-105-B _20040601	SD-105-B	SB	N	0.0207	0.0529	8.62E-04	0.00410		0.0710	0.0121	17	0.27	**1.73**	0.83	Y
SD-105-C _20040601	SD-105-C	SB	N	0.00653	0.00100	7.24E-04	0.00220		0.00432	0.00497	17	0.03	0.21	0.10	N
SD-106 _20031201	SD-106	SB	N	0.0222	0.00327	0.00555	0.00829		0.0128	0.0191	17	0.14	0.88	0.42	N
SD-108 _20031201	SD-108	SB	N	0.361	0.149	0.0229	0.246		0.404	0.251	17	**2.12**	**13.64**	**6.51**	N
SD-110_20031201	SD-110	SB	N	0.202	0.0627	0.0174	0.0534		0.163	0.139	17	**1.03**	**6.61**	**3.16**	N
SD-112 _20031201	SD-112	SB	N	0.119	0.0361	0.0192	0.0504		0.124	0.0947	17	0.71	**4.57**	**2.18**	N
SD-112-A _20040601	SD-112-A	SB	N	0.0642	0.0113	0.0118	0.0273		0.0519	0.0463	17	0.36	**2.34**	**1.12**	Y
SD-112-B _20040601	SD-112-B	SB	N	0.0932	0.0156	0.0145	0.0233		0.0427	0.0417	17	0.47	**3.05**	**1.46**	N
SD-112-C _20040601	SD-112-C	SB	N	0.0995	0.0116	0.0151	0.0122		0.0544	0.0538	17	0.45	**2.92**	**1.39**	Y
SD-113 _20031201	SD-113	SB	N	0.0129	0.00211	0.00611	0.00295		0.00191	0.0143	17	0.09	0.60	0.29	N
SD-114 _20031201	SD-114	SB	N	0.00682	9.40E-04	0.00267	0.00247		0.00390	0.00777	17	0.05	0.31	0.15	N
SD-115_20031201	SD-115	SB	N	0.00471	0.00135	0.00143	9.41E-04		0.00209	0.00499	17	0.03	0.19	0.09	N
SD-116 _20031201	SD-116	SB	N	0.00806	0.00115	0.00502	0.00312		0.00554	0.0100	17	0.06	0.41	0.20	N
SD-117 _20031201	SD-117	SB	N	0.0410	0.00799	0.0184	0.0206		0.0314	0.0402	17	0.32	**2.08**	0.99	N
SD-117-A _20040601	SD-117-A	SB	N	0.0141	0.00258	0.00309	0.00361		0.00233	0.0120	17	0.08	0.51	0.25	N
SD-117-B _20040601	SD-117-B	SB	N	0.00896	0.00582	0.00203	0.0113		0.0162	0.00765	17	0.08	0.54	0.26	N
SD-117-C _20040601	SD-117-C	SB	N	0.0223	0.00514	0.00602	0.0222		0.0221	0.0189	17	0.18	**1.2**	0.56	Y
SD-119_20031201	SD-119	SB	N	0.0193	0.00372	0.00978	0.0116		0.0145	0.0222	17	0.16	**1.05**	0.50	N
SD-119-A _20040601	SD-119-A	SB	N	0.0427	0.0154	0.00117	0.0215		0.0457	0.0297	17	0.23	**1.46**	0.70	N
SD-119-B _20040601	SD-119-B	SB	N	0.0191	0.00835	0.00243	0.0351		0.0219	0.0159	17	0.15	0.99	0.47	Y
SD-119-C _20040601	SD-119-C	SB	N	0.0159	0.00920	6.51E-04	0.0231		0.0244	0.0123	17	0.12	0.74	0.36	Y
SD-120 _20031201	SD-120	SB	N	0.00663	0.00245	0.00614	0.00342		0.00221	0.0121	17	0.08	0.53	0.26	N
SD-121 _20040601	SD-121	SB	N	0.00864	0.00176	0.00199	0.00390		0.00848	0.00701	17	0.06	0.36	0.17	N
SD-122 _20040601	SD-122	SB	N	0.0587	0.0163	0.00309	0.0182		0.0549	0.0386	17	0.28	**1.80**	0.86	N
SD-123 _20040601	SD-123	SB	N	0.0273	0.00784	0.00594	0.00767		0.0293	0.0207	17	0.24	**1.51**	0.72	N
SD-124 _20040601	SD-124	SB	N	0.0130	8.83E-04	0.00172	0.00147		0.00475	0.0108	17	0.06	0.39	0.19	N
SD-125 _20050401	SD-125	SB	N	0.112	0.0349	0.00291	0.0346		0.112	0.0837	17	0.53	**3.38**	**1.62**	N
SD-126_20050401	SD-126	SB	N	0.0856	0.0237	0.00457	0.00910		0.0748	0.0731	17	0.41	**2.62**	**1.25**	N
SD-127 _20050401	SD-127	SB	N	0.129	0.0522	0.00315	0.0255		0.181	0.0874	17	0.65	**4.20**	**2.01**	Y
SD-128 _20050401	SD-128	SB	N	0.0637	0.0558	0.00110	0.0195		0.151	0.0462	17	0.45	**2.87**	**1.37**	N
SD-130 _20050401	SD-130	SB	N	0.0312	0.00612	0.00272	0.00986		0.0217	0.0232	17	0.16	1.00	0.48	N
SD-131 _20050401	SD-131	SB	N	0.892	0.0457	0.0481	0.0361		0.270	0.679	17	**3.36**	**21.6**	**10.31**	Y
SD-132 _20050401	SD-132	SB	N	0.140	0.0119	0.00408	0.00972		0.0852	0.0844	17	0.44	**2.83**	**1.35**	Y
SD-133 _20050401	SD-133	SB	N	0.0272	0.00147	0.00384	0.00218		0.0116	0.0269	17	0.12	0.79	0.38	N
SD-134_20050401	SD-134	SB	N	0.297	0.0390	0.0203	0.0147		0.160	0.227	17	**1.34**	**8.63**	**4.12**	N
SD-135 _20050401	SD-135	SB	N	0.262	0.0144	0.0208	0.0145		0.143	0.175	17	0.99	**6.35**	**3.03**	Y
SD-135_DUP_20050401	SD-135	SB	FD	0.155	0.00948	0.0180	0.0100		0.0571	0.131	17	0.68	**4.37**	**2.09**	N
SD-136 _20050401	SD-136	SB	N	0.154	0.0164	0.0342	0.00442		0.0582	0.127	17	1.04	**6.68**	**3.19**	Y
SD-137 _20050401	SD-137	SB	N	0.00262	2.87E-04	0.00194	8.84E-04		0.00131	0.00296	17	0.03	0.17	0.08	N
SD-139 _20050401	SD-139	SB	N	0.00578	0.00425	0.00137	0.00191		0.00686	0.00547	17	0.05	0.32	0.15	N
SD-140_20050401	SD-140	SB	N	0.0290	0.00156	0.00414	0.00182		0.00688	0.0282	17	0.13	0.83	0.40	N
SD-141_20050401	SD-141	SB	N	0.00276	7.09E-04	0.00137	8.14E-04		0.00213	0.00316	17	0.03	0.20	0.10	N
SHI6D_19961101	SHID6	SB	N	0.0204	0.00283	0.00305	0.00291		0.0128	0.0195	15	0.11	0.81	NC	N
SHID1_19961001	SHID1	SB	N	0.0120	4.77E-04	0.00368	6.66E-04		0.00314	0.0107	15	0.06	0.46	NC	N
SHID2 _19961001	SHID2	SB	N	0.00778	0.00441	0.00213	0.00617		0.00398	0.00933	15	0.07	0.51	NC	N

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracene	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracene	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracene	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracene	Chrysene	Dibenzo(a,h)anthracene
Final Chronic Value (mg/kg OC)				491	452	594	841	965	979	967	1,095	981	929	770	611	444	670	1,008	686	510	746	1,112	769	581	829	1,214	657	913	844	1,123
2011 Sediment Data																														
MCO3-0-0.3	MC03	MC	N	0.00316	0.00343	0.00261	0.00184	0.00161	0.00158	0.00160	0.00142	0.00158	0.00838	0.0101	0.0127	0.0175	0.0116	0.00772	0.0113	0.0153	0.0104	0.00700	0.0101	0.0134	0.00939	0.0128	0.0118	0.0170	0.00184	0.00138
MC04-0-0.3	MC04	MC	N	0.0390	0.00107	0.00364	5.73E-04	5.00E-04	4.92E-04		4.40E-04	4.91E-04																	5.71E-04	4.29E-04
SB01-0-0.3	SB01	SB	N	0.00194	0.00211	0.00332	0.00326	0.00272	0.00281		0.00240	0.00280																	0.00487	8.50E-04
SB02-0.0.3	SB02	SB	N	0.00155	0.00169	0.00345	0.00276	0.00188	0.00200	0.00168	0.00140	0.00199	0.00410	0.00495	0.00624	0.00859	0.00569	0.00378	0.00556	0.00748	0.00511	0.00343	0.00496	0.00656	0.00460	0.00628	0.00580	0.00835	0.00330	6.79E-04
SB03_0-0.3	SB03	SB	N	9.47E-04	0.00103	0.00283	0.00208	0.00147	0.00160		0.00135	0.00160																	0.00290	4.14E-04
SB04-0-0.3	SB04	SB	N	0.00560	0.00195	0.0107	0.00657	0.00491	0.00496		0.00416	0.00495																	0.00903	7.84E-04
SB06-0-0.3	SB06	SB	N	0.00184	0.00200	0.00911	0.00849	0.00617	0.00664		0.00440	0.00663																	0.0168	8.05E-04
SB07-0-0.3	SB07	SB	N	8.76E-04	9.51E-04	7.24E-04	5.11E-04	4.46E-04	4.39E-04		3.93E-04	4.38E-04																	5.09E-04	3.83E-04
SB08-0-0.3	SB08	SB	N	0.00312	0.00161	0.00484	0.00439	0.00344	0.00398	0.00292	0.00229	0.00397	0.00392	0.00472	0.00595	0.00819	0.00543	0.00361	0.00530	0.00713	0.00488	0.00327	0.00473	0.00626	0.00439	0.00599	0.00554	0.00797	0.00695	6.48E-04
SB09-0-0.3	SB09	SB	N	0.393	0.00774	0.105	0.0353	0.0125	0.0148	0.00979	0.00701	0.0147	0.0188	0.0872	0.0807	0.352	0.226	0.0174	0.0255	0.263	0.0967	0.0157	0.0228	0.181	0.0211	0.0288	0.0728	0.0383	0.0407	0.00312
SB12-0-0.3	SB12	SB	N	0.0162	0.0176	0.0278	0.0269	0.00825	0.00813		0.00727	0.00812																	0.0375	0.00709
SB13-0-0.3	SB13	SB	N	0.0241	0.00640	0.0140	0.0122	0.00300	0.00296		0.00264	0.00296																	0.0118	0.00258
SB17-0-0.3	SB17	SB	N	0.0221	0.0240	0.0183	0.0352	0.0112	0.0242		0.00991	0.0242																	0.0500	0.00966
SB19-0-0.3	SB19	SB	N	0.0279	0.0303	0.0230	0.0163	0.0142	0.0140		0.0125	0.0139																	0.0162	0.0122

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	No. of PAH analytes available	ΣESBTU	Adjusted ΣESBTU based on UF from USEPA (2003) for fewer than 34 PAH analytes[4]	Adjusted ΣESBTU based on site-specific UF for fewer than 34 PAH analytes[5]	Sample used in bioassay?
Final Chronic Value (mg/kg OC)				707	538	1,115	385	967	596	697	--	--	--	--	--
2011 Sediment Data															
MCO3-0-0.3	MC03	MC	N	0.00219	0.00288	0.00139	0.00403	0.00925	0.00260	0.00223	34	0.23	NC	NC	N
MC04-0-0.3	MC04	MC	N	0.00238	0.0223	4.32E-04	0.0161		0.0282	0.00181	16	0.12	0.82	0.36	N
SB01-0-0.3	SB01	SB	N	0.00831	0.00177	0.00217	0.00248		0.00544	0.00795	16	0.06	0.38	0.17	N
SB02-0.0.3	SB02	SB	N	0.00913	0.00142	0.00141	0.00848	0.00174	0.00672	0.00765	34	0.15	NC	NC	N
SB03_0-0.3	SB03	SB	N	0.00732	8.65E-04	0.00128	0.00381		0.00375	0.00604	16	0.04	0.27	0.12	N
SB04-0-0.3	SB04	SB	N	0.0291	0.00664	0.00374	0.0104		0.0269	0.0213	16	0.15	**1.05**	0.47	N
SB06-0-0.3	SB06	SB	N	0.0212	0.00372	0.00424	0.00737		0.0112	0.0175	16	0.13	0.89	0.39	N
SB07-0-0.3	SB07	SB	N	6.08E-04	7.99E-04	3.86E-04	0.00713		7.21E-04	6.17E-04	16	0.02	0.11	0.05	N
SB08-0-0.3	SB08	SB	N	0.0135	0.00135	0.00227	0.0127	7.52E-04	0.00688	0.0105	34	0.17	NC	NC	N
SB09-0-0.3	SB09	SB	N	0.369	0.393	0.00692	1.49	0.00362	0.689	0.217	34	**5.36**	NC	NC	N
SB12-0-0.3	SB12	SB	N	0.118	0.0148	0.00714	0.0207		0.0794	0.0872	16	0.49	**3.41**	**1.51**	N
SB13-0-0.3	SB13	SB	N	0.0531	0.0220	0.00260	0.00752		0.0707	0.0369	16	0.28	**1.91**	0.84	N
SB17-0-0.3	SB17	SB	N	0.149	0.0202	0.00973	0.0282		0.0764	0.112	16	0.62	**4.33**	**1.92**	N
SB19-0-0.3	SB19	SB	N	0.0437	0.0254	0.0123	0.0355		0.0230	0.0196	16	0.34	**2.36**	**1.04**	N

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracene	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracene	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracene	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracene	Chrysene	Dibenzo(a,h)anthracene
Final Chronic Value (mg/kg OC)				491	452	594	841	965	979	967	1,095	981	929	770	611	444	670	1,008	686	510	746	1,112	769	581	829	1,214	657	913	844	1,123
SB20-0-0.3	SB20	SB	N	0.0282	0.00869	0.0172	0.0184	0.0110	0.0162		0.00770	0.0161																	0.0280	0.00350
SB21-0-0.3	SB21	SB	N	0.00948	0.0103	0.00784	0.0189	0.0153	0.0151		0.00425	0.0150																	0.0231	0.00415
SB24-0-0.3	SB24	SB	N	0.129	0.0435	0.0331	0.0589	0.0204	0.0201		0.0180	0.0201																	0.0504	0.0175
SB26-0-0.3	SB26	SB	N	0.0836	0.0315	0.0558	0.0358	0.0148	0.0145		0.0130	0.0145																	0.0169	0.0127
SB27-0-0.3	SB27	SB	N	1.22	0.0311	0.227	0.0713	0.0145	0.0144		0.0128	0.0143																	0.0742	0.0125
SB28-0-0.3	SB28	SB	N	0.589	0.0325	0.309	0.129	0.0587	0.112	0.0521	0.0277	0.0339	0.0638	0.260	0.119	1.17	0.429	0.0149	0.0391	0.521	0.167	0.00303	0.0240	0.219	0.0563	0.00555	0.0738	0.0176	0.211	0.00732
2012 Sediment Data																														
PWS-27_8-11_SE	PWS-27	MC	N	0.00112	4.95E-04	0.00167	0.00461	0.00587	0.00766	0.00408	0.00204	0.00259	0.00483	0.00613	0.00366	0.00276	0.00334	0.00799	0.00326	0.00438	0.00300	0.00201	0.00291	0.00385	0.00270	0.00368	0.00340	0.00490	0.00553	0.00199
PWS-01_8-9_SE	PWS-01	SB	N	0.244	0.00467	0.0305	0.0169	0.0110	0.0235	0.0117	0.00477	0.00746	0.00576	0.0297	0.0270	0.0621	0.0407	0.00531	0.00780	0.110	0.0183	0.00481	0.00696	0.0363	0.00645	0.00883	0.00814	0.0117	0.0239	0.00109
PWS-03_8-11_SE	PWS-03	SB	N	0.0997	0.0387	0.162	0.237	0.129	0.277	0.140	0.0571	0.0965	0.142	0.417	0.0446	0.209	0.225	0.0383	0.0391	0.136	0.145	0.0280	0.0189	0.0768	0.0724	0.0110	0.0331	0.0147	0.413	0.0141
PWS-04_1-4_SE	PWS-04	SB	N	0.0273	0.00948	0.0389	0.0457	0.0321	0.0638	0.0331	0.0158	0.0211	0.0250	0.0665	0.0140	0.0587	0.0515	0.00951	0.0102	0.0332	0.0322	0.00967	0.00384	0.0218	0.0147	0.00487	0.0109	0.00648	0.0618	0.00386
PWS-04_8-11_SE	PWS-04	SB	N	0.106	0.0170	0.0941	0.0794	0.0489	0.0964	0.0524	0.0230	0.0290	0.0420	0.132	0.0288	0.161	0.139	0.0171	0.0280	0.128	0.0769	0.0147	0.0243	0.0627	0.0388	0.00597	0.0311	0.00794	0.120	0.00609
PWS-05_8-11_SE	PWS-05	SB	N	0.0950	0.0171	0.0908	0.100	0.0593	0.110	0.0580	0.0248	0.0342	0.0486	0.144	0.0251	0.136	0.114	0.0184	0.0181	0.108	0.0681	0.0113	0.00954	0.0557	0.0318	0.00362	0.0229	0.0767	0.136	0.00608
PWS-06_8-11_SE	PWS-06	SB	N	0.344	0.0226	0.249	0.126	0.0439	0.109	0.0495	0.0139	0.0328	0.0604	0.303	0.0740	0.685	0.395	0.0217	0.0608	0.386	0.196	0.0130	0.0243	0.174	0.0671	0.0117	0.0668	0.200	0.192	0.00414
PWS-07_8-11_SE	PWS-07	SB	N	0.0960	0.0171	0.0890	0.0722	0.0503	0.0981	0.0521	0.0231	0.0303	0.0504	0.105	0.0209	0.180	0.0997	0.0161	0.00210	0.0994	0.0536	0.0107	0.0184	0.0485	0.0238	0.00237	0.0219	0.00958	0.101	0.00563
PWS-08_8-11_SE	PWS-08	SB	N	0.102	0.00751	0.0666	0.0401	0.0184	0.0354	0.0174	0.00726	0.0107	0.0209	0.0730	0.0232	0.156	0.110	0.00902	0.0209	0.118	0.0526	0.00741	0.00941	0.0611	0.0233	0.00349	0.0267	0.0188	0.0452	0.00209
PWS-09_8-11_SE	PWS-09	SB	N	0.0339	0.00426	0.0254	0.0215	0.0130	0.0212	0.0112	0.00502	0.00683	0.0105	0.0368	0.0160	0.0441	0.0483	0.00457	0.00787	0.0356	0.0202	0.00200	0.00289	0.0231	0.00881	0.00367	0.00890	0.0127	0.0242	0.00132
PWS-12_8-11_SE	PWS-12	SB	N	0.00897	0.00329	0.0104	0.0152	0.0139	0.0230	0.0128	0.00776	0.00815	0.00909	0.0197	0.00445	0.0105	0.0136	0.00606	0.00396	0.00533	0.00968	0.00245	0.00354	0.00468	0.00328	0.00448	0.00414	0.00596	0.0217	0.00173
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.00487	0.00242	0.00793	0.00971	0.00818	0.0138	0.00741	0.00402	0.00420	0.00628	0.0142	0.00424	0.00847	0.0111	0.00257	0.00378	0.00508	0.00717	0.00233	0.00337	0.00446	0.00313	0.00428	0.00394	0.00569	0.0142	9.45E-04
PWS-13_1-4_SE	PWS-13	SB	N	0.00714	0.00279	0.0170	0.00846	0.0107	0.0127	0.00735	0.00561	0.00404	0.00518	0.0114	0.00306	0.0169	0.0142	0.00186	0.00273	0.0146	0.00804	0.00168	0.00243	0.0117	0.00226	0.00307	0.00285	0.00408	0.0122	9.07E-04
PWS-13_8-11_SE	PWS-13	SB	N	0.00749	0.00263	0.00909	0.0141	0.0130	0.0237	0.0113	0.00575	0.00775	0.0120	0.0182	0.00376	0.0159	0.0140	0.00466	0.00335	0.0119	0.00845	0.00495	0.00298	0.00861	0.00802	0.00379	0.00349	0.00504	0.0186	0.00134
PWS-15_8-11_SE	PWS-15	SB	N	0.00123	5.60E-04	0.00141	0.00142	0.00142	0.00180	0.00116	2.31E-04	0.00106	0.00272	0.00329	0.00414	0.00260	0.00378	0.00251	0.00369	0.00496	0.00339	0.00228	0.00329	0.0103	0.00305	0.00417	0.00385	0.0174	0.00196	2.25E-04
PWS-16B_8-11_SE	PWS-16	SB	N	0.0259	0.00600	0.0257	0.0237	0.0120	0.0251	0.0133	0.00614	0.00783	0.0126	0.0360	0.00796	0.0558	0.0313	0.00455	0.00676	0.0291	0.0188	0.00462	0.00253	0.0163	0.0121	0.00320	0.00816	0.00426	0.0298	0.00173
PWS-16_8-11_SE	PWS-16	SB	N	0.132	0.0175	0.130	0.0554	0.0226	0.0511	0.0267	0.00913	0.0143	0.0339	0.103	0.0362	0.349	0.154	0.0111	0.0265	0.179	0.0677	0.0112	0.0111	0.0830	0.0227	0.00348	0.0295	0.0127	0.0658	0.00188
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0100	0.00215	0.00641	0.0131	0.00642	0.0117	0.00564	0.00236	0.00332	0.0104	0.0223	0.00297	0.00529	0.0122	0.00645	0.00264	0.00355	0.0147	0.00337	0.00236	0.00312	0.0154	0.00299	0.00596	0.00397	0.0164	8.10E-04
PWS-25_8-11_SE	PWS-25	SB	N	0.0682	0.0151	0.0536	0.0591	0.0516	0.0977	0.0506	0.0240	0.0333	0.0389	0.101	0.0177	0.121	0.0889	0.0166	0.0179	0.0641	0.0497	0.0130	0.00878	0.0399	0.0219	0.00422	0.0197	0.0188	0.0926	0.00651
PWS-26_8-11_SE	PWS-26	SB	N	0.0971	0.00933	0.0669	0.0350	0.0250	0.0438	0.0228	0.0139	0.0146	0.0197	0.0629	0.0222	0.174	0.0935	0.0113	0.0162	0.0908	0.0381	0.00854	0.00444	0.0506	0.0169	0.00563	0.0200	0.0371	0.0496	0.00304
PWS-17_4-7	PWS-17	MC	N	0.0319	0.00207	0.00422	0.00329	0.00221	0.00506	0.00308	0.00183	0.00147	0.00313	0.00378	0.00476	0.0299	0.00434	0.00289	0.00424	0.0123	0.00390	0.00262	0.00378	0.00501	0.00351	0.00481	0.00443	0.00640	0.00503	2.59E-04
PWS-27_8-11	PWS-27	MC	N	0.00125	0.00122	0.00261	0.00451	0.00394	0.00571	0.00353	0.00264	0.00203	0.00441	0.00729	0.00332	0.00174	0.0104	0.00411	0.00295	0.00397	0.00930	0.00526	0.00264	0.00349	0.00685	0.00334	0.00308	0.00445	0.00643	5.40E-04
PWS-30_8-11	PWS-30	MC	N	7.90E-04	8.58E-04	6.53E-04	4.61E-04	4.02E-04	3.96E-04	4.01E-04	3.54E-04	3.95E-04	0.00417	0.00504	0.00635	0.00175	0.00579	0.00385	0.00565	0.00760	0.00520	0.00349	0.00504	0.00667	0.00468	0.00640	0.00590	0.00851	4.59E-04	3.45E-04
LSI-01_8-11	LSI-01	SB	N	0.0364	0.00777	0.0424	0.0240	0.0161	0.0267	0.0164	0.0117	0.00805	0.0181	0.0219	0.0276	0.0902	0.0251	0.0167	0.0246	0.0330	0.0226	0.0151	0.0219	0.0290	0.0203	0.0277	0.0256	0.0369	0.0291	0.00150
LSI-02_8-11	LSI-02	SB	N	0.00780	0.00252	0.0138	0.00832	0.00613	0.0134	0.00750	0.00366	0.00445	0.00561	0.0111	0.00412	0.00802	0.0127	0.00250	0.00367	0.00493	0.00712	0.00226	0.00327	0.00433	0.00303	0.00414	0.00383	0.00551	0.0122	8.74E-04
LSI-20_8-11	LSI-20	SB	N	0.0784	0.0250	0.0969	0.157	0.0999	0.201	0.1000	0.0399	0.0667	0.107	0.236	0.0338	0.0759	0.190	0.0418	0.0342	0.0497	0.118	0.0352	0.0500	0.0527	0.0742	0.0149	0.0422	0.0197	0.213	0.0120
LSI-24_8-11	LSI-24	SB	N	0.0255	0.00839	0.00705	0.0216	0.0266	0.0306	0.0185	0.0174	0.0114	0.0142	0.0283	0.00558	0.0111	0.0200	0.00724	0.00497	0.00668	0.0205	0.00306	0.00443	0.00586	0.0174	0.00561	0.00519	0.00746	0.0275	0.00235
PWS-1_8-10	PWS-01	SB	N	0.0268	0.00123	0.00571	0.0170	0.00897	0.0138	0.00781	0.00444	0.00521	0.00601	0.0262	0.00913	0.00251	0.00833	0.00554	0.00813	0.0109	0.00748	0.00502	0.00726	0.00960	0.00673	0.00919	0.00849	0.215	0.0347	9.95E-04
PWS-3_8-11	PWS-03	SB	N	0.0361	0.0247	0.0751	0.120	0.0789	0.171	0.0815	0.0260	0.0572	0.0667	0.182	0.0161	0.0599	0.113	0.0231	0.0127	0.0394	0.0670	0.0188	0.0309	0.0279	0.0317	0.00824	0.0157	0.0146	0.290	0.00990
PWS-4_8-11	PWS-04	SB	N	0.0301	0.0252	0.212	0.132	0.219	0.295	0.189	0.0834	0.0830	0.0866	0.186	0.00763	0.0439	0.115	0.0401	0.00679	0.0266	0.0575	0.0311	0.0245	0.0202	0.0278	0.00770	0.00709	0.0102	0.349	0.0246
PWS-5_8-11	PWS-05	SB	N	0.0480	0.0104	0.0384	0.0508	0.0394	0.0734	0.0352	0.0156	0.0250	0.0283	0.0632	0.0132	0.0580	0.0567	0.0123	0.0103	0.0420	0.0355	0.00997	0.0159	0.0311	0.0145	0.00515	0.0160	0.0193	0.122	0.00448
PWS-6_8-11	PWS-06	SB	N	0.133	0.00988	0.0979	0.0480	0.0256	0.0501	0.0248	0.00968	0.0181	0.0253	0.0732	0.0319	0.186	0.128	0.0126	0.0174	0.136	0.0570	0.0110	0.0167	0.0878	0.0236	0.00453	0.0331	0.0942	0.0547	0.00317
PWS-7_8-10	PWS-07	SB	N	0.105	0.0228	0.266	0.125	0.0908	0.161	0.0779	0.0242	0.0523	0.0640	0.157	0.0367	0.132	0.176	0.0304	0.0249	0.106	0.0930	0.0258	0.0421	0.0975	0.0472	0.00809	0.0480	0.0244	0.144	0.00974
PWS-7_8-10 DUP	PWS-07	SB	FD	0.103	0.0239	0.0971	0.0965	0.0988	0.162	0.0870	0.0316	0.0496	0.0591	0.134	0.0325	0.174	0.136	0.0264	0.0201	0.101	0.0759	0.0222	0.0324	0.0678	0.0343	0.00727	0.0299	0.0182	0.178	0.0103
PWS-8_8-11	PWS-08	SB	N	0.0354	0.00771	0.0386	0.0328	0.0253	0.0509	0.0250	0.0110	0.0186	0.0215	0.0468	0.0117	0.0578	0.0510	0.00926	0.00832	0.0391	0.0317	0.00905	0.0129	0.0241	0.0146	0.00453	0.0140	0.0450	0.0486	0.00329
PWS-9_8-11	PWS-09	SB	N	0.00559	5.79E-04	0.00644	0.00552	0.00315	0.00529	0.00272	0.00167	0.00211	0.00282	0.0101	0.00428	0.00744	0.0103	0.00260	0.00381	0.00513	0.00351	0.00235	0.00340	0.00450	0.00316	0.00430	0.00398	0.00572	0.0149	2.33E-04
PWS-12_8-11	PWS-12	SB	N	5.46E-04	5.93E-04	4.51E-04	0.00157	0.00126	0.00206	0.00126	0.00100	7.14E-04	0.00288	0.00348	0.00439	0.00121	0.00400	0.00266	0.00391	0.00525	0.00359	0.00241	0.00349	0.00461	0.00323	0.00442	0.00408	0.00588	0.00216	2.39E-04
PWS-13_8-11	PWS-13	SB	N	0.0229	0.00299	0.0165	0.0268	0.0132	0.0126	0.0113	0.00355	0.00496	0.0734	0.116	0.0501	0.0157	0.257	0.0830	0.0934	0.148	0.346	0.0576	0.103	0.417	0.252	0.0209	0.262	0.218	0.0477	0.00178
PWS-13_8-11_1	PWS-13	SB	FD	0.0321	0.00540	0.0243	0.0324	0.0152	0.0199	0.0147	0.00664	0.00639	0.0866	0.138	0.0475	0.0423	0.290	0.0929	0.0709	0.195	0.335	0.0679	0.0839	0.437	0.288	0.0205	0.255	0.146	0.0603	0.00175
PWS-13_8-11_2	PWS-13	SB	FT	0.0173	0.00343	0.0122	0.0157	0.0122	0.0140	0.0118	0.00560	0.00420	0.0597	0.0785	0.0295	0.0200	0.180	0.0681	0.0481	0.134	0.219	0.0433	0.0562	0.324	0.203	0.0201	0.183	0.109	0.0242	0.00159
PWS-15_8-11	PWS-15	SB	N	0.00593	9.12E-04	0.00210	0.00314	0.00143	0.00261	0.00137	9.83E-04	9.84E-04	0.00444	0.00536	0.00675	0.00435	0.00615	0.00409	0.00601	0.00809	0.00553	0.00371	0.00536	0.00710	0.00497	0.00681	0.00628	0.00906	0.00314	3.67E-04
PWS-16_8-11	PWS-16	SB	N	0.0104	0.00243	0.0112	0.0109	0.00524	0.0116	0.00639	0.00299	0.00352	0.00679	0.0170	0.00364	0.0172	0.0179	0.00220	0.00324	0.0112	0.0120	0.00525	0.00289	0.00876	0.00608	0.00366	0.00338	0.00486	0.0146	8.24E-04
PWS-25_4-8	PWS-25	SB	N	0.0335	0.0107	0.0630	0.161	0.121	0.181	0.0882	0.0409	0.0638	0.0635	0.160	0.0154	0.0559	0.0608	0.0199	0.00546	0.0340	0.0410	0.0134	0.0157	0.0198	0.0188	0.00618	0.00570	0.0334	0.198	0.0127
PWS-26_8-11	PWS-26	SB	N	0.0656	0.0117	0.0734	0.0466	0.0413	0.0752	0.0369	0.0188	0.0280	0.0292	0.0768	0.0239	0.110	0.0913	0.0131	0.0132	0.0678	0.0477	0.0102	0.0168	0.0432	0.0217	0.00614	0.0198	0.284	0.0842	0.00493
PWS-26_8-11_DUP	PWS-26	SB	FD	0.0474	0.0111	0.0608	0.0753	0.0574	0.0978	0.0466	0.0211	0.0339	0.0421	0.101	0.0188	0.0877	0.0888	0.0172	0.0128	0.0506	0.0574	0.0118	0.0202	0.0311	0.0256	0.00444	0.0166	0.0685	0.112	0.00633
PWS-28_8-11	PWS-28	SB	N	5.58E-04	0.00332	0.00162	0.00452	0.00804	0.00817	0.00642	0.00573	0.00287	0.00680	0.00356	0.00449	0.00351	0.00409	0.00615	0.00400	0.00537	0.00367	0.00504	0.00356	0.00472	0.00331	0.00453	0.00417	0.00602	0.00709	8.34E-04

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	No. of PAH analytes available	ΣESBTU	Adjusted ΣESBTU based on UF from USEPA (2003) for fewer than 34 PAH analytes[4]	Adjusted ΣESBTU based on site-specific UF for fewer than 34 PAH analytes[5]	Sample used in bioassay?	Calculation of Site-Specific Uncertainty Factors (UFs) for ΣESBTUs based on 16 and 17 PAHs				Comparison of $\Sigma ESBTU_{34}$ to $\Sigma IWTU_{sed}$	
																$\Sigma ESBTU_{16}$ based on 16 priority PAHs	Ratio of $\Sigma ESBTU_{34}$ to $\Sigma ESBTU_{16}$	$\Sigma ESBTU_{17}$ based on 16 priority PAHs plus C-1 naphthalenes	Ratio of $\Sigma ESBTU_{34}$ to $\Sigma ESBTU_{17}$	$\Sigma IWTU_{sed}$	Ratio of $\Sigma ESBTU_{34}$ to $\Sigma IWTU_{sed}$
Final Chronic Value (mg/kg OC)				707	538	1,115	385	967	596	697	--	--	--	--	--						
SB20-0-0.3	SB20	SB	N	0.0658	0.0217	0.00931	0.0262		0.0606	0.0493	16	0.39	**2.69**	**1.19**	N						
SB21-0-0.3	SB21	SB	N	0.0380	0.00865	0.00881	0.0121		0.0215	0.0375	16	0.25	**1.73**	0.77	N						
SB24-0-0.3	SB24	SB	N	0.347	0.126	0.0176	0.171		0.534	0.246	16	**1.85**	**12.8**	**5.68**	N						
SB26-0-0.3	SB26	SB	N	0.165	0.1000	0.0128	0.262		0.271	0.113	16	**1.22**	**8.43**	**3.73**	N						
SB27-0-0.3	SB27	SB	N	0.702	0.840	0.0126	0.419		1.47	0.418	16	**5.56**	**38.5**	**17.0**	N						
SB28-0-0.3	SB28	SB	N	0.891	0.533	0.0322	2.85	0.0151	1.45	0.558	34	**11.1**	NC	NC	N						
2012 Sediment Data																					
PWS-27_8-11_SE	PWS-27	MC	N	0.0101	0.00133	0.00201	0.00960	0.00495	0.00608	0.0108	34	0.15	NC	NC	N	0.0735	1.98	0.0762	1.91	0.015	9.65
PWS-01_8-9_SE	PWS-01	SB	N	0.0972	0.162	0.00508	0.0285	0.00419	0.130	0.0731	34	**1.27**	NC	NC	N	0.864	1.47	0.926	1.37	0.158	8.04
PWS-03_8-11_SE	PWS-03	SB	N	0.940	0.129	0.0615	0.529	0.0307	0.388	0.743	34	**6.14**	NC	NC	N	4.31	1.42	4.52	1.36	3.48	1.76
PWS-04_1-4_SE	PWS-04	SB	N	0.178	0.0342	0.0165	0.150	0.0103	0.108	0.142	34	**1.37**	NC	NC	N	0.949	1.44	1.01	1.36	0.278	4.92
PWS-04_8-11_SE	PWS-04	SB	N	0.392	0.106	0.0271	0.400	0.0158	0.314	0.288	34	**3.15**	NC	NC	N	2.15	1.47	2.31	1.37	0.971	3.25
PWS-05_8-11_SE	PWS-05	SB	N	0.349	0.0951	0.0252	0.317	0.0198	0.293	0.262	34	**2.99**	NC	NC	N	2.01	1.48	2.15	1.39	1.12	2.65
PWS-06_8-11_SE	PWS-06	SB	N	1.04	0.335	0.0158	1.95	0.0110	0.992	0.667	34	**8.94**	NC	NC	N	6.14	1.46	6.83	1.31	4.08	2.19
PWS-07_8-11_SE	PWS-07	SB	N	0.289	0.0949	0.0244	0.496	0.0178	0.279	0.237	34	**2.84**	NC	NC	N	2.00	1.42	2.18	1.30	1.27	2.24
PWS-08_8-11_SE	PWS-08	SB	N	0.233	0.104	0.00794	0.302	0.00606	0.320	0.172	34	**2.23**	NC	NC	N	1.47	1.51	1.63	1.37	0.629	3.55
PWS-09_8-11_SE	PWS-09	SB	N	0.101	0.0304	0.00556	0.151	0.00646	0.107	0.0789	34	0.93	NC	NC	N	0.630	1.48	0.674	1.39	0.202	4.63
PWS-12_8-11_SE	PWS-12	SB	N	0.0453	0.00909	0.00842	0.0245	0.00965	0.0261	0.0427	34	0.40	NC	NC	N	0.270	1.49	0.281	1.44	0.057	7.03
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0303	0.00686	0.00438	0.0248	0.00638	0.0222	0.0269	34	0.29	NC	NC	N	0.186	1.56	0.194	1.49	0.036	8.10
PWS-13_1-4_SE	PWS-13	SB	N	0.0312	0.00978	0.00538	0.0345	0.00362	0.0308	0.0325	34	0.34	NC	NC	N	0.226	1.52	0.243	1.41	0.068	5.04
PWS-13_8-11_SE	PWS-13	SB	N	0.0306	0.00902	0.00565	0.0331	0.00522	0.0286	0.0265	34	0.38	NC	NC	N	0.237	1.61	0.253	1.51	0.061	6.27
PWS-15_8-11_SE	PWS-15	SB	N	0.00920	0.00121	4.65E-04	0.00403	0.00593	0.00823	0.00755	34	0.12	NC	NC	N	0.0420	2.96	0.0446	2.79	0.015	8.29
PWS-16B_8-11_SE	PWS-16	SB	N	0.0894	0.0263	0.00717	0.118	0.00611	0.0683	0.0711	34	0.82	NC	NC	N	0.544	1.50	0.600	1.36	0.181	4.51
PWS-16_8-11_SE	PWS-16	SB	N	0.347	0.145	0.0103	0.706	0.00895	0.482	0.250	34	**3.61**	NC	NC	N	2.44	1.48	2.79	1.29	1.51	2.39
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0207	0.00564	0.00288	0.0158	0.00221	0.0232	0.0192	34	0.29	NC	NC	N	0.160	1.78	0.165	1.73	0.038	7.56
PWS-25_8-11_SE	PWS-25	SB	N	0.248	0.0747	0.0288	0.235	0.0140	0.211	0.212	34	**2.22**	NC	NC	N	1.51	1.47	1.63	1.36	0.630	3.52
PWS-26_8-11_SE	PWS-26	SB	N	0.189	0.117	0.0143	0.292	0.0104	0.277	0.148	34	**2.10**	NC	NC	N	1.40	1.51	1.57	1.34	0.389	5.41
PWS-17_4-7	PWS-17	MC	N	0.0123	0.0122	0.00162	0.0533	0.00176	0.0219	0.00858	34	0.27	NC	NC	N	0.167	1.63	0.197	1.38	0.017	16.3
PWS-27_8-11	PWS-27	MC	N	0.0155	0.00154	0.00230	0.00348	0.00314	0.0102	0.0157	34	0.16	NC	NC	N	0.0795	2.05	0.0813	2.00	0.012	13.8
PWS-30_8-11	PWS-30	MC	N	5.48E-04	7.21E-04	3.48E-04	0.00101	4.01E-04	6.51E-04	5.56E-04	34	0.10	NC	NC	N	0.00894	10.7	0.0107	8.96	0.005	20.2
LSI-01_8-11	LSI-01	SB	N	0.115	0.0378	0.0115	0.257	0.00507	0.134	0.0778	34	**1.32**	NC	NC	N	0.837	1.57	0.928	1.42	0.007	179
LSI-02_8-11	LSI-02	SB	N	0.0343	0.00826	0.00387	0.0188	0.00229	0.0262	0.0256	34	0.29	NC	NC	N	0.190	1.50	0.198	1.44	0.019	14.9
LSI-20_8-11	LSI-20	SB	N	0.630	0.0526	0.0440	0.201	0.0274	0.314	0.487	34	**4.02**	NC	NC	N	2.72	1.48	2.79	1.44	0.148	27.2
LSI-24_8-11	LSI-24	SB	N	0.0510	0.00586	0.0144	0.0255	0.00932	0.0256	0.0482	34	0.54	NC	NC	N	0.349	1.56	0.360	1.51	0.024	22.6
PWS-1_8-10	PWS-01	SB	N	0.0253	0.0119	0.00468	0.00705	0.00288	0.0147	0.0221	34	0.56	NC	NC	N	0.205	2.74	0.207	2.71	0.150	3.73
PWS-3_8-11	PWS-03	SB	N	0.307	0.0450	0.0355	0.126	0.0171	0.159	0.237	34	**2.62**	NC	NC	N	1.80	1.46	1.86	1.41	0.771	3.40
PWS-4_8-11	PWS-04	SB	N	0.275	0.0420	0.103	0.128	0.0704	0.173	0.239	34	**3.37**	NC	NC	N	2.41	1.40	2.46	1.37	0.704	4.79
PWS-5_8-11	PWS-05	SB	N	0.144	0.0429	0.0174	0.137	0.0107	0.123	0.102	34	**1.47**	NC	NC	N	0.995	1.48	1.05	1.40	0.187	7.88
PWS-6_8-11	PWS-06	SB	N	0.224	0.120	0.0110	0.355	0.00646	0.310	0.160	34	**2.60**	NC	NC	N	1.63	1.60	1.82	1.43	0.381	6.82
PWS-7_8-10	PWS-07	SB	N	0.369	0.115	0.0327	0.304	0.0250	0.312	0.295	34	**3.64**	NC	NC	N	2.43	1.50	2.56	1.42	0.904	4.03
PWS-7_8-10 DUP	PWS-07	SB	FD	0.274	0.105	0.0400	0.387	0.0282	0.239	0.219	34	**3.20**	NC	NC	N	2.11	1.51	2.29	1.40	0.703	4.55
PWS-8_8-11	PWS-08	SB	N	0.106	0.0397	0.0125	0.103	0.00632	0.108	0.0741	34	**1.15**	NC	NC	N	0.714	1.61	0.772	1.49	0.112	10.2
PWS-9_8-11	PWS-09	SB	N	0.0160	0.00697	0.00176	0.0136	0.00119	0.0167	0.0119	34	0.19	NC	NC	N	0.112	1.72	0.120	1.62	0.010	19.8
PWS-12_8-11	PWS-12	SB	N	0.00424	4.98E-04	0.00102	0.00189	7.79E-04	0.00227	0.00403	34	0.09	NC	NC	N	0.0245	3.51	0.0258	3.34	0.003	31.8
PWS-13_8-11	PWS-13	SB	N	0.0628	0.0176	0.00286	0.0326	0.00454	0.0946	0.0659	34	**2.96**	NC	NC	N	0.429	6.89	0.445	6.65	0.967	3.06
PWS-13_8-11_1	PWS-13	SB	FD	0.105	0.0282	0.00518	0.0904	0.00578	0.135	0.104	34	**3.29**	NC	NC	N	0.672	4.89	0.715	4.60	1.06	3.11
PWS-13_8-11_2	PWS-13	SB	FT	0.0426	0.0143	0.00444	0.0360	0.00414	0.0736	0.0488	34	**2.12**	NC	NC	N	0.330	6.43	0.350	6.06	0.596	3.56
PWS-15_8-11	PWS-15	SB	N	0.0102	0.00344	9.75E-04	0.0105	0.00337	0.00839	0.00850	34	0.16	NC	NC	N	0.0637	2.55	0.0680	2.39	0.006	28.5
PWS-16_8-11	PWS-16	SB	N	0.0411	0.0115	0.00309	0.0304	0.00197	0.0331	0.0304	34	0.36	NC	NC	N	0.223	1.60	0.240	1.49	0.023	15.8
PWS-25_4-8	PWS-25	SB	N	0.225	0.0508	0.0472	0.125	0.0289	0.114	0.163	34	**2.30**	NC	NC	N	1.61	1.43	1.67	1.38	0.477	4.82
PWS-26_8-11	PWS-26	SB	N	0.173	0.0809	0.0198	0.202	0.00982	0.183	0.123	34	**2.15**	NC	NC	N	1.23	1.75	1.34	1.61	0.249	8.65
PWS-26_8-11_DUP	PWS-26	SB	FD	0.179	0.0568	0.0239	0.186	0.0129	0.144	0.131	34	**1.96**	NC	NC	N	1.24	1.57	1.33	1.47	0.271	7.21
PWS-28_8-11	PWS-28	SB	N	0.0170	0.00107	0.00457	0.00498	0.00270	0.00923	0.0138	34	0.18	NC	NC	N	0.0934	1.88	0.0969	1.81	0.007	25.5
												Site-specific Uncertainty Factors[6]:				UF_{16} =	3.24	UF_{17} =	3.07	mean =	12.9

Notes:

[1]All values in toxic units (TUs) based on narcotic effects in benthic invertebrates. **BOLD** indicates value greater than 1.

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

[4]Uncertainty factors based on linear interpolation of 90% confidence UFs presented in USEPA (2003): 7.43 for 15 PAHs, 6.93 for 16 PAHs, and 6.42 for 17 PAHs.

[5]Uncertainty factors based on 90th percentiles of site-specific data presented in this table: 3.24 for 16 PAHs and 3.07 for 17 PAHs (a UF for 15 PAHs was not calculated).

[6]Uncertainty factors based on 90th percentiles of the ratios between $\Sigma ESBTU_{34}$ and $\Sigma ESBTU_{16\ or\ 17}$

ESBTU = equilibrium partitioning sediment benchmark toxic units

$\Sigma ESBTU_n$ = sum of equilibrium partitioning sediment benchmark toxic units based on n PAHs

$\Sigma IWTU_{sed}$ = sum of interstitial water toxic units based on sediment data (see Appendix G-B)

mg/kg = milligrams per kilogram

NC = not calculated

OC = organic carbon

PAH = polycyclic aromatic hydrocarbon

UF_n = uncertainty factor for n PAHs

ATTACHMENT B

Interstitial Water Toxic Unit (IWTU) Calculation for 2012 Sediment Data Based on Two-Carbon Partitioning Model (2012 Sediment Data)

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Black Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.018	0.0013	1.18	0.00987 J	0.00805 U	0.0179	0.0698	0.102	0.135	0.0711	0.0805 U	0.0458	0.0807	0.0849	0.0805 U
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.0063	0.001	3.57	0.755	0.0133 J	0.114	0.0895	0.0666	0.145	0.071	0.0329	0.0461	0.0674 U	0.144	0.104
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	0.028	0.0017	92.19	1.37	0.49	2.69	5.57	3.49	7.6	3.8	1.75	2.65	3.7	9	0.763
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.012	0.0013	8.63	0.161	0.0514	0.277 J	0.461	0.372	0.75	0.384	0.207	0.248	0.279	0.614	0.103
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.01	0.001	15.29	0.521	0.0769	0.559	0.668	0.472	0.944	0.507	0.252	0.284	0.39	1.02	0.176
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	0.018	0.0014	26.65	0.84	0.139	0.971	1.52	1.03	1.93	1.01	0.489	0.604	0.812	2	0.276
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	0.023	0.0023	89.71	3.89	0.235	3.4	2.43	0.975	2.46	1.1	0.35	0.739	1.29	5.37	1.04
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	0.028	0.0017	39.53	1.32	0.216	1.48	1.7	1.36	2.69	1.41	0.707	0.832	1.31	2.27	0.357
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	0.021	0.002	20.71	1.05	0.0713	0.831	0.708	0.372	0.727	0.353	0.167	0.22	0.408	1.18	0.298
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.02	0.0017	8.53	0.333	0.0385	0.302	0.361	0.251	0.415	0.216	0.11	0.134	0.196	0.566	0.196
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.018	0.0016	4.05	0.0793 J	0.0268	0.111	0.23	0.241 J	0.405	0.222 J	0.153 J	0.144 J	0.152	0.273	0.0979 U
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.018	0.0015	2.66	0.043 J	0.0197	0.0848	0.147	0.142 J	0.244	0.129 J	0.0792 J	0.0742 J	0.105	0.197	0.0933 U
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.027	0.0016	4.64	0.0947	0.0341	0.272	0.192	0.278	0.336	0.192	0.166	0.107	0.13	0.238	0.101 U
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.02	0.0015	3.86	0.0736	0.0238	0.108	0.238	0.25	0.464	0.218	0.126	0.152 J	0.223	0.281	0.0918 U
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.015	0.001	0.55	0.00906 J	0.00759 U	0.0126 J	0.0179	0.0205 J	0.0265	0.0168 J	0.00759 U	0.0156 J	0.0759 U	0.0759 U	0.0759 U
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.022	0.0017	8.64	0.28	0.0597	0.336	0.439	0.254	0.54	0.283	0.148 J	0.169	0.258	0.609	0.107
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	0.02	0.0015	32.15	1.3	0.158	1.55	0.932	0.436	1	0.517	0.2	0.281	0.63	1.58	0.442
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.02	0.0016	2.76	0.0986	0.0194	0.0762	0.221 J	0.124 J	0.229 J	0.109 J	0.0516 J	0.0652 J	0.194	0.343	0.0725 U
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.016	0.0015	18.23	0.536	0.109	0.509	0.795	0.797	1.53	0.783	0.421	0.522	0.578	1.25	0.173
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.012	0.0016	11.58	0.572	0.0506	0.477	0.353	0.29	0.515	0.264	0.183	0.172	0.22	0.581	0.163
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.0095	0.0012	1.12	0.149	0.00891 J	0.0238	0.0263	0.0203	0.0471 J	0.0283	0.019	0.0137 J	0.0553 U	0.0553 U	0.0553 U
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.0170	0.0017	1.26	0.0104 J	0.00934 J	0.0264	0.0645	0.0646	0.095	0.058	0.0491	0.0339	0.0697	0.0954	0.0689 U
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.0110	0.0013	0.09	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.0853 U	0.0853 U	0.0853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0019	0.0021	1.14	0.034	0.00667 J	0.0478	0.0384	0.0296	0.0497 J	0.0301	0.0243	0.015 J	0.064 U	0.064 U	0.064 U
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.0160	0.0021	2.60	0.0613	0.0182	0.131	0.112	0.0946	0.21 J	0.116	0.0641	0.0699 J	0.0834	0.137	0.0805 U
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.0033	0.0021	7.82	0.127	0.0373	0.19	0.436	0.318	0.649	0.319	0.144	0.216	0.327	0.6	0.0681
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.0091	0.0021	3.05	0.114	0.0345	0.0381	0.165	0.234	0.273	0.163	0.173	0.102	0.12	0.198	0.062 U
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.0056	0.0005	1.01	0.0736	0.00625 U	0.019	0.0802	0.0485	0.0757	0.0423	0.0272	0.0286	0.0625 U	0.113	0.0625 U
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.0260	0.0028	43.83	0.461	0.29	1.16	2.63	1.98	4.36	2.05	0.739	1.46	1.61	3.64	0.256
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.0069	0.0012	17.49	0.102	0.0787	0.868	0.765	1.46	1.99 J	1.26	0.63	0.562 J	0.555	0.987	0.0643 U
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.0120	0.0019	10.31	0.283	0.0563	0.274	0.513	0.456	0.862	0.408	0.205	0.294	0.315	0.584	0.097
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	0.0150	0.0026	17.47	0.977	0.067	0.872	0.606	0.371	0.735	0.36	0.159	0.266	0.352	0.846	0.292
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.017	0.0022	34.11	0.878	0.175	2.69 J	1.78	1.49	2.68	1.28	0.45	0.873	1.01	2.06	0.381
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	0.017	0.0023	31.01	0.859	0.184	0.981 J	1.38	1.62	2.69 J	1.43	0.588	0.828 J	0.933	1.76	0.338
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.0150	0.0025	9.11	0.261	0.0523	0.344	0.414	0.366	0.747	0.363	0.18	0.274	0.299	0.541	0.107
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.0180	0.0023	1.64	0.0494	0.00942 U	0.0689	0.0836	0.0548	0.0932	0.0474	0.0329	0.0373	0.0942 U	0.14	0.0942 U
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.0150	0.0020	0.36	0.00804 U	0.00804 U	0.00804 U	0.0198	0.0183	0.0303 J	0.0183	0.0165	0.0105 J	0.0804 U	0.0804 U	0.0804 U
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.022	0.0024	7.31	0.247	0.0297	0.215	0.496	0.28	0.271	0.241	0.0856	0.107	1.5	1.96	0.674
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.022	0.0024	11.18	0.347 J	0.0537 J	0.317 J	0.599 J	0.323 J	0.429 J	0.312 J	0.16 J	0.138 J	1.77 J	2.34 J	0.638 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.022	0.0024		0.187	0.0341	0.159	0.29	0.258	0.302	0.252	0.135	0.0906	1.22	1.33	0.396
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.0081	0.0012	0.42	0.0236	0.00668 U	0.0101 J	0.0214	0.0112 J	0.0207 J	0.0107 J	0.00872 J	0.00782 J	0.0668 U	0.0668 U	0.0668 U
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.0160	0.0023	2.88	0.0817	0.0176	0.106	0.146	0.0809	0.181 J	0.0988	0.0524	0.0553 J	0.101	0.209	0.0711 U
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.0098	0.0014	15.83	0.161	0.0476	0.367	1.33	1.14	1.74	0.836	0.439	0.613	0.578	1.21	0.0922
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.010	0.0021	10.09	0.322	0.0527	0.436	0.392 J	0.399 J	0.736 J	0.357 J	0.206	0.275 J	0.271 J	0.591 J	0.146
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.014	0.0023	15.26	0.326	0.0702	0.506	0.886 J	0.776 J	1.34 J	0.631 J	0.324	0.466 J	0.548 J	1.09 J	0.161
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0110	0.0017	1.03	0.00603 U	0.0165	0.0106 J	0.0418	0.0853	0.088	0.0683	0.069	0.031	0.0695	0.0603 U	0.0603 U

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Naphthalenes[4]	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.0220	0.0805 U	0.145	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	0.084
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.1736	0.172	0.0674 U	0.0674 U	0.355	0.0862	0.0674 U	0.0674 U	0.133	0.0674 U	0.135 U	0.0674 U	0.135 U	0.127
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	2.601	4.23	1.08	0.751	1.94	3.03	0.872	0.407	1.25	1.68	0.751 U	0.609	0.751 U	9.76
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.3125	0.414	0.115	0.0837	0.203	0.288	0.129	0.0708 U	0.152	0.146	0.142 U	0.0857	0.142 U	0.626
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.715	0.932	0.172	0.192	0.655	0.574	0.163	0.187	0.364	0.322	0.145 U	0.204	0.145 U	1.01
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	1.087	1.38	0.334	0.224	0.995	0.915	0.227	0.132	0.582	0.474	0.158 U	0.271	1.26	2.06
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	7.0	6.08	0.502	0.96	4.53	3.36	0.333	0.429	2.32	1.28	0.656 U	1.01	4.21	3.72
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	2.234	1.87	0.455	0.0807 U	1.42	1.12	0.334	0.397	0.789	0.553	0.161 U	0.403	0.245	2.38
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	1.453	1.55	0.191	0.301	1.26	0.824	0.173	0.152	0.745	0.405	0.178 U	0.369	0.361	0.802
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.392	0.647	0.0922	0.108	0.363	0.302	0.089 U	0.089 U	0.268	0.146	0.178 U	0.117	0.231	0.409
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.0839	0.164	0.11	0.0979 U	0.0979 U	0.13	0.0979 U	0.0979 U	0.0979 U	0.0979 U	0.196 U	0.0979 U	0.196 U	0.33
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.0677	0.134	0.0933 U	0.0933 U	0.0933 U	0.0963	0.0933 U	0.0933 U	0.0933 U	0.0933 U	0.187 U	0.0933 U	0.187 U	0.216
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.2029	0.257	0.101 U	0.101 U	0.201	0.162	0.101 U	0.101 U	0.184	0.101 U	0.201 U	0.101 U	0.201 U	0.277
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.1408	0.187	0.094	0.0918 U	0.121	0.126	0.11	0.0918 U	0.1	0.133	0.184 U	0.0918 U	0.184 U	0.314
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.01734	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0896	0.0759 U	0.152 U	0.0759 U	0.238	0.0248
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.545	0.462	0.101	0.102	0.327	0.309	0.113	0.0855 U	0.208	0.221	0.171 U	0.118	0.171 U	0.554
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	3.096	2.07	0.223	0.363	1.83	1.01	0.25	0.17	0.964	0.377	0.169 U	0.388	0.232	1.11
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.047	0.164	0.13	0.0725 U	0.0725 U	0.219	0.0749	0.0725 U	0.0725 U	0.255	0.145 U	0.0783	0.145 U	0.277
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.862	0.953	0.267	0.197	0.523	0.593	0.231	0.108	0.371	0.291	0.164 U	0.207	0.275	1.25
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.926	0.752	0.137	0.133	0.556	0.341	0.114	0.0819 U	0.353	0.168	0.164 U	0.158	0.406	0.502
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.1261	0.0553 U	0.0553 U	0.0553 U	0.0597	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.111 U	0.0553 U	0.111 U	0.0403
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.01317	0.119	0.0705	0.0689 U	0.0689 U	0.118	0.0994	0.0689 U	0.0689 U	0.0965	0.138 U	0.0689 U	0.138 U	0.0923
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.00853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.171 U	0.0853 U	0.171 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0761	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.128 U	0.064 U	0.128 U	0.0467
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.057	0.136	0.0805 U	0.0805 U	0.0805 U	0.085	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	0.165
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.1112	0.421	0.139	0.0774	0.0837	0.291	0.129	0.127	0.101	0.203	0.119 U	0.0914	0.119 U	0.593
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.0447	0.122	0.0664	0.062 U	0.062 U	0.139	0.062 U	0.062 U	0.062 U	0.131	0.124 U	0.062 U	0.124 U	0.211
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.00625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.125 U	0.0625 U	1.1	0.164
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.691	1.96	0.605	0.227	0.522	1.3	0.543	0.618	0.422	0.684	0.26	0.268	0.346	6.36
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.1345	0.531	0.279	0.0643 U	0.0937	0.296	0.239	0.13	0.081	0.159	0.129 U	0.0643 U	0.129 U	2.03
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.3092	0.456	0.149	0.0849	0.257	0.318	0.133	0.147	0.217	0.144	0.15 U	0.126	0.211	1.24
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	1.24	1.29	0.19	0.179	1.04	0.638	0.184	0.193	0.765	0.294	0.165 U	0.326	1.29	0.693
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.996	2.01	0.521	0.29	0.915	1.18	0.488	0.551	0.963	0.665	0.167	0.536	0.378	2.07
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	1.313	1.55	0.452	0.234	0.877	0.962	0.42	0.424	0.67	0.483	0.15	0.334	0.282	2.56
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.385	0.513	0.14	0.0856	0.299	0.355	0.151	0.149	0.21	0.182	0.165 U	0.138	0.616	0.615
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.0595	0.124	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.188 U	0.0942 U	0.188 U	0.227
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.00804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.161 U	0.0804 U	0.161 U	0.0273
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.1538	3.79	1.84	1.41	1.66	5.68	1.41	1.74	5.33	4.6	0.557	3.79	4.37	0.885
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.413	4.27 J	2.06 J	1.07 J	2.19 J	5.5 J	1.66 J	1.42 J	5.59 J	5.26 J	0.547 J	3.68 J	2.93 J	1.12 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.1955	2.66	1.51	0.73	1.50	3.59	1.06	0.95	4.14	3.70	0.537	2.64	2.18	0.45
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.01564	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.134 U	0.0668 U	0.134 U	0.0215
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.1219	0.192	0.0711 U	0.0711 U	0.0916	0.143	0.0934	0.0711 U	0.0814	0.0806	0.142 U	0.0711 U	0.142 U	0.197
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.2432	0.399	0.197	0.0734 U	0.17	0.3	0.146	0.118	0.113	0.153	0.147 U	0.0734 U	0.299	1.64
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.49	0.612	0.132 J	0.0903	0.346	0.356 J	0.113	0.129 J	0.251	0.18	0.149 U	0.13	2.59 J	0.711 J
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.545	0.833	0.243 J	0.123	0.361	0.599 J	0.183	0.217 J	0.253	0.297	0.151 U	0.153	0.876 J	1.32 J
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.01714	0.0603 U	0.0682	0.0603 U	0.0603 U	0.0603 U	0.0616	0.0603 U	0.0603 U	0.0603 U	0.121 U	0.0603 U	0.121 U	0.0658

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.0805 U	0.129	0.0129 J	0.0805 U	0.0665	0.0862	0.0652	0.135	0.00805 U	0.018
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.00772 J	0.433	0.55	0.0357	0.0692	0.0255	0.489	0.321	0.14	0.0336
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	0.443	18.6	1.95	1.92	5.7	0.83	6.48	14.5	0.661	1.94
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.052	1.51	0.221	0.221	0.693	0.12	0.772	1.19	0.0865	0.226
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.0684	2.77	0.571	0.302	1.54	0.153	1.87	2.01	0.216	0.499
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	0.123 J	4.44	0.921	0.506	2.2	0.345	3.14	3.29	0.302	0.785
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	0.107 J	16.9	4.15	0.406	17.3	0.244	13.6	10.7	2.11	4.89
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	0.177	5.72	1.43	0.762	5.35	0.481	4.65	4.63	0.604	1.63
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	0.0492	3.46	1.17	0.186	2.44	0.123	4.01	2.52	0.471	0.982
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.0297	1.43	0.327	0.124	1.16	0.125	1.27	1.1	0.133	0.259
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.035	0.576	0.088	0.169 J	0.17	0.168	0.28	0.536	0.0222	0.0617
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.0191	0.386	0.0664	0.088 J	0.172	0.111	0.238	0.337	0.0168 J	0.0509
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.0275	0.596	0.142	0.162	0.359	0.0946	0.496	0.612	0.0589	0.144
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.0301	0.433	0.0971	0.126	0.255	0.101	0.341	0.37	0.0378	0.103
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.00759 U	0.0976	0.00974 J	0.00778 J	0.0233	0.086	0.0736	0.0789	0.00782 J	0.00952 J
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.0855 U	1.39	0.311	0.176	0.999	0.13	0.895	1.09	0.15	0.395
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	0.0844 U	4.9	1.56	0.229	5.44	0.173	5.75	3.48	0.896	2.2
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.0182	0.292	0.0607	0.0643 J	0.122	0.0428 J	0.277	0.267	0.0137 J	0.0333
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.117 J	2.8	0.643	0.514	1.45	0.217	2.01	2.36	0.237	0.625
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.0819 U	1.6	0.756	0.191	1.35	0.121	1.98	1.24	0.253	0.673
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.00553 U	0.0825	0.0625	0.0172	0.195	0.0162	0.124	0.0568	0.0803	0.0458
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.0103 J	0.186	0.0141	0.0436	0.0228	0.0516	0.103	0.186	0.00689 U	0.00972 J
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0064 U	0.155	0.0386	0.0243	0.188	0.00931 J	0.152	0.103	0.0212	0.0549
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.0157 J	0.388	0.0711	0.069	0.116	0.0355	0.25	0.285	0.0164	0.0406
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.0445	1.47	0.0933	0.162	0.256	0.0873	0.618	1.12	0.0304	0.0808
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.024	0.328	0.0287	0.146	0.0893	0.082	0.139	0.306	0.014	0.0307
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.00626 J	0.1	0.036	0.0292	0.0152	0.0156	0.049	0.0862	0.00625 U	0.00625 U
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.289	5.64	0.629	1.03	1.26	0.43	2.47	4.3	0.208	0.483
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.191	1.34	0.156	0.793	0.339	0.47	0.711	1.15 J	0.0375	0.097
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.0604	1.22	0.277	0.233	0.634	0.124	0.882	0.855	0.0992	0.21
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	0.0534	2.38	0.969	0.184	2.05	0.0937	2.77	1.67	0.4	0.84
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.186	4.43	1.05	0.619	1.99	0.411	3.16	3.5	0.307	0.689 J
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	0.197	3.29	0.962	0.758	2.53	0.463	2.42	2.6	0.381	0.932 J
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.0554	1.12	0.32	0.209	0.593	0.0916	0.962	0.775	0.12	0.265
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.00942 U	0.203	0.0675	0.0354	0.0943	0.0208	0.179	0.149	0.0193	0.0402
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.00804 U	0.045	0.00804 U	0.017	0.0109 J	0.0113 J	0.0203	0.0421	0.00804 U	0.00804 U
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.044	0.977	0.208	0.0701	0.276	0.0965	1.24	1.01	0.0508	0.103
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.0432 J	1.63 J	0.334 J	0.127 J	0.766 J	0.123 J	1.77 J	1.6 J	0.111 J	0.302 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.0392	0.66	0.169	0.109	0.305	0.088	0.965	0.748	0.0585	0.137
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.00668 U	0.0584	0.015	0.00881 J	0.0329	0.0264	0.0405	0.048	0.00668 U	0.0123 J
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.0148	0.465	0.0989	0.0551	0.187	0.0305	0.316	0.339	0.0375	0.0844
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.14	1.56	0.268	0.516	0.473	0.274	0.667	1.11	0.0732	0.17
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.0554 J	1.22	0.435	0.221 J	0.776	0.095 J	1.09	0.854	0.154	0.336
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.0995 J	1.77	0.428	0.373 J	1	0.175 J	1.2	1.28	0.163	0.382
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0103 J	0.132	0.00635 J	0.056	0.0211	0.0287	0.0605	0.106	0.00614 J	0.011 J

Notes:

[1]All PAH concentrations in mg/kg sediment (dry weight).

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

[4]C-1 naphthalenes = sum of 1- and 2-methylnaphthalene. Non-detections included as 1/2 the MDL.

g/g = grams per gram
J = estimated value
MDL = method detection limit
mg/kg = milligrams per kilogram
PAH = polycyclic aromatic hydrocarbon
U = not detected

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 2: Conversion of Sediment Concentrations to Pore Water Concentrations [1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene		Acenaphthylene		Anthracene		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b) fluoranthene		Benzo(e)pyrene		Benzo(g,h,i)perylene		Benzo(k) fluoranthene		C-1 Benz(a)anth/ Chrysenes	
				Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)
PWS-27_8-11_SE	PWS-27	MC	N	0.00987	0.00141858	0.004025	0.00168735	0.0179	0.00127754	0.0698	0.00106351	0.102	0.00075538	0.135	0.00084285	0.0711	0.00041377	0.04025	7.7742E-05	0.0458	0.00014672	0.0807	0.00048708
PWS-01_8-9_SE	PWS-01	SB	N	0.755	2.40151012	0.0133	0.01912429	0.114	0.04170184	0.0895	0.00266244	0.0666	0.00065573	0.145	0.00165692	0.071	0.00069784	0.0329	9.2855E-05	0.0461	0.00024597	0.0337	0.00020139
PWS-03_8-11_SE	PWS-03	SB	N	1.37	1.86393445	0.49	2.33622117	2.69	1.49229071	5.57	0.31047496	3.49	0.06684361	7.6	0.12191488	3.8	0.07030858	1.75	0.011718	2.65	0.03158879	3.7	0.06660221
PWS-04_1-4_SE	PWS-04	SB	N	0.161	0.1345495	0.0514	0.1129447	0.277	0.10572643	0.461	0.02088874	0.372	0.00594572	0.75	0.01200414	0.384	0.00595868	0.207	0.00106973	0.248	0.00218047	0.279	0.00357126
PWS-04_8-11_SE	PWS-04	SB	N	0.521	1.20661987	0.0769	0.32930184	0.559	0.44339021	0.668	0.05097465	0.472	0.01208307	0.944	0.02311878	0.507	0.01277402	0.252	0.002089	0.284	0.00387644	0.39	0.00848493
PWS-05_8-11_SE	PWS-05	SB	N	0.84	1.3633786	0.139	0.4797582	0.971	0.55079405	1.52	0.08856458	1.03	0.02024237	1.93	0.03352684	1.01	0.01874363	0.489	0.00307106	0.604	0.00648102	0.812	0.0135129
PWS-06_8-11_SE	PWS-06	SB	N	3.89	6.54417899	0.235	0.51896024	3.4	1.7725938	2.43	0.09687544	0.975	0.01034203	2.46	0.02742938	1.1	0.01174694	0.35	0.00097936	0.739	0.00465121	1.29	0.0143399
PWS-07_8-11_SE	PWS-07	SB	N	1.32	1.77075014	0.216	0.67586142	1.48	0.67420884	1.7	0.06932783	1.36	0.01993292	2.69	0.0343084	1.41	0.01984874	0.707	0.00351468	0.832	0.00690538	1.31	0.0175728
PWS-08_8-11_SE	PWS-08	SB	N	1.05	1.20220612	0.0713	0.0946338	0.831	0.2818066	0.708	0.0200018	0.372	0.00300409	0.727	0.00587676	0.353	0.00265457	0.167	0.00038519	0.22	0.00091121	0.408	0.00319848
PWS-09_8-11_SE	PWS-09	SB	N	0.333	0.26382382	0.0385	0.04486707	0.302	0.07591571	0.361	0.00906185	0.251	0.00205813	0.415	0.00316093	0.216	0.00156773	0.11	0.00025373	0.134	0.00053203	0.196	0.00130809
PWS-12_8-11_SE	PWS-12	SB	N	0.0793	0.03047869	0.0268	0.02745137	0.111	0.01761678	0.23	0.00508336	0.241	0.002145	0.405	0.00338228	0.222	0.00181163	0.153	0.00046853	0.144	0.00065906	0.152	0.00097998
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.043	0.0125234	0.0197	0.01836717	0.0848	0.01261988	0.147	0.00278312	0.142	0.0010388	0.244	0.00172021	0.129	0.00085784	0.0792	0.00018406	0.0742	0.00025588	0.105	0.00060247
PWS-13_1-4_SE	PWS-13	SB	N	0.0947	0.03845279	0.0341	0.03970393	0.272	0.06495552	0.192	0.00349293	0.278	0.00235921	0.336	0.00224086	0.192	0.00130773	0.166	0.00047913	0.107	0.00038347	0.13	0.00070606
PWS-13_8-11_SE	PWS-13	SB	N	0.0736	0.02946161	0.0238	0.02491917	0.108	0.01824015	0.238	0.00565839	0.25	0.00238755	0.464	0.00426463	0.218	0.00185992	0.126	0.00037013	0.152	0.00076253	0.223	0.00186437
PWS-15_8-11_SE	PWS-15	SB	N	0.00906	0.0018897	0.003795	0.00235877	0.0126	0.00110024	0.0179	0.00018381	0.0205	9.0457E-05	0.0265	9.9579E-05	0.0168	6.3111E-05	0.003795	2.5979E-06	0.0156	3.9638E-05	0.03795	0.00022268
PWS-16B_8-11_SE	PWS-16	SB	N	0.28	0.19807972	0.0597	0.09095155	0.336	0.08734005	0.439	0.01175879	0.254	0.00204428	0.54	0.00448028	0.283	0.00229741	0.148	0.00039355	0.169	0.00074569	0.258	0.00193855
PWS-16_8-11_SE	PWS-16	SB	N	1.3	2.26567495	0.158	0.52374047	1.55	0.94406481	0.932	0.04065768	0.436	0.00540063	1	0.01247569	0.517	0.00657769	0.2	0.00074441	0.281	0.00191715	0.63	0.00846422
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0986	0.04269458	0.0194	0.0160828	0.0762	0.00955515	0.221	0.00466624	0.124	0.00075632	0.229	0.00140396	0.109	0.00059315	0.0516	8.4067E-05	0.0652	0.00018733	0.194	0.00139308
PWS-25_8-11_SE	PWS-25	SB	N	0.536	0.6740298	0.109	0.29871364	0.509	0.20741534	0.795	0.03571181	0.797	0.01396551	1.53	0.02488477	0.783	0.01298059	0.421	0.00239854	0.522	0.00511514	0.578	0.0081511
PWS-26_8-11_SE	PWS-26	SB	N	0.572	0.73323203	0.0506	0.07927597	0.477	0.18545494	0.353	0.01073314	0.29	0.00311874	0.515	0.00545959	0.264	0.00258258	0.183	0.00066856	0.172	0.00093406	0.22	0.00187823
PWS-17_4-7	PWS-17	MC	N	0.149	0.1378548	0.00891	0.00725421	0.0238	0.0023888	0.0263	0.0002678	0.0203	6.9632E-05	0.0471	0.00020036	0.0283	0.00011507	0.019	2.7779E-05	0.0137	2.4873E-05	0.02765	0.00010679
PWS-27_8-11	PWS-27	MC	N	0.0104	0.00100351	0.00934	0.00438663	0.0264	0.00158243	0.0645	0.00063948	0.0646	0.00025378	0.095	0.00034295	0.058	0.00020496	0.0491	7.2308E-05	0.0339	6.0977E-05	0.0697	0.00026544
PWS-30_8-11	PWS-30	MC	N	0.004265	0.00035872	0.004265	0.00187101	0.004265	0.00012232	0.004265	1.1731E-05	0.004265	4.6657E-06	0.004265	3.429E-06	0.004265	4.4879E-06	0.004265	2.0805E-06	0.004265	3.177E-06	0.04265	0.00018855
LSI-01_8-11	LSI-01	SB	N	0.034	0.00536751	0.00667	0.001851	0.0478	0.00323409	0.0384	0.00021608	0.0296	5.5743E-05	0.0497	9.7291E-05	0.0301	5.5164E-05	0.0243	1.7922E-05	0.015	1.2231E-05	0.032	5.879E-05
LSI-02_8-11	LSI-02	SB	N	0.0613	0.01368279	0.0182	0.00968248	0.131	0.01596467	0.112	0.00117014	0.0946	0.00035319	0.21	0.0009203	0.116	0.0004705	0.0641	8.3501E-05	0.0699	0.00014725	0.0834	0.00026697
LSI-20_8-11	LSI-20	SB	N	0.127	0.04791848	0.0373	0.0325219	0.19	0.03192051	0.436	0.01211914	0.318	0.00285988	0.649	0.00682001	0.319	0.00276518	0.144	0.00034334	0.216	0.00102649	0.327	0.00277377
LSI-24_8-11	LSI-24	SB	N	0.114	0.0388934	0.0345	0.02822808	0.0381	0.00217263	0.165	0.0023028	0.234	0.00160824	0.273	0.00150949	0.163	0.0008603	0.173	0.00043753	0.102	0.00028368	0.12	0.00050369
PWS-1_8-10	PWS-01	SB	N	0.0736	0.17118811	0.003125	0.00541567	0.019	0.00672767	0.0802	0.00601361	0.0485	0.00109363	0.0757	0.00157244	0.0423	0.00084751	0.0272	0.00019503	0.0286	0.00032501	0.03125	0.0005103
PWS-3_8-11	PWS-03	SB	N	0.461	0.21059786	0.29	0.5349268	1.16	0.2908058	2.63	0.08511816	1.98	0.0221891	4.36	0.04739347	2.05	0.02221103	0.739	0.00228838	1.46	0.009664	1.61	0.01529758
PWS-4_8-11	PWS-04	SB	N	0.102	0.07721635	0.0787	0.26538515	0.868	0.76884527	0.765	0.05784231	1.46	0.05870762	1.99	0.06589547	1.26	0.04524968	0.63	0.00738416	0.562	0.00963594	0.555	0.01294894
PWS-5_8-11	PWS-05	SB	N	0.283	0.18940113	0.0563	0.07173728	0.274	0.06076693	0.513	0.01520891	0.456	0.00499176	0.862	0.00960921	0.408	0.00402363	0.205	0.00062661	0.294	0.00170416	0.315	0.00259438
PWS-6_8-11	PWS-06	SB	N	0.977	0.83347347	0.067	0.05716611	0.872	0.23439387	0.606	0.01230768	0.371	0.0022416	0.735	0.00477748	0.36	0.00205018	0.159	0.00025536	0.266	0.00089566	0.352	0.00190989
PWS-7_8-10	PWS-07	SB	N	0.878	0.86312035	0.175	0.35606904	2.69	1.5173531	1.78	0.07431043	1.49	0.0224264	2.68	0.0372317	1.28	0.01716002	0.45	0.00163563	0.873	0.00689592	1.01	0.01174789
PWS-7_8-10 DUP	PWS-07	SB	FD	0.859	0.78689922	0.184	0.36066655	0.981	0.3226194	1.38	0.04882776	1.62	0.02413521	2.69	0.03591178	1.43	0.01920855	0.588	0.00232335	0.828	0.0060398	0.933	0.00990376
PWS-8_8-11	PWS-08	SB	N	0.261	0.1074015	0.0523	0.04047796	0.344	0.05671045	0.414	0.00713927	0.366	0.00232107	0.747	0.00515831	0.363	0.00219748	0.18	0.00033076	0.274	0.00099469	0.299	0.00155968
PWS-9_8-11	PWS-09	SB	N	0.0494	0.00800973	0.00471	0.00085594	0.0689	0.0046949	0.0836	0.00061017	0.0548	0.00012186	0.0932	0.00021116	0.0474	9.2445E-05	0.0329	2.3544E-05	0.0373	4.4234E-05	0.0471	8.8173E-05
PWS-12_8-11	PWS-12	SB	N	0.00402	0.00015924	0.00402	0.00083009	0.00402	5.4327E-05	0.0198	7.2922E-05	0.0183	2.5453E-05	0.0303	4.2779E-05	0.0183	2.4476E-05	0.0165	9.5586E-06	0.0105	6.9304E-06	0.0402	8.5741E-05
PWS-13_8-11	PWS-13	SB	N	0.247	0.10037048	0.0297	0.01681331	0.215	0.02715298	0.496	0.00928049	0.28	0.00151333	0.271	0.00104849	0.241	0.00114782	0.0856	0.00010237	0.107	0.00022471	1.5	0.01732841
PWS-13_8-11_1	PWS-13	SB	FD	0.347	0.17201864	0.0537	0.04453864	0.317	0.05019867	0.599	0.01236146	0.323	0.00188893	0.429	0.00212603	0.312	0.00171489	0.16	0.00027701	0.138	0.00033713	1.77	0.02193622
PWS-13_8-11_2	PWS-13	SB	FT	0.187	0.06434065	0.0341	0.0211117	0.159	0.01676761	0.29	0.00405439	0.258	0.00133215	0.302	0.00124014	0.252	0.00123064	0.135	0.00021173	0.0906	0.00017211	1.22	0.01286695
PWS-15_8-11	PWS-15	SB	N	0.0236	0.00696847	0.00334	0.00142712	0.0101	0.00058466	0.0214	0.0001927	0.0112	2.6391E-05	0.0207	5.3194E-05	0.0107	2.3539E-05	0.00872	7.7814E-06	0.00782	9.9308E-06	0.0334	0.00014679
PWS-16_8-11	PWS-16	SB	N	0.0817	0.01837721	0.0176	0.00764316	0.106	0.00954809	0.146	0.00151722	0.0809	0.0002315	0.181	0.00062002	0.0988	0.00030746	0.0524	5.07E-05	0.0553	8.4737E-05	0.101	0.00030722
PWS-25_4-8	PWS-25	SB	N	0.161	0.12366179	0.0476	0.08955512	0.367	0.15390362	1.33	0.09734999	1.14	0.0304035	1.74	0.04009788	0.836	0.01845296	0.439	0.00321192	0.613	0.00822952	0.578	0.01033041
PWS-26_8-11	PWS-26	SB	N	0.322	0.20423187	0.0527	0.0550144	0.436	0.11267603	0.392	0.00892984	0.399	0.00363227	0.736	0.00694813	0.357	0.00291984	0.206	0.00055769	0.275	0.00136125	0.271	0.00181319
PWS-26_8-11_DUP	PWS-26	SB	FD	0.326	0.17561473	0.0702	0.07542129	0.506	0.11957822	0.886	0.02651733	0.776	0.00851251	1.34	0.01412958	0.631	0.00592801	0.324	0.00096055	0.466	0.00261734	0.548	0.00460583
PWS-28_8-11	PWS-28	SB	N	0.003015	0.00012948	0.0165	0.0113469	0.0106	0.00035611	0.0418	0.00032688	0.0853	0.00041415	0.088	0.00031907	0.0683	0.00027752	0.069	0.00013029	0.031	5.4119E-05	0.0695	0.00027521
Partition Coefficients (Log K_{OC} | K_{OC})				3.944	8790	3.168	1472	4.457	28642	5.577	377572	6.003	1006932	6.160	1445440	6.031	1073989	6.397	2494595	6.184	1527566	6.036	1086426
Partition Coefficients (Log K_{BC} | K_{BC})				5.58	380189	5.15	141254	5.86	724436	6.47	2951209	6.71	5128614	6.79	6165950	6.72	5248075	6.92	8317638	6.81	6456542	6.73	5370318

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 2: Conversion of Sediment Concentrations to Pore Water Concentrations [1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-1 Fluoranthrenes/ Pyrenes		C-1 Fluorenes		C-1 Naphthalenes		C-1 Phenanthrenes/ Anthracenes		C-2 Benz(a)anth/ Chrysenes		C-2 Fluorenes		C-2 Naphthalenes		C-2 Phenanthrenes/ Anthracenes		C-3 Benz(a)anth/ Chrysenes		C-3 Fluorenes	
				Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)
PWS-27_8-11_SE	PWS-27	MC	N	0.0849	0.00326872	0.04025	0.00322015	0.022025	0.00837195	0.04025	0.00166527	0.145	0.00066114	0.04025	0.00117701	0.04025	0.00783255	0.04025	0.00068424	0.04025	3.0719E-05	0.04025	0.00041349
PWS-01_8-9_SE	PWS-01	SB	N	0.144	0.01282499	0.104	0.02443099	0.1736	0.38440178	0.172	0.02819513	0.0337	0.00011274	0.0337	0.00143839	0.355	0.41696042	0.0862	0.00384478	0.0337	3.8299E-05	0.0337	0.00050795
PWS-03_8-11_SE	PWS-03	SB	N	9	1.29959832	0.763	0.18074239	2.601	7.08183346	4.23	0.88510321	1.08	0.00734729	0.751	0.06293745	1.94	1.62222802	3.03	0.23089967	0.872	0.00181017	0.407	0.00903029
PWS-04_1-4_SE	PWS-04	SB	N	0.614	0.07284082	0.103	0.01513632	0.3125	0.60476538	0.414	0.06772858	0.115	0.00050484	0.0837	0.00397003	0.203	0.10788124	0.288	0.01591718	0.129	0.00020344	0.0354	0.00034975
PWS-04_8-11_SE	PWS-04	SB	N	1.02	0.21264359	0.176	0.05238207	0.715	3.06529005	0.932	0.31590567	0.172	0.00138236	0.192	0.02170819	0.655	0.92934979	0.574	0.06394267	0.163	0.00042703	0.187	0.00725439
PWS-05_8-11_SE	PWS-05	SB	N	2	0.2958907	0.276	0.05885756	1.087	3.14401249	1.38	0.30419502	0.334	0.00208605	0.224	0.01550113	0.995	0.94996271	0.915	0.06937207	0.227	0.00039446	0.132	0.00240235
PWS-06_8-11_SE	PWS-06	SB	N	5.37	0.65323351	1.04	0.2186238	7	23.2427387	6.08	1.30630006	0.502	0.00197859	0.96	0.06982716	4.53	4.38577166	3.36	0.23668566	0.333	0.00035691	0.429	0.00722613
PWS-07_8-11_SE	PWS-07	SB	N	2.27	0.23496684	0.357	0.06036797	2.234	5.78521949	1.87	0.30983434	0.455	0.00224228	0.04035	0.00075512	1.42	1.06448354	1.12	0.06245873	0.334	0.00047895	0.397	0.0087119
PWS-08_8-11_SE	PWS-08	SB	N	1.18	0.09609904	0.298	0.04008804	1.453	3.08474688	1.55	0.23846275	0.191	0.00055535	0.301	0.01477297	1.26	0.86326706	0.824	0.03881729	0.173	0.00016035	0.152	0.00177993
PWS-09_8-11_SE	PWS-09	SB	N	0.566	0.04024634	0.196	0.02634993	0.392	0.53881913	0.647	0.08206268	0.0922	0.00022532	0.108	0.00376615	0.363	0.1666585	0.302	0.01072733	0.0445	2.403E-05	0.0445	0.00032145
PWS-12_8-11_SE	PWS-12	SB	N	0.273	0.01499822	0.04895	0.00321966	0.0839	0.05297405	0.164	0.01138092	0.11	0.000329	0.04895	0.00117873	0.04895	0.00782227	0.13	0.00324073	0.04895	3.0979E-05	0.04895	0.00041485
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.197	0.00990782	0.04665	0.00328771	0.0677	0.0413647	0.134	0.00908052	0.04665	9.3239E-05	0.04665	0.00120301	0.04665	0.00799065	0.0963	0.002216	0.04665	3.1544E-05	0.04665	0.00042314
PWS-13_1-4_SE	PWS-13	SB	N	0.238	0.01096625	0.0505	0.0032488	0.2029	0.19932844	0.257	0.02056663	0.0505	9.1028E-05	0.0505	0.00118531	0.201	0.06832092	0.162	0.00418974	0.0505	3.0693E-05	0.0505	0.00041554
PWS-13_8-11_SE	PWS-13	SB	N	0.281	0.01653248	0.0459	0.0031718	0.1408	0.13074728	0.187	0.01489586	0.094	0.00027615	0.0459	0.00115976	0.121	0.03607102	0.126	0.00331247	0.11	0.0001183	0.0459	0.00040759
PWS-15_8-11_SE	PWS-15	SB	N	0.03795	0.00137543	0.03795	0.00441837	0.01734	0.00865007	0.03795	0.00228156	0.03795	0.00012381	0.03795	0.00161207	0.03795	0.01076114	0.03795	0.00093616	0.03795	4.1748E-05	0.03795	0.00056517
PWS-16B_8-11_SE	PWS-16	SB	N	0.609	0.0433396	0.107	0.01004651	0.545	0.86490919	0.462	0.04851191	0.101	0.00025562	0.102	0.00339395	0.327	0.13899376	0.309	0.01083268	0.113	0.00010237	0.04275	0.00029862
PWS-16_8-11_SE	PWS-16	SB	N	1.58	0.19312582	0.442	0.10619242	3.096	11.8268847	2.07	0.46992782	0.223	0.0010274	0.363	0.02853755	1.83	1.97790288	1.01	0.07113488	0.25	0.00040616	0.17	0.00316122
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.343	0.02059223	0.03625	0.00196387	0.047	0.0206114	0.164	0.01116371	0.13	0.00041776	0.03625	0.00071935	0.03625	0.0047695	0.219	0.00711363	0.0749	5.9759E-05	0.03625	0.00025332
PWS-25_8-11_SE	PWS-25	SB	N	1.25	0.15576782	0.173	0.02682225	0.862	2.17769688	0.953	0.17852119	0.267	0.00143138	0.197	0.01192998	0.523	0.35853358	0.593	0.03634745	0.231	0.00038535	0.108	0.00163078
PWS-26_8-11_SE	PWS-26	SB	N	0.581	0.05225707	0.163	0.02318126	0.926	2.43910878	0.752	0.12884499	0.137	0.00049555	0.133	0.00611818	0.556	0.38915048	0.341	0.01568825	0.114	0.00012519	0.04095	0.00032077
PWS-17_4-7	PWS-17	MC	N	0.02765	0.0006529	0.02765	0.00207752	0.1261	0.16763852	0.02765	0.00107833	0.02765	5.9777E-05	0.02765	0.00076281	0.0597	0.01767468	0.02765	0.00044464	0.02765	2.0307E-05	0.02765	0.00026936
PWS-27_8-11	PWS-27	MC	N	0.0954	0.00269653	0.03445	0.00166284	0.013165	0.00234846	0.119	0.00635493	0.0705	0.00015077	0.03445	0.00061009	0.03445	0.00403361	0.118	0.00257348	0.0994	8.7808E-05	0.03445	0.00021525
PWS-30_8-11	PWS-30	MC	N	0.04265	0.00115537	0.04265	0.00368403	0.00853	0.00179306	0.04265	0.00191003	0.04265	0.00010538	0.04265	0.00135081	0.04265	0.00894062	0.04265	0.00078674	0.04265	3.574E-05	0.04265	0.00047624
LSI-01_8-11	LSI-01	SB	N	0.032	0.00035695	0.032	0.00112869	0.0761	0.03258803	0.032	0.00058784	0.032	3.3061E-05	0.032	0.00041616	0.032	0.00272833	0.032	0.00024318	0.032	1.129E-05	0.032	0.00014767
LSI-02_8-11	LSI-02	SB	N	0.137	0.00364331	0.04025	0.00158794	0.057	0.01926606	0.136	0.00596157	0.04025	4.5784E-05	0.04025	0.00058333	0.04025	0.00384858	0.085	0.00114913	0.04025	1.5562E-05	0.04025	0.0002061
LSI-20_8-11	LSI-20	SB	N	0.6	0.0460403	0.0681	0.00395168	0.1112	0.06090315	0.421	0.04227739	0.139	0.00037762	0.0774	0.00180166	0.0837	0.01346634	0.291	0.00947967	0.129	0.00011381	0.127	0.00145441
LSI-24_8-11	LSI-24	SB	N	0.198	0.00696331	0.031	0.00105156	0.0447	0.01316562	0.122	0.00522168	0.0664	0.00010716	0.031	0.00038708	0.031	0.00254484	0.139	0.00266517	0.031	1.0423E-05	0.031	0.00013709
PWS-1_8-10	PWS-01	SB	N	0.113	0.02297311	0.03125	0.01012948	0.00625	0.00514568	0.03125	0.00523006	0.03125	0.00028368	0.03125	0.00369527	0.03125	0.02467335	0.03125	0.00214574	0.03125	9.564E-05	0.03125	0.00129531
PWS-3_8-11	PWS-03	SB	N	3.64	0.3082035	0.256	0.01899327	0.691	0.62915427	1.96	0.21634848	0.605	0.00198917	0.227	0.00572508	0.522	0.14211965	1.3	0.04818781	0.543	0.00056595	0.618	0.00950559
PWS-4_8-11	PWS-04	SB	N	0.987	0.19301459	0.03215	0.0027001	0.1345	0.19191764	0.531	0.12569186	0.279	0.00248922	0.03215	0.00099234	0.0937	0.03764877	0.296	0.02071567	0.239	0.00065908	0.13	0.00338956
PWS-5_8-11	PWS-05	SB	N	0.584	0.04213041	0.097	0.00771819	0.3092	0.34654617	0.456	0.04764206	0.149	0.00044064	0.0849	0.00227896	0.257	0.09060224	0.318	0.01107357	0.133	0.00012444	0.147	0.00195389
PWS-6_8-11	PWS-06	SB	N	0.846	0.04689418	0.292	0.02789847	1.24	1.92315773	1.29	0.14976227	0.19	0.00039747	0.179	0.00463197	1.04	0.51086462	0.638	0.02053483	0.184	0.00012796	0.193	0.00184397
PWS-7_8-10	PWS-07	SB	N	2.06	0.21019546	0.381	0.05353327	0.996	1.66574685	2.01	0.34069547	0.521	0.00239677	0.29	0.01268498	0.915	0.50906856	1.18	0.06327582	0.488	0.00072778	0.551	0.01204194
PWS-7_8-10 DUP	PWS-07	SB	FD	1.76	0.15946994	0.338	0.04160055	1.313	2.39793799	1.55	0.2216169	0.452	0.00182021	0.234	0.00846339	0.877	0.45035121	0.962	0.04418674	0.42	0.00054651	0.424	0.00756764
PWS-8_8-11	PWS-08	SB	N	0.541	0.02459946	0.107	0.00580738	0.385	0.31904073	0.513	0.03755277	0.14	0.00025781	0.0856	0.00148031	0.299	0.07476308	0.355	0.00859529	0.151	9.8781E-05	0.149	0.0012883
PWS-9_8-11	PWS-09	SB	N	0.14	0.00315627	0.0471	0.00171348	0.0595	0.01723835	0.124	0.00429627	0.0471	4.9374E-05	0.0471	0.00062936	0.0471	0.00415325	0.0471	0.00036693	0.0471	1.678E-05	0.0471	0.00022233
PWS-12_8-11	PWS-12	SB	N	0.0402	0.00052373	0.0402	0.00166511	0.00804	0.00079789	0.0402	0.00086466	0.0402	4.8024E-05	0.0402	0.00061172	0.0402	0.00403538	0.0402	0.00035669	0.0402	1.6325E-05	0.0402	0.00021615
PWS-13_8-11	PWS-13	SB	N	1.96	0.16140702	0.674	0.10943513	0.1538	0.07460463	3.79	0.68487973	1.84	0.01264293	1.41	0.1187037	1.66	1.03693001	5.68	0.47445613	1.41	0.00287471	1.74	0.05529091
PWS-13_8-11_1	PWS-13	SB	FD	2.34	0.20749577	0.638	0.10063482	0.413	0.35947142	4.27	0.806307	2.06	0.01480594	1.07	0.07911733	2.19	1.55112238	5.5	0.45455831	1.66	0.00361806	1.42	0.04128235
PWS-13_8-11_2	PWS-13	SB	FT	1.33	0.09227309	0.396	0.04818404	0.1955	0.10969721	2.66	0.41867674	1.51	0.00956362	0.726	0.04428065	1.5	0.89347459	3.59	0.25545191	1.06	0.00191228	0.951	0.02296232
PWS-15_8-11	PWS-15	SB	N	0.0334	0.00089711	0.0334	0.00285368	0.01564	0.00560548	0.0334	0.00148146	0.0334	8.2187E-05	0.0334	0.00104802	0.0334	0.00691751	0.0334	0.00061097	0.0334	2.7927E-05	0.0334	0.00037017
PWS-16_8-11	PWS-16	SB	N	0.209	0.00607876	0.03555	0.00108441	0.1219	0.05604447	0.192	0.00878695	0.03555	3.1381E-05	0.03555	0.0003987	0.0916	0.01241417	0.143	0.00224951	0.0934	5.1354E-05	0.03555	0.00014101
PWS-25_4-8	PWS-25	SB	N	1.21	0.19426398	0.0922	0.01157597	0.2432	0.37969404	0.399	0.06103978	0.197	0.0010954	0.0367	0.00094829	0.17	0.07532563	0.3	0.01603523	0.146	0.00023096	0.118	0.00221632
PWS-26_8-11	PWS-26	SB	N	0.591	0.03868148	0.146	0.01301058	0.49	0.6381172	0.612	0.06782247	0.132	0.00031718	0.0903	0.00217631	0.346	0.12826194	0.356	0.01175043	0.113	8.3707E-05	0.129	0.00137738
PWS-26_8-11_DUP	PWS-26	SB	FD	1.09	0.08265859	0.161	0.01292769	0.545	0.63394496	0.833	0.09109201	0.243	0.00071228	0.123	0.00306075	0.361	0.11546328	0.599	0.02232014	0.183	0.0001534	0.217	0.00269812
PWS-28_8-11	PWS-28	SB	N	0.03015	0.00042936	0.03015	0.00136349	0.01714	0.00367038	0.03015	0.00070848	0.0682	0.00014931	0.03015	0.0005013	0.03015	0.00330258	0.03015	0.00029244	0.0616	4.2989E-05	0.03015	0.00017729
Partition Coefficients (Log K_{OC} | K_{OC})				5.197	157398	4.640	43652	3.736	5445	4.955	90157	6.320	2089296	5.112	129420	4.227	16866	5.367	232809	6.822	6637431	5.603	400867
Partition Coefficients (Log K_{BC} | K_{BC})				6.26	1819701	5.96	912011	5.46	288403	6.13	1348963	6.88	7585776	6.22	1659587	5.73	537032	6.36	2290868	7.16	14454398	6.49	3090295

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 2: Conversion of Sediment Concentrations to Pore Water Concentrations [1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-3 Naphthalenes		C-3 Phenanthrenes/ Anthracenes		C-4 Benz(a)anth/ Chrysenes		C-4 Naphthalenes		C-4 Phenanthrenes/ Anthracenes		Chrysene		Dibenzo(a,h) anthracene		Fluoranthene		Fluorene		Indeno(1,2,3-cd) pyrene	
				Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)
PWS-27_8-11_SE	PWS-27	MC	N	0.04025	0.00275449	0.04025	0.00025976	0.0805	3.8091E-05	0.04025	0.00096815	0.0805	0.0003398	0.084	0.0012709	0.04025	4.9023E-05	0.129	0.00930341	0.0129	0.00149601	0.04025	4.8893E-05
PWS-01_8-9_SE	PWS-01	SB	N	0.133	0.03099933	0.0337	0.00031983	0.0675	4.9932E-05	0.0337	0.0011853	0.0675	0.00043696	0.127	0.00416046	0.00772	5.4359E-06	0.433	0.10640761	0.55	0.99642589	0.0357	6.6795E-05
PWS-03_8-11_SE	PWS-03	SB	N	1.25	0.30376013	1.68	0.03941695	0.3755	0.00023347	0.609	0.03817353	0.3755	0.00216134	9.76	0.55199093	0.443	0.00115589	18.6	4.72256746	1.95	1.99400801	1.92	0.00820761
PWS-04_1-4_SE	PWS-04	SB	N	0.152	0.02396425	0.146	0.00210344	0.071	3.3822E-05	0.0857	0.00339039	0.071	0.0002977	0.626	0.02944601	0.052	7.7517E-05	1.51	0.39984837	0.221	0.14963541	0.221	0.00074162
PWS-04_8-11_SE	PWS-04	SB	N	0.364	0.13479885	0.322	0.01025825	0.0725	5.1949E-05	0.204	0.01952054	0.0725	0.00046026	1.01	0.08200112	0.0684	0.0001794	2.77	1.24860982	0.571	0.92527947	0.302	0.00170851
PWS-05_8-11_SE	PWS-05	SB	N	0.582	0.15116614	0.474	0.01031752	0.079	3.3553E-05	0.271	0.01691407	1.26	0.01694122	2.06	0.11973933	0.123	0.00025193	4.44	1.27211319	0.921	1.03726281	0.506	0.00201468
PWS-06_8-11_SE	PWS-06	SB	N	2.32	0.59167258	1.28	0.02276966	0.328	0.0001463	1.01	0.06149209	4.21	0.05002308	3.72	0.15603158	0.107	9.7643E-05	16.9	4.32000346	4.15	4.74733541	0.406	0.0007691
PWS-07_8-11_SE	PWS-07	SB	N	0.789	0.16072402	0.553	0.0086975	0.0805	2.4323E-05	0.403	0.02112887	0.245	0.00116409	2.38	0.09701945	0.177	0.00030565	5.72	1.15927826	1.43	1.31114058	0.762	0.0024281
PWS-08_8-11_SE	PWS-08	SB	N	0.745	0.13751593	0.405	0.00505772	0.089	2.4018E-05	0.369	0.01655608	0.361	0.00185522	0.802	0.02156267	0.0492	3.5066E-05	3.46	0.64955557	1.17	0.94328373	0.186	0.00028591
PWS-09_8-11_SE	PWS-09	SB	N	0.268	0.03645296	0.146	0.00132541	0.089	3.0389E-05	0.117	0.00351062	0.231	0.00117337	0.409	0.00979346	0.0297	1.9993E-05	1.43	0.22858184	0.327	0.17269789	0.124	0.00019199
PWS-12_8-11_SE	PWS-12	SB	N	0.04895	0.00275545	0.04895	0.00026082	0.098	3.9102E-05	0.04895	0.00097019	0.098	0.00034659	0.33	0.00787656	0.035	2.884E-05	0.576	0.06871564	0.088	0.02439791	0.169	0.0003426
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.04665	0.00281323	0.04665	0.00026596	0.0935	3.967E-05	0.04665	0.00098996	0.0935	0.00035239	0.216	0.00449905	0.0191	1.1965E-05	0.386	0.04094965	0.0664	0.01711272	0.088	0.00013638
PWS-13_1-4_SE	PWS-13	SB	N	0.184	0.02074483	0.0505	0.00026081	0.1005	3.7116E-05	0.0505	0.00097427	0.1005	0.00033337	0.277	0.00539347	0.0275	1.878E-05	0.596	0.0624709	0.142	0.04876408	0.162	0.00028955
PWS-13_8-11_SE	PWS-13	SB	N	0.1	0.00935588	0.133	0.00135854	0.092	3.7851E-05	0.0459	0.00095409	0.092	0.0003372	0.314	0.00767504	0.0301	2.4688E-05	0.433	0.04703694	0.0971	0.03096283	0.126	0.0002323
PWS-15_8-11_SE	PWS-15	SB	N	0.0896	0.0145294	0.03795	0.00035473	0.076	5.0975E-05	0.03795	0.00132506	0.238	0.00249082	0.0248	0.00027697	0.003795	1.6391E-06	0.0976	0.00892178	0.00974	0.00144549	0.00778	5.287E-06
PWS-16B_8-11_SE	PWS-16	SB	N	0.208	0.02419964	0.221	0.00245389	0.0855	2.805E-05	0.118	0.00350417	0.0855	0.00024876	0.554	0.01482937	0.04275	3.5531E-05	1.39	0.21048549	0.311	0.15653848	0.176	0.00032149
PWS-16_8-11_SE	PWS-16	SB	N	0.964	0.27753795	0.377	0.00649522	0.0845	3.3217E-05	0.388	0.02573889	0.232	0.00137782	1.11	0.04661978	0.0422	4.2328E-05	4.9	1.28946849	1.56	1.93913717	0.229	0.00057072
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.03625	0.00168099	0.255	0.00336785	0.0725	2.4007E-05	0.0783	0.00203119	0.0725	0.00021233	0.277	0.00588555	0.0182	9.9345E-06	0.292	0.02416252	0.0607	0.01330307	0.0643	7.4879E-05
PWS-25_8-11_SE	PWS-25	SB	N	0.371	0.0740939	0.291	0.0047213	0.082	3.3079E-05	0.207	0.01056594	0.275	0.00189123	1.25	0.06092888	0.117	0.00021781	2.8	0.71334625	0.643	0.59356061	0.514	0.00200734
PWS-26_8-11_SE	PWS-26	SB	N	0.353	0.06713603	0.168	0.00195702	0.082	3.1482E-05	0.158	0.00662434	0.406	0.00338867	0.502	0.01649945	0.04095	3.8453E-05	1.6	0.35184878	0.756	0.75710589	0.191	0.00044933
PWS-17_4-7	PWS-17	MC	N	0.02765	0.0017796	0.02765	0.0001696	0.0555	2.655E-05	0.02765	0.00062858	0.0555	0.0002324	0.0403	0.00047875	0.002765	7.3266E-07	0.0825	0.00566477	0.0625	0.02308947	0.0172	1.4878E-05
PWS-27_8-11	PWS-27	MC	N	0.03445	0.00142405	0.0965	0.00070942	0.069	2.092E-05	0.03445	0.00050259	0.069	0.00018373	0.0923	0.00101359	0.0103	3.5911E-06	0.186	0.01148856	0.0141	0.00112815	0.0436	3.7606E-05
PWS-30_8-11	PWS-30	MC	N	0.04265	0.00315437	0.04265	0.00029965	0.0855	4.5936E-05	0.04265	0.00111249	0.0855	0.00040456	0.004265	1.0459E-05	0.004265	1.3128E-06	0.004265	3.8632E-05	0.004265	0.00024421	0.004265	1.3123E-06
LSI-01_8-11	LSI-01	SB	N	0.032	0.00096809	0.032	9.3173E-05	0.064	1.5415E-05	0.032	0.00034351	0.064	0.00013218	0.0467	0.00026686	0.0032	3.8595E-07	0.155	0.00727064	0.0386	0.00451834	0.0243	1.1308E-05
LSI-02_8-11	LSI-02	SB	N	0.04025	0.00136043	0.04025	0.0001298	0.0805	2.0338E-05	0.04025	0.00048078	0.0805	0.00017763	0.165	0.0019443	0.0157	5.2894E-06	0.388	0.02809079	0.0711	0.01184437	0.069	5.9233E-05
LSI-20_8-11	LSI-20	SB	N	0.101	0.00652588	0.203	0.00199732	0.0595	1.3526E-05	0.0914	0.00196003	0.0595	0.00011618	0.593	0.01795773	0.0445	3.0805E-05	1.47	0.29588487	0.0933	0.01954493	0.162	0.00026327
LSI-24_8-11	LSI-24	SB	N	0.031	0.00090147	0.131	0.00092289	0.062	1.3948E-05	0.031	0.00031929	0.062	0.00012062	0.211	0.00306465	0.024	1.0839E-05	0.328	0.02326475	0.0287	0.00271423	0.146	0.00020932
PWS-1_8-10	PWS-01	SB	N	0.03125	0.00865941	0.03125	0.00081295	0.0625	0.00011639	0.03125	0.0030372	1.1	0.05927616	0.164	0.01572207	0.00626	1.1698E-05	0.1	0.02852139	0.036	0.03750942	0.0292	0.00013702
PWS-3_8-11	PWS-03	SB	N	0.422	0.03563791	0.684	0.00693329	0.26	7.7333E-05	0.268	0.00611816	0.346	0.00107056	6.36	0.2558667	0.289	0.00034548	5.64	0.8511937	0.629	0.23055262	1.03	0.00233828
PWS-4_8-11	PWS-04	SB	N	0.081	0.01047942	0.159	0.00293861	0.0645	3.5028E-05	0.03215	0.00081803	0.0645	0.00030527	2.03	0.21728278	0.191	0.00074109	1.34	0.4552194	0.156	0.10417888	0.793	0.00652011
PWS-5_8-11	PWS-05	SB	N	0.217	0.0242857	0.144	0.00118853	0.075	2.1101E-05	0.126	0.00356212	0.211	0.00096745	1.24	0.05222869	0.0604	5.538E-05	1.22	0.19358904	0.277	0.12395049	0.233	0.00048252
PWS-6_8-11	PWS-06	SB	N	0.765	0.11046496	0.294	0.00228083	0.0825	1.4929E-05	0.326	0.01002047	1.29	0.01004272	0.693	0.01358377	0.0534	2.728E-05	2.38	0.33853086	0.969	0.55552032	0.184	0.0002034
PWS-7_8-10	PWS-07	SB	N	0.963	0.19106125	0.665	0.01003961	0.167	5.8402E-05	0.536	0.02716539	0.378	0.00185054	2.07	0.08299623	0.186	0.00026075	4.43	0.93449681	1.05	0.7629546	0.619	0.0016648
PWS-7_8-10 DUP	PWS-07	SB	FD	0.67	0.10363231	0.483	0.0058056	0.15	4.6265E-05	0.334	0.01222565	0.282	0.00110356	2.56	0.10745848	0.197	0.00026792	3.29	0.59110117	0.962	0.63072654	0.758	0.00213794
PWS-8_8-11	PWS-08	SB	N	0.21	0.014885	0.182	0.0011198	0.0825	1.5862E-05	0.138	0.00265712	0.616	0.00340904	0.615	0.01189599	0.0554	3.0833E-05	1.12	0.1134109	0.32	0.10116609	0.209	0.00026446
PWS-9_8-11	PWS-09	SB	N	0.0471	0.00146792	0.0471	0.00014001	0.094	2.1821E-05	0.0471	0.00051868	0.094	0.00019069	0.227	0.00270564	0.00471	6.0279E-07	0.203	0.00846284	0.0675	0.00907884	0.0354	1.6725E-05
PWS-12_8-11	PWS-12	SB	N	0.0402	0.00142658	0.0402	0.00013613	0.0805	2.1396E-05	0.0402	0.00050419	0.0805	0.0001868	0.0273	0.00011033	0.00402	5.8483E-07	0.045	0.00092768	0.00402	0.00010844	0.017	6.3299E-06
PWS-13_8-11	PWS-13	SB	N	5.33	1.8314093	4.6	0.13160226	0.557	0.00031061	3.79	0.39143895	4.37	0.05224144	0.885	0.01990849	0.044	2.2044E-05	0.977	0.08776688	0.208	0.05165378	0.0701	4.6748E-05
PWS-13_8-11_1	PWS-13	SB	FD	5.59	1.95278205	5.26	0.15730464	0.547	0.00030238	3.68	0.37597268	2.93	0.03050514	1.12	0.02818925	0.0432	2.1396E-05	1.63	0.18643372	0.334	0.10944174	0.127	0.00012089
PWS-13_8-11_2	PWS-13	SB	FT	4.14	1.29857993	3.7	0.09816643	0.537	0.00029421	2.64	0.23734308	2.18	0.02030233	0.449	0.00713923	0.0392	1.8269E-05	0.662	0.04882344	0.169	0.03705459	0.109	9.4808E-05
PWS-15_8-11	PWS-15	SB	N	0.0334	0.00244462	0.0334	0.0002331	0.067	3.6567E-05	0.0334	0.00086368	0.067	0.00031975	0.0215	0.00017323	0.00334	1.0044E-06	0.0584	0.00328735	0.015	0.0022449	0.00881	4.9906E-06
PWS-16_8-11	PWS-16	SB	N	0.0814	0.00361462	0.0806	0.00033855	0.071	1.4061E-05	0.03555	0.00032872	0.071	0.0001223	0.197	0.00219193	0.0148	4.0136E-06	0.465	0.03198293	0.0989	0.01705865	0.0551	3.467E-05
PWS-25_4-8	PWS-25	SB	N	0.113	0.0137539	0.153	0.00210583	0.0735	3.2996E-05	0.0367	0.00078149	0.299	0.00264421	1.64	0.11824927	0.14	0.00034506	1.56	0.42248504	0.268	0.18858708	0.516	0.00256869
PWS-26_8-11	PWS-26	SB	N	0.251	0.02689144	0.18	0.00148979	0.0745	1.8151E-05	0.13	0.00325539	2.59	0.04146447	0.711	0.02047898	0.0554	4.1521E-05	1.22	0.1785416	0.435	0.22494076	0.221	0.00039309
PWS-26_8-11_DUP	PWS-26	SB	FD	0.253	0.02295741	0.297	0.00279878	0.0755	1.5708E-05	0.153	0.00359162	0.876	0.00663065	1.32	0.04355272	0.0995	9.159E-05	1.77	0.25687768	0.428	0.18387203	0.373	0.00075344
PWS-28_8-11	PWS-28	SB	N	0.03015	0.00116844	0.03015	0.0001117	0.0605	1.781E-05	0.03015	0.00041331	0.0605	0.00015493	0.0658	0.00061184	0.0103	3.6409E-06	0.132	0.00702986	0.00635	0.00030393	0.056	5.8499E-05
Partition Coefficients (Log K_{OC} | K_{OC})				4.719	52360	5.820	660693	7.235	17179084	5.210	162181	6.213	1633052	5.616	413048	6.599	3971915	4.998	99541	4.137	13709	6.608	4055085
Partition Coefficients (Log K_{BC} | K_{BC})				6.00	1000000	6.61	4073803	7.38	23988329	6.27	1862087	6.82	6606934	6.50	3162278	7.04	10964782	6.16	1445440	5.68	478630	7.04	10964782

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 2: Conversion of Sediment Concentrations to Pore Water Concentrations [1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Naphthalene		Perylene		Phenanthrene		Pyrene	
				Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)
PWS-27_8-11_SE	PWS-27	MC	N	0.0665	0.1261743	0.0862	0.00055797	0.0652	0.00948056	0.135	0.01415063
PWS-01_8-9_SE	PWS-01	SB	N	0.0692	0.21986863	0.0255	0.00013258	0.489	0.38202785	0.321	0.09503212
PWS-03_8-11_SE	PWS-03	SB	N	5.7	51.5101345	0.83	0.00975266	6.48	4.1874092	14.5	5.07257956
PWS-04_1-4_SE	PWS-04	SB	N	0.693	5.22361258	0.12	0.00100497	0.772	0.45966717	1.19	0.40640152
PWS-04_8-11_SE	PWS-04	SB	N	1.54	23.8436285	0.153	0.00216198	1.87	2.25728556	2.01	1.16394147
PWS-05_8-11_SE	PWS-05	SB	N	2.2	21.8437433	0.345	0.00410672	3.14	2.50557368	3.29	1.23890239
PWS-06_8-11_SE	PWS-06	SB	N	17.3	198.387268	0.244	0.00123038	13.6	10.1866569	10.7	3.48715807
PWS-07_8-11_SE	PWS-07	SB	N	5.35	47.5282415	0.481	0.00457044	4.65	2.77102129	4.63	1.27661668
PWS-08_8-11_SE	PWS-08	SB	N	2.44	16.806496	0.123	0.00052016	4.01	2.41814846	2.52	0.60119263
PWS-09_8-11_SE	PWS-09	SB	N	1.16	6.98425956	0.125	0.00067533	1.27	0.5858214	1.1	0.22490274
PWS-12_8-11_SE	PWS-12	SB	N	0.17	0.41420851	0.168	0.00118259	0.28	0.06926004	0.536	0.0877702
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.172	0.46282373	0.111	0.00067961	0.238	0.05876435	0.337	0.04743497
PWS-13_1-4_SE	PWS-13	SB	N	0.359	1.21055591	0.0946	0.00044928	0.496	0.14504958	0.612	0.09233191
PWS-13_8-11_SE	PWS-13	SB	N	0.255	0.83925357	0.101	0.00057554	0.341	0.09890292	0.37	0.0529723
PWS-15_8-11_SE	PWS-15	SB	N	0.0233	0.0352944	0.086	0.00081756	0.0736	0.01713444	0.0789	0.00910961
PWS-16B_8-11_SE	PWS-16	SB	N	0.999	5.43746871	0.13	0.00070486	0.895	0.3425698	1.09	0.21350232
PWS-16_8-11_SE	PWS-16	SB	N	5.44	64.991503	0.173	0.00131303	5.75	4.86815528	3.48	1.19186005
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.122	0.24133654	0.0428	0.00013555	0.277	0.06655829	0.267	0.02993253
PWS-25_8-11_SE	PWS-25	SB	N	1.45	11.9764492	0.217	0.00195516	2.01	1.38519635	2.36	0.80826869
PWS-26_8-11_SE	PWS-26	SB	N	1.35	11.0360211	0.121	0.00075635	1.98	1.44247166	1.24	0.34485968
PWS-17_4-7	PWS-17	MC	N	0.195	0.85213948	0.0162	4.6263E-05	0.124	0.03212342	0.0568	0.00439031
PWS-27_8-11	PWS-27	MC	N	0.0228	0.01461738	0.0516	0.00016986	0.103	0.01332104	0.186	0.0162773
PWS-30_8-11	PWS-30	MC	N	0.004265	0.00142975	0.004265	4.4879E-06	0.004265	0.00011327	0.004265	5.4584E-05
LSI-01_8-11	LSI-01	SB	N	0.188	0.36971111	0.00931	7.802E-06	0.152	0.02060827	0.103	0.00519531
LSI-02_8-11	LSI-02	SB	N	0.116	0.15507681	0.0355	6.9097E-05	0.25	0.0416222	0.285	0.02451115
LSI-20_8-11	LSI-20	SB	N	0.256	0.61178175	0.0873	0.00032255	0.618	0.20858338	1.12	0.26763632
LSI-24_8-11	LSI-24	SB	N	0.0893	0.10391185	0.082	0.00028046	0.139	0.01695087	0.306	0.02942454
PWS-1_8-10	PWS-01	SB	N	0.0152	0.05547851	0.0156	0.00017548	0.049	0.02814271	0.0862	0.03225871
PWS-3_8-11	PWS-03	SB	N	1.26	4.03738105	0.43	0.0022111	2.47	0.8157602	4.3	0.83782243
PWS-4_8-11	PWS-04	SB	N	0.339	2.143581	0.47	0.01038361	0.711	0.52415996	1.15	0.51537699
PWS-5_8-11	PWS-05	SB	N	0.634	2.75097476	0.124	0.00060926	0.882	0.35248104	0.855	0.16001494
PWS-6_8-11	PWS-06	SB	N	2.05	10.6752506	0.0937	0.00023447	2.77	1.27164203	1.67	0.28183036
PWS-7_8-10	PWS-07	SB	N	1.99	12.1350364	0.411	0.00311106	3.16	1.76382425	3.5	0.95887351
PWS-7_8-10 DUP	PWS-07	SB	FD	2.53	16.451595	0.463	0.00352437	2.42	1.1468292	2.6	0.60076011
PWS-8_8-11	PWS-08	SB	N	0.593	1.61353535	0.0916	0.00024024	0.962	0.2666537	0.775	0.09086692
PWS-9_8-11	PWS-09	SB	N	0.0943	0.09235723	0.0208	2.3972E-05	0.179	0.02042914	0.149	0.00729416
PWS-12_8-11	PWS-12	SB	N	0.0109	0.00332348	0.0113	1.1053E-05	0.0203	0.00073575	0.0421	0.00117593
PWS-13_8-11	PWS-13	SB	N	0.276	0.48236431	0.0965	0.00026919	1.24	0.37501957	1.01	0.13098262
PWS-13_8-11_1	PWS-13	SB	FD	0.766	2.39449619	0.123	0.00039681	1.77	0.63264061	1.6	0.25804069
PWS-13_8-11_2	PWS-13	SB	FT	0.305	0.56553276	0.088	0.00023215	0.965	0.25788296	0.748	0.08339495
PWS-15_8-11	PWS-15	SB	N	0.0329	0.04808528	0.0264	0.00010375	0.0405	0.00532532	0.048	0.00337872
PWS-16_8-11	PWS-16	SB	N	0.187	0.28374765	0.0305	4.5186E-05	0.316	0.051417	0.339	0.0275195
PWS-25_4-8	PWS-25	SB	N	0.473	2.75641208	0.274	0.00341269	0.667	0.35784346	1.11	0.36495241
PWS-26_8-11	PWS-26	SB	N	0.776	3.37394868	0.095	0.00034402	1.09	0.44521345	0.854	0.1451066
PWS-26_8-11_DUP	PWS-26	SB	FD	1	4.19474666	0.175	0.00078279	1.2	0.4254173	1.28	0.22343478
PWS-28_8-11	PWS-28	SB	N	0.0211	0.01302378	0.0287	6.7383E-05	0.0605	0.00582133	0.106	0.00697468
Partition Coefficients (Log K_{OC} | K_{OC})				3.299	1991	6.031	1073989	4.494	31189	4.839	69024
Partition Coefficients (Log K_{BC} | K_{BC})				5.22	165959	6.72	5248075	5.88	758578	6.07	1174898

Notes:

[1]Non-detections included at 1/2 the MDL.

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

K_{OC} = organic carbon partition coefficient

K_{BC} = black carbon partition coefficient

Log = logarithm base 10
MDL = method detection limit
mg/kg = milligrams per kilogram
PAH = polycyclic aromatic hydrocarbon
µg/L = micrograms per liter

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 3: IWTU and ΣIWTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)Anthracene	Benzo(a)Pyrene	Benzo(b)Fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)Perylene	Benzo(k)Fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes
Final Chronic Value (µg/L)				55.85	306.9	20.73	2.227	0.9573	0.6774	0.9008	0.4391	0.6415	0.8557	4.887	13.99	81.690	7.436	0.4827	5.305	30.24	3.199	0.1675
PWS-27_8-11_SE	PWS-27	MC	N	2.54E-05	5.498E-06	6.163E-05	0.0004776	0.0007891	0.0012442	0.0004593	0.000177	0.0002287	0.0005692	0.0006689	0.0002302	0.0001025	0.0002239	0.0013697	0.0002219	0.000259	0.0002139	0.0001834
PWS-01_8-9_SE	PWS-01	SB	N	0.0429993	6.231E-05	0.0020117	0.0011955	0.000685	0.002446	0.0007747	0.0002115	0.0003834	0.0002354	0.0026243	0.0017463	0.0047056	0.0037917	0.0002336	0.0002711	0.0137884	0.0012019	0.0002287
PWS-03_8-11_SE	PWS-03	SB	N	0.0333739	0.0076123	0.071987	0.139414	0.0698251	0.1799747	0.0780513	0.0266864	0.0492421	0.0778336	0.2659297	0.0129194	0.0866916	0.1190295	0.0152212	0.0118638	0.0536451	0.0721787	0.010807
PWS-04_1-4_SE	PWS-04	SB	N	0.0024091	0.000368	0.0051002	0.0093798	0.0062109	0.0177209	0.0066149	0.0024362	0.003399	0.0041735	0.014905	0.0010819	0.0074032	0.0091082	0.0010459	0.0007484	0.0035675	0.0049757	0.0012146
PWS-04_8-11_SE	PWS-04	SB	N	0.0216047	0.001073	0.0213888	0.0228894	0.012622	0.0341287	0.0141808	0.0047575	0.0060428	0.0099158	0.0435121	0.0037443	0.0375234	0.0424833	0.0028638	0.004092	0.0307325	0.0199883	0.0025494
PWS-05_8-11_SE	PWS-05	SB	N	0.0244114	0.0015632	0.0265699	0.0397686	0.0211453	0.0494934	0.0208078	0.006994	0.0101029	0.0157916	0.0605465	0.0042071	0.0384871	0.0409084	0.0043216	0.002922	0.0314141	0.0216855	0.002355
PWS-06_8-11_SE	PWS-06	SB	N	0.1171742	0.001691	0.0855086	0.0435004	0.0108033	0.0404922	0.0130406	0.0022304	0.0072505	0.0167581	0.1336676	0.0156271	0.2845237	0.1756724	0.004099	0.0131625	0.1450321	0.0739874	0.0021308
PWS-07_8-11_SE	PWS-07	SB	N	0.0317055	0.0022022	0.0325233	0.0311306	0.020822	0.0506472	0.0220346	0.0080043	0.0107644	0.0205362	0.04808	0.0043151	0.0708192	0.0416668	0.0046453	0.0001423	0.0352012	0.0195245	0.0028594
PWS-08_8-11_SE	PWS-08	SB	N	0.0215256	0.0003084	0.0135941	0.0089815	0.0031381	0.0086755	0.0029469	0.0008772	0.0014204	0.0037379	0.0196642	0.0028655	0.0377616	0.0320687	0.0011505	0.0027847	0.0285472	0.0121342	0.0009573
PWS-09_8-11_SE	PWS-09	SB	N	0.0047238	0.0001462	0.0036621	0.0040691	0.0021499	0.0046663	0.0017404	0.0005778	0.0008294	0.0015287	0.0082354	0.0018835	0.0065959	0.0110359	0.0004668	0.0007099	0.0055112	0.0033533	0.0001435
PWS-12_8-11_SE	PWS-12	SB	N	0.0005457	8.945E-05	0.0008498	0.0022826	0.0022407	0.004993	0.0020111	0.001067	0.0010274	0.0011452	0.003069	0.0002301	0.0006485	0.0015305	0.0006816	0.0002222	0.0002587	0.001013	0.0001849
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0002242	5.985E-05	0.0006088	0.0012497	0.0010851	0.0025394	0.0009523	0.0004192	0.0003989	0.0007041	0.0020274	0.000235	0.0005064	0.0012212	0.0001932	0.0002268	0.0002642	0.0006927	0.0001883
PWS-13_1-4_SE	PWS-13	SB	N	0.0006885	0.0001294	0.0031334	0.0015684	0.0024644	0.003308	0.0014517	0.0010912	0.0005978	0.0008251	0.002244	0.0002322	0.0024401	0.0027658	0.0001886	0.0002234	0.0022593	0.0013097	0.0001832
PWS-13_8-11_SE	PWS-13	SB	N	0.0005275	8.12E-05	0.0008799	0.0025408	0.002494	0.0062956	0.0020647	0.0008429	0.0011887	0.0021788	0.003383	0.0002267	0.0016005	0.0020032	0.0005721	0.0002186	0.0011928	0.0010355	0.0007063
PWS-15_8-11_SE	PWS-15	SB	N	3.384E-05	7.686E-06	5.307E-05	8.254E-05	9.449E-05	0.000147	7.006E-05	5.916E-06	6.179E-05	0.0002602	0.0002814	0.0003158	0.0001059	0.0003068	0.0002565	0.0003039	0.0003559	0.0002926	0.0002492
PWS-16B_8-11_SE	PWS-16	SB	N	0.0035466	0.0002964	0.0042132	0.0052801	0.0021355	0.0066139	0.0025504	0.0008963	0.0011624	0.0022655	0.0088683	0.0007181	0.0105877	0.0065239	0.0005296	0.0006398	0.0045964	0.0033863	0.0006111
PWS-16_8-11_SE	PWS-16	SB	N	0.0405671	0.0017066	0.045541	0.0182567	0.0056415	0.018417	0.007302	0.0016953	0.0029885	0.0098916	0.0395183	0.0075906	0.1447776	0.0631963	0.0021285	0.0053794	0.0654068	0.0222366	0.0024248
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0007645	5.24E-05	0.0004609	0.0020953	0.0007901	0.0020726	0.0006585	0.0001915	0.000292	0.001628	0.0042137	0.0001404	0.0002523	0.0015013	0.0008655	0.0001356	0.0001577	0.0022237	0.0003568
PWS-25_8-11_SE	PWS-25	SB	N	0.0120686	0.0009733	0.0100056	0.0160358	0.0145884	0.0367357	0.0144101	0.0054624	0.0079737	0.0095256	0.0318739	0.0019172	0.0266581	0.0240077	0.0029654	0.0022488	0.0118563	0.0113621	0.0023006
PWS-26_8-11_SE	PWS-26	SB	N	0.0131286	0.0002583	0.0089462	0.0048195	0.0032579	0.0080596	0.002867	0.0015226	0.0014561	0.002195	0.0106931	0.001657	0.0298581	0.0173272	0.0010266	0.0011533	0.0128687	0.0049041	0.0007474
PWS-17_4-7	PWS-17	MC	N	0.0024683	2.364E-05	0.0001152	0.0001203	7.274E-05	0.0002958	0.0001277	6.326E-05	3.877E-05	0.0001248	0.0001336	0.0001485	0.0020521	0.000145	0.0001238	0.0001438	0.0005845	0.000139	0.0001212
PWS-27_8-11	PWS-27	MC	N	1.797E-05	1.429E-05	7.634E-05	0.0002871	0.0002651	0.0005063	0.0002275	0.0001647	9.505E-05	0.0003102	0.0005518	0.0001189	2.875E-05	0.0008546	0.0003123	0.000115	0.0001334	0.0008045	0.0005242
PWS-30_8-11	PWS-30	MC	N	6.423E-06	6.096E-06	5.901E-06	5.267E-06	4.874E-06	5.062E-06	4.982E-06	4.738E-06	4.952E-06	0.0002203	0.0002364	0.0002633	2.195E-05	0.0002569	0.0002183	0.0002546	0.0002957	0.0002459	0.0002134
LSI-01_8-11	LSI-01	SB	N	9.611E-05	6.031E-06	0.000156	9.703E-05	5.823E-05	0.0001436	6.124E-05	4.082E-05	1.907E-05	6.87E-05	7.304E-05	8.068E-05	0.0003989	7.905E-05	6.849E-05	7.845E-05	9.022E-05	7.602E-05	6.74E-05
LSI-02_8-11	LSI-02	SB	N	0.000245	3.155E-05	0.0007701	0.0005254	0.0003689	0.0013586	0.0005223	0.0001902	0.0002295	0.000312	0.0007455	0.0001135	0.0002358	0.0008017	9.485E-05	0.00011	0.0001273	0.0003592	9.291E-05
LSI-20_8-11	LSI-20	SB	N	0.000858	0.000106	0.0015398	0.0054419	0.0029874	0.0100679	0.0030697	0.0007819	0.0016001	0.0032415	0.009421	0.0002825	0.0007455	0.0056855	0.0007823	0.0003396	0.0004453	0.0029633	0.0006795
LSI-24_8-11	LSI-24	SB	N	0.0006964	9.198E-05	0.0001048	0.001034	0.00168	0.0022284	0.000955	0.0009964	0.0004422	0.0005886	0.0014249	7.516E-05	0.0001612	0.0007022	0.000222	7.297E-05	8.415E-05	0.0008331	6.223E-05
PWS-1_8-10	PWS-01	SB	N	0.0030651	1.765E-05	0.0003245	0.0027003	0.0011424	0.0023213	0.0009408	0.0004442	0.0005066	0.0005963	0.0047009	0.0007241	6.299E-05	0.0007033	0.0005877	0.0006966	0.0008159	0.0006708	0.000571
PWS-3_8-11	PWS-03	SB	N	0.0037708	0.001743	0.0140283	0.038221	0.0231788	0.0699638	0.024657	0.0052115	0.0150647	0.0178773	0.063066	0.0013576	0.0077017	0.0290947	0.0041209	0.0010792	0.0046997	0.0150634	0.0033788
PWS-4_8-11	PWS-04	SB	N	0.0013826	0.0008647	0.0370885	0.0259732	0.0613263	0.097277	0.0502328	0.0168166	0.0150209	0.0151326	0.0394955	0.000193	0.0023493	0.0169032	0.0051569	0.0001871	0.001245	0.0064757	0.0039348
PWS-5_8-11	PWS-05	SB	N	0.0033912	0.0002337	0.0029314	0.0068293	0.0052144	0.0141854	0.0044667	0.001427	0.0026565	0.0030319	0.0086209	0.0005517	0.0042422	0.0064069	0.0009129	0.0004296	0.0029961	0.0034616	0.0007429
PWS-6_8-11	PWS-06	SB	N	0.0149234	0.0001863	0.011307	0.0055266	0.0023416	0.0070527	0.002276	0.0005816	0.0013962	0.002232	0.0095957	0.0019942	0.0235421	0.0201402	0.0008234	0.0008731	0.0168937	0.0064191	0.000764
PWS-7_8-10	PWS-07	SB	N	0.0154543	0.0011602	0.073196	0.033368	0.0234267	0.0549626	0.0190498	0.003725	0.0107497	0.013729	0.0430111	0.0038265	0.0203911	0.045817	0.0049653	0.0023911	0.0168343	0.0197799	0.004345
PWS-7_8-10 DUP	PWS-07	SB	FD	0.0140895	0.0011752	0.0155629	0.0219254	0.0252118	0.0530141	0.0213239	0.0052912	0.0094151	0.0115739	0.0326315	0.0029736	0.0293541	0.0298032	0.0037709	0.0015954	0.0148926	0.0138127	0.0032627
PWS-8_8-11	PWS-08	SB	N	0.001923	0.0001319	0.0027357	0.0032058	0.0024246	0.0076149	0.0024395	0.0007533	0.0015506	0.0018227	0.0050337	0.0004151	0.0039055	0.0050501	0.0005341	0.000279	0.0024723	0.0026869	0.0005897
PWS-9_8-11	PWS-09	SB	N	0.0001434	2.789E-06	0.0002265	0.000274	0.0001273	0.0003117	0.0001026	5.362E-05	6.895E-05	0.000103	0.0006459	0.0001225	0.000211	0.0005778	0.0001023	0.0001186	0.0001373	0.0001147	0.0001002
PWS-12_8-11	PWS-12	SB	N	2.851E-06	2.705E-06	2.621E-06	3.274E-05	2.659E-05	6.315E-05	2.717E-05	2.177E-05	1.08E-05	0.0001002	0.0001072	0.000119	9.767E-06	0.0001163	9.949E-05	0.0001153	0.0001334	0.0001115	9.746E-05
PWS-13_8-11	PWS-13	SB	N	0.0017971	5.478E-05	0.0013098	0.0041673	0.0015808	0.0015478	0.0012742	0.0002331	0.0003503	0.0202506	0.0330278	0.0078224	0.0009133	0.0921032	0.0261921	0.0223758	0.03429	0.1483139	0.0171624
PWS-13_8-11_1	PWS-13	SB	FD	0.00308	0.0001451	0.0024215	0.0055507	0.0019732	0.0031385	0.0019037	0.0006309	0.0005255	0.0256354	0.0424587	0.0071933	0.0044004	0.1084329	0.0306732	0.0149137	0.0512937	0.1420939	0.0216003
PWS-13_8-11_2	PWS-13	SB	FT	0.001152	6.879E-05	0.0008089	0.0018206	0.0013916	0.0018307	0.0013662	0.0004822	0.0002683	0.0150368	0.0188813	0.0034442	0.0013428	0.056304	0.0198128	0.008347	0.0295461	0.0798537	0.0114166
PWS-15_8-11	PWS-15	SB	N	0.0001248	4.65E-06	2.82E-05	8.653E-05	2.757E-05	7.853E-05	2.613E-05	1.772E-05	1.548E-05	0.0001715	0.0001836	0.000204	6.862E-05	0.0001992	0.0001703	0.0001976	0.0002288	0.000191	0.0001667
PWS-16_8-11	PWS-16	SB	N	0.000329	2.49E-05	0.0004606	0.0006813	0.0002418	0.0009153	0.0003413	0.0001155	0.0001321	0.000359	0.0012439	7.751E-05	0.0006861	0.0011817	6.501E-05	7.516E-05	0.0004105	0.0007032	0.0003066
PWS-25_4-8	PWS-25	SB	N	0.0022142	0.0002918	0.0074242	0.0437135	0.0317596	0.0591938	0.0204851	0.0073148	0.0128286	0.0120725	0.0397512	0.0008274	0.004648	0.0082087	0.0022693	0.0001788	0.0024909	0.0050126	0.0013789
PWS-26_8-11	PWS-26	SB	N	0.0036568	0.0001793	0.0054354	0.0040098	0.0037943	0.0102571	0.0032414	0.0012701	0.002122	0.002119	0.0079152	0.00093	0.0078114	0.0091208	0.0006571	0.0004102	0.0042415	0.0036732	0.0004997
PWS-26_8-11_DUP	PWS-26	SB	FD	0.0031444	0.0002458	0.0057684	0.0119072	0.0088922	0.0208585	0.0065808	0.0021875	0.00408	0.0053825	0.016914	0.0009241	0.0077604	0.0122501	0.0014756	0.000577	0.0038182	0.0069772	0.0009158
PWS-28_8-11	PWS-28	SB	N	2.318E-06	3.697E-05	1.718E-05	0.0001468	0.0004326	0.000471	0.0003081	0.0002967	8.436E-05	0.0003216	8.786E-05	9.746E-05	4.493E-05	9.528E-05	0.0003093	9.45E-05	0.0001092	9.142E-05	0.0002566

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 3: IWTU and ΣIWTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	ΣIWTU
Final Chronic Value (µg/L)				1.916	11.1	1.256	0.07062	4.048	0.5594	2.042	0.2825	7.109	39.3	0.275	193.6	0.9008	19.13	10.11	--
PWS-27_8-11_SE	PWS-27	MC	N	0.0002158	0.0002482	0.0002068	0.0005394	0.0002392	0.0006074	0.0006224	0.0001735	0.0013087	3.807E-05	0.0001778	0.0006519	0.0006194	0.0004956	0.0013997	0.015
PWS-01_8-9_SE	PWS-01	SB	N	0.0002651	0.0027927	0.0002546	0.000707	0.0002928	0.0007811	0.0020374	1.924E-05	0.014968	0.0253543	0.0002429	0.001136	0.0001472	0.0199701	0.0093998	0.16
PWS-03_8-11_SE	PWS-03	SB	N	0.0047131	0.0273658	0.0313829	0.003306	0.0094302	0.0038637	0.2703188	0.0040916	0.6643083	0.0507381	0.0298458	0.2661335	0.0108267	0.2188923	0.5017388	**3.5**
PWS-04_1-4_SE	PWS-04	SB	N	0.0001825	0.0021589	0.0016747	0.0004789	0.0008375	0.0005322	0.0144202	0.0002744	0.0562454	0.0038075	0.0026968	0.0269884	0.0011156	0.0240286	0.040198	0.28
PWS-04_8-11_SE	PWS-04	SB	N	0.0037862	0.012144	0.0081674	0.0007356	0.0048223	0.0008228	0.0401573	0.0006351	0.1756379	0.023544	0.0062128	0.1231911	0.0024001	0.1179972	0.1151277	0.97
PWS-05_8-11_SE	PWS-05	SB	N	0.0012538	0.0136186	0.0080713	0.0004751	0.0041784	0.0302846	0.0586383	0.0008918	0.178944	0.0263935	0.0073261	0.1128584	0.004559	0.1309761	0.1225423	**1.1**
PWS-06_8-11_SE	PWS-06	SB	N	0.0037715	0.0533038	0.0181287	0.0020716	0.0151907	0.0894227	0.0764112	0.0003456	0.6076809	0.1207973	0.0027967	1.0249923	0.0013659	0.5324964	0.3449217	**4.1**
PWS-07_8-11_SE	PWS-07	SB	N	0.0045469	0.0144796	0.0069248	0.0003444	0.0052196	0.002081	0.047512	0.0010819	0.1630719	0.0333624	0.0088294	0.2455605	0.0050738	0.1448521	0.1262727	**1.3**
PWS-08_8-11_SE	PWS-08	SB	N	0.000929	0.0123888	0.0040268	0.0003401	0.0040899	0.0033164	0.0105596	0.0001241	0.0913709	0.0240021	0.0010397	0.0868328	0.0005774	0.1264061	0.0594651	0.63
PWS-09_8-11_SE	PWS-09	SB	N	0.0001678	0.0032841	0.0010553	0.0004303	0.0008672	0.0020976	0.004796	7.077E-05	0.0321539	0.0043943	0.0006981	0.036085	0.0007497	0.0306232	0.0222456	0.20
PWS-12_8-11_SE	PWS-12	SB	N	0.0002165	0.0002482	0.0002077	0.0005537	0.0002397	0.0006196	0.0038573	0.0001021	0.009666	0.0006208	0.0012458	0.0021401	0.0013128	0.0036205	0.0086815	0.057
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0002208	0.0002534	0.0002118	0.0005617	0.0002446	0.0006299	0.0022033	4.235E-05	0.0057603	0.0004354	0.0004959	0.0023912	0.0007544	0.0030718	0.0046919	0.036
PWS-13_1-4_SE	PWS-13	SB	N	0.0002169	0.0018689	0.0002077	0.0005256	0.0002407	0.0005959	0.0026413	6.648E-05	0.0087876	0.0012408	0.0010529	0.0062545	0.0004988	0.0075823	0.0091327	0.068
PWS-13_8-11_SE	PWS-13	SB	N	0.0002127	0.0008429	0.0010816	0.000536	0.0002357	0.0006028	0.0037586	8.739E-05	0.0066165	0.0007879	0.0008447	0.0043361	0.0006389	0.00517	0.0052396	0.061
PWS-15_8-11_SE	PWS-15	SB	N	0.000295	0.001309	0.0002824	0.0007218	0.0003273	0.0044527	0.0001356	5.802E-06	0.001255	3.678E-05	1.923E-05	0.0001824	0.0009076	0.0008957	0.000901	0.015
PWS-16B_8-11_SE	PWS-16	SB	N	0.0001559	0.0021801	0.0019537	0.0003972	0.0008657	0.0004447	0.0072622	0.0001258	0.0296083	0.0039832	0.001169	0.0280934	0.0007825	0.0179075	0.0211179	0.18
PWS-16_8-11_SE	PWS-16	SB	N	0.0016499	0.0250034	0.0051714	0.0004704	0.0063584	0.002463	0.0228305	0.0001498	0.1813854	0.0493419	0.0020753	0.3357866	0.0014576	0.2544775	0.1178892	**1.5**
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0001322	0.0001514	0.0026814	0.00034	0.0005018	0.0003796	0.0028822	3.517E-05	0.0033989	0.0003385	0.0002723	0.0012469	0.0001505	0.0034793	0.0029607	0.038
PWS-25_8-11_SE	PWS-25	SB	N	0.0008511	0.0066751	0.003759	0.0004684	0.0026102	0.0033808	0.0298378	0.000771	0.1003441	0.0151033	0.0072994	0.0618778	0.0021705	0.0724096	0.0799474	0.63
PWS-26_8-11_SE	PWS-26	SB	N	0.0001674	0.0060483	0.0015581	0.0004458	0.0016364	0.0060577	0.00808	0.0001361	0.0494934	0.0192648	0.0016339	0.057019	0.0008396	0.0754036	0.0341107	0.39
PWS-17_4-7	PWS-17	MC	N	0.0001406	0.0001603	0.000135	0.000376	0.0001553	0.0004154	0.0002345	2.593E-06	0.0007968	0.0005875	5.41E-05	0.0044027	5.136E-05	0.0016792	0.0004343	0.017
PWS-27_8-11	PWS-27	MC	N	0.0001123	0.0001283	0.0005648	0.0002962	0.0001242	0.0003284	0.0004964	1.271E-05	0.0016161	2.871E-05	0.0001368	7.552E-05	0.0001886	0.0006963	0.00161	0.012
PWS-30_8-11	PWS-30	MC	N	0.0002486	0.0002842	0.0002386	0.0006505	0.0002748	0.0007232	5.122E-06	4.647E-06	5.434E-06	6.214E-06	4.772E-06	7.387E-06	4.982E-06	5.921E-06	5.399E-06	0.0047
LSI-01_8-11	LSI-01	SB	N	7.707E-05	8.722E-05	7.418E-05	0.0002183	8.486E-05	0.0002363	0.0001307	1.366E-06	0.0010227	0.000115	4.112E-05	0.0019102	8.661E-06	0.0010773	0.0005139	0.0074
LSI-02_8-11	LSI-02	SB	N	0.0001076	0.0001226	0.0001033	0.000288	0.0001188	0.0003175	0.0009522	1.872E-05	0.0039514	0.0003014	0.0002154	0.0008012	7.671E-05	0.0021758	0.0024244	0.019
LSI-20_8-11	LSI-20	SB	N	0.0007591	0.0005879	0.0015902	0.0001915	0.0004842	0.0002077	0.0087942	0.000109	0.0416212	0.0004973	0.0009573	0.0031608	0.0003581	0.0109035	0.0264724	0.15
LSI-24_8-11	LSI-24	SB	N	7.155E-05	8.121E-05	0.0007348	0.0001975	7.888E-05	0.0002156	0.0015008	3.837E-05	0.0032726	6.906E-05	0.0007612	0.0005369	0.0003113	0.0008861	0.0029104	0.024
PWS-1_8-10	PWS-01	SB	N	0.000676	0.0007801	0.0006473	0.0016481	0.0007503	0.1059638	0.0076994	4.141E-05	0.004012	0.0009544	0.0004983	0.0002866	0.0001948	0.0014711	0.0031908	0.15
PWS-3_8-11	PWS-03	SB	N	0.0049612	0.0032106	0.0055201	0.0010951	0.0015114	0.0019138	0.125302	0.0012229	0.1197347	0.0058665	0.0085028	0.0208596	0.0024546	0.042643	0.0828707	0.77
PWS-4_8-11	PWS-04	SB	N	0.0017691	0.0009441	0.0023397	0.000496	0.0002021	0.0005457	0.1064068	0.0026233	0.0640342	0.0026509	0.0237095	0.0110751	0.0115271	0.0273999	0.050977	0.70
PWS-5_8-11	PWS-05	SB	N	0.0010198	0.0021879	0.0009463	0.0002988	0.00088	0.0017294	0.0255772	0.000196	0.0272315	0.003154	0.0017546	0.0142133	0.0006764	0.0184256	0.0158274	0.19
PWS-6_8-11	PWS-06	SB	N	0.0009624	0.0099518	0.0018159	0.0002114	0.0024754	0.0179527	0.0066522	9.657E-05	0.04762	0.0141354	0.0007396	0.055155	0.0002603	0.0664737	0.0278764	0.38
PWS-7_8-10	PWS-07	SB	N	0.0062849	0.0172127	0.0079933	0.000827	0.0067108	0.0033081	0.0406446	0.000923	0.1314526	0.0194136	0.0060538	0.0626972	0.0034537	0.092202	0.0948441	0.90
PWS-7_8-10 DUP	PWS-07	SB	FD	0.0039497	0.0093362	0.0046223	0.0006551	0.0030202	0.0019728	0.0526241	0.0009484	0.0831483	0.016049	0.0077743	0.0849992	0.0039125	0.0599493	0.0594224	0.70
PWS-8_8-11	PWS-08	SB	N	0.0006724	0.001341	0.0008916	0.0002246	0.0006564	0.0060941	0.0058257	0.0001091	0.0159531	0.0025742	0.0009617	0.0083365	0.0002667	0.013939	0.0089878	0.11
PWS-9_8-11	PWS-09	SB	N	0.000116	0.0001322	0.0001115	0.000309	0.0001281	0.0003409	0.001325	2.134E-06	0.0011904	0.000231	6.082E-05	0.0004772	2.661E-05	0.0010679	0.0007215	0.010
PWS-12_8-11	PWS-12	SB	N	0.0001128	0.0001285	0.0001084	0.000303	0.0001246	0.0003339	5.403E-05	2.07E-06	0.0001305	2.759E-06	2.302E-05	1.717E-05	1.227E-05	3.846E-05	0.0001163	0.00
PWS-13_8-11	PWS-13	SB	N	0.0288575	0.1649918	0.1047789	0.0043983	0.0966993	0.0933883	0.0097495	7.803E-05	0.0123459	0.0013143	0.00017	0.0024922	0.0002988	0.0196037	0.0129557	0.97
PWS-13_8-11_1	PWS-13	SB	FD	0.0215461	0.1759263	0.1252425	0.0042818	0.0928786	0.0545319	0.0138047	7.574E-05	0.026225	0.0027848	0.0004396	0.0123715	0.0004405	0.0330706	0.0255233	**1.1**
PWS-13_8-11_2	PWS-13	SB	FT	0.0119845	0.1169892	0.078158	0.0041662	0.0586322	0.036293	0.0034962	6.467E-05	0.0068678	0.0009429	0.0003448	0.0029219	0.0002577	0.0134806	0.0082488	0.60
PWS-15_8-11	PWS-15	SB	N	0.0001932	0.0002202	0.0001856	0.0005178	0.0002134	0.0005716	8.483E-05	3.555E-06	0.0004624	5.712E-05	1.815E-05	0.0002484	0.0001152	0.0002784	0.0003342	0.0057
PWS-16_8-11	PWS-16	SB	N	7.36E-05	0.0003256	0.0002695	0.0001991	8.121E-05	0.0002186	0.0010734	1.421E-05	0.0044989	0.0004341	0.0001261	0.001466	5.016E-05	0.0026878	0.002722	0.023
PWS-25_4-8	PWS-25	SB	N	0.0011567	0.0012391	0.0016766	0.0004672	0.0001931	0.0047269	0.0579086	0.0012214	0.0594296	0.0047987	0.0093407	0.0142413	0.0037885	0.0187059	0.0360982	0.48
PWS-26_8-11	PWS-26	SB	N	0.0007189	0.0024227	0.0011861	0.000257	0.0008042	0.0741231	0.0100289	0.000147	0.0251149	0.0057237	0.0014294	0.0174319	0.0003819	0.0232731	0.0143528	0.25
PWS-26_8-11_DUP	PWS-26	SB	FD	0.0014082	0.0020682	0.0022283	0.0002224	0.0008873	0.0118532	0.0213285	0.0003242	0.0361342	0.0046787	0.0027398	0.0216727	0.000869	0.0222382	0.0221004	0.27
PWS-28_8-11	PWS-28	SB	N	9.253E-05	0.0001053	8.894E-05	0.0002522	0.0001021	0.000277	0.0002996	1.289E-05	0.0009889	7.734E-06	0.0002127	6.729E-05	7.48E-05	0.0003043	0.0006899	0.0069

Notes:

[1]All values in toxic units (TUs) based on narcotic effects in benthic invertebrates. **BOLD** indicates value greater than 1.

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

IWTU = interstitial water toxic units

ΣIWTU = sum of interstitial water toxic units

µg/L = micrograms per liter

ATTACHMENT C

Interstitial Water Toxic Unit (IWTU) Calculation for 2012 and 2017 Porewater Data (Direct Measurement)

ATTACHMENT G-C: IWTU Calculation for Pore Water Data (direct measurement)

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	NAPL or non-NAPL Area	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	No. of Detected Analytes	Total PAHs	Naphthalene	C1-Naphthalenes[4]	C2-Naphthalenes	C3-Naphthalenes	C4-Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C1-Fluorenes	C2-Fluorenes	C3-Fluorenes	Phenanthrene	Anthracene	C1-Phenanthrenes/Anth	C2-Phenanthrenes/Anth	C3-Phenanthrenes/Anth	C4-Phenanthrenes/Anth	Fluoranthene	Pyrene	C1-Fluoranthenes/Pyre	Benzo(a)anthracene	Chrysene	C1-Benz(a)anth/Chryser	C2-Benz(a)anth/Chryser	C3-Benz(a)anth/Chryser	C4-Benz(a)anth/Chryser	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	1-Methylnaphthalene	2-Methylnaphthalene
PWS-27_8-11_PW	PWS-27	MC	non-NAPL	7/13/2012	N	8	11	8	2.41	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.15 U	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-01_8-9_PW	PWS-01	SB	non-NAPL	7/10/2012	N	8	9	8	17.7	1.12 U	1.50	1.63	0.479 J	0.0046 U	0.902	9.31	2.05	0.466	0.339 U	0.0603 U	0.15 U	0.0447	2.63	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	1.36	0.27 U
PWS-03_8-11_PW	PWS-03	SB	non-NAPL	7/12/2012	N	8	11	10	5.46	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.14	0.916	0.71	0.274 U	0.339 U	0.0603 U	0.401	0.097 J	0.387	0.165 J	0.0051 U	0.0173 U	0.468	0.252	0.114 U	0.0107 UJ	0.0215 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-04_8-11_PW	PWS-04	SB	non-NAPL	7/10/2012	N	8	11	3	2.80	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.281	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.145	0.0955	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-05_8-11_PW	PWS-05	SB	non-NAPL	7/12/2012	N	8	11	7	3.91	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.853	0.254	0.493	0.339 U	0.0603 U	0.183	0.021 J	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0938	0.0551	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-06_8-11_PW	PWS-06	SB	non-NAPL	7/12/2012	N	8	11	3	3.36	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.902	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.113	0.0608	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-07_8-11_PW	PWS-07	SB	non-NAPL	7/10/2012	N	8	11	10	4.89	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.121	0.993	0.365	0.304	0.339 U	0.0603 U	0.342	0.0589	0.367	0.205 J	0.0051 U	0.0173 U	0.226	0.137	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-08_8-11_PW	PWS-08	SB	non-NAPL	7/12/2012	N	8	11	10	4.42	1.12 U	0.59 U	0.778 U	0.233 J	0.0046 U	0.12 U	0.718	0.215	0.309	0.339 U	0.0603 U	0.226	0.0168	0.35	0.21 J	0.0051 U	0.0173 U	0.193	0.118	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-09_8-11_PW	PWS-09	SB	non-NAPL	7/12/2012	N	8	11	1	2.52	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.185	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-12_8-11 DUP_PW	PWS-12	SB	non-NAPL	7/12/2012	FD	8	11	1	2.51	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.175	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-12_8-11_PW	PWS-12	SB	non-NAPL	7/12/2012	N	8	11	1	2.43	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.0973 J	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-13_1-4_PW	PWS-13	SB	non-NAPL	7/11/2012	N	1	4	0	2.41	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.15 U	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-13_8-11_PW	PWS-13	SB	non-NAPL	7/11/2012	N	8	11	0	2.41	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.15 U	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-15_8-11 PW	PWS-15	SB	non-NAPL	7/12/2012	N	8	11	0	2.41	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.15 U	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-16_8-11_PW	PWS-16	SB	non-NAPL	7/9/2012	N	8	11	1	2.65	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.262	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-16B_8-11_PW	PWS-16	SB	non-NAPL	7/13/2012	N	8	11	2	2.62	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.233	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0579 J	0.0051 U	0.0173 U	0.0581 U	0.0493 UJ	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-25_8-11_PW	PWS-25	SB	non-NAPL	7/13/2012	N	8	11	7	3.89	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.647	0.2 U	0.274 U	0.339 U	0.0603 U	0.178	0.0161 U	0.299	0.315 J	0.0051 U	0.0173 U	0.209	0.163 J	0.114 U	0.0107 UJ	0.0092 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-26_8-11_PW	PWS-26	SB	non-NAPL	7/13/2012	N	8	11	4	2.77	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.23	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.151	0.101 J	0.114 U	0.0107 UJ	0.00636 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-17_4-7 POREWATER	PWS-17	MC	non-NAPL	10/10/2012	N	4	7	8	7.18	1.12 U	1.13	0.778 U	0.37 J	0.0046 U	0.23	2.72	0.46	3.27 J	0.339 UJ	0.0603 UJ	0.28	0.0301	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.99	0.27 U
PWS-27_8-11 POREWATER	PWS-27	MC	non-NAPL	10/9/2012	N	8	11	2	2.47	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.15 U	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 U	0.0834	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.00616 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
PWS-30_8-11 POREWATER	PWS-30	MC	non-NAPL	10/12/2012	N	8	11	0	2.39	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.15 U	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 U	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
LSI-01_8-11 POREWATER	LSI-01	SB	non-NAPL	10/16/2012	N	8	11	1	2.56	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.18	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 U	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.32 U	0.27 U
LSI-02_8-11 POREWATER	LSI-02	SB	non-NAPL	10/9/2012	N	8	11	5	3.63	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.76	0.26	0.274 UJ	0.339 UJ	0.0603 UJ	0.17	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.165 J	0.114 J	0.114 UJ	0.0107 UJ	0.00893 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.32 U	0.27 U
LSI-20_8-11 POREWATER	LSI-20	SB	non-NAPL	10/10/2012	N	8	11	5	4.31	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	1.49	0.2 U	0.38 J	0.339 UJ	0.0603 UJ	0.15 U	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.133 J	0.113 J	0.114 UJ	0.0107 UJ	0.0084 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.32 U	0.27 U
LSI-24-8-11 POREWATER	LSI-24	SB	non-NAPL	10/12/2012	N	8	11	6	4.42	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.18	1.66	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.16	0.022	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.117 J	0.0947 J	0.114 UJ	0.0107 UJ	0.00855 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.32 U	0.27 U
PWS-1_8-10 POREWATER	PWS-01	SB	non-NAPL	10/10/2012	N	8	10	8	10.1	1.12 UJ	0.59 UJ	1.35 J	0.00329 UJ	0.0046 UJ	0.35 J	4.89 J	1.16 J	0.36 J	0.339 UJ	0.0603 UJ	0.32 J	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0969 J	0.0511 J	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-3_8-11 POREWATER	PWS-03	SB	non-NAPL	10/10/2012	N	8	11	9	4.19	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.64 J	0.52 J	0.292 J	0.339 UJ	0.0603 UJ	0.2 J	0.0428	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.328 J	0.198 J	0.114 UJ	0.0122 J	0.0206 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-4_8-11 POREWATER	PWS-04	SB	non-NAPL	10/10/2012	N	8	11	5	3.13	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.54 J	0.23 J	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 UJ	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.12 J	0.0714 J	0.114 UJ	0.0107 UJ	0.00764 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-5_8-11 POREWATER	PWS-05	SB	non-NAPL	10/10/2012	N	8	11	5	3.40	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.68 J	0.23 J	0.274 UJ	0.339 UJ	0.0603 UJ	0.23 J	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.114 J	0.0619 J	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-6_8-11 POREWATER	PWS-06	SB	non-NAPL	10/10/2012	N	8	11	8	6.30	1.12 UJ	0.59 UJ	0.778 J	1.11 J	0.0046 UJ	0.13 J	1.68 J	0.33 J	0.279 J	0.339 UJ	0.0603 UJ	0.2 J	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.126 J	0.0726 J	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-7_8-10 DUP POREWATER	PWS-07	SB	non-NAPL	10/11/2012	FD	8	10	13	23.2	1.12 U	0.59 U	2.82 J	2.4 J	0.0046 UJ	0.48 J	4.57 J	2.8 J	1.2 J	0.339 UJ	0.0603 UJ	3.27 J	0.862 J	0.946 J	0.377 J	0.0051 UJ	0.0173 UJ	1.16 J	0.638 J	0.226 J	0.0735 UJ	0.0543 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
PWS-7_8-10 POREWATER	PWS-07	SB	non-NAPL	10/11/2012	N	8	10	10	6.68	1.12 U	0.59 U	0.778 UJ	0.815 J	0.0046 UJ	0.13 J	1.21 J	0.54 J	0.6 J	0.339 UJ	0.0603 UJ	0.5 J	0.0853 UJ	0.358 J	0.298 J	0.0051 UJ	0.0173 UJ	0.239 J	0.141 J	0.114 UJ	0.0107 UJ	0.0167 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-8_8-11 POREWATER	PWS-08	SB	non-NAPL	10/9/2012	N	8	11	9	4.26	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.7 J	0.5 J	0.3 J	0.339 UJ	0.0603 UJ	0.45 J	0.0454	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.187 J	0.113 J	0.114 UJ	0.017 J	0.00931 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-9_8-11 POREWATER	PWS-09	SB	non-NAPL	10/9/2012	N	8	11	5	3.13	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.45 J	0.27 J	0.284 J	0.339 UJ	0.0603 UJ	0.15 UJ	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0722 J	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-12_8-11 POREWATER	PWS-12	SB	non-NAPL	10/9/2012	N	8	11	2	2.41	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.15 UJ	0.2 UJ	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 UJ	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0176 J	0.0144 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-13_8-11 POREWATER	PWS-13	SB	non-NAPL	10/9/2012	N	8	11	18	57.9	1.12 U	0.59 U	13.7 J	25.1 J	3.8 J	0.24	1.39	0.59	1.97 J	1.99 J	0.0603 UJ	1.7	0.0796	3.01 J	2.12 J	0.41 J	0.0173 UJ	0.266 J	0.216 J	0.175 J	0.019 J	0.0233 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
PWS-15_8-11 POREWATER	PWS-15	SB	non-NAPL	10/11/2012	N	8	11	3	2.91	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.46	0.2 U	0.274 U	0.339 UJ	0.0603 UJ	0.17	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0655 J	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-16_8-11 POREWATER	PWS-16	SB	non-NAPL	10/9/2012	N	8	11	9	5.87	1.12 U	0.59 U	1.17 J	0.00329 UJ	0.0046 UJ	0.12 U	1.23	0.78	0.357 J	0.339 UJ	0.0603 UJ	0.5	0.0342	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.159 J	0.0852 J	0.114 UJ	0.0107 UJ	0.00481 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-25 4-8 POREWATER	PWS-25	SB	non-NAPL	10/11/2012	N	4	8	6	3.13	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.19	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.17	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.334 J	0.217 J	0.114 UJ	0.024 J	0.0154 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-26_8-11 POREWATER	PWS-26	SB	non-NAPL	10/11/2012	N	8	11	5	3.17	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.55	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.21	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.137 J	0.0828 J	0.114 UJ	0.0107 UJ	0.00431 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-26_8-11 DUP POREWATER	PWS-26	SB	non-NAPL	10/11/2012	FD	8	11	7	3.29	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.56	0.22	0.274 UJ	0.339 UJ	0.0603 UJ	0.19	0.0163	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.138 J	0.0836 J	0.114 UJ	0.0107 UJ	0.00634 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
PWS-28_8-11 POREWATER	PWS-28	SB	non-NAPL	10/10/2012	N	8	11	0	2.39	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.15 U	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 U	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ

ATTACHMENT G-C: IWTU Calculation for Pore Water Data (direct measurement)
Table 2: Calculation of Percent Freely Dissolved PAH in Pore Water

Sample ID	Location	Exposure Area[1]	NAPL or non-NAPL Area	Sample Type[2]	Dissolved Organic Carbon[3] (mg/L)	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/Anthracenes	C-2 Phenanthrenes/Anthracenes	C-3 Phenanthrenes/Anthracenes	C-4 Phenanthrenes/Anthracenes	Fluoranthene	Pyrene	C-1 Fluoranthrenes/Pyrenes	Benzo(a)anthracene	Chrysene	C-1 Benz(a)anth/Chrysenes	C-2 Benz(a)anth/Chrysenes	C-3 Benz(a)anth/Chrysenes	C-4 Benz(a)anth/Chrysenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
Log K_{DOC}						2.44	2.88	3.38	3.87	4.37	2.31	3.09	3.29	3.79	4.27	4.76	3.65	3.61	4.11	4.53	4.98	5.38	4.15	3.99	4.35	4.74	4.78	5.20	5.48	5.99	6.41	5.32	5.35	5.19	5.17	5.19	5.77	5.77	5.56
PWS-27_8-11_PW	PWS-27	MC	non-NAPL	N	93.0	97.5%	93.4%	81.8%	59.2%	31.4%	98.1%	89.7%	84.6%	63.6%	36.6%	15.7%	70.7%	72.5%	45.5%	24.1%	10.1%	4.3%	43.2%	52.4%	32.4%	16.4%	15.1%	6.4%	3.4%	1.1%	0.4%	4.9%	4.6%	6.5%	6.8%	6.5%	1.8%	1.8%	2.9%
PWS-01_8-9_PW	PWS-01	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-03_8-11_PW	PWS-03	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-04_8-11_PW	PWS-04	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-05_8-11_PW	PWS-05	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-06_8-11_PW	PWS-06	SB	non-NAPL	N	2.06	99.9%	99.8%	99.5%	98.5%	95.4%	100.0%	99.7%	99.6%	98.7%	96.3%	89.4%	99.1%	99.2%	97.4%	93.5%	83.6%	66.9%	97.2%	98.0%	95.6%	89.8%	89.0%	75.4%	61.6%	33.2%	15.9%	69.9%	68.4%	75.8%	76.6%	75.8%	45.2%	45.2%	57.2%
PWS-07_8-11_PW	PWS-07	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-08_8-11_PW	PWS-08	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-09_8-11_PW	PWS-09	SB	non-NAPL	N	2.10	99.9%	99.8%	99.5%	98.5%	95.3%	100.0%	99.7%	99.6%	98.7%	96.2%	89.2%	99.1%	99.2%	97.4%	93.4%	83.3%	66.5%	97.1%	98.0%	95.5%	89.7%	88.8%	75.0%	61.2%	32.8%	15.6%	69.5%	68.0%	75.5%	76.3%	75.5%	44.7%	44.7%	56.7%
PWS-12_8-11 DUP_PW	PWS-12	SB	non-NAPL	FD	2.57	99.9%	99.8%	99.4%	98.1%	94.3%	99.9%	99.7%	99.5%	98.4%	95.4%	87.1%	98.9%	99.0%	96.8%	92.0%	80.3%	61.9%	96.5%	97.6%	94.6%	87.6%	86.6%	71.1%	56.3%	28.5%	13.1%	65.1%	63.5%	71.5%	72.5%	71.5%	39.8%	39.8%	51.7%
PWS-12_8-11_PW	PWS-12	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-13_1-4_PW	PWS-13	SB	non-NAPL	N	2.31	99.9%	99.8%	99.4%	98.3%	94.9%	100.0%	99.7%	99.6%	98.6%	95.9%	88.3%	99.0%	99.1%	97.1%	92.7%	81.9%	64.3%	96.8%	97.8%	95.1%	88.7%	87.8%	73.2%	58.9%	30.7%	14.4%	67.4%	65.9%	73.6%	74.5%	73.6%	42.4%	42.4%	54.4%
PWS-13_8-11_PW	PWS-13	SB	non-NAPL	N	2.08	99.9%	99.8%	99.5%	98.5%	95.4%	100.0%	99.7%	99.6%	98.7%	96.3%	89.3%	99.1%	99.2%	97.4%	93.4%	83.4%	66.7%	97.1%	98.0%	95.6%	89.7%	88.9%	75.2%	61.4%	33.0%	15.8%	69.7%	68.2%	75.6%	76.5%	75.6%	44.9%	44.9%	57.0%
PWS-15_8-11_PW	PWS-15	SB	non-NAPL	N	93.8	97.5%	93.4%	81.6%	59.0%	31.3%	98.1%	89.7%	84.5%	63.4%	36.4%	15.6%	70.5%	72.4%	45.3%	23.9%	10.0%	4.3%	43.0%	52.2%	32.3%	16.2%	15.0%	6.3%	3.4%	1.1%	0.4%	4.9%	4.5%	6.4%	6.7%	6.4%	1.8%	1.8%	2.9%
PWS-16_8-11_PW	PWS-16	SB	non-NAPL	N	19.1	99.5%	98.6%	95.6%	87.6%	69.1%	99.6%	97.7%	96.4%	89.5%	73.8%	47.6%	92.1%	92.8%	80.3%	60.7%	35.4%	17.9%	78.8%	84.3%	70.0%	48.8%	46.5%	24.8%	14.8%	5.1%	2.0%	20.0%	19.0%	25.3%	26.1%	25.3%	8.2%	8.2%	12.6%
PWS-16B_8-11_PW	PWS-16	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-25_8-11_PW	PWS-25	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-26_8-11_PW	PWS-26	SB	non-NAPL	N	2.51	99.9%	99.8%	99.4%	98.2%	94.4%	99.9%	99.7%	99.5%	98.5%	95.5%	87.4%	98.9%	99.0%	96.9%	92.2%	80.7%	62.4%	96.6%	97.6%	94.7%	87.9%	86.9%	71.5%	56.9%	29.0%	13.4%	65.6%	64.0%	72.0%	72.9%	72.0%	40.4%	40.4%	52.3%
PWS-17_4-7 POREWATER	PWS-17	MC	non-NAPL	N	8.09	99.8%	99.4%	98.1%	94.3%	84.1%	99.8%	99.0%	98.4%	95.2%	86.9%	68.2%	96.5%	96.8%	90.6%	78.5%	56.4%	34.0%	89.7%	92.7%	84.7%	69.2%	67.2%	43.8%	29.0%	11.2%	4.6%	37.2%	35.6%	44.4%	45.5%	44.4%	17.3%	17.3%	25.4%
PWS-27_8-11 POREWATER	PWS-27	MC	non-NAPL	N	47.8	98.7%	96.5%	89.7%	73.8%	47.2%	99.0%	94.4%	91.5%	77.2%	52.9%	26.7%	82.4%	83.7%	61.9%	38.2%	18.0%	8.0%	59.7%	68.2%	48.3%	27.6%	25.8%	11.7%	6.5%	2.1%	0.8%	9.1%	8.5%	11.9%	12.4%	11.9%	3.4%	3.4%	5.4%
PWS-30_8-11 POREWATER	PWS-30	MC	non-NAPL	N	4.36	99.9%	99.7%	99.0%	96.9%	90.7%	99.9%	99.5%	99.2%	97.4%	92.5%	79.9%	98.1%	98.3%	94.7%	87.1%	70.6%	48.9%	94.2%	95.9%	91.1%	80.7%	79.2%	59.1%	43.2%	19.0%	8.2%	52.3%	50.6%	59.7%	60.8%	59.7%	28.0%	28.0%	38.7%
LSI-01_8-11 POREWATER	LSI-01	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
LSI-02_8-11 POREWATER	LSI-02	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
LSI-20_8-11 POREWATER	LSI-20	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
LSI-24-8-11 POREWATER	LSI-24	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
PWS-1_8-10 POREWATER	PWS-01	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-3_8-11 POREWATER	PWS-03	SB	non-NAPL	N	3.69	99.9%	99.7%	99.1%	97.3%	92.0%	99.9%	99.5%	99.3%	97.8%	93.6%	82.5%	98.4%	98.5%	95.5%	88.9%	73.9%	53.0%	95.0%	96.5%	92.4%	83.1%	81.8%	63.1%	47.3%	21.7%	9.5%	56.5%	54.8%	63.6%	64.7%	63.6%	31.5%	31.5%	42.7%
PWS-4_8-11 POREWATER	PWS-04	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-5_8-11 POREWATER	PWS-05	SB	non-NAPL	N	12.4	99.7%	99.1%	97.1%	91.6%	77.5%	99.7%	98.5%	97.6%	92.9%	81.2%	58.4%	94.8%	95.2%	86.2%	70.4%	45.8%	25.2%	85.1%	89.2%	78.3%	59.5%	57.2%	33.7%	21.1%	7.6%	3.0%	27.8%	26.5%	34.2%	35.3%	34.2%	12.0%	12.0%	18.2%
PWS-6_8-11 POREWATER	PWS-06	SB	non-NAPL	N	30.4	99.2%	97.7%	93.2%	81.6%	58.4%	99.4%	96.4%	94.4%	84.2%	63.9%	36.4%	88.0%	89.0%	71.9%	49.3%	25.6%	12.1%	70.0%	77.1%	59.5%	37.4%	35.3%	17.2%	9.8%	3.3%	1.3%	13.6%	12.8%	17.5%	18.2%	17.5%	5.3%	5.3%	8.3%
PWS-7_8-10 DUP POREWATER	PWS-07	SB	non-NAPL	FD	8.22	99.8%	99.4%	98.1%	94.3%	83.8%	99.8%	99.0%	98.4%	95.2%	86.7%	67.9%	96.5%	96.8%	90.4%	78.2%	56.0%	33.6%	89.6%	92.6%	84.5%	68.9%	66.9%	43.4%	28.7%	11.1%	4.5%	36.8%	35.2%	44.0%	45.1%	44.0%	17.1%	17.1%	25.1%
PWS-7_8-10 POREWATER	PWS-07	SB	non-NAPL	N	7.68	99.8%	99.4%	98.2%	94.6%	84.7%	99.8%	99.1%	98.5%	95.5%	87.5%	69.4%	96.7%	97.0%	91.0%	79.4%	57.7%	35.2%	90.2%	93.0%	85.3%	70.3%	68.4%	45.1%	30.1%	11.8%	4.8%	38.4%	36.8%	45.7%	46.8%	45.7%	18.1%	18.1%	26.4%
PWS-8_8-11 POREWATER	PWS-08	SB	non-NAPL	N	4.1	99.9%	99.7%	99.0%	97.1%	91.2%	99.9%	99.5%	99.2%	97.5%	92.9%	80.9%	98.2%	98.4%	95.0%	87.8%	71.9%	50.4%	94.5%	96.1%	91.6%	81.6%	80.2%	60.6%	44.7%	20.0%	8.7%	53.9%	52.1%	61.2%	62.2%	61.2%	29.3%	29.3%	40.2%
PWS-9_8-11 POREWATER	PWS-09	SB	non-NAPL	N	9.46	99.7%	99.3%	97.8%	93.4%	81.8%	99.8%	98.8%	98.2%	94.5%	85.0%	64.8%	95.9%	96.3%	89.1%	75.7%	52.5%	30.6%	88.2%	91.5%	82.5%	65.8%	63.7%	40.0%	25.9%	9.8%	4.0%	33.6%	32.1%	40.6%	41.7%	40.6%	15.2%	15.2%	22.5%
PWS-12_8-11 POREWATER	PWS-12	SB	non-NAPL	N	41.2	98.9%	97.0%	91.0%	76.6%	50.9%	99.2%	95.2%	92.6%	79.7%	56.6%	29.7%	84.5%	85.6%	65.3%	41.7%	20.3%	9.2%	63.2%	71.3%	52.0%	30.6%	28.7%	13.3%	7.4%	2.4%	0.9%	10.4%	9.8%	13.5%	14.1%	13.5%	4.0%	4.0%	6.3%
PWS-13_8-11 POREWATER	PWS-13	SB	non-NAPL	N	91.2	97.5%	93.5%	82.0%	59.7%	31.9%	98.2%	89.9%	84.9%	64.0%	37.1%	16.0%	71.1%	72.9%	46.0%	24.4%	10.3%	4.4%	43.7%	52.9%	32.9%	16.6%	15.4%	6.5%	3.5%	1.1%	0.4%	5.0%	4.7%	6.6%	6.9%	6.6%	1.8%	1.8%	2.9%
PWS-15_8-11 POREWATER	PWS-15	SB	non-NAPL	N	6.83	99.8%	99.5%	98.4%	95.2%	86.2%	99.9%	99.2%	98.7%	96.0%	88.7%	71.8%	97.0%	97.3%	91.9%	81.2%	60.5%	37.9%	91.2%	93.7%	86.7%	72.7%	70.8%	48.0%	32.7%	13.0%	5.4%	41.2%	39.5%	48.6%	49.7%	48.6%	19.9%	19.9%	28.7%
PWS-16_8-11 POREWATER	PWS-16	SB	non-NAPL	N	109	97.1%	92.4%	79.3%	55.3%	28.1%	97.8%	88.2%	82.5%	59.8%	33.0%	13.8%	67.3%	69.2%	41.6%	21.3%	8.8%	3.7%	39.4%	48.4%	29.1%	14.3%	13.2%	5.5%	2.9%	0.9%	0.4%	4.2%	3.9%	5.6%	5.8%	5.6%	1.5%	1.5%	2.5%
PWS-25_4-8 POREWATER	PWS-25	SB	non-NAPL	N	4.55	99.9%	99.7%	98.9%	96.7%	90.4%	99.9%	99.4%	99.1%	97.3%	92.2%	79.3%	98.0%	98.2%	94.5%	86.6%	69.7%	47.8%	94.0%	95.7%	90.8%	80.0%	78.5%	58.1%	42.1%	18.4%	7.9%	51.3%	49.5%	58.7%	59.8%	58.7%	27.2%	27.2%	37.7%
PWS-26_8-11 POREWATER	PWS-26	SB	non-NAPL	N	8.95	99.8%	99.3%	97.9%	93.8%	82.7%	99.8%	98.9%	98.3%	94.8%	85.7%	66.0%	96.2%	96.5%	89.7%	76.7%	53.9%	31.8%	88.8%	92.0%	83.3%	67.0%	65.0%	41.3%	27.0%	10.3%	4.2%	34.8%	33.3%	41.9%	43.0%	41.9%	15.9%	15.9%	23.5%
PWS-26_8-11_DUP POREWATER	PWS-26	SB	non-NAPL	FD	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-28_8-11 POREWATER	PWS-28	SB	non-NAPL	N	4.01	99.9%	99.7%	99.0%	97.1%	91.4%	99.9%	99.5%	99.2%	97.6%	93.1%	81.3%	98.2%	98.4%	95.1%	88.0%	72.3%	51.0%	94.6%	96.2%	91.8%	81.9%	80.5%	61.1%	45.2%	20.3%	8.8%	54.4%	52.7%	61.7%	62.8%	61.7%	29.8%	29.8%	40.7%
Shallow Porewater Site 1	PWS-1	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 1	PWS-1	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 2	PWS-2	MC	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 2	PWS-2	MC	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 3	PWS-3	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 3	PWS-3	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 4	PWS-4	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 4	PWS-4	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 5	PWS-5	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 5	PWS-5	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 6	PWS-6	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 6	PWS-6	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 7	PWS-7	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 7	PWS-7	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 8	PWS-8	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 8	PWS-8	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 9	PWS-9	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 9	PWS-9	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 10	PWS-10	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 10	PWS-10	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%

ATTACHMENT G-C: IWTU Calculation for Pore Water Data (direct measurement)

Table 3: Analytical Data Converted to Freely Dissolved Concentration[1]

Sample ID	Location	Exposure Area[2]	NAPL or non-NAPL Area	Sample Type[3]	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/Anthracenes	C-2 Phenanthrenes/Anthracenes	C-3 Phenanthrenes/Anthracenes	C-4 Phenanthrenes/Anthracenes	Fluoranthene	Pyrene	C-1 Fluoranthrenes/Pyrenes	Benzo(a)anthracene	Chrysene	C-1 Benz(a)anth/Chrysenes	C-2 Benz(a)anth/Chrysenes	C-3 Benz(a)anth/Chrysenes	C-4 Benz(a)anth/Chrysenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
PWS-27_8-11_PW	PWS-27	MC	non-NAPL	N	1.09E+00	5.51E-01	6.36E-01	1.95E-03	1.44E-03	1.18E-01	1.35E-01	1.69E-01	1.74E-01	1.24E-01	9.49E-03	1.06E-01	1.17E-02	1.20E-01	8.94E-04	5.17E-04	7.42E-04	2.51E-02	2.58E-02	3.70E-02	1.75E-03	6.06E-04	4.10E-04	4.30E-04	1.99E-05	1.06E-04	2.59E-03	2.43E-03	3.44E-03	3.59E-03	3.44E-03	9.50E-04	9.50E-04	1.52E-03
PWS-01_8-9_PW	PWS-01	SB	non-NAPL	N	1.12E+00	1.49E+00	1.63E+00	4.75E-01	4.48E-03	9.02E-01	9.30E+00	2.05E+00	4.63E-01	3.33E-01	5.70E-02	1.49E-01	4.45E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	5.73E-02	4.88E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-03_8-11_PW	PWS-03	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.40E-01	9.15E-01	7.09E-01	2.72E-01	3.33E-01	5.70E-02	3.99E-01	9.66E-02	3.82E-01	1.60E-01	4.66E-03	1.40E-02	4.61E-01	2.50E-01	1.12E-01	1.01E-02	2.03E-02	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-04_8-11_PW	PWS-04	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	2.81E-01	2.00E-01	2.72E-01	3.33E-01	5.70E-02	1.49E-01	1.60E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	1.43E-01	9.46E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-05_8-11_PW	PWS-05	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	8.52E-01	2.54E-01	4.90E-01	3.33E-01	5.70E-02	1.82E-01	2.09E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	9.25E-02	5.46E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-06_8-11_PW	PWS-06	SB	non-NAPL	N	1.12E+00	5.89E-01	7.74E-01	3.24E-03	4.38E-03	1.20E-01	9.00E-01	1.99E-01	2.71E-01	3.26E-01	5.39E-02	1.49E-01	1.60E-02	2.56E-01	3.47E-03	4.27E-03	1.16E-02	1.10E-01	5.96E-02	1.09E-01	9.61E-03	3.56E-03	4.86E-03	7.71E-03	6.07E-04	4.05E-03	3.71E-02	3.63E-02	4.02E-02	4.06E-02	4.02E-02	2.39E-02	2.39E-02	3.03E-02
PWS-07_8-11_PW	PWS-07	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.21E-01	9.92E-01	3.64E-01	3.02E-01	3.33E-01	5.70E-02	3.40E-01	5.87E-02	3.62E-01	1.98E-01	4.66E-03	1.40E-02	2.23E-01	1.36E-01	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-08_8-11_PW	PWS-08	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	2.31E-01	4.48E-03	1.20E-01	7.17E-01	2.15E-01	3.07E-01	3.33E-01	5.70E-02	2.25E-01	1.67E-02	3.46E-01	2.03E-01	4.66E-03	1.40E-02	1.90E-01	1.17E-01	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-09_8-11_PW	PWS-09	SB	non-NAPL	N	1.12E+00	5.89E-01	7.74E-01	3.24E-03	4.37E-03	1.20E-01	1.85E-01	1.99E-01	2.70E-01	3.26E-01	5.38E-02	1.49E-01	1.60E-02	2.56E-01	3.46E-03	4.26E-03	1.15E-02	5.64E-02	4.83E-02	1.09E-01	9.59E-03	3.55E-03	4.84E-03	7.65E-03	6.00E-04	3.99E-03	3.68E-02	3.61E-02	4.00E-02	4.04E-02	4.00E-02	2.37E-02	2.37E-02	3.01E-02
PWS-12_8-11 DUP_PW	PWS-12	SB	non-NAPL	FD	1.12E+00	5.89E-01	7.73E-01	3.23E-03	4.33E-03	1.20E-01	1.74E-01	1.99E-01	2.70E-01	3.24E-01	5.25E-02	1.48E-01	1.59E-02	2.55E-01	3.41E-03	4.10E-03	1.07E-02	5.61E-02	4.81E-02	1.08E-01	9.38E-03	3.46E-03	4.58E-03	7.04E-03	5.21E-04	3.35E-03	3.45E-02	3.36E-02	3.79E-02	3.84E-02	3.79E-02	2.11E-02	2.11E-02	2.74E-02
PWS-12_8-11_PW	PWS-12	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	9.72E-02	2.00E-01	2.72E-01	3.33E-01	5.70E-02	1.49E-01	1.60E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	5.73E-02	4.88E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-13_1-4_PW	PWS-13	SB	non-NAPL	N	1.12E+00	5.89E-01	7.74E-01	3.23E-03	4.35E-03	1.20E-01	1.50E-01	1.99E-01	2.70E-01	3.25E-01	5.32E-02	1.48E-01	1.59E-02	2.55E-01	3.44E-03	4.19E-03	1.11E-02	5.63E-02	4.82E-02	1.08E-01	9.49E-03	3.51E-03	4.72E-03	7.36E-03	5.62E-04	3.68E-03	3.57E-02	3.49E-02	3.90E-02	3.95E-02	3.90E-02	2.25E-02	2.25E-02	2.88E-02
PWS-13_8-11_PW	PWS-13	SB	non-NAPL	N	1.12E+00	5.89E-01	7.74E-01	3.24E-03	4.38E-03	1.20E-01	1.50E-01	1.99E-01	2.71E-01	3.26E-01	5.39E-02	1.49E-01	1.60E-02	2.56E-01	3.47E-03	4.26E-03	1.15E-02	5.64E-02	4.83E-02	1.09E-01	9.60E-03	3.55E-03	4.85E-03	7.68E-03	6.03E-04	4.02E-03	3.69E-02	3.62E-02	4.01E-02	4.05E-02	4.01E-02	2.38E-02	2.38E-02	3.02E-02
PWS-15_8-11_PW	PWS-15	SB	non-NAPL	N	1.09E+00	5.51E-01	6.35E-01	1.94E-03	1.43E-03	1.18E-01	1.34E-01	1.69E-01	1.74E-01	1.23E-01	9.43E-03	1.06E-01	1.16E-02	1.19E-01	8.88E-04	5.13E-04	7.36E-04	2.50E-02	2.57E-02	3.68E-02	1.74E-03	6.01E-04	4.07E-04	4.26E-04	1.97E-05	1.05E-04	2.57E-03	2.41E-03	3.41E-03	3.56E-03	3.41E-03	9.42E-04	9.42E-04	1.51E-03
PWS-16_8-11_PW	PWS-16	SB	non-NAPL	N	1.11E+00	5.82E-01	7.44E-01	2.88E-03	3.17E-03	1.20E-01	2.56E-01	1.93E-01	2.45E-01	2.50E-01	2.87E-02	1.38E-01	1.49E-02	2.11E-01	2.25E-03	1.81E-03	3.10E-03	4.58E-02	4.15E-02	7.99E-02	5.22E-03	1.86E-03	1.60E-03	1.85E-03	9.31E-05	5.09E-04	1.06E-02	1.00E-02	1.34E-02	1.39E-02	1.34E-02	4.33E-03	4.33E-03	6.68E-03
PWS-16B_8-11_PW	PWS-16	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	2.33E-01	2.00E-01	2.72E-01	3.33E-01	5.70E-02	1.49E-01	1.60E-02	2.60E-01	5.60E-02	4.66E-03	1.40E-02	5.73E-02	4.88E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-25_8-11_PW	PWS-25	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	6.46E-01	2.00E-01	2.72E-01	3.33E-01	5.70E-02	1.77E-01	1.60E-02	2.95E-01	3.05E-01	4.66E-03	1.40E-02	2.06E-01	1.61E-01	1.12E-01	1.01E-02	8.68E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-26_8-11_PW	PWS-26	SB	non-NAPL	N	1.12E+00	5.89E-01	7.73E-01	3.23E-03	4.33E-03	1.20E-01	2.29E-01	1.99E-01	2.70E-01	3.24E-01	5.27E-02	1.48E-01	1.59E-02	2.55E-01	3.42E-03	4.12E-03	1.08E-02	1.46E-01	9.86E-02	1.08E-01	9.40E-03	5.52E-03	4.61E-03	7.11E-03	5.30E-04	3.42E-03	3.48E-02	3.39E-02	3.82E-02	3.87E-02	3.82E-02	2.14E-02	2.14E-02	2.77E-02
PWS-17_4-7 POREWATER	PWS-17	MC	non-NAPL	N	1.12E+00	1.12E+00	7.63E-01	3.49E-01	3.86E-03	2.30E-01	2.69E+00	4.53E-01	3.11E-01	2.95E-01	4.11E-02	2.70E-01	2.91E-02	2.38E-01	2.91E-03	2.88E-03	5.88E-03	5.21E-02	4.57E-02	9.65E-02	7.41E-03	2.69E-03	2.83E-03	3.63E-03	2.05E-04	1.17E-03	1.49E-02	1.42E-02	1.78E-02	1.82E-02	1.78E-02	6.94E-03	6.94E-03	1.02E-02
PWS-27_8-11 POREWATER	PWS-27	MC	non-NAPL	N	1.11E+00	5.69E-01	6.98E-01	2.43E-03	2.16E-03	1.19E-01	1.42E-01	1.83E-01	2.12E-01	1.79E-01	1.61E-02	1.24E-01	6.98E-02	1.63E-01	1.42E-03	9.18E-04	1.39E-03	3.47E-02	3.36E-02	5.51E-02	2.95E-03	1.59E-03	7.52E-04	8.10E-04	3.84E-05	2.06E-04	3.64E-03	3.42E-03	4.76E-03	4.96E-03	4.76E-03	1.37E-03	1.37E-03	2.18E-03
PWS-30_8-11_ POREWATER	PWS-30	MC	non-NAPL	N	1.12E+00	5.88E-01	7.70E-01	3.19E-03	4.16E-03	1.20E-01	1.49E-01	1.98E-01	2.67E-01	3.14E-01	4.82E-02	1.47E-01	1.58E-02	2.49E-01	3.23E-03	3.61E-03	8.46E-03	5.47E-02	4.73E-02	1.04E-01	8.63E-03	3.17E-03	3.81E-03	5.40E-03	3.48E-04	2.09E-03	2.09E-02	2.02E-02	2.39E-02	2.43E-02	2.39E-02	1.12E-02	1.12E-02	1.55E-02
LSI-01_8-11 POREWATER	LSI-01	SB	non-NAPL	N	1.11E+00	5.81E-01	7.42E-01	2.86E-03	3.11E-03	1.20E-01	1.76E-01	1.92E-01	2.44E-01	2.46E-01	2.78E-02	1.38E-01	1.49E-02	2.09E-01	2.20E-03	1.74E-03	2.95E-03	4.52E-02	4.11E-02	7.84E-02	5.06E-03	1.80E-03	1.53E-03	1.75E-03	8.79E-05	4.80E-04	1.01E-02	9.57E-03	1.28E-02	1.33E-02	1.28E-02	4.10E-03	4.10E-03	6.34E-03
LSI-02_8-11 POREWATER	LSI-02	SB	non-NAPL	N	1.11E+00	5.81E-01	7.42E-01	2.86E-03	3.11E-03	1.20E-01	7.42E-01	2.50E-01	2.44E-01	2.46E-01	2.78E-02	1.56E-01	1.49E-02	2.09E-01	2.20E-03	1.74E-03	2.95E-03	1.28E-01	9.51E-02	7.84E-02	5.06E-03	4.02E-03	1.53E-03	1.75E-03	8.79E-05	4.80E-04	1.01E-02	9.57E-03	1.28E-02	1.33E-02	1.28E-02	4.10E-03	4.10E-03	6.34E-03
LSI-20_8-11 POREWATER	LSI-20	SB	non-NAPL	N	1.11E+00	5.81E-01	7.42E-01	2.86E-03	3.11E-03	1.20E-01	1.45E+00	1.92E-01	3.38E-01	2.46E-01	2.78E-02	1.38E-01	1.49E-02	2.09E-01	2.20E-03	1.74E-03	2.95E-03	1.03E-01	9.43E-02	7.84E-02	5.06E-03	3.78E-03	1.53E-03	1.75E-03	8.79E-05	4.80E-04	1.01E-02	9.57E-03	1.28E-02	1.33E-02	1.28E-02	4.10E-03	4.10E-03	6.34E-03
LSI-24-8-11 POREWATER	LSI-24	SB	non-NAPL	N	1.11E+00	5.81E-01	7.42E-01	2.86E-03	3.11E-03	1.79E-01	1.62E+00	1.92E-01	2.44E-01	2.46E-01	2.78E-02	1.47E-01	2.03E-02	2.09E-01	2.20E-03	1.74E-03	2.95E-03	9.10E-02	7.90E-02	7.84E-02	5.06E-03	3.85E-03	1.53E-03	1.75E-03	8.79E-05	4.80E-04	1.01E-02	9.57E-03	1.28E-02	1.33E-02	1.28E-02	4.10E-03	4.10E-03	6.34E-03
PWS-1_8-10 POREWATER	PWS-01	SB	non-NAPL	N	1.12E+00	5.90E-01	1.35E+00	3.27E-03	4.48E-03	3.50E-01	4.88E+00	1.16E+00	3.58E-01	3.33E-01	5.70E-02	3.19E-01	1.60E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	8.96E-02	5.06E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	3.31E-02	3.27E-02	3.46E-02	3.48E-02	3.46E-02	2.52E-02	2.52E-02	2.93E-02
PWS-3_8-11 POREWATER	PWS-03	SB	non-NAPL	N	1.12E+00	5.88E-01	7.71E-01	3.20E-03	4.22E-03	1.20E-01	6.37E-01	5.16E-01	2.86E-01	3.17E-01	4.97E-02	1.97E-01	4.22E-02	2.51E-01	3.30E-03	3.78E-03	9.18E-03	3.12E-01	1.91E-01	1.05E-01	1.01E-02	1.69E-02	4.07E-03	5.91E-03	3.97E-04	2.43E-03	2.26E-02	2.19E-02	2.55E-02	2.59E-02	2.55E-02	1.26E-02	1.26E-02	1.71E-02
PWS-4_8-11 POREWATER	PWS-04	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	5.39E-01	2.30E-01	2.72E-01	3.33E-01	5.70E-02	1.49E-01	1.60E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	1.18E-01	7.07E-02	1.12E-01	1.01E-02	7.21E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	3.31E-02	3.27E-02	3.46E-02	3.48E-02	3.46E-02	2.52E-02	2.52E-02	2.93E-02
PWS-5_8-11 POREWATER	PWS-05	SB	non-NAPL	N	1.12E+00	5.85E-01	7.56E-01	3.01E-03	3.56E-03	1.20E-01	6.70E-01	2.25E-01	2.55E-01	2.75E-01	3.52E-02	2.18E-01	1.53E-02	2.27E-01	2.61E-03	2.34E-03	4.35E-03	9.70E-02	5.52E-02	8.92E-02	6.36E-03	2.29E-03	2.18E-03	2.63E-03	1.40E-04	7.76E-04	1.11E-02	1.06E-02	1.37E-02	1.41E-02	1.37E-02	4.82E-03	4.82E-03	7.27E-03
PWS-6_8-11 POREWATER	PWS-06	SB	non-NAPL	N	1.11E+00	5.77E-01	8.16E-01	9.06E-01	2.68E-03	1.29E-01	1.62E+00	3.12E-01	2.35E-01	2.16E-01	2.19E-02	1.76E-01	1.43E-02	1.89E-01	1.83E-03	1.31E-03	2.09E-03	8.81E-02	5.60E-02	6.78E-02	4.01E-03	1.41E-03	1.11E-03	1.23E-03	5.96E-05	3.22E-04	5.44E-03	5.12E-03	7.01E-03	7.28E-03	7.01E-03	2.12E-03	2.12E-03	3.32E-03
PWS-7_8-10 DUP POREWATER	PWS-07	SB	non-NAPL	FD	1.12E+00	5.86E-01	2.77E+00	2.26E+00	3.85E-03	4.79E-01	4.52E+00	2.76E+00	1.14E+00	2.94E-01	4.09E-02	3.15E+00	8.34E-01	8.55E-01	2.95E-01	2.86E-03	5.82E-03	1.04E+00	5.91E-01	1.91E-01	5.06E-02	3.63E-02	2.80E-03	3.59E-03	2.03E-04	1.15E-03	1.47E-02	1.41E-02	1.76E-02	1.81E-02	1.76E-02	6.85E-03	6.85E-03	1.00E-02
PWS-7_8-10 POREWATER	PWS-07	SB	non-NAPL	N	1.12E+00	5.87E-01	7.64E-01	7.71E-01	3.89E-03	1.30E-01	1.20E+00	5.32E-01	5.73E-01	2.97E-01	4.18E-02	4.83E-01	8.27E-02	3.26E-01	2.36E-01	2.95E-03	6.09E-03	2.16E-01	1.31E-01	9.73E-02	7.52E-03	1.14E-02	2.91E-03	3.77E-03	2.15E-04	1.23E-03	1.54E-02	1.47E-02	1.83E-02	1.87E-02	1.83E-02	7.24E-03	7.24E-03	1.06E-02
PWS-8_8-11 POREWATER	PWS-08	SB	non-NAPL	N	1.12E+00	5.88E-01	7.70E-01	3.19E-03	4.19E-03	1.20E-01	6.96E-01	4.96E-01	2.93E-01	3.15E-01	4.88E-02	4.42E-01	4.47E-02	2.50E-01	3.26E-03	3.67E-03	8.72E-03	1.77E-01	1.09E-01	1.04E-01	1.39E-02	7.47E-03	3.91E-03	5.58E-03	3.66E-04	2.21E-03	2.15E-02	2.09E-02	2.45E-02	2.49E-02	2.45E-02	1.17E-02	1.17E-02	1.61E-02
PWS-9_8-11 POREWATER	PWS-09	SB	non-NAPL	N	1.12E+00	5.86E-01	7.61E-01	3.07E-03	3.76E-03	1.20E-01	4.45E-01	2.65E-01	2.68E-01	2.88E-01	3.90E-02	1.44E-01	1.55E-02	2.34E-01	2.81E-03	2.68E-03	5.29E-03	6.37E-02	4.51E-02	9.41E-02	7.04E-03	6.62E-03	2.58E-03	3.24E-03	1.79E-04	1.01E-03	1.34E-02	1.28E-02	1.62E-02	1.67E-02	1.62E-02	6.09E-03	6.09E-03	9.02E-03
PWS-12_8-11 POREWATER	PWS-12	SB	non-NAPL	N	1.11E+00	5.72E-01	7.08E-01	2.52E-03	2.33E-03	1.19E-01	1.43E-01	1.85E-01	2.18E-01	1.92E-01	1.79E-02	1.27E-01	1.38E-02	1.72E-01	1.55E-03	1.04E-03	1.59E-03	3.67E-02	3.51E-02	5.93E-02	5.39E-03	4.13E-03	8.57E-04	9.30E-04	4.44E-05	2.39E-04	4.16E-03	3.91E-03	5.42E-03	5.64E-03	5.42E-03	1.58E-03	1.58E-03	2.51E-03
PWS-13_8-11 POREWATER	PWS-13	SB	non-NAPL	N	1.09E+00	5.52E-01	1.12E+01	1.50E+01	1.21E+00	2.36E-01	1.25E+00	5.01E-01	1.26E+00	7.38E-01	9.65E-03	1.21E+00	5.80E-02	1.38E+00	5.18E-01	4.22E-02	7.56E-04	1.16E-01	1.14E-01	5.75E-02	3.16E-03	3.59E-03	4.17E-04	4.38E-04	2.03E-05	1.08E-04	1.99E-03	1.87E-03	2.64E-03	2.76E-03	2.64E-03	7.31E-04	7.31E-04	1.17E-03
PWS-15_8-11 POREWATER	PWS-15	SB	non-NAPL	N	1.12E+00	5.87E-01	7.65E-01	3.13E-03	3.96E-03	1.20E-01	4.56E-01	1.97E-01	2.63E-01	3.01E-01	4.33E-02	1.65E-01	1.57E-02	2.42E-01	3.01E-03	3.09E-03	6.56E-03	5.97E-02	4.62E-02	9.89E-02	7.78E-03	2.83E-03	3.10E-03	4.08E-03	2.38E-04	1.37E-03	1.65E-02	1.58E-02	1.94E-02	1.99E-02	1.94E-02	7.97E-03	7.97E-03	1.15E-02
PWS-16_8-11 POREWATER	PWS-16	SB	non-NAPL	N	1.09E+00	5.45E-01	9.27E-01	1.82E-03	1.29E-03	1.17E-01	1.08E+00	6.43E-01	2.14E-01	1.12E-01	8.29E-03	3.36E-01	2.37E-02	1.09E-01	7.90E-04	4.48E-04	6.37E-04	6.26E-02	4.13E-02	3.31E-02	1.53E-03	6.36E-04	3.53E-04	3.69E-04	1.70E-05	9.07E-05	1.68E-03	1.57E-03	2.24E-03	2.34E-03	2.24E-03	6.14E-04	6.14E-04	9.86E-04
PWS-25_4-8 POREWATER	PWS-25	SB	non-NAPL	N	1.12E+00	5.88E-01	7.70E-01	3.18E-03	4.15E-03	1.20E-01	1.89E-01	1.98E-01	2.67E-01	3.13E-01	4.78E-02	1.67E-01	1.58E-02	2.48E-01	3.21E-03	3.56E-03	8.27E-03	3.14E-01	2.08E-01	1.03E-01	1.92E-02	1.21E-02	3.75E-03	5.27E-03	3.36E-04	2.01E-03	2.05E-02	1.98E-02	2.35E-02	2.39E-02	2.35E-02	1.09E-02	1.09E-02	1.51E-02
PWS-26_8-11 POREWATER	PWS-26	SB	non-NAPL	N	1.12E+00	5.86E-01	7.82E-01	3.09E-03	3.79E-03	1.20E-01	5.44E-01	1.97E-01	2.60E-01	2.91E-01	3.98E-02	2.02E-01	1.55E-02	2.36E-01	2.85E-03	2.76E-03	5.50E-03	1.22E-01	7.61E-02	9.50E-02	7.17E-03	2.80E-03	2.67E-03	3.38E-03	1.88E-04	1.06E-03	1.39E-02	1.32E-02	1.68E-02	1.72E-02	1.68E-02	6.38E-03	6.38E-03	9.41E-03
PWS-26_8-11_DUP POREWATER	PWS-26	SB	non-NAPL	FD	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	5.59E-01	2.20E-01	2.72E-01	3.33E-01	5.70E-02	1.89E-01	1.62E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	1.36E-01	8.28E-02	1.12E-01	1.01E-02	5.98E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	3.31E-02	3.27E-02	3.46E-02	3.48E-02	3.46E-02	2.52E-02	2.52E-02	2.93E-02
PWS-28_8-11 POREWATER	PWS-28	SB	non-NAPL	N	1.12E+00	5.88E-01	7.71E-01	3.20E-03	4.20E-03	1.20E-01	1.49E-01	1.98E-01	2.67E-01	3.15E-01	4.90E-02	1.47E-01	1.58E-02	2.50E-01	3.27E-03	3.69E-03	8.82E-03	5.50E-02	4.74E-02	1.05E-01	8.77E-03	3.22E-03	3.94E-03	5.65E-03	3.72E-04	2.26E-03	2.18E-02	2.11E-02	2.47E-02	2.51E-02	2.47E-02	1.19E-02	1.19E-02	1.63E-02
Shallow Porewater Site 1	PWS-1	SB	non-NAPL	N	3.17E-03	4.93E-03	2.08E-02	8.20E-02	1.59E-01	1.13E-04	1.27E-02	6.27E-03	4.30E-03	6.60E-03	3.20E-03	1.08E-03	4.43E-04	1.05E-03	1.94E-03	1.61E-03	2.46E-04	5.09E-04	5.22E-04	1.99E-04	1.09E-05	1.11E-05	5.84E-06	1.97E-07	6.73E-08	2.64E-08	1.99E-06	1.41E-07	2.87E-07	4.35E-07	4.27E-08	3.86E-08	1.55E-07	7.50E-08
Deep Porewater Site 1	PWS-1	SB	non-NAPL	N	5.37E-02	1.98E+00	7.58E+00	9.82E+00	5.14E+00	2.20E-02	3.39E+00	5.27E-01	2.33E-01	1.40E-01	3.21E-02	2.71E-01	7.72E-03	4.29E-02	2.57E-02	1.21E-02	1.05E-03	7.11E-03	6.26E-03	1.98E-03	8.89E-05	7.34E-05	2.68E-05	1.21E-06	6.34E-08	2.49E-08	7.35E-06	4.21E-06	8.21E-06	7.23E-06	8.74E-06	3.62E-08	1.46E-07	7.03E-08
Shallow Porewater Site 2	PWS-2	MC	non-NAPL	N	9.83E-02	1.65E+00	2.34E+01	3.89E+01	2.95E+01	1.13E-04	8.05E-02	5.91E-02	1.83E-01	4.17E-01	1.41E-01	2.50E-02	3.37E-03	5.49E-02	8.77E-02	4.97E-02	1.09E-02	2.68E-04	1.01E-03	8.80E-04	1.46E-05	2.04E-05	3.75E-05	2.27E-06	5.62E-08	2.20E-08	1.35E-06	1.16E-07	2.44E-06	3.58E-07	3.04E-07

ATTACHMENT G-C: IWTU Calculation for Pore Water Data (direct measurement)

Table 4: IWTU and ΣIWTU Calculations[1]

NAPL or non-NAPL Area	Sampling Period	Exposure Area[2]	Location	Sample ID	Sample Type[3]	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/Anthracenes	C-2 Phenanthrenes/Anthracenes	C-3 Phenanthrenes/Anthracenes	C-4 Phenanthrenes/Anthracenes	Fluoranthene	Pyrene	C-1 Fluoranthenes/Pyrenes	Benzo(a)anthracene	Chrysene	C-1 Benz(a)anth/Chrysenes	C-2 Benz(a)anth/Chrysenes	C-3 Benz(a)anth/Chrysenes	C-4 Benz(a)anth/Chrysenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	ΣIWTU Full DLs	ΣIWTU 1/2 DLs
Final Chronic Value (µg/L)						193.6	81.69	30.24	11.1000	4.048	306.9	55.85	39.3	13.99	5.305	1.916	19.13	20.73	7.436	3.199	1.256	0.5594	7.109	10.11	4.887	2.227	2.042	0.8557	0.4827	0.1675	0.07062	0.6774	0.6415	0.9008	0.9573	0.9008	0.275	0.2825	0.4391	--	--
Non-NAPL Areas	July 2012	MC	PWS-27	PWS-27_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.08
		SB	PWS-01	PWS-01_8-9_PW	N	0.0058	0.0183	0.0539	0.0432	0.0011	0.0029	0.1667	0.0522	0.0333	0.0639	0.0315	0.0078	0.0022	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.84**	0.85
		SB	PWS-03	PWS-03_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0005	0.0164	0.0181	0.0196	0.0639	0.0315	0.0210	0.0047	0.0520	0.0516	0.0041	0.0309	0.0658	0.0249	0.0233	0.0048	0.0105	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.72**	0.74
		SB	PWS-04	PWS-04_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0050	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0204	0.0094	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**	0.54
		SB	PWS-05	PWS-05_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0153	0.0065	0.0352	0.0639	0.0315	0.0096	0.0010	0.0354	0.0012	0.0041	0.0309	0.0132	0.0055	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.56**	0.57
		SB	PWS-06	PWS-06_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0162	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0159	0.0060	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**	0.45
		SB	PWS-07	PWS-07_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0178	0.0093	0.0217	0.0639	0.0315	0.0179	0.0028	0.0494	0.0641	0.0041	0.0309	0.0318	0.0136	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.67**	0.69
		SB	PWS-08	PWS-08_8-11_PW	N	0.0058	0.0072	0.0257	0.0210	0.0011	0.0004	0.0129	0.0055	0.0221	0.0639	0.0315	0.0118	0.0008	0.0471	0.0656	0.0041	0.0309	0.0271	0.0117	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.67**	0.69
		SB	PWS-09	PWS-09_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0033	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.42
		SB	PWS-12	PWS-12_8-11 DUP_PW	FD	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0031	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.39
		SB	PWS-12	PWS-12_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0017	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.51
		SB	PWS-13	PWS-13_1-4_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.40
		SB	PWS-13	PWS-13_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.42
		SB	PWS-15	PWS-15_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.08
		SB	PWS-16	PWS-16_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0047	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.17
		SB	PWS-16	PWS-16B_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0042	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0181	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**	0.53
		SB	PWS-25	PWS-25_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0116	0.0051	0.0196	0.0639	0.0315	0.0093	0.0008	0.0402	0.0985	0.0041	0.0309	0.0294	0.0161	0.0233	0.0048	0.0045	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.67**	0.68
		SB	PWS-26	PWS-26_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0041	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0212	0.0100	0.0233	0.0048	0.0031	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**	0.42
	October 2012	MC	PWS-17	PWS-17_4-7 POREWATER	N	0.0058	0.0138	0.0257	0.0333	0.0011	0.0007	0.0487	0.0117	0.0234	0.0639	0.0315	0.0146	0.0015	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.43**	0.34
		MC	PWS-27	PWS-27_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0040	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0030	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.33**	0.10
		MC	PWS-30	PWS-30_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.32**	0.28
		SB	LSI-01	LSI-01_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0032	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.16
		SB	LSI-02	LSI-02_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0136	0.0066	0.0196	0.0639	0.0315	0.0089	0.0008	0.0354	0.0012	0.0041	0.0309	0.0232	0.0113	0.0233	0.0048	0.0044	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.56**	0.21
		SB	LSI-20	LSI-20_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0267	0.0051	0.0272	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0187	0.0112	0.0233	0.0048	0.0041	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.58**	0.22
		SB	LSI-24	LSI-24-8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0006	0.0297	0.0051	0.0196	0.0639	0.0315	0.0084	0.0011	0.0354	0.0012	0.0041	0.0309	0.0165	0.0094	0.0233	0.0048	0.0042	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.57**	0.21
		SB	PWS-01	PWS-1_8-10 POREWATER	N	0.0058	0.0072	0.0446	0.0003	0.0011	0.0011	0.0876	0.0295	0.0257	0.0639	0.0315	0.0167	0.0008	0.0354	0.0012	0.0041	0.0309	0.0128	0.0051	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.47**	0.62
		SB	PWS-03	PWS-3_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0115	0.0132	0.0209	0.0639	0.0315	0.0105	0.0021	0.0354	0.0012	0.0041	0.0309	0.0461	0.0196	0.0233	0.0055	0.0101	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.41**	0.40
		SB	PWS-04	PWS-4_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0097	0.0059	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0169	0.0071	0.0233	0.0048	0.0037	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.34**	0.47
		SB	PWS-05	PWS-5_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0122	0.0059	0.0196	0.0639	0.0315	0.0120	0.0008	0.0354	0.0012	0.0041	0.0309	0.0160	0.0061	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.35**	0.22
		SB	PWS-06	PWS-6_8-11 POREWATER	N	0.0058	0.0072	0.0289	0.1000	0.0011	0.0004	0.0301	0.0084	0.0199	0.0639	0.0315	0.0105	0.0008	0.0354	0.0012	0.0041	0.0309	0.0177	0.0072	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.47**	0.28
		SB	PWS-07	PWS-7_8-10 DUP POREWATER	FD	0.0058	0.0072	0.0933	0.2162	0.0011	0.0016	0.0818	0.0712	0.0858	0.0639	0.0315	0.1709	0.0416	0.1272	0.1178	0.0041	0.0309	0.1632	0.0631	0.0462	0.0330	0.0266	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**2.52**	**1.36**
		SB	PWS-07	PWS-7_8-10 POREWATER	N	0.0058	0.0072	0.0257	0.0734	0.0011	0.0004	0.0217	0.0137	0.0429	0.0639	0.0315	0.0261	0.0041	0.0481	0.0932	0.0041	0.0309	0.0336	0.0139	0.0233	0.0048	0.0082	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.61**	0.52
		SB	PWS-08	PWS-8_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0125	0.0127	0.0214	0.0639	0.0315	0.0235	0.0022	0.0354	0.0012	0.0041	0.0309	0.0263	0.0112	0.0233	0.0076	0.0046	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.39**	0.37
		SB	PWS-09	PWS-9_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0081	0.0069	0.0203	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0102	0.0049	0.0233	0.0048	0.0051	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.34**	0.23
		SB	PWS-12	PWS-12_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0079	0.0071	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.33**	0.11
		SB	PWS-13	PWS-13_8-11 POREWATER	N	0.0058	0.0072	0.4530	**2.2613**	0.9387	0.0008	0.0249	0.0150	0.1408	0.3751	0.0315	0.0889	0.0038	0.4048	0.6627	0.3264	0.0309	0.0374	0.0214	0.0358	0.0085	0.0114	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**6.92**	**2.80**
		SB	PWS-15	PWS-15_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0082	0.0051	0.0196	0.0639	0.0315	0.0089	0.0008	0.0354	0.0012	0.0041	0.0309	0.0092	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.33**	0.25
		SB	PWS-16	PWS-16_8-11 POREWATER	N	0.0058	0.0072	0.0387	0.0003	0.0011	0.0004	0.0220	0.0198	0.0255	0.0639	0.0315	0.0261	0.0016	0.0354	0.0012	0.0041	0.0309	0.0224	0.0084	0.0233	0.0048	0.0024	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.41**	0.16
		SB	PWS-25	PWS-25_4-8 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0034	0.0051	0.0196	0.0639	0.0315	0.0089	0.0008	0.0354	0.0012	0.0041	0.0309	0.0470	0.0215	0.0233	0.0108	0.0075	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.39**	0.35
		SB	PWS-26	PWS-26_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0098	0.0051	0.0196	0.0639	0.0315	0.0110	0.0008	0.0354	0.0012	0.0041	0.0309	0.0193	0.0082	0.0233	0.0048	0.0021	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.35**	0.24
		SB	PWS-26	PWS-26_8-11_DUP POREWATER	FD	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0100	0.0056	0.0196	0.0639	0.0315	0.0099	0.0008	0.0354	0.0012	0.0041	0.0309	0.0194	0.0083	0.0233	0.0048	0.0031	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.35**	0.48
		SB	PWS-28	PWS-28_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.32**	0.29
	Sept 2017	SB	PWS-1	Shallow Porewater Site 1	N	0.0000	0.0001	0.0007	0.0085	0.0578	0.0000	0.0002	0.0002	0.0003	0.0017	0.0036	0.0001	0.0000	0.0002	0.0010	0.0038	0.0026	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.08	
		MC	PWS-2	Shallow Porewater Site 2	N	0.0005	0.0206	0.8102	**4.0270**	**10.7460**	0.0000	0.0015	0.0016	0.0147	0.1084	0.1597	0.0014	0.0002	0.0093	0.0463	0.1162	0.1139	0.0000	0.0001	0.0003	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**16.2**	
		SB	PWS-3	Shallow Porewater Site 3	N	0.0000	0.0000	0.0002	0.0010	0.0181	0.0000	0.0000	0.0000	0.0000	0.0002	0.0006	0.0000	0.0000	0.0001	0.0006	0.0006	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.02	
		SB	PWS-4	Shallow Porewater Site 4	N	0.0000	0.0001	0.0007	0.0040	0.0371	0.0000	0.0001	0.0001	0.0000	0.0006	0.0030	0.0001	0.0000	0.0003	0.0009	0.0027	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.05	
		SB	PWS-5	Shallow Porewater Site 5	N	0.0002	0.0003	0.0033	0.0337	0.1336	0.0000	0.0002	0.0001	0.0002	0.0021	0.0049	0.0001	0.0000	0.0002	0.0014	0.0050	0.0046	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.19	
		SB	PWS-6	Shallow Porewater Site 6	N	0.0000	0.0001	0.0006	0.0038	0.0230	0.0000	0.0001	0.0001	0.0001	0.0005	0.0020	0.0000	0.0000	0.0001	0.0006	0.0025	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.04	
		SB	PWS-7	Shallow Porewater Site 7	N	0.0000	0.0001	0.0006	0.0045	0.0257	0.0000	0.0001	0.0001	0.0001	0.0007	0.0037	0.0000	0.0000	0.0001	0.0006	0.0006	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.04	
		SB	PWS-8	Shallow Porewater Site 8	N	0.0001	0.0002	0.0012	0.0095	0.0590	0.0000	0.0002	0.0001	0.0003	0.0018	0.0064	0.0001	0.0000	0.0002	0.0015	0.0052	0.0043	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.09	
		SB	PWS-9	Shallow Porewater Site 9	N	0.0000	0.0001	0.0006	0.0046	0.0292	0.0000	0.0002	0.0001	0.0001	0.0006	0.0033	0.0000	0.0000	0.0001	0.0008	0.0034	0.0025	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.05	
		SB	PWS-10	Shallow Porewater Site 10	N	0.0000	0.0001	0.0009	0.0123	0.1010	0.0000	0.0003	0.0002	0.0004	0.0020	0.0035	0.0001	0.0000	0.0002	0.0012	0.0036	0.0025	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.13	
		SB	PWS-11	Shallow Porewater Site 11	N	0.0000	0.0001	0.0006	0.0077	0.0578	0.0000	0.0003	0.0002	0.0002	0.0014	0.0033	0.0001	0.0001	0.0002	0.0014	0.0045	0.0025	0.0002	0.0001	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.08	
		SB	PWS-12	Shallow Porewater Site 12	N	0.0026	0.0045	0.0148	0.0537	0.1964	0.0000	0.0011	0.0024	0.0026	0.0061	0.0090	0.0042	0.0002	0.0020	0.0047	0.0090	0.0078	0.0017

ATTACHMENT D

Pro-UCL Version 5.0 Output Sheets

APPENDIX G-D-1

Pro-UCL Version 5.0 Output Sheets

Scappoose Bay Porewater Data, 90% Upper Confidence Limits

(Only results for PAHs with 5 or more detections are presented)

Acenaphthene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	34
Number of Detects	30	Number of Non-Detects	4
Number of Distinct Detects	30	Number of Distinct Non-Detects	4
Minimum Detect	0.174	Minimum Non-Detect	0.134
Maximum Detect	9.299	Maximum Non-Detect	0.15
Variance Detects	3.526	Percent Non-Detects	11.76%
Mean Detects	1.241	SD Detects	1.878
Median Detects	0.683	CV Detects	1.514
Skewness Detects	3.323	Kurtosis Detects	12.08
Mean of Logged Detects	-0.363	SD of Logged Detects	0.998

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.549	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.32	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.162	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.111	Standard Error of Mean	0.309
SD	1.771	90% KM (BCA) UCL	1.526
90% KM (t) UCL	1.514	90% KM (Percentile Bootstrap) UCL	1.527
90% KM (z) UCL	1.506	90% KM Bootstrap t UCL	1.848
90% KM Chebyshev UCL	2.037	95% KM Chebyshev UCL	2.457
97.5% KM Chebyshev UCL	3.039	99% KM Chebyshev UCL	4.184

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.606	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.776	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.184	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.165	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.998	k star (bias corrected MLE)	0.921
Theta hat (MLE)	1.243	Theta star (bias corrected MLE)	1.347
nu hat (MLE)	59.9	nu star (bias corrected)	55.25
MLE Mean (bias corrected)	1.241	MLE Sd (bias corrected)	1.293

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.393	nu hat (KM)	26.75
Approximate Chi Square Value (26.75, α)	17.91	Adjusted Chi Square Value (26.75, β)	17.63
90% Gamma Approximate KM-UCL (use when n>=50)	1.659	90% Gamma Adjusted KM-UCL (use when n<50)	1.685

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.096
Maximum	9.299	Median	0.642

SD	1.806	CV	1.648
k hat (MLE)	0.642	k star (bias corrected MLE)	0.605
Theta hat (MLE)	1.708	Theta star (bias corrected MLE)	1.812
nu hat (MLE)	43.64	nu star (bias corrected)	41.13
MLE Mean (bias corrected)	1.096	MLE Sd (bias corrected)	1.409
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (41.13, α)	30.01	Adjusted Chi Square Value (41.13, β)	29.64
90% Gamma Approximate UCL (use when n>=50)	1.502	90% Gamma Adjusted UCL (use when n<50)	1.52

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.933	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.927	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0986	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.162	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.104	Mean in Log Scale	-0.625
SD in Original Scale	1.801	SD in Log Scale	1.187
90% t UCL (assumes normality of ROS data)	1.508	90% Percentile Bootstrap UCL	1.51
90% BCA Bootstrap UCL	1.663	90% Bootstrap t UCL	1.904
90% H-UCL (Log ROS)	1.634		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.556	90% H-UCL (KM -Log)	1.429
KM SD (logged)	1.063	90% Critical H Value (KM-Log)	1.88
KM Standard Error of Mean (logged)	0.185		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.103	Mean in Log Scale	-0.63
SD in Original Scale	1.801	SD in Log Scale	1.194
90% t UCL (Assumes normality)	1.507	90% H-Stat UCL	1.648

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Acenaphthylene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	25
Number of Detects	8	Number of Non-Detects	26
Number of Distinct Detects	8	Number of Distinct Non-Detects	17
Minimum Detect	0.121	Minimum Non-Detect	0.117
Maximum Detect	0.902	Maximum Non-Detect	0.12
Variance Detects	0.0714	Percent Non-Detects	76.47%
Mean Detects	0.317	SD Detects	0.267
Median Detects	0.207	CV Detects	0.843
Skewness Detects	1.81	Kurtosis Detects	3.282
Mean of Logged Detects	-1.397	SD of Logged Detects	0.717

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.776	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.245	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.164	Standard Error of Mean	0.0271
SD	0.148	90% KM (BCA) UCL	0.197
90% KM (t) UCL	0.2	90% KM (Percentile Bootstrap) UCL	0.201
90% KM (z) UCL	0.199	90% KM Bootstrap t UCL	0.238
90% KM Chebyshev UCL	0.246	95% KM Chebyshev UCL	0.283
97.5% KM Chebyshev UCL	0.334	99% KM Chebyshev UCL	0.434

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.476	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.201	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.165	k star (bias corrected MLE)	1.436
Theta hat (MLE)	0.146	Theta star (bias corrected MLE)	0.221
nu hat (MLE)	34.63	nu star (bias corrected)	22.98
MLE Mean (bias corrected)	0.317	MLE Sd (bias corrected)	0.265

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.235	nu hat (KM)	83.97
Approximate Chi Square Value (83.97, α)	67.85	Adjusted Chi Square Value (83.97, β)	67.28
90% Gamma Approximate KM-UCL (use when n>=50)	0.203	90% Gamma Adjusted KM-UCL (use when n<50)	0.205

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0823
Maximum	0.902	Median	0.01

SD	0.181	CV	2.196
k hat (MLE)	0.474	k star (bias corrected MLE)	0.452
Theta hat (MLE)	0.174	Theta star (bias corrected MLE)	0.182
nu hat (MLE)	32.21	nu star (bias corrected)	30.7
MLE Mean (bias corrected)	0.0822	MLE Sd (bias corrected)	0.122
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (30.70, α)	21.19	Adjusted Chi Square Value (30.70, β)	20.88
90% Gamma Approximate UCL (use when n>=50)	0.119	90% Gamma Adjusted UCL (use when n<50)	0.121

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.173	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0868	Mean in Log Scale	-3.642
SD in Original Scale	0.179	SD in Log Scale	1.431
90% t UCL (assumes normality of ROS data)	0.127	90% Percentile Bootstrap UCL	0.127
90% BCA Bootstrap UCL	0.144	90% Bootstrap t UCL	0.163
90% H-UCL (Log ROS)	0.127		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.967	90% H-UCL (KM -Log)	0.174
KM SD (logged)	0.453	90% Critical H Value (KM-Log)	1.443
KM Standard Error of Mean (logged)	0.0831		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.12	Mean in Log Scale	-2.483
SD in Original Scale	0.166	SD in Log Scale	0.694
90% t UCL (Assumes normality)	0.157	90% H-Stat UCL	0.129

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Anthracene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	27
Number of Detects	12	Number of Non-Detects	22
Number of Distinct Detects	12	Number of Distinct Non-Detects	15
Minimum Detect	0.0162	Minimum Non-Detect	0.0116
Maximum Detect	0.834	Maximum Non-Detect	0.016
Variance Detects	0.0531	Percent Non-Detects	64.71%
Mean Detects	0.106	SD Detects	0.23
Median Detects	0.0433	CV Detects	2.165
Skewness Detects	3.401	Kurtosis Detects	11.68
Mean of Logged Detects	-3.109	SD of Logged Detects	1.083

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.413	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.434	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.256	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0451	Standard Error of Mean	0.0248
SD	0.139	90% KM (BCA) UCL	0.0915
90% KM (t) UCL	0.0776	90% KM (Percentile Bootstrap) UCL	0.0725
90% KM (z) UCL	0.0769	90% KM Bootstrap t UCL	0.267
90% KM Chebyshev UCL	0.12	95% KM Chebyshev UCL	0.153
97.5% KM Chebyshev UCL	0.2	99% KM Chebyshev UCL	0.292

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.794	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.77	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.347	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.256	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.697	k star (bias corrected MLE)	0.578
Theta hat (MLE)	0.153	Theta star (bias corrected MLE)	0.184
nu hat (MLE)	16.72	nu star (bias corrected)	13.87
MLE Mean (bias corrected)	0.106	MLE Sd (bias corrected)	0.14

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.106	nu hat (KM)	7.192
Approximate Chi Square Value (7.19, α)	2.959	Adjusted Chi Square Value (7.19, β)	2.855
90% Gamma Approximate KM-UCL (use when n>=50)	0.11	90% Gamma Adjusted KM-UCL (use when n<50)	0.114

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.044	
Maximum	0.834	Median	0.01	

SD	0.141	CV	3.203
k hat (MLE)	0.641	k star (bias corrected MLE)	0.604
Theta hat (MLE)	0.0686	Theta star (bias corrected MLE)	0.0728
nu hat (MLE)	43.62	nu star (bias corrected)	41.1
MLE Mean (bias corrected)	0.044	MLE Sd (bias corrected)	0.0566
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (41.10, α)	30	Adjusted Chi Square Value (41.10, β)	29.63
90% Gamma Approximate UCL (use when n>=50)	0.0603	90% Gamma Adjusted UCL (use when n<50)	0.0611

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.799	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.256	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0388	Mean in Log Scale	-5.256
SD in Original Scale	0.142	SD in Log Scale	1.808
90% t UCL (assumes normality of ROS data)	0.0707	90% Percentile Bootstrap UCL	0.0693
90% BCA Bootstrap UCL	0.0948	90% Bootstrap t UCL	0.229
90% H-UCL (Log ROS)	0.0612		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.978	90% H-UCL (KM -Log)	0.0364
KM SD (logged)	0.89	90% Critical H Value (KM-Log)	1.735
KM Standard Error of Mean (logged)	0.159		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0425	Mean in Log Scale	-4.25
SD in Original Scale	0.141	SD in Log Scale	1.061
90% t UCL (Assumes normality)	0.0742	90% H-Stat UCL	0.0354

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Benzo(a)Anthracene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	20
Number of Detects	5	Number of Non-Detects	29
Number of Distinct Detects	5	Number of Distinct Non-Detects	15
Minimum Detect	0.00316	Minimum Non-Detect	0.00153
Maximum Detect	0.0192	Maximum Non-Detect	0.0506
Variance Detects	4.1761E-5	Percent Non-Detects	85.29%
Mean Detects	0.0104	SD Detects	0.00646
Median Detects	0.0101	CV Detects	0.624
Skewness Detects	0.373	Kurtosis Detects	-1.148
Mean of Logged Detects	-4.76	SD of Logged Detects	0.728

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.179	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0035	Standard Error of Mean	8.7482E-4
SD	0.00381	90% KM (BCA) UCL	0.00492
90% KM (t) UCL	0.00464	90% KM (Percentile Bootstrap) UCL	0.00477
90% KM (z) UCL	0.00462	90% KM Bootstrap t UCL	0.0041
90% KM Chebyshev UCL	0.00612	95% KM Chebyshev UCL	0.00731
97.5% KM Chebyshev UCL	0.00896	99% KM Chebyshev UCL	0.0122

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.212	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.683	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.789	k star (bias corrected MLE)	1.249
Theta hat (MLE)	0.00371	Theta star (bias corrected MLE)	0.00829
nu hat (MLE)	27.89	nu star (bias corrected)	12.49
MLE Mean (bias corrected)	0.0104	MLE Sd (bias corrected)	0.00927

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.841	nu hat (KM)	57.18
Approximate Chi Square Value (57.18, α)	43.98	Adjusted Chi Square Value (57.18, β)	43.52
90% Gamma Approximate KM-UCL (use when n>=50)	0.00455	90% Gamma Adjusted KM-UCL (use when n<50)	0.00459

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.00316	Mean	0.0104	
Maximum	0.0192	Median	0.01	

SD	0.00225	CV	0.224
k hat (MLE)	18.02	k star (bias corrected MLE)	16.45
Theta hat (MLE)	5.5778E-4	Theta star (bias corrected MLE)	6.1103E-4
nu hat (MLE)	1225	nu star (bias corrected)	1119
MLE Mean (bias corrected)	0.0101	MLE Sd (bias corrected)	0.00248
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (N/A, α)	1058	Adjusted Chi Square Value (N/A, β)	1056
90% Gamma Approximate UCL (use when n>=50)	0.0106	90% Gamma Adjusted UCL (use when n<50)	0.0106

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.192	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00287	Mean in Log Scale	-6.367
SD in Original Scale	0.00401	SD in Log Scale	0.934
90% t UCL (assumes normality of ROS data)	0.00377	90% Percentile Bootstrap UCL	0.00374
90% BCA Bootstrap UCL	0.00401	90% Bootstrap t UCL	0.0043
90% H-UCL (Log ROS)	0.00354		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-5.969	90% H-UCL (KM -Log)	0.00392
KM SD (logged)	0.688	90% Critical H Value (KM-Log)	1.584
KM Standard Error of Mean (logged)	0.231		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.00554	Mean in Log Scale	-5.44
SD in Original Scale	0.00491	SD in Log Scale	0.688
90% t UCL (Assumes normality)	0.00664	90% H-Stat UCL	0.00665

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-1 Fluorenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	26
Number of Detects	13	Number of Non-Detects	21
Number of Distinct Detects	13	Number of Distinct Non-Detects	13
Minimum Detect	0.214	Minimum Non-Detect	0.174
Maximum Detect	1.261	Maximum Non-Detect	0.272
Variance Detects	0.116	Percent Non-Detects	61.76%
Mean Detects	0.458	SD Detects	0.34
Median Detects	0.307	CV Detects	0.742
Skewness Detects	1.966	Kurtosis Detects	2.717
Mean of Logged Detects	-0.954	SD of Logged Detects	0.555

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.658	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.309	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.246	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.302	Standard Error of Mean	0.0434
SD	0.238	90% KM (BCA) UCL	0.364
90% KM (t) UCL	0.358	90% KM (Percentile Bootstrap) UCL	0.357
90% KM (z) UCL	0.357	90% KM Bootstrap t UCL	0.418
90% KM Chebyshev UCL	0.432	95% KM Chebyshev UCL	0.491
97.5% KM Chebyshev UCL	0.572	99% KM Chebyshev UCL	0.733

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.403	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.739	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.279	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.238	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.043	k star (bias corrected MLE)	2.392
Theta hat (MLE)	0.151	Theta star (bias corrected MLE)	0.192
nu hat (MLE)	79.11	nu star (bias corrected)	62.19
MLE Mean (bias corrected)	0.458	MLE Sd (bias corrected)	0.296

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.61	nu hat (KM)	109.5
Approximate Chi Square Value (109.45, α)	90.97	Adjusted Chi Square Value (109.45, β)	90.31
90% Gamma Approximate KM-UCL (use when n>=50)	0.363	90% Gamma Adjusted KM-UCL (use when n<50)	0.365

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.19
Maximum	1.261	Median	0.0103

SD	0.298	CV	1.573
k hat (MLE)	0.475	k star (bias corrected MLE)	0.452
Theta hat (MLE)	0.399	Theta star (bias corrected MLE)	0.419
nu hat (MLE)	32.27	nu star (bias corrected)	30.76
MLE Mean (bias corrected)	0.19	MLE Sd (bias corrected)	0.282
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (30.76, α)	21.23	Adjusted Chi Square Value (30.76, β)	20.92
90% Gamma Approximate UCL (use when n>=50)	0.275	90% Gamma Adjusted UCL (use when n<50)	0.279

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.812	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.245	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.246	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.256	Mean in Log Scale	-1.647
SD in Original Scale	0.263	SD in Log Scale	0.692
90% t UCL (assumes normality of ROS data)	0.315	90% Percentile Bootstrap UCL	0.314
90% BCA Bootstrap UCL	0.329	90% Bootstrap t UCL	0.361
90% H-UCL (Log ROS)	0.297		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.35	90% H-UCL (KM -Log)	0.325
KM SD (logged)	0.466	90% Critical H Value (KM-Log)	1.45
KM Standard Error of Mean (logged)	0.0947		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.255	Mean in Log Scale	-1.634
SD in Original Scale	0.262	SD in Log Scale	0.644
90% t UCL (Assumes normality)	0.313	90% H-Stat UCL	0.286

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-1 Phenanthrenes/Anthracenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	24
Number of Detects	6	Number of Non-Detects	28
Number of Distinct Detects	6	Number of Distinct Non-Detects	18
Minimum Detect	0.295	Minimum Non-Detect	0.109
Maximum Detect	1.384	Maximum Non-Detect	0.26
Variance Detects	0.188	Percent Non-Detects	82.35%
Mean Detects	0.604	SD Detects	0.434
Median Detects	0.372	CV Detects	0.718
Skewness Detects	1.536	Kurtosis Detects	1.517
Mean of Logged Detects	-0.682	SD of Logged Detects	0.619

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.758	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.362	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.197	Standard Error of Mean	0.0472
SD	0.252	90% KM (BCA) UCL	0.301
90% KM (t) UCL	0.258	90% KM (Percentile Bootstrap) UCL	0.269
90% KM (z) UCL	0.257	90% KM Bootstrap t UCL	0.268
90% KM Chebyshev UCL	0.338	95% KM Chebyshev UCL	0.403
97.5% KM Chebyshev UCL	0.492	99% KM Chebyshev UCL	0.667

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.712	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.701	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.369	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.335	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.968	k star (bias corrected MLE)	1.595
Theta hat (MLE)	0.204	Theta star (bias corrected MLE)	0.379
nu hat (MLE)	35.61	nu star (bias corrected)	19.14
MLE Mean (bias corrected)	0.604	MLE Sd (bias corrected)	0.478

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.612	nu hat (KM)	41.59
Approximate Chi Square Value (41.59, α)	30.41	Adjusted Chi Square Value (41.59, β)	30.04
90% Gamma Approximate KM-UCL (use when n>=50)	0.269	90% Gamma Adjusted KM-UCL (use when n<50)	0.272

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.115
Maximum	1.384	Median	0.01

SD	0.285	CV	2.484
k hat (MLE)	0.38	k star (bias corrected MLE)	0.366
Theta hat (MLE)	0.303	Theta star (bias corrected MLE)	0.314
nu hat (MLE)	25.81	nu star (bias corrected)	24.86
MLE Mean (bias corrected)	0.115	MLE Sd (bias corrected)	0.19
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (24.86, α)	16.36	Adjusted Chi Square Value (24.86, β)	16.09
90% Gamma Approximate UCL (use when n>=50)	0.175	90% Gamma Adjusted UCL (use when n<50)	0.177

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.82	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.341	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.135	Mean in Log Scale	-3.05
SD in Original Scale	0.278	SD in Log Scale	1.292
90% t UCL (assumes normality of ROS data)	0.198	90% Percentile Bootstrap UCL	0.198
90% BCA Bootstrap UCL	0.22	90% Bootstrap t UCL	0.257
90% H-UCL (Log ROS)	0.175		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.943	90% H-UCL (KM -Log)	0.207
KM SD (logged)	0.63	90% Critical H Value (KM-Log)	1.545
KM Standard Error of Mean (logged)	0.118		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.201	Mean in Log Scale	-1.919
SD in Original Scale	0.254	SD in Log Scale	0.66
90% t UCL (Assumes normality)	0.258	90% H-Stat UCL	0.219

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-2 Naphthalenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	22
Number of Detects	6	Number of Non-Detects	28
Number of Distinct Detects	6	Number of Distinct Non-Detects	16
Minimum Detect	0.816	Minimum Non-Detect	0.635
Maximum Detect	11.24	Maximum Non-Detect	0.776
Variance Detects	16.31	Percent Non-Detects	82.35%
Mean Detects	3.12	SD Detects	4.039
Median Detects	1.486	CV Detects	1.294
Skewness Detects	2.294	Kurtosis Detects	5.362
Mean of Logged Detects	0.657	SD of Logged Detects	0.967

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.643	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.368	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.074	Standard Error of Mean	0.341
SD	1.816	90% KM (BCA) UCL	1.69
90% KM (t) UCL	1.52	90% KM (Percentile Bootstrap) UCL	1.502
90% KM (z) UCL	1.511	90% KM Bootstrap t UCL	2.726
90% KM Chebyshev UCL	2.097	95% KM Chebyshev UCL	2.561
97.5% KM Chebyshev UCL	3.204	99% KM Chebyshev UCL	4.468

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.678	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.29	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.34	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.178	k star (bias corrected MLE)	0.7
Theta hat (MLE)	2.649	Theta star (bias corrected MLE)	4.456
nu hat (MLE)	14.14	nu star (bias corrected)	8.402
MLE Mean (bias corrected)	3.12	MLE Sd (bias corrected)	3.729

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.35	nu hat (KM)	23.78
Approximate Chi Square Value (23.78, α)	15.48	Adjusted Chi Square Value (23.78, β)	15.22
90% Gamma Approximate KM-UCL (use when n>=50)	1.649	90% Gamma Adjusted KM-UCL (use when n<50)	1.678

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01		Mean	0.559
Maximum	11.24		Median	0.01

SD	1.98	CV	3.543
k hat (MLE)	0.232	k star (bias corrected MLE)	0.231
Theta hat (MLE)	2.406	Theta star (bias corrected MLE)	2.416
nu hat (MLE)	15.79	nu star (bias corrected)	15.73
MLE Mean (bias corrected)	0.559	MLE Sd (bias corrected)	1.162
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (15.73, α)	9.107	Adjusted Chi Square Value (15.73, β)	8.911
90% Gamma Approximate UCL (use when n>=50)	0.965	90% Gamma Adjusted UCL (use when n<50)	0.987

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.865	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.362	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.581	Mean in Log Scale	-3.116
SD in Original Scale	1.974	SD in Log Scale	2.114
90% t UCL (assumes normality of ROS data)	1.024	90% Percentile Bootstrap UCL	0.996
90% BCA Bootstrap UCL	1.318	90% Bootstrap t UCL	2.2
90% H-UCL (Log ROS)	1.238		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.258	90% H-UCL (KM -Log)	1.049
KM SD (logged)	0.563	90% Critical H Value (KM-Log)	1.504
KM Standard Error of Mean (logged)	0.106		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.864	Mean in Log Scale	-0.682
SD in Original Scale	1.896	SD in Log Scale	0.734
90% t UCL (Assumes normality)	1.289	90% H-Stat UCL	0.814

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-2 Phenanthrenes/Anthracenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	25
Number of Detects	7	Number of Non-Detects	27
Number of Distinct Detects	7	Number of Distinct Non-Detects	18
Minimum Detect	0.056	Minimum Non-Detect	7.9047E-4
Maximum Detect	0.518	Maximum Non-Detect	0.00359
Variance Detects	0.0213	Percent Non-Detects	79.41%
Mean Detects	0.248	SD Detects	0.146
Median Detects	0.203	CV Detects	0.589
Skewness Detects	0.911	Kurtosis Detects	1.604
Mean of Logged Detects	-1.571	SD of Logged Detects	0.695

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.936	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0517	Standard Error of Mean	0.0217
SD	0.117	90% KM (BCA) UCL	0.0769
90% KM (t) UCL	0.08	90% KM (Percentile Bootstrap) UCL	0.0782
90% KM (z) UCL	0.0795	90% KM Bootstrap t UCL	0.0804
90% KM Chebyshev UCL	0.117	95% KM Chebyshev UCL	0.146
97.5% KM Chebyshev UCL	0.187	99% KM Chebyshev UCL	0.268

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.262	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.162	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.314	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.998	k star (bias corrected MLE)	1.809
Theta hat (MLE)	0.0827	Theta star (bias corrected MLE)	0.137
nu hat (MLE)	41.98	nu star (bias corrected)	25.32
MLE Mean (bias corrected)	0.248	MLE Sd (bias corrected)	0.184

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.194	nu hat (KM)	13.21
Approximate Chi Square Value (13.21, α)	7.199	Adjusted Chi Square Value (13.21, β)	7.027
90% Gamma Approximate KM-UCL (use when n>=50)	0.0948	90% Gamma Adjusted KM-UCL (use when n<50)	0.0971

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.059
Maximum	0.518	Median	0.01

SD	0.116	CV	1.963
k hat (MLE)	0.545	k star (bias corrected MLE)	0.517
Theta hat (MLE)	0.108	Theta star (bias corrected MLE)	0.114
nu hat (MLE)	37.07	nu star (bias corrected)	35.14
MLE Mean (bias corrected)	0.059	MLE Sd (bias corrected)	0.082
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (35.14, α)	24.91	Adjusted Chi Square Value (35.14, β)	24.57
90% Gamma Approximate UCL (use when n>=50)	0.0832	90% Gamma Adjusted UCL (use when n<50)	0.0843

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0636	Mean in Log Scale	-3.749
SD in Original Scale	0.114	SD in Log Scale	1.285
90% t UCL (assumes normality of ROS data)	0.0892	90% Percentile Bootstrap UCL	0.0885
90% BCA Bootstrap UCL	0.0965	90% Bootstrap t UCL	0.101
90% H-UCL (Log ROS)	0.0857		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-5.996	90% H-UCL (KM -Log)	0.115
KM SD (logged)	2.272	90% Critical H Value (KM-Log)	3.157
KM Standard Error of Mean (logged)	0.421		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0521	Mean in Log Scale	-5.584
SD in Original Scale	0.119	SD in Log Scale	2.126
90% t UCL (Assumes normality)	0.0788	90% H-Stat UCL	0.109

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-3 Naphthalenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	22
Number of Detects	5	Number of Non-Detects	29
Number of Distinct Detects	5	Number of Distinct Non-Detects	17
Minimum Detect	0.231	Minimum Non-Detect	0.00182
Maximum Detect	14.98	Maximum Non-Detect	0.00327
Variance Detects	39.85	Percent Non-Detects	85.29%
Mean Detects	3.77	SD Detects	6.313
Median Detects	0.906	CV Detects	1.675
Skewness Detects	2.153	Kurtosis Detects	4.681
Mean of Logged Detects	0.243	SD of Logged Detects	1.613

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.656	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.394	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.556	Standard Error of Mean	0.488
SD	2.544	90% KM (BCA) UCL	1.042
90% KM (t) UCL	1.194	90% KM (Percentile Bootstrap) UCL	1.109
90% KM (z) UCL	1.181	90% KM Bootstrap t UCL	3.235
90% KM Chebyshev UCL	2.019	95% KM Chebyshev UCL	2.682
97.5% KM Chebyshev UCL	3.602	99% KM Chebyshev UCL	5.409

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.456	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.26	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.37	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.574	k star (bias corrected MLE)	0.363
Theta hat (MLE)	6.569	Theta star (bias corrected MLE)	10.39
nu hat (MLE)	5.739	nu star (bias corrected)	3.629
MLE Mean (bias corrected)	3.77	MLE Sd (bias corrected)	6.258

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0478	nu hat (KM)	3.249
Approximate Chi Square Value (3.25, α)	0.704	Adjusted Chi Square Value (3.25, β)	0.662
90% Gamma Approximate KM-UCL (use when n>=50)	2.566	90% Gamma Adjusted KM-UCL (use when n<50)	2.728

Gamma (KM) may not be used when k hat (KM) is < 0.1

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.563

Maximum	14.98	Median	0.01
SD	2.58	CV	4.584
k hat (MLE)	0.219	k star (bias corrected MLE)	0.219
Theta hat (MLE)	2.574	Theta star (bias corrected MLE)	2.57
nu hat (MLE)	14.87	nu star (bias corrected)	14.89
MLE Mean (bias corrected)	0.563	MLE Sd (bias corrected)	1.203
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (14.89, α)	8.466	Adjusted Chi Square Value (14.89, β)	8.278
90% Gamma Approximate UCL (use when n>=50)	0.99	90% Gamma Adjusted UCL (use when n<50)	1.013

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.184	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.556	Mean in Log Scale	-7.158
SD in Original Scale	2.582	SD in Log Scale	3.779
90% t UCL (assumes normality of ROS data)	1.135	90% Percentile Bootstrap UCL	1.082
90% BCA Bootstrap UCL	1.566	90% Bootstrap t UCL	6.085
90% H-UCL (Log ROS)	25.83		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-5.346	90% H-UCL (KM -Log)	0.322
KM SD (logged)	2.386	90% Critical H Value (KM-Log)	3.29
KM Standard Error of Mean (logged)	0.457		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.556	Mean in Log Scale	-5.506
SD in Original Scale	2.582	SD in Log Scale	2.491
90% t UCL (Assumes normality)	1.135	90% H-Stat UCL	0.397

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Chrysene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	27
Number of Detects	14	Number of Non-Detects	20
Number of Distinct Detects	14	Number of Distinct Non-Detects	13
Minimum Detect	6.3558E-4	Minimum Non-Detect	6.0132E-4
Maximum Detect	0.0203	Maximum Non-Detect	0.0363
Variance Detects	2.9208E-5	Percent Non-Detects	58.82%
Mean Detects	0.00763	SD Detects	0.0054
Median Detects	0.0063	CV Detects	0.708
Skewness Detects	1.322	Kurtosis Detects	1.385
Mean of Logged Detects	-5.135	SD of Logged Detects	0.836

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.00367	Standard Error of Mean	8.7834E-4
SD	0.00483	90% KM (BCA) UCL	0.00501
90% KM (t) UCL	0.00481	90% KM (Percentile Bootstrap) UCL	0.00492
90% KM (z) UCL	0.00479	90% KM Bootstrap t UCL	0.00511
90% KM Chebyshev UCL	0.0063	95% KM Chebyshev UCL	0.00749
97.5% KM Chebyshev UCL	0.00915	99% KM Chebyshev UCL	0.0124

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.364	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.163	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.232	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.08	k star (bias corrected MLE)	1.682
Theta hat (MLE)	0.00367	Theta star (bias corrected MLE)	0.00454
nu hat (MLE)	58.25	nu star (bias corrected)	47.1
MLE Mean (bias corrected)	0.00763	MLE Sd (bias corrected)	0.00588

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.576	nu hat (KM)	39.19
Approximate Chi Square Value (39.19, α)	28.36	Adjusted Chi Square Value (39.19, β)	28
90% Gamma Approximate KM-UCL (use when n>=50)	0.00507	90% Gamma Adjusted KM-UCL (use when n<50)	0.00513

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	6.3558E-4	Mean	0.00908
Maximum	0.0203	Median	0.01

SD	0.00359	CV	0.398
k hat (MLE)	4.493	k star (bias corrected MLE)	4.116
Theta hat (MLE)	0.00201	Theta star (bias corrected MLE)	0.00219
nu hat (MLE)	305.5	nu star (bias corrected)	279.9
MLE Mean (bias corrected)	0.00903	MLE Sd (bias corrected)	0.00445
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (279.89, α)	250	Adjusted Chi Square Value (279.89, β)	248.9
90% Gamma Approximate UCL (use when n>=50)	0.0101	90% Gamma Adjusted UCL (use when n<50)	0.0101

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.895	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00367	Mean in Log Scale	-6.316
SD in Original Scale	0.00479	SD in Log Scale	1.204
90% t UCL (assumes normality of ROS data)	0.00475	90% Percentile Bootstrap UCL	0.00483
90% BCA Bootstrap UCL	0.00496	90% Bootstrap t UCL	0.0051
90% H-UCL (Log ROS)	0.00569		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-6.391	90% H-UCL (KM -Log)	0.00551
KM SD (logged)	1.229	90% Critical H Value (KM-Log)	2.034
KM Standard Error of Mean (logged)	0.231		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.00454	Mean in Log Scale	-5.896
SD in Original Scale	0.00515	SD in Log Scale	1.004
90% t UCL (Assumes normality)	0.00569	90% H-Stat UCL	0.00627

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Fluoranthene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	32
Number of Detects	24	Number of Non-Detects	10
Number of Distinct Detects	24	Number of Distinct Non-Detects	8
Minimum Detect	0.0597	Minimum Non-Detect	0.025
Maximum Detect	1.039	Maximum Non-Detect	0.0573
Variance Detects	0.0417	Percent Non-Detects	29.41%
Mean Detects	0.19	SD Detects	0.204
Median Detects	0.123	CV Detects	1.073
Skewness Detects	3.461	Kurtosis Detects	13.65
Mean of Logged Detects	-1.938	SD of Logged Detects	0.671

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.575	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.27	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.181	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.142	Standard Error of Mean	0.0323
SD	0.184	90% KM (BCA) UCL	0.187
90% KM (t) UCL	0.184	90% KM (Percentile Bootstrap) UCL	0.187
90% KM (z) UCL	0.183	90% KM Bootstrap t UCL	0.221
90% KM Chebyshev UCL	0.238	95% KM Chebyshev UCL	0.282
97.5% KM Chebyshev UCL	0.343	99% KM Chebyshev UCL	0.463

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.399	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.756	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.21	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.18	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.943	k star (bias corrected MLE)	1.728
Theta hat (MLE)	0.0979	Theta star (bias corrected MLE)	0.11
nu hat (MLE)	93.28	nu star (bias corrected)	82.96
MLE Mean (bias corrected)	0.19	MLE Sd (bias corrected)	0.145

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.592	nu hat (KM)	40.27
Approximate Chi Square Value (40.27, α)	29.28	Adjusted Chi Square Value (40.27, β)	28.92
90% Gamma Approximate KM-UCL (use when n>=50)	0.195	90% Gamma Adjusted KM-UCL (use when n<50)	0.197

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.137
Maximum	1.039	Median	0.0948

SD	0.19	CV	1.383
k hat (MLE)	0.805	k star (bias corrected MLE)	0.754
Theta hat (MLE)	0.171	Theta star (bias corrected MLE)	0.182
nu hat (MLE)	54.74	nu star (bias corrected)	51.24
MLE Mean (bias corrected)	0.137	MLE Sd (bias corrected)	0.158
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (51.24, α)	38.77	Adjusted Chi Square Value (51.24, β)	38.35
90% Gamma Approximate UCL (use when n>=50)	0.181	90% Gamma Adjusted UCL (use when n<50)	0.183

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.181	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.144	Mean in Log Scale	-2.391
SD in Original Scale	0.186	SD in Log Scale	0.911
90% t UCL (assumes normality of ROS data)	0.185	90% Percentile Bootstrap UCL	0.183
90% BCA Bootstrap UCL	0.202	90% Bootstrap t UCL	0.222
90% H-UCL (Log ROS)	0.183		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.453	90% H-UCL (KM -Log)	0.187
KM SD (logged)	0.97	90% Critical H Value (KM-Log)	1.801
KM Standard Error of Mean (logged)	0.17		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.142	Mean in Log Scale	-2.466
SD in Original Scale	0.187	SD in Log Scale	1.012
90% t UCL (Assumes normality)	0.184	90% H-Stat UCL	0.196

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Fluorene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	29
Number of Detects	17	Number of Non-Detects	17
Number of Distinct Detects	17	Number of Distinct Non-Detects	12
Minimum Detect	0.215	Minimum Non-Detect	0.169
Maximum Detect	2.756	Maximum Non-Detect	0.2
Variance Detects	0.506	Percent Non-Detects	50%
Mean Detects	0.656	SD Detects	0.712
Median Detects	0.364	CV Detects	1.084
Skewness Detects	2.254	Kurtosis Detects	4.677
Mean of Logged Detects	-0.779	SD of Logged Detects	0.789

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.656	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.294	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.215	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.413	Standard Error of Mean	0.0964
SD	0.546	90% KM (BCA) UCL	0.55
90% KM (t) UCL	0.539	90% KM (Percentile Bootstrap) UCL	0.547
90% KM (z) UCL	0.536	90% KM Bootstrap t UCL	0.623
90% KM Chebyshev UCL	0.702	95% KM Chebyshev UCL	0.833
97.5% KM Chebyshev UCL	1.015	99% KM Chebyshev UCL	1.372

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.315	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.755	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.21	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.213	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.542	k star (bias corrected MLE)	1.309
Theta hat (MLE)	0.426	Theta star (bias corrected MLE)	0.501
nu hat (MLE)	52.43	nu star (bias corrected)	44.51
MLE Mean (bias corrected)	0.656	MLE Sd (bias corrected)	0.574

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.572	nu hat (KM)	38.91
Approximate Chi Square Value (38.91, α)	28.12	Adjusted Chi Square Value (38.91, β)	27.76
90% Gamma Approximate KM-UCL (use when n>=50)	0.571	90% Gamma Adjusted KM-UCL (use when n<50)	0.578

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01		Mean	0.333
Maximum	2.756		Median	0.112

SD	0.594	CV	1.784
k hat (MLE)	0.411	k star (bias corrected MLE)	0.395
Theta hat (MLE)	0.81	Theta star (bias corrected MLE)	0.844
nu hat (MLE)	27.96	nu star (bias corrected)	26.83
MLE Mean (bias corrected)	0.333	MLE Sd (bias corrected)	0.53
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (26.83, α)	17.97	Adjusted Chi Square Value (26.83, β)	17.69
90% Gamma Approximate UCL (use when n>=50)	0.497	90% Gamma Adjusted UCL (use when n<50)	0.505

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.858	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.892	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.215	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.357	Mean in Log Scale	-1.84
SD in Original Scale	0.581	SD in Log Scale	1.234
90% t UCL (assumes normality of ROS data)	0.488	90% Percentile Bootstrap UCL	0.482
90% BCA Bootstrap UCL	0.53	90% Bootstrap t UCL	0.584
90% H-UCL (Log ROS)	0.527		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.278	90% H-UCL (KM -Log)	0.449
KM SD (logged)	0.736	90% Critical H Value (KM-Log)	1.618
KM Standard Error of Mean (logged)	0.13		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.377	Mean in Log Scale	-1.554
SD in Original Scale	0.571	SD in Log Scale	0.96
90% t UCL (Assumes normality)	0.505	90% H-Stat UCL	0.452

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Phenanthrene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	29
Number of Detects	18	Number of Non-Detects	16
Number of Distinct Detects	18	Number of Distinct Non-Detects	11
Minimum Detect	0.147	Minimum Non-Detect	0.106
Maximum Detect	3.154	Maximum Non-Detect	0.149
Variance Detects	0.513	Percent Non-Detects	47.06%
Mean Detects	0.456	SD Detects	0.716
Median Detects	0.21	CV Detects	1.57
Skewness Detects	3.571	Kurtosis Detects	13.38
Mean of Logged Detects	-1.25	SD of Logged Detects	0.792

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.453	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.397	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.209	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.293	Standard Error of Mean	0.0945
SD	0.535	90% KM (BCA) UCL	0.412
90% KM (t) UCL	0.417	90% KM (Percentile Bootstrap) UCL	0.42
90% KM (z) UCL	0.414	90% KM Bootstrap t UCL	0.829
90% KM Chebyshev UCL	0.576	95% KM Chebyshev UCL	0.705
97.5% KM Chebyshev UCL	0.883	99% KM Chebyshev UCL	1.233

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.523	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.762	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.282	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.208	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.216	k star (bias corrected MLE)	1.05
Theta hat (MLE)	0.375	Theta star (bias corrected MLE)	0.434
nu hat (MLE)	43.78	nu star (bias corrected)	37.82
MLE Mean (bias corrected)	0.456	MLE Sd (bias corrected)	0.445

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.299	nu hat (KM)	20.36
Approximate Chi Square Value (20.36, α)	12.73	Adjusted Chi Square Value (20.36, β)	12.5
90% Gamma Approximate KM-UCL (use when n>=50)	0.469	90% Gamma Adjusted KM-UCL (use when n<50)	0.477

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01		Mean	0.246
Maximum	3.154		Median	0.151

SD	0.562	CV	2.281
k hat (MLE)	0.452	k star (bias corrected MLE)	0.432
Theta hat (MLE)	0.544	Theta star (bias corrected MLE)	0.57
nu hat (MLE)	30.75	nu star (bias corrected)	29.37
MLE Mean (bias corrected)	0.246	MLE Sd (bias corrected)	0.375
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (29.37, α)	20.08	Adjusted Chi Square Value (29.37, β)	19.77
90% Gamma Approximate UCL (use when n>=50)	0.36	90% Gamma Adjusted UCL (use when n<50)	0.366

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.231	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.209	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.262	Mean in Log Scale	-2.15
SD in Original Scale	0.555	SD in Log Scale	1.147
90% t UCL (assumes normality of ROS data)	0.387	90% Percentile Bootstrap UCL	0.386
90% BCA Bootstrap UCL	0.461	90% Bootstrap t UCL	0.712
90% H-UCL (Log ROS)	0.333		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.275	Mean in Log Scale	-1.907
SD in Original Scale	0.55	SD in Log Scale	0.91
90% t UCL (Assumes normality)	0.398	90% H-Stat UCL	0.297

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Pyrene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	32
Number of Detects	22	Number of Non-Detects	12
Number of Distinct Detects	22	Number of Distinct Non-Detects	10
Minimum Detect	0.0413	Minimum Non-Detect	0.0257
Maximum Detect	0.591	Maximum Non-Detect	0.0488
Variance Detects	0.0137	Percent Non-Detects	35.29%
Mean Detects	0.128	SD Detects	0.117
Median Detects	0.0949	CV Detects	0.916
Skewness Detects	3.238	Kurtosis Detects	12.28
Mean of Logged Detects	-2.284	SD of Logged Detects	0.621

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.624	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.264	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.189	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0927	Standard Error of Mean	0.0182
SD	0.103	90% KM (BCA) UCL	0.118
90% KM (t) UCL	0.116	90% KM (Percentile Bootstrap) UCL	0.117
90% KM (z) UCL	0.116	90% KM Bootstrap t UCL	0.135
90% KM Chebyshev UCL	0.147	95% KM Chebyshev UCL	0.172
97.5% KM Chebyshev UCL	0.206	99% KM Chebyshev UCL	0.274

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.937	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.193	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.187	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.372	k star (bias corrected MLE)	2.079
Theta hat (MLE)	0.0538	Theta star (bias corrected MLE)	0.0614
nu hat (MLE)	104.4	nu star (bias corrected)	91.47
MLE Mean (bias corrected)	0.128	MLE Sd (bias corrected)	0.0885

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.804	nu hat (KM)	54.66
Approximate Chi Square Value (54.66, α)	41.76	Adjusted Chi Square Value (54.66, β)	41.32
90% Gamma Approximate KM-UCL (use when n>=50)	0.121	90% Gamma Adjusted KM-UCL (use when n<50)	0.123

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01		Mean	0.0861
Maximum	0.591		Median	0.0578

SD	0.109	CV	1.269
k hat (MLE)	0.898	k star (bias corrected MLE)	0.838
Theta hat (MLE)	0.0959	Theta star (bias corrected MLE)	0.103
nu hat (MLE)	61.07	nu star (bias corrected)	57.01
MLE Mean (bias corrected)	0.0861	MLE Sd (bias corrected)	0.0941
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (57.01, α)	43.83	Adjusted Chi Square Value (57.01, β)	43.37
90% Gamma Approximate UCL (use when n>=50)	0.112	90% Gamma Adjusted UCL (use when n<50)	0.113

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.14	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0912	Mean in Log Scale	-2.795
SD in Original Scale	0.106	SD in Log Scale	0.866
90% t UCL (assumes normality of ROS data)	0.115	90% Percentile Bootstrap UCL	0.113
90% BCA Bootstrap UCL	0.123	90% Bootstrap t UCL	0.133
90% H-UCL (Log ROS)	0.115		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.738	90% H-UCL (KM -Log)	0.111
KM SD (logged)	0.793	90% Critical H Value (KM-Log)	1.66
KM Standard Error of Mean (logged)	0.143		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0903	Mean in Log Scale	-2.832
SD in Original Scale	0.106	SD in Log Scale	0.908
90% t UCL (Assumes normality)	0.114	90% H-Stat UCL	0.117

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

APPENDIX G-D-2

Pro-UCL Version 5.0 Output Sheets

Milton Creek Sediment Data

90% Upper Confidence Limits for Bioaccumulation Screen

(Only results for fluoranthene and pyrene presented)

Fluoranthene

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.02	Minimum Non-Detect	0.00853
Maximum Detect	1.2	Maximum Non-Detect	0.0273
Variance Detects	0.138	Percent Non-Detects	18.18%
Mean Detects	0.249	SD Detects	0.371
Median Detects	0.129	CV Detects	1.489
Skewness Detects	2.587	Kurtosis Detects	7.037
Mean of Logged Detects	-2.124	SD of Logged Detects	1.278

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.631	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.206	Standard Error of Mean	0.105
SD	0.33	90% KM (BCA) UCL	0.33
90% KM (t) UCL	0.351	90% KM (Percentile Bootstrap) UCL	0.329
90% KM (z) UCL	0.341	90% KM Bootstrap t UCL	0.715
90% KM Chebyshev UCL	0.523	95% KM Chebyshev UCL	0.666
97.5% KM Chebyshev UCL	0.865	99% KM Chebyshev UCL	1.255

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.427	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.225	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.289	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.807	k star (bias corrected MLE)	0.612
Theta hat (MLE)	0.309	Theta star (bias corrected MLE)	0.407
nu hat (MLE)	14.53	nu star (bias corrected)	11.02
MLE Mean (bias corrected)	0.249	MLE Sd (bias corrected)	0.319

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.392	nu hat (KM)	8.626
Approximate Chi Square Value (8.63, α)	3.913	Adjusted Chi Square Value (8.63, β)	3.525
90% Gamma Approximate KM-UCL (use when n>=50)	0.455	90% Gamma Adjusted KM-UCL (use when n<50)	0.505

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.206
Maximum	1.2	Median	0.0825
SD	0.346	CV	1.681
k hat (MLE)	0.619	k star (bias corrected MLE)	0.511
Theta hat (MLE)	0.333	Theta star (bias corrected MLE)	0.403
nu hat (MLE)	13.61	nu star (bias corrected)	11.23
MLE Mean (bias corrected)	0.206	MLE Sd (bias corrected)	0.288
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (11.23, α)	5.747	Adjusted Chi Square Value (11.23, β)	5.262
90% Gamma Approximate UCL (use when n>=50)	0.402	90% Gamma Adjusted UCL (use when n<50)	0.439

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.143	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.206	Mean in Log Scale	-2.595
SD in Original Scale	0.346	SD in Log Scale	1.571
90% t UCL (assumes normality of ROS data)	0.349	90% Percentile Bootstrap UCL	0.334
90% BCA Bootstrap UCL	0.422	90% Bootstrap t UCL	0.623
90% H-UCL (Log ROS)	1.09		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.547	90% H-UCL (KM -Log)	0.729
KM SD (logged)	1.425	90% Critical H Value (KM-Log)	2.696
KM Standard Error of Mean (logged)	0.458		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.206	Mean in Log Scale	-2.624
SD in Original Scale	0.346	SD in Log Scale	1.617
90% t UCL (Assumes normality)	0.349	90% H-Stat UCL	1.229

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Pyrene

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.017	Minimum Non-Detect	0.00853
Maximum Detect	1.2	Maximum Non-Detect	0.0273
Variance Detects	0.138	Percent Non-Detects	18.18%
Mean Detects	0.241	SD Detects	0.371
Median Detects	0.135	CV Detects	1.542
Skewness Detects	2.662	Kurtosis Detects	7.44
Mean of Logged Detects	-2.216	SD of Logged Detects	1.349

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.615	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.336	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.199	Standard Error of Mean	0.105
SD	0.329	90% KM (BCA) UCL	0.316
90% KM (t) UCL	0.343	90% KM (Percentile Bootstrap) UCL	0.324
90% KM (z) UCL	0.334	90% KM Bootstrap t UCL	0.693
90% KM Chebyshev UCL	0.515	95% KM Chebyshev UCL	0.658
97.5% KM Chebyshev UCL	0.856	99% KM Chebyshev UCL	1.246

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.417	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.207	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.289	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.754	k star (bias corrected MLE)	0.577
Theta hat (MLE)	0.319	Theta star (bias corrected MLE)	0.417
nu hat (MLE)	13.58	nu star (bias corrected)	10.39
MLE Mean (bias corrected)	0.241	MLE Sd (bias corrected)	0.317

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.367	nu hat (KM)	8.066
Approximate Chi Square Value (8.07, α)	3.535	Adjusted Chi Square Value (8.07, β)	3.169
90% Gamma Approximate KM-UCL (use when n>=50)	0.454	90% Gamma Adjusted KM-UCL (use when n<50)	0.507

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.199
Maximum	1.2	Median	0.085

SD	0.345	CV	1.735
k hat (MLE)	0.597	k star (bias corrected MLE)	0.495
Theta hat (MLE)	0.333	Theta star (bias corrected MLE)	0.402
nu hat (MLE)	13.14	nu star (bias corrected)	10.89
MLE Mean (bias corrected)	0.199	MLE Sd (bias corrected)	0.283
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (10.89, α)	5.496	Adjusted Chi Square Value (10.89, β)	5.024
90% Gamma Approximate UCL (use when n>=50)	0.394	90% Gamma Adjusted UCL (use when n<50)	0.431

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.199	Mean in Log Scale	-2.713
SD in Original Scale	0.345	SD in Log Scale	1.657
90% t UCL (assumes normality of ROS data)	0.341	90% Percentile Bootstrap UCL	0.329
90% BCA Bootstrap UCL	0.397	90% Bootstrap t UCL	0.697
90% H-UCL (Log ROS)	1.288		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.637	90% H-UCL (KM -Log)	0.745
KM SD (logged)	1.463	90% Critical H Value (KM-Log)	2.751
KM Standard Error of Mean (logged)	0.469		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.199	Mean in Log Scale	-2.7
SD in Original Scale	0.345	SD in Log Scale	1.638
90% t UCL (Assumes normality)	0.341	90% H-Stat UCL	1.221

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

APPENDIX G-D-3

Pro-UCL Version 5.0 Output Sheets

Scappoose Bay Sediment Data

90% Upper Confidence Limits for Bioaccumulation Screen

(Only results for fluoranthene and pyrene presented)

Fluoranthene

General Statistics

Total Number of Observations	112	Number of Distinct Observations	95
Number of Detects	111	Number of Non-Detects	1
Number of Distinct Detects	94	Number of Distinct Non-Detects	1
Minimum Detect	0.0089	Minimum Non-Detect	0.0129
Maximum Detect	20	Maximum Non-Detect	0.0129
Variance Detects	15	Percent Non-Detects	0.893%
Mean Detects	2.053	SD Detects	3.873
Median Detects	0.465	CV Detects	1.886
Skewness Detects	3.181	Kurtosis Detects	10.2
Mean of Logged Detects	-0.554	SD of Logged Detects	1.72

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.543	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0841	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.035	Standard Error of Mean	0.365
SD	3.843	90% KM (BCA) UCL	2.545
90% KM (t) UCL	2.505	90% KM (Percentile Bootstrap) UCL	2.518
90% KM (z) UCL	2.503	90% KM Bootstrap t UCL	2.62
90% KM Chebyshev UCL	3.129	95% KM Chebyshev UCL	3.625
97.5% KM Chebyshev UCL	4.313	99% KM Chebyshev UCL	5.665

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.737	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.819	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.141	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0916	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.499	k star (bias corrected MLE)	0.492
Theta hat (MLE)	4.114	Theta star (bias corrected MLE)	4.177
nu hat (MLE)	110.8	nu star (bias corrected)	109.1
MLE Mean (bias corrected)	2.053	MLE Sd (bias corrected)	2.929

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.28	nu hat (KM)	62.8
Approximate Chi Square Value (62.80, α)	48.94	Adjusted Chi Square Value (62.80, β)	48.81
90% Gamma Approximate KM-UCL (use when n>=50)	2.612	90% Gamma Adjusted KM-UCL (use when n<50)	2.619

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0089	Mean	2.035
Maximum	20	Median	0.449

SD	3.861	CV	1.897
k hat (MLE)	0.49	k star (bias corrected MLE)	0.483
Theta hat (MLE)	4.153	Theta star (bias corrected MLE)	4.215
nu hat (MLE)	109.8	nu star (bias corrected)	108.1
MLE Mean (bias corrected)	2.035	MLE Sd (bias corrected)	2.929
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (108.15, α)	89.78	Adjusted Chi Square Value (108.15, β)	89.6
90% Gamma Approximate UCL (use when n>=50)	2.451	90% Gamma Adjusted UCL (use when n<50)	2.456

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0609	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0841	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.035	Mean in Log Scale	-0.592
SD in Original Scale	3.861	SD in Log Scale	1.76
90% t UCL (assumes normality of ROS data)	2.505	90% Percentile Bootstrap UCL	2.532
90% BCA Bootstrap UCL	2.562	90% Bootstrap t UCL	2.647
90% H-UCL (Log ROS)	3.822		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.591	90% H-UCL (KM -Log)	3.741
KM SD (logged)	1.749	90% Critical H Value (KM-Log)	2.292
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.035	Mean in Log Scale	-0.594
SD in Original Scale	3.861	SD in Log Scale	1.764
90% t UCL (Assumes normality)	2.505	90% H-Stat UCL	3.851

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Pyrene

General Statistics

Total Number of Observations	112	Number of Distinct Observations	104
Number of Detects	110	Number of Non-Detects	2
Number of Distinct Detects	102	Number of Distinct Non-Detects	2
Minimum Detect	0.015	Minimum Non-Detect	0.0129
Maximum Detect	15	Maximum Non-Detect	0.383
Variance Detects	7.223	Percent Non-Detects	1.786%
Mean Detects	1.463	SD Detects	2.687
Median Detects	0.4	CV Detects	1.837
Skewness Detects	3.346	Kurtosis Detects	12.08
Mean of Logged Detects	-0.775	SD of Logged Detects	1.609

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.552	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.295	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0845	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.438	Standard Error of Mean	0.252
SD	2.658	90% KM (BCA) UCL	1.764
90% KM (t) UCL	1.763	90% KM (Percentile Bootstrap) UCL	1.764
90% KM (z) UCL	1.761	90% KM Bootstrap t UCL	1.879
90% KM Chebyshev UCL	2.195	95% KM Chebyshev UCL	2.538
97.5% KM Chebyshev UCL	3.014	99% KM Chebyshev UCL	3.948

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.609	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.815	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.13	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0916	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.543	k star (bias corrected MLE)	0.534
Theta hat (MLE)	2.695	Theta star (bias corrected MLE)	2.739
nu hat (MLE)	119.4	nu star (bias corrected)	117.5
MLE Mean (bias corrected)	1.463	MLE Sd (bias corrected)	2.002

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.293	nu hat (KM)	65.6
Approximate Chi Square Value (65.60, α)	51.41	Adjusted Chi Square Value (65.60, β)	51.28
90% Gamma Approximate KM-UCL (use when n>=50)	1.835	90% Gamma Adjusted KM-UCL (use when n<50)	1.84

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.437
Maximum	15	Median	0.375

SD	2.67	CV	1.859
k hat (MLE)	0.523	k star (bias corrected MLE)	0.515
Theta hat (MLE)	2.747	Theta star (bias corrected MLE)	2.79
nu hat (MLE)	117.1	nu star (bias corrected)	115.3
MLE Mean (bias corrected)	1.437	MLE Sd (bias corrected)	2.002
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (115.34, α)	96.35	Adjusted Chi Square Value (115.34, β)	96.17
90% Gamma Approximate UCL (use when n>=50)	1.72	90% Gamma Adjusted UCL (use when n<50)	1.723

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0495	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0845	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.438	Mean in Log Scale	-0.826
SD in Original Scale	2.67	SD in Log Scale	1.653
90% t UCL (assumes normality of ROS data)	1.763	90% Percentile Bootstrap UCL	1.771
90% BCA Bootstrap UCL	1.81	90% Bootstrap t UCL	1.829
90% H-UCL (Log ROS)	2.427		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.819	90% H-UCL (KM -Log)	2.335
KM SD (logged)	1.63	90% Critical H Value (KM-Log)	2.188
KM Standard Error of Mean (logged)	0.155		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.438	Mean in Log Scale	-0.821
SD in Original Scale	2.669	SD in Log Scale	1.647
90% t UCL (Assumes normality)	1.763	90% H-Stat UCL	2.409

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Cascadia
Associates, LLC

APPENDIX G

UPDATED SUPPLEMENTAL ERA

Updated Supplemental Ecological Risk Assessment

Former Pope & Talbot Wood-Treating Site

St. Helens, Oregon

ECSI ID #959

Prepared for:

Port of Columbia County
P.O. Box 190
Columbia City, Oregon 97018

Prepared by:

Cascadia Associates, LLC
5820 SW Kelly Avenue, Suite B
Portland, Oregon 97239

Project No. 0034-001-005
January 2020

Updated Supplemental Ecological Risk Assessment

Former Pope & Talbot Wood-Treating Site

St. Helens, Oregon

ECSI ID #959

Prepared for:

Port of Columbia County
Project No. 0034-001-005
January 2020

Prepared by:

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1.0 INTRODUCTION

This appendix has been prepared by Cascadia Associates, LLC (Cascadia), to supplement the ecological risk assessment (ERA) previously submitted to the Oregon Department of Environmental Quality (DEQ) for the former Pope & Talbot wood-treating property located at 1550 Railroad Avenue in St. Helens, Oregon, (the "Site"). This supplement is necessitated by three main factors:

- Recent (2011, 2012, and 2017) collection of additional data from Site media (specifically sediment, porewater, and surface water) with potential direct exposure pathways to ecological receptors;
- Recent progress in the science of evaluating the potential for adverse effects to benthic invertebrate infauna from exposure to polycyclic aromatic hydrocarbons (PAHs) in these media; and
- Recent (2010, 2011, 2012, 2013, 2017, and 2018) investigations on non-aqueous phase liquid (NAPL) delineation.

The scope of this Updated Supplemental ERA (as detailed in Section 2.0) is limited to data collected since 2005 and to the exposure pathways and receptors associated with media related to those data.

This supplemental assessment focuses on application of new methods and research to the evaluation of these data (Section 3.1) as additional lines of evidence (LOEs) to be used in overall assessment of ecological risk at this Site. However, as described in Section 3.2, updates to the direct screening of media concentrations (porewater and sediment) have also been included. Section 4.0 describes the LOEs used to assess ecological risk in this Updated Supplemental ERA. A summary of the previously submitted ERA documents is presented in Section 5.0 followed by a summary and analysis of sediment data collected in 2011 (Section 6.0). Section 6.0 provides a newly examined LOE associated with historic (2010 – 2012) groundwater data to begin to analyze potential risk to aquatic receptors from dissolved phase constituents in upland groundwater following discharge to surface water. Section 7.0 presents the results of analysis of porewater and sediment samples collected in 2012 (two rounds). Section 8.0 provides an analysis of the LOEs based on 2012 data that are relevant to the potential for risk to receptors associated with the benthic environment of the Site and a discussion of the uncertainties associated with those LOEs. Section 9.0 describes the LOEs associated with the most recent (2017) data. Section 10.0 summarizes the LOEs and Section 11.0 provides overall ERA conclusions.

NAPL has been found to occur in soil, groundwater, groundwater seeps, and sediment at the Site. The nature of NAPL has been investigated, and results provided in the 2000 Remedial Investigation (RI) Report (GeoEngineers, 2000) indicate a NAPL composition consistent with analytical results for creosote-related constituents in NAPL reported in the Supplemental RI Report (Table 5-2). The extent of NAPL at the Site has been inferred based on field observations of NAPL during the multiple investigation events conducted as part of the Supplemental RI. The inferred extent of

subsurface NAPL is shown on Figure G-2. The presence of NAPL is presumed to present an unacceptable risk for ecological receptors. Therefore, media within the estimated extent of NAPL at the Site has not been evaluated in this Updated Supplemental ERA.

2.0 SCOPE OF THE UPDATED SUPPLEMENTAL ERA

As indicated in Section 1.0, the scope of this Updated Supplemental ERA is limited to new data (collected since 2005) and exposure pathways and receptors associated with the sampled media. Although historical data (1996-2005) is evaluated herein using updated methods (Section 5.4), this is done as part of the review of the previous ERAs and is not considered to be directly part of the Updated Supplemental ERA scope. The historical data are, however, used in the determination of sediment exposure point concentrations (EPCs) for the evaluation of potential bioaccumulation risk for fluoranthene and pyrene.

DEQ has requested that Cascadia prepare an update to the ecological conceptual site model (CSM) for the entire Site as part of the Updated Supplemental ERA. This CSM is presented diagrammatically on Figure G-1. Based on discussions with DEQ, the scope of this ERA is limited to potential risks associated with PAH residues in near- and offshore sediments and associated porewater (including Milton Creek), but excluding delineated areas of inferred NAPL presence (based on observed sheen) where risk to ecological receptors is presumed to occur.

This evaluation primarily focused on the biological active zone (0 to 12 inches below the mudline), which is the zone of significant biological activity based on observed macroinvertebrates in sediment core samples. Deeper sediment porewater (2 to 2.4 feet below the mudline) was analyzed to assess the spatial distribution of dissolved phase PAHs. Figures G-3 and G-4 show the locations of all sediment samples collected within the upper 1 foot from 1996 through 2017. Figure G-3 shows RI sampling locations before initiating the Supplemental RI in 2010 and Figure G-4 shows the Supplemental RI sampling locations (2011 – 2017). It should be noted that for the purposes of this evaluation, the Site was divided into two ecologically distinct exposure units—Milton Creek and Scappoose Bay. Receptors included in this assessment (for both exposure areas) are benthic invertebrates that may be exposed to dissolved-phase PAHs in the interstitial water of the Site sediments, and fish (resident and anadromous) exposed through direct contact with these waters (released to surface water).

Sediment data collected in July 2011, July 2012, October 2012, and September 2017 serve as the basis for this Supplemental ERA. The July samples represented high-water conditions of the Columbia River, and September and October represented low-water conditions. These sediment samples were analyzed for bulk PAH concentrations. Most of the samples collected in 2011 were analyzed for the 16 priority PAHs, but some were analyzed for the full suite of 34 PAH analytes (18 parent PAHs and 16 groups of alkylated PAHs). All of the 2012 and 2017 sediment samples were analyzed for the full suite of 34 PAH analytes. All 2017 samples were also analyzed for volatile organic compounds (VOCs), volatile petroleum hydrocarbons (VPH), and extractable petroleum hydrocarbons (EPH). All of these samples (2011, 2012, and 2017) were analyzed for total organic

carbon (TOC), and the 2012 and 2017 samples were also analyzed for black carbon (BC). Although some of the 2011 samples were also analyzed for metals and a limited suite of VOCs, the metals were found to be within site-specific background ranges as established in the 2000 RI Report (GeoEngineers, 2000), and no VOCs were detected in the one sample located outside of the inferred NAPL area that was analyzed for VOCs.

Sediment samples collected in 2012 (both rounds) were centrifuged to extract porewater for PAH analysis using ASTM International (ASTM) method D7376. The extracted porewaters were analyzed for the full suite of 34 PAH analytes as well as dissolved organic carbon (DOC). To get a better understanding of the bioavailability of PAHs (and therefore, a better understanding of risk to benthic organisms as a result of exposure), the 2017 sediment porewater samples were collected through the use of passive samplers (i.e., low density polyethylene [LDPE] passive sampling media within sediment probes), described in further detail in Section 3.7 of the Updated Supplemental RI Report. The locations where porewater samples were collected are shown on Figure G-4.

In addition to sediment and porewater, this Updated Supplemental ERA included a screening of surface water and groundwater data. Groundwater was collected from monitoring wells (shown on Figure G-4) from 2010 to 2012 as part of DEQ objectives for the supplemental RI to assess the quality of groundwater discharging to adjacent surface water bodies. This Updated Supplemental ERA included an analysis of this groundwater data from nearshore monitoring wells to evaluate the potential risks from dissolved phase constituents from discharge of upland groundwater into adjacent surface water. Surface water was examined directly in 2017 via passive samplers deployed for 21 days at locations shown on Figure G-4.

3.0 ASSESSMENT METHODS

This Updated Supplemental ERA generally utilized two main assessment methods to evaluate risk. The first method, which is targeted at risk to benthic organisms, is based on narcosis as the mode of toxicity and assesses risk as a sum of toxic units (TUs) calculated over all (34) PAH analytes (EPA, 2003; EPA, 2012). The second method is based on more traditional comparisons of environmental concentrations to screening level values (SLVs) based on toxic responses in aquatic organisms to individual chemical constituents. These two approaches are described in detail in the following sections. A description of how they were used specifically as LOEs in risk evaluation are described in Section 4.0.

3.1 NARCOSIS MODELS FOR PAH RISK TO BENTHIC INVERTEBRATES

The narcosis model for PAH risk to benthic invertebrates LOE is based on narcosis as the mode of toxicity and assesses risk as a sum of TUs calculated over all (34) PAH analytes. The United States Environmental Protection Agency (EPA) has developed an approach to evaluating the toxicity of PAHs in sediment based on the target lipid model of narcosis and equilibrium partitioning theory (EPA, 2003; EPA, 2012). PAHs are non-polar organic compounds that can be classified as type I narcotic chemicals that exhibit an inverse correlation between their median lethal concentrations

(LC50, in millimoles per liter [mmol/L]) and the logarithms of their octanol-water partition coefficients (log Kow). This inverse relationship relates the toxicity of the aqueous medium (e.g., interstitial water) to chemical body burden (or more specifically, the lipids) of the exposed organism.

The target lipid model is based on the assumption that mortality occurs when the chemical concentration in the target lipid reaches a threshold concentration. In the EPA (2003) approach, that threshold (the final chronic value [FCV] for lipid concentration [FCV_{lipid}]) in benthic invertebrates is established as 2.24 micromoles (µmoles) per gram of lipid (µmol/g) for all PAHs (here, "lipid" is used as an equivalent to octanol for the purposes of describing partitioning in the environment). This FCV_{lipid} can be converted to an equivalent concentration of dissolved PAH in the interstitial water (FCV_D) assuming that equilibrium has been achieved between the lipid and the freely dissolved PAH in the interstitial water. Further, an equivalent FCV for the PAH concentration in sediment organic carbon ([OC], FCV_{OC}) can be determined based on the assumption that equilibrium has been achieved between the dissolved PAH and the sediment OC. However, it should be noted that for both of these cases, these FCV concentrations (FCV_D and FCV_{OC}) are unique to individual PAHs, because each PAH has a distinct molecular weight and log Kow that are used in the conversions.

The FCV benchmarks for water and sediment OC are presented in Table G-1. In the following subsections, methods are described for the calculation of TU values for individual PAHs based on the FCV benchmark values. Section 3.1.1 describes methods by which the TU values are calculated from bulk sediment PAH concentrations using equilibrium partitioning (EqP) as the basis. Section 3.1.2 describes a method that uses data from direct measurements of PAHs in porewater samples to calculate TUs. For the TU calculations performed for this assessment, non-detections were treated as the method detection limit (MDL) to account for elevated reporting limits and to provide a more conservative assessment.

The narcosis-based TUs are considered additive, and evaluation of the sum of the TUs requires that either all 34 PAH analytes have been included in the sum or that the sum has been adjusted to account for the absence of some analytes. A potential for risk to benthic invertebrates exists when the sum of 34 individual TUs exceeds 1.

3.1.1 Equilibrium Partitioning-Based TU Estimation

The EPA has published guidance for two approaches to calculate narcosis-based TUs for benthic invertebrates based on bulk sediment data for PAHs. These are referred to as the one-carbon model (EPA, 2003) and the two-carbon model (EPA, 2012). These names refer to the number of carbon compartments addressed in the model (one-carbon indicates only TOC as a single compartment, and two-carbon indicates that BC is included as a distinct compartment in the partitioning model from "natural sediment OC").

One-Carbon Model

In the one-carbon model approach, the concentration of each PAH partitioned to the sediment OC is estimated by Equation (1):

$$C_{OC,i} = \frac{C_{S,i}}{f_{OC}} \quad \text{Equation (1)}$$

where:

COC,i = Concentration of PAH i in sediment OC (in milligrams per kilogram [mg/kg])

CS,i = Concentration of PAH i in bulk sediment (in mg/kg)

fOC = Fraction of sediment consisting of OC (unitless).

Here, fOC is based directly on the TOC measurement expressed as grams OC per gram of bulk sediment. The PAH-specific TU (referred to in the EPA guidance as the equilibrium partitioning sediment benchmark TU [ESBTU] is calculated as:

$$ESBTU_i = \frac{C_{OC,i}}{FCV_{OC,i}} \quad \text{Equation (2)}$$

where:

ESBTUi = Equilibrium partitioning sediment benchmark TU of PAH i (in toxic units)

COC,i = Concentration of PAH i in sediment OC (mg/kg OC)

FCVOC,i = Final chronic value of PAH i in OC (mg/kg OC)

Based on the additivity of TUs, the sum of the ESBTUs over the k PAHs for which analytical data are available is:

$$\Sigma ESBTU_k = \sum_{i=1}^{k} ESBTU_i \quad \text{Equation (3)}$$

If k is less than 34, then an uncertainty factor (UF) is applied that is specific to the number of PAHs available (k) and a level of confidence (cl) that the adjusted ΣESBTU does not underestimate its true value:

$$\Sigma ESBTU_{34,cl} = UF_{k,cl} \cdot \Sigma ESBTU_k \quad \text{Equation (4)}$$

In this assessment for the Site, the confidence level for all adjusted ΣESBTU values is 90%. EPA (2003) provided empirically based UF values for two k values—13 and 23. The UF13,0.9 is 8.45 and that for UF23,0.9 is 3.37. The data evaluated in this ERA have analyses for 15, 16, 17, or all 34 PAH analytes. Linear interpolation (i.e., using a line between the two values specified by EPA as the basis

of estimating intervening values) was used in this assessment to estimate the UFs for samples with fewer than 34 PAHs analyzed. The resulting UF values were 7.43, 6.93, and 6.42 for k = 15, 16, and 17, respectively.

Calculations of ΣESBTU values using the one-carbon model are shown in Attachment G-A.

Two-Carbon Model

The two-carbon model approach (EPA, 2012) is based on estimating the dissolved concentration of each PAH in the interstitial water from its bulk sediment concentration using Equation (5):

$$C_{D,i} = \frac{C_{S,i}}{f_{NSOC} \cdot K_{OC} + f_{BC} \cdot K_{BC} \cdot C_{D,i}^{(n-1)}} \qquad \text{Equation (5)}$$

where:

CD,i = Concentration of dissolved PAH i in the interstitial water (in micrograms per liter [µg/L])

CS,i = Concentration of PAH i in bulk sediment (in micrograms per kilogram [µg/kg])

fNSOC = Fraction of sediment consisting of natural OC (unitless)

KOC = OC-water partition coefficient (unitless)

fBC = Fraction of sediment consisting of BC (unitless)

KBC = BC-water partition coefficient (unitless)

n = Freundlich exponent for nonlinear sorption behavior.

Values of KOC and KBC are taken from EPA (2012) and are listed in Table G-1. The value of n (0.6) is also from EPA (2012). The value of fNSOC is calculated as the difference between fOC and fBC. Because CD,i occurs on both sides of the equation, its value was derived through an iterative process in Microsoft® Excel by allowing circular calculations with a maximum of 300 iterations and a maximum difference of 1 x 10-6.

The PAH-specific TU (referred to in the EPA guidance as the interstitial water TU [IWTU]) is calculated as:

$$IWTU_i = \frac{C_{D,i}}{FCV_{D,i}} \qquad \text{Equation (6)}$$

Based on the additivity of TUs, the sum of the IWTUs over the 34 PAHs is:

$$\Sigma IWTU_{34} = \sum_{i=1}^{34} IWTU_i \qquad \text{Equation (7)}$$

Because all samples for which BC was included as an analyte also included all 34 PAHs, the use of UFs was not necessary for the ΣIWTU calculations.

Calculations of ΣIWTU values using the two-carbon model are shown in Attachment G-B.

3.1.2 Freely Dissolved PAH

For cases where porewater was sampled directly, the concentration of freely dissolved PAH in the porewater was estimated based on the following equation from EPA (2012):

$$C_{FD,i} = \frac{C_{PW,i}}{f_{DOC} \cdot K_{DOC} + 1} \qquad \text{Equation (8)}$$

where:

CFD,i = Concentration of freely dissolved PAH i in the porewater (in µg/L)

CPW,i = Concentration of PAH i measured in the porewater sample (in µg/L)

FDOC = Fraction of DOC in the porewater (unitless)

KDOC = Dissolved OC-water partition coefficient (unitless)

Values of KDOC were obtained from EPA (2012) and are listed in Table G-1. The PAH-specific IWTU is calculated as:

$$IWTU_i = \frac{C_{FD,i}}{FCV_{D,i}} \qquad \text{Equation (9)}$$

The sum of the IWTUs over the 34 PAHs is:

$$\Sigma IWTU_{34} = \sum_{i=1}^{34} IWTU_i \qquad \text{Equation (10)}$$

Again, because all samples for which porewater was collected also included all 34 PAHs, the use of UFs was not necessary for the ΣIWTU calculations for porewater.

Calculations of ΣIWTU values using directly measured concentrations of freely dissolved PAHs are shown in Attachment G-C.

The same method was used to calculate TUs for surface water (to obtain a surface water TU [SWTU]) and groundwater (to obtain a groundwater TU [GWTU]). Groundwater was not analyzed for the full 34 PAHs and there currently is no UF appropriate for groundwater use; therefore, GWTUs were calculated using either the 14 or 16 parent PAHs and may be biased low as a result.

3.2 DIRECT CONCENTRATION SCREENING

The potential for risk to fish was evaluated based on the concentrations of freely dissolved PAHs (CFD,i) calculated from the measured porewater concentrations as described in Section 3.1.2. Because fish are mobile, EPCs were used to represent each of the two exposure areas (Milton Creek and Scappoose Bay). When a sufficient number of data points (10 or more) were available and a sufficient number of detections were made among those data points (three or more), the ProUCL software package, Version 5.0 (EPA, 2013), was used to estimate the 90% upper confidence limit (UCL) of the mean, which was used as the EPC for that PAH analyte. When insufficient data points were available (as was the case for Milton Creek) or insufficient detections made for statistical analysis of the dataset, the maximum detected concentration was used as the EPC.

The SLVs used to evaluate these EPCs for potential risk to fish are presented in Tables G-2a-c. When possible, fish-specific SLVs were used; however, several of the SLVs are based on Tier II secondary chronic values (SCVs) according to Suter and Tsao (1996) and EPA regional screening levels for surface water. As noted in Table G-2a, some correspond to DEQ Level II SLVs for surface water.

The DEQ guidance for bioaccumulative chemicals in sediment (DEQ, 2007) provides sediment-based SLVs for evaluating potential risk to fish from the bioaccumulation of selected chemicals in tissues. These include two PAHs: fluoranthene (SLV = 37 mg/kg) and pyrene (SLV = 1.9 mg/kg). However, this guidance was released after the completion of the previous ERAs for the Site; therefore, comparisons of sediment PAH concentrations to these screening levels have not previously been performed. To fill this gap, EPCs for these two PAHs were calculated as the 90% UCLs of the sediment data (0- to 12-inch depth interval) for each of the two exposure areas. For completeness, these UCLs included both the recent (2011 and 2012) sediment data as well as the historical (1996 to 2005) data.

Additional comparisons of concentrations to SLVs are described in the following section.

4.0 LINES OF EVIDENCE

This Updated Supplemental ERA utilized multiple LOEs to evaluate risk. The first, and primary, LOE involved the presence or absence of a surface sheen. Additional LOEs included comparisons of environmental concentrations (of various environmental media) to SLVs based on toxic responses in aquatic organisms (e.g. benthic organisms and fish) to individual chemical constituents. The various LOEs are discussed in detail in the following sections.

4.1 PRESENCE/ABSENCE OF SHEEN

The presence or absence of NAPL or a sheen was used as a primary LOE in evaluating risk to aquatic receptors. The presence of NAPL or a sheen is a violation of narrative water quality criteria and is considered an unacceptable risk to ecological receptors due to the potential for fouling of membranes and gills or ingestion of accumulated product on feathers or fur during preening.

Multiple field events (2010, 2011, 2012, 2013, 2017, and 2018) were conducted to properly delineate the boundary of NAPL/sheen, and the results are shown on Figure G-2.

4.2 SEDIMENT TOXICITY

4.2.1 Total PAHs

Bulk sediment concentrations of total PAHs were compared with the threshold effects concentration (TEC) and probable effects concentration (PEC) to evaluate risk to direct contact with sediment to benthic organisms (Macdonald et al., 2000). TECs and PECs were developed from a number of published sediment quality guidelines (SQGs). TECs reflect lower limits of sediment toxicity where toxicity is not predicted to occur; PECs reflect upper limits, above which adverse effects are predicted to have a high probability of occurring. Evaluating bulk sediment concentrations against both TECs and PECs provides a bracket for expected toxicity and provides a secondary LOE in assessing risk of sediment toxicity to the benthos. Concentrations of total PAHs and a comparison to PEC and TEC values are presented in Table G-10.

4.2.2 Total Petroleum Hydrocarbons

No PECs/TECs exist for TPH, so TPH fractions were screened against criteria developed as part of the Portland Harbor ERA, with values updated to correct a calculation error. Use of Portland Harbor SLVs are considered a secondary LOE in risk evaluation. Concentrations and SLVs are presented in Table G-10.

4.3 POREWATER TOXICITY

4.3.1 PAHs

Concentrations of total PAHs in porewater samples were converted into total TU values (i.e., the sum of interstitial water toxic unit, ΣIWTU) to evaluate the potential for narcosis risk to benthic invertebrates. Each individual PAH congener concentration was divided by its unique final chronic value (based on narcotic effects to benthic organisms) to calculate the TU. The sum of all TUs for a sample was calculated as the ΣIWTU. ΣIWTU values greater than 1 indicate potential risk to benthic organisms. ΣIWTU values are presented in Table G-6a and Table G-11a.

4.3.2 VPH

Concentrations of VPH in 2017 porewater samples were used as a secondary LOE for determining risk at the Site. Concentrations were compared to Portland Harbor ERA SLV and presented in Table G-11b.

4.3.3 Oxygenated PAHs

Oxygenated PAHs (OPAHs) were measured in 2017 porewater samples to provide a secondary LOE for determining risk at the Site. Due to their greater polarity, OPAHs have the potential for increased dissolved concentrations, which can lead to increased metabolite concentrations. No

SLVs exist for OPAHs, so there was no quantitative assessment of risk based on OPAH concentrations. Concentrations of OPAHs in surface water samples are presented in Table G-12a.

4.4 SURFACE WATER TOXICITY

4.4.1 PAHs

As with porewater, concentrations of PAHs in surface water samples were converted to TUs. The sum of all TUs for a given sample were calculated as the ΣSWTU (sum of surface water toxic units). A ΣSWTU greater than 1 indicates the potential risk to benthic organisms, and these calculations were used as a primary LOE in risk evaluation. ΣSWTUs are presented in Table G-6b and G-12a.

Concentrations of C_{free} PAHs in surface water were also compared to published SLVs for individual PAHs where available and presented in Table G-12b.

4.4.2 Oxygenated PAHs

As with porewater, OPAHs were measured at a number of samples to further define risk from PAHs. Concentrations of OPAHs in surface water were not screened against any SLVs, as no risk-based screening criteria exists. Total OPAH concentrations are presented in Table G-12a.

4.5 GROUNDWATER TOXICITY

Groundwater was evaluated to determine if upland dissolved phase constituents have the potential to adversely affect Scappoose Bay. Dissolved phase concentrations in groundwater were evaluated based on the same approach used for surface water and porewater. This approach was completed for nearshore groundwater wells and did not account for any potential change in concentrations during migration to Scappoose Bay.

4.5.1 PAHs

As with porewater and surface water, concentrations of PAHs in groundwater were converted to TUs. The sum of all TUs in a given sample were calculated as the ΣGWTU (sum of groundwater TUs). A ΣGWTU greater than 1 indicates the potential risk to benthic organisms. As mentioned above, benthic organisms are not directly exposed to groundwater; thus, this analysis is strictly used to examine the potential for risk to benthic organisms following upland groundwater migration to Scappoose Bay. PAH concentrations and ΣGWTUs are presented in Table G-13.

Concentrations of individual PAHs in groundwater were compared to DEQ Level II SLVs (DEQ, 2001) to evaluate potential risk after upland groundwater migration to Scappoose Bay. Concentrations and associated SLVs are presented in Table G-13.

4.5.2 TPH

Concentrations of diesel- and gasoline-range hydrocarbons were compared to Freshwater Ecotox Aquatic Habitat Goal Levels from San Francisco Bay Regional Water Quality Control Board (SFBRWQCB, 2019). As described above, this approach was used as a conservative analysis of

potential risk to Scappoose Bay from upland groundwater migration. Concentrations and comparisons to SLVs are presented in Table G-13.

5.0 SUMMARY OF PREVIOUS ERA ACTIVITIES (2003 – 2006)

In 2003, a Level II (screening) ERA was performed by the Bridgewater Group and Hart Crowser (Bridgewater, 2003) based on Phase I and Phase II RI data collected by GeoEngineers (2000). The Phase I investigation was conducted between July 1996 and November 1997 to characterize constituents of concern in soil, sediment, surface water, and groundwater at the Site. The Phase II investigation (conducted between September and November 1998) involved collection of additional soil, surface water, and groundwater data as well as investigations of the Basalt Bedrock and seep water. The Level II ERA was conducted in accordance with DEQ (2001) guidance and involved the comparison of maximum measured Site concentrations to DEQ-established SLVs. Chemical constituents for which the maximum detected concentration exceeded the SLV or which were detected but lacked an SLV for the medium in question were identified as chemicals of potential ecological concern (CPECs). (Metals and dioxins/furans were identified as CPECs for Scappoose Bay groundwater with NAPL seeps due only to the absence of analytical data for these analytes in that medium.)

The Level II ERA found no CPECs associated with soils at the Site. Therefore, ecological soil pathways were eliminated from further consideration. No CPECs were identified for surface water and seeps along Milton Creek; however, several PAHs (including 2-methylnaphthalene) were identified as CPECs from Scappoose Bay surface water (8 PAHs) and seep (15 PAHs) samples, either due to detected concentrations exceeding SLVs or to the lack of SLVs for detected PAH compounds. For sediments from Scappoose Bay, 16 PAHs were identified as CPECs. These were:

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Benzo(g,h,i)perylene
- Chrysene
- Dibenz(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Naphthalene
- Phenanthrene
- Pyrene

Benzo(a)pyrene was also found to exceed its SLV for bioaccumulation of 0.1 mg/kg. In addition to these 16 PAHs, arsenic was identified as a CPEC pending further analysis of its regional background.

5.1 ADDITIONAL SEDIMENT SAMPLING

Between 2003 and 2005, three rounds of additional sediment sampling were conducted to further assess the potential for risk to aquatic organisms (benthic invertebrates and fish) and piscivorous mammals and birds (Bridgewater, 2006). During Phase IA sampling (December 2003), near-surface sediments were collected from 22 offshore locations at the Site and five locations representing regional background. These samples were analyzed for PAHs, arsenic, TOC, and grain size distribution. The Phase IB and Phase II sampling (June 2004) involved collection of near-surface sediment from 27 offshore locations (including 5 from Milton Creek). Eight of these samples were used for bioassay tests. Three additional samples were collected upstream on the Columbia River to serve as reference sediments for the bioassay tests. PAHs, TOC, total sulfides, ammonia, and grain size distribution were measured in all of these samples. The Phase III sampling (April 2005) involved collection of an additional 17 offshore sediment samples, of which 6 were used for bioassay, and 2 were used as reference sediment samples. Analytes measured in these samples were the same as those for the Phase Ib and Phase II samples. It should be noted that only one of the reference sediments was used in each of the two rounds of bioassay tests.

5.2 BIOASSAY ANALYSIS

The bioassay tests were performed by Kennedy/Jenks Consultants. On each of the 14 Site samples and two reference samples submitted, the following bioassay tests were conducted:

- Amphipod (*Hyallela azteca*) 10-day survival
- Midge larva (*Chironomus tentans*) 10-day survival
- Midge larva (*C. tentans*) 10-day growth

A negative control group was also evaluated for each round of bioassays. The results were interpreted based on two criteria levels: "one-hit" criteria and "two-hit" criteria. The one-hit criteria consisted of predetermined levels of difference between the test and reference group results. These were:

- Amphipod survival—test group mortality is 15% greater than that of the reference group and is statistically different from the reference group ($\alpha = 0.05$).
- Midge larva survival—test group mortality is 20% greater than that of the reference group and is statistically different from the reference group ($\alpha = 0.05$).
- Midge larva growth—test group growth (as mean biomass) is less than 60% that of the reference group and is statistically different from the reference group ($\alpha = 0.05$).

If any one of the above criteria is true, the test sediment is interpreted as potentially toxic. For the two-hit criteria, if any two of the responses in the test group are less than the predetermined margins of difference shown above for the one-hit criteria, but are still found to be significantly different from the reference group ($\alpha = 0.05$), the test sediment is interpreted as potentially toxic.

The results of the bioassay tests (Bridgewater, 2006) showed that none of the 14 sediment samples from the Site resulted in a failure based on the one-hit or two-hit criteria described above.

5.3 2006 ERA SUMMARY REPORT

In 2006, Bridgewater Group, Inc., and Hart/Crowser prepared an ERA report that addressed the following issues concerning the potential for ecological risk at the Site:

1. Potential risk from Site-related arsenic in sediment,
2. Potential risk to piscivorous birds and mammals from exposure to benzo(a)pyrene and dioxins/furans due to bioaccumulation in the food chain, and
3. Potential risk to benthic invertebrates and fish (resident and anadromous) from direct contact to sediments.

The report concluded that the arsenic measured in the sediments at the Site were not Site related because arsenic concentrations were not correlated to PAH concentrations and upstream concentrations of arsenic were higher than those at the Site. Further, based on food-chain modeling, neither benzo(a)pyrene nor dioxins/furans posed a significant bioaccumulation risk to mammalian and avian predators foraging on the Site.

The evaluation of potential risk to benthic invertebrates and fish relied heavily on the results of the bioassay tests, which failed to show a toxic response in any tested sediments despite the fact that the sediments were selected for testing based on high total PAH as a selection criterion. Based on this result, it was concluded that the PAHs in the sediments (and overlying surface water) did not pose a significant risk to benthic invertebrates in direct contact with these sediments and that these benthic invertebrates served as conservative surrogate receptors for resident and anadromous fish (the latter having lower exposure than the former due to their low ingestion rates while migrating and lower residence time at the Site). Therefore, the 2006 ERA report (Bridgewater, 2006) concluded that the Site does not pose a risk to terrestrial or aquatic receptors.

5.4 NARCOSIS EVALUATION OF HISTORICAL DATA

Although the mechanism of narcotic toxicity in aquatic organisms is briefly discussed in the Bridgewater (2006) ERA report, the method described by EPA (2003) (based on the one-carbon estimation model) had only recently been published at that time of that analysis and was not applied to these data. To fill this gap in the complete evaluation of the historical dataset, the one-carbon ESBTU method (Section 3.1.1) was applied to the historical (1996 – 2005) data collected from the upper 1 foot of sediment at locations outside of the currently delineated NAPL area (Attachment G-A).

The analysis included data from the following 63 samples:

- 3 from October/November 1996 (Scappoose Bay),
- 17 from December 2003 (Scappoose Bay),
- 22 from June 2004 (Scappoose Bay),
- 5 from June 2004 (Milton Creek), and
- 16 (including one duplicate) from April 2005 (Scappoose Bay).

None of these samples was analyzed for the full suite of 34 PAH analytes. The samples from 2003–2005 were tested for 17 PAH analytes each, and the three samples from 1996 were tested for only 15. Therefore, UFs were applied to adjust the ΣESBTU for all of these samples. The UFs were linearly interpolated from UFs presented by EPA (2003) for datasets containing either 13 or 23 PAH measurements. For 90% confidence that the UF-adjusted ΣESBTU will not underestimate the true ΣESBTU, the UF for 13 PAHs is 8.45 and that for 23 PAHs is 3.37. Based on interpolation, the UF was estimated at 7.43 for 15 PAHs and 6.42 for 17 PAHs. Non-detections were represented in the ΣESBTU calculations by the full MDL value.

The ΣESBTU values for the historical data are presented in Table G-3. Values greater than 1 are interpreted as having a potential for risk to benthic invertebrates from narcosis (pending uncertainty analysis). Of the five samples from Milton Creek, only one (SD-MC-A) showed an ΣESBTU value greater than 1 (ΣESBTU = 3.5). This sample was collected near a point where a visible sheen on the sediment had been observed. Of the 59 samples from Scappoose Bay, nearly half (28 samples) showed ΣESBTU values greater than 1, with a maximum of 22 at SD-131 (located in the small embayment west of the former hog fuel loading hopper). Only one other sample (SD-108, also west of the hopper, but farther from the shore than SD-131) had a ΣESBTU value greater than 10 (ΣESBTU = 13.6).

Thirteen of the fourteen samples submitted for bioassay are part of the non-NAPL area dataset. The ΣESBTU values for these samples ranged from 0.41 to the maximum ΣESBTU of 22. All but three showed ΣESBTU greater than 1. These included the high-concentration sample from Milton Creek (SD-MC-A).

Despite showing calculated ΣESBTU greater than 1, these samples did not show toxicity in the bioassay tests. These apparently contradictory results call into question the capacity of the ΣESBTU method (based on the one-carbon model and adjusted for 17 PAHs using a conservative UF) to predict the actual risk to benthic organisms. Uncertainties associated with both of these results are discussed in Section 7.2. As discussed in Section 7.2, this discrepancy between predicted toxicity based on equilibrium partitioning and the narcosis model is consistent with the recent literature on benthic toxicity of PAHs.

6.0 2010 - 2012 GROUNDWATER DATA

As described in Section 4.5, historic (2010 – 2012) groundwater data were evaluated per DEQ's request to determine potential risks to aquatic receptors from dissolved phase constituents after discharge of groundwater to Scappoose Bay. Data are presented in Table G-13 and on Figures G-5, G-6, and G-7.

PAHs

Concentrations of PAHs in the upland nearshore groundwater were screened against DEQ Level II SLVs, as shown in Table G-13. Monitoring wells MW-5, MW-7, and MW-18 had no exceedances; all other monitoring wells had one or more exceedance. Exceedances in one or more sample were found for all PAHs with a DEQ Level II SLV (acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, fluoranthene, fluorene, naphthalene, and phenanthrene). Concentrations of naphthalene in groundwater are shown on Figure G-5.

ΣGWTUs were calculated for groundwater samples, as described in Section 3.0. Nearshore monitoring wells with ΣGWTUs greater than 1 in one or more sample included MW-3A, MW-3B, MW-6A, MW-10, MW-19, and MW-25. ΣGWTUs are shown spatially on Figure G-5.

As mentioned in Section 4.5, this approach of analyzing potential risk to benthic organisms from groundwater is highly conservative as there is no exposure at the source and it does not account for any changes in concentration as water migrates from upland to Scappoose Bay.

TPH

Concentrations of gasoline- and diesel-range hydrocarbons in upland groundwater samples were compared to Freshwater Ecotox Aquatic Habitat Goal Levels (HGLs), as shown in Table G-13 and on Figure G-6. There were exceedances of diesel-range hydrocarbon HGLs in one or more groundwater sample from nearshore monitoring wells MW-3A, MW-3B, MW-6A, MW-10, MW-19, and MW-25. There were exceedances of gasoline-range hydrocarbon HGLs in one or more sample from nearshore monitoring wells MW-3A, MW-3B, and MW-6A; all other monitoring wells had no exceedances detected in samples. No HGLs exist for oil-range hydrocarbons.

7.0 2011 SEDIMENT SAMPLING DATA

In 2011, AMEC collected approximately 120 sediment samples from Scappoose Bay and Milton Creek to further characterize the nature and extent of NAPL and related PAHs in the offshore areas of the Site. The depth of these samples extended as far as 30 feet below sediment surface (BSS); however, for the purposes of this ERA, only the top 1 foot of sediment is considered to be biologically active. Of the samples collected in 2011, 36 were from the upper 1 foot of sediment: 34 from Scappoose Bay (one as duplicate) and two from Milton Creek. Five of the Scappoose Bay samples (including the duplicate) were field screened for total PAHs but were not further analyzed. The remaining 31 samples were submitted for laboratory analysis of PAHs and TOC. Twenty of the

samples were analyzed for 16 specific PAHs and 11 were analyzed for the full suite of 34 PAH analytes.

Of the 31 surface sediment samples analyzed, 20 were from locations outside of the currently delineated NAPL areas in Scappoose Bay and Milton Creek and are, therefore, included in the evaluation of potential ecological risk on the non-NAPL areas. Although the analyses of these samples included TOC, BC was not evaluated in these samples and porewater was not specifically sampled or analyzed. Therefore, the evaluation of potential narcosis toxicity to benthic invertebrates is limited to the use of ΣESBTU based on the one-carbon model of PAH solubility (see Section 3.1.1). Further, only five of these 20 samples (one from Milton Creek and four from Scappoose Bay) were analyzed for the full suite of 34 PAH analytes. For this reason, a UF of 6.93 (representing 90% confidence) was applied to the ΣESBTU values for samples analyzed for only 16 PAHs (this UF is interpolated from UFs presented in EPA [2003], as described in Section 3.1.1). Non-detections were represented in the ΣESBTU calculations by one-half the MDL value.

Calculation of the ΣESBTU values for the (July) 2011 sediment data are shown in Attachment G-A. The resulting ΣESBTU values are listed in Table G-4.

7.1 MILTON CREEK

As shown in Table G-4, neither of the two surface sediment samples from Milton Creek (from locations MC-03 and MC-04) resulted in ΣESBTU values greater than 1. MC-03 (ΣESBTU = 0.23) was based on data for all 34 PAH analytes and MC-04 (ΣESBTU = 0.82) was based on data for 16 PAHs with the uncertainty factor of 6.93 applied. Although both of these locations are well below the delineated NAPL seep area, MC-03 was collected near a point where a visible sheen on the sediment had been observed and near the 2004 sampling location SD-MC-A, which showed a ΣESBTU value of 3.5.

7.2 SCAPPOOSE BAY

Twelve of the 18 sediment samples from Scappoose Bay showed ΣESBTU values greater than 1 (Table G-4). The maximum ΣESBTU was 39 from SB-27, located in the small embayment west of the former hog fuel loading hopper; however, this is an adjusted value based on 16 PAHs. Of the four samples analyzed for the full suite of 34 PAH analytes (no UF applied), the maximum ΣESBTU was 11.1 for SB-28, which is also located in the small embayment.

8.0 2012 SEDIMENT AND POREWATER DATA

In 2012, AMEC conducted two rounds of sampling in the offshore environment of the Site: the first in July to represent high-water conditions, and the second in October to represent low-water conditions. These sampling efforts were expanded and enhanced over previous efforts (as described in the previous sections). First, porewater samples were extracted from the sediment through centrifugation and analyzed separately from the sediment. Second, all samples (both porewater and sediment) were analyzed for the full suite of 34 PAH analytes. Third, BC was

analyzed in the sediment samples along with TOC to allow application of the two-carbon model to estimate the dissolved fraction of PAHs. And finally, DOC was measured in the porewater samples to allow estimation of freely dissolved PAH in the interstitial water. This enhanced dataset provides a basis for a more accurate, state-of-the-art evaluation of potential risk to both benthic invertebrates and fish than was previously possible with the previous datasets.

The evaluation of risk to invertebrates and fish described in this section is based on the following:

1. Risk to benthic invertebrates from narcosis based on ΣIWTU determined by estimating dissolved-fraction PAH concentrations from measured PAH concentrations in sediments based on the two-carbon model (incorporating BC measurements; Section 3.1.1);
2. Risk to benthic invertebrates from narcosis based on ΣIWTU determined by estimating freely dissolved PAH concentrations in porewater samples using measured PAH concentrations in porewater based on the method described in Section 3.1.2; and
3. Risk to fish from direct contact with interstitial water based on the comparison of PAH concentrations in interstitial water throughout the exposure area to PAH-specific screening levels for fish as described in Section 3.2.

The data and calculations are presented in Attachments G-B (sediment) and G-C (porewater). Results of the calculations are summarized in Tables G-5 through G-7. The results of the evaluations for the two exposure areas (Milton Creek and Scappoose Bay) are described in the following sections.

8.1 MILTON CREEK EXPOSURE AREA

This risk assessment includes data for 2012 sampling in the Milton Creek exposure area at three locations: PWS-17, PWS-27, and PWS-30. PWS-17 is located immediately upstream of the reach delineated along the creek's southern bank, where NAPL seeps have been observed. PWS-30 is located immediately downstream of this reach. Each of these locations was sampled for both sediment and porewater during the low-water period (October) of 2012. PWS-27 is located near the mouth of Milton Creek, where it discharges into Scappoose Bay. This location was sampled twice during 2012, once during the high-water period (July), and again during the low-water period (October). Both of these sampling events included sediment and porewater.

8.1.1 Sediment

The two-carbon model was used to estimate dissolved PAH concentrations in the porewater of sediments from Milton Creek. These estimates were used to calculate ΣIWTU values (Table G-5) to evaluate the potential for narcosis risk to benthic invertebrates. Using ½ the detection limit to calculate ΣIWTU values, all were less than 1, with a maximum of 0.017 at PWS-17.

8.1.2 Porewater

ΣIWTUs were calculated for each of the four porewater samples collected from Milton Creek (Table G-6a; Figure G-7). Using 1/2 the detection limit to calculate ΣIWTU values, all were less than 1, with a maximum of 0.34 at PWS-17. Using the full detection limit to replace non-detects when calculating ΣIWTU values, all samples were greater than 1, with a maximum of 1.53 from sample PWS-27_8-11_PW. This sample had the lowest ΣIWTU value (0.077) when calculating using 1/2 the detection limit for non-detects, indicating the high degree of uncertainty that exists due to elevated detection limits.

Because the porewater dataset for the Milton Creek exposure area is limited to four samples, insufficient data are available to calculate an area-wide EPC based on a 90% UCL. Therefore, for the purposes of evaluating the potential risk to fish from direct exposure to interstitial water, the maximum detected concentration (dissolved fraction) among the four samples was used to represent area-wide exposure. These maximum concentrations were compared to the surface water screening values shown in Table G-2. No detected concentrations of PAHs from Milton Creek porewater exceeded their respective screening values for fish toxicity (Table G-7).

Twenty-six of 36 PAH analytes (1- and 2-methylnaphthalene being included as separate analytes) were not detected in any of the four porewater samples. In most cases where an SLV was available, the maximum MDL (converted to dissolved fraction concentration) did not exceed the SLV. However, in the case for benzo(a)pyrene, the maximum MDL (0.024 µg/L) was greater than the SLV of 0.014 µg/L. Although this SLV is derived directly from the Oregon Level II screening values (DEQ, 2001), it was based on the Tier II SCV presented in Suter and Tsao (1996). However, that document also states that the lowest 20% effective concentration (EC20) for fish is greater than 2.99 µg/L. Therefore, because the maximum MDL for benzo(a)pyrene is less than two-times the SLV value and more than two-orders of magnitude less than the reported EC20 for fish, it can be concluded that the potential for risk to fish from exposure to benzo(a)pyrene in the interstitial water is negligible.

8.2 SCAPPOOSE BAY EXPOSURE AREA

The 2012 data from Scappoose Bay used in this risk assessment include 20 locations within the non-NAPL area. Of these, 15 were sampled in July during the high-water period and 19 were sampled in October during the low-water period. All locations are represented by at least one sediment sample and all except one (PWS-22) by at least one porewater sample. Of the 15 locations sampled in July, sediments were collected from the 8- to 9- or 11-inch depth interval at all locations, and additional shallow sediment samples (1- to 4-inch interval) were collected at PWS-4 and PWS-13. A replicate sample was collected at PWS-16 (designated PWS-16B), and a duplicate sample was collected at PWS-12. Porewater samples were collected with all of these sediment samples with the exceptions of PWS-22 and the shallow sediment sample at PWS-4. Thus, the total number of sediment samples from the July 2012 sampling event is 19 and the number of porewater samples is 17.

Of the 19 locations sampled in October, sediments were collected from the 8- to 10- or 11-inch depth interval at all locations except PWS-25, where the sediment sample was from the 4- to 8-inch

interval. No additional shallow sediment samples were collected. Duplicate samples were collected at PWS-7, PWS-13, and PWS-26 with a triplicate sample collected at PWS-13. Porewater samples were collected with all of these sediment samples with the exceptions of the duplicate and triplicate samples from PWS-13. Thus, the total number of sediment samples from the October 2012 sampling event is 23 and the number of porewater samples is 21.

8.2.1 Sediment

The two-carbon model was used to estimate dissolved PAH concentrations in the porewater for the 42 sediment samples from Scappoose Bay. These estimates were used to calculate ΣIWTU values (Table G-5) to evaluate the potential for narcosis risk to benthic invertebrates. Of the 19 samples collected in July, five showed ΣIWTU values greater than 1: PWS-03 (ΣIWTU = 3.5), PWS-05 (ΣIWTU = 1.1), PWS-06 (ΣIWTU = 4.1), PWS-07 (ΣIWTU = 1.3), and PWS-16 (ΣIWTU = 1.5). Of the 23 samples collected the following October, only one (one of the triplicate samples collected at PWS-13) showed a ΣIWTU value greater than 1 (ΣIWTU = 1.1). The other two sediment samples at that location resulted in ΣIWTU values of 0.97 and 0.6, indicating that the mean is within an acceptable level of potential risk. It should also be noted that none of the five locations where ΣIWTU values were found to exceed 1 in the July (high-water) samples exhibited similar levels in the October (low-water) samples. All showed ΣIWTU values less than 1, including the two duplicate samples collected at PWS-07.

8.2.2 Porewater

The ΣIWTU values calculated for each of the 38 porewater samples collected from Scappoose Bay are presented in Table G-6a and shown on Figure G-8. When using the full detection limit to replace non-detect values, all samples showed a ΣIWTU greater than 1. Of the 17 samples collected in July, all ΣIWTU values were less than 1 when replacing non-detect values with 1/2 the detection limit. Of the 21 porewater samples collected in October, two ΣIWTU values exceeded 1 using 1/2 the detection limit. These were from PWS-07 (ΣIWTU = 1.4) and PWS-13 (ΣIWTU = 2.8). PWS-07 is located in the embayment west of the former hog fuel loading hopper structure and is near the boundary of the inferred NAPL extent (Figure G-2). A duplicate porewater sample was collected at this location which showed a ΣIWTU value of 0.5, indicating that the level of potential risk to benthic invertebrates from narcosis (based on the average of these two samples) is acceptable.

The ΣIWTU value from PWS-13 reflects the relatively high ΣIWTU value (1.1) found for this location in the sediment evaluation. Because this location is approximately 400 feet south of the inferred NAPL source with no other intervening locations indicating transport from the shoreline across that distance, these results appear anomalous. Further, no PAHs were detected in the two porewater samples (shallow and deep) collected from this location in July. It is also notable that the PAHs detected in the October sample do not correspond with the typical “fingerprint” of PAHs from near the NAPL areas of the Site. The PWS-13 porewater sample shows high concentrations of C2-, C3-, and C4-alkylated naphthalenes, which were rarely detected in the other samples. A similar pattern is seen in the three sediment samples collected from this location in October, but this pattern is not reflected in the two sediment samples (shallow and deep) collected in July.

Sufficient detections were made in the porewater samples from Scappoose Bay to allow the estimation of 90% UCLs for 14 of the 36 PAH analytes using ProUCL Version 5.0 (EPA, 2013). Model output is presented in Attachment G-D. Only six analytes were detected in one or two samples, which was considered insufficient for statistical analysis, and 16 analytes were not detected in any of the porewater samples. The results of the statistical analysis are presented in Table G-8. The potential for risk to fish in the Scappoose Bay exposure area was evaluated through the comparison of either 90% UCLs (when available) or maximum detected concentrations (when insufficient detections were available to estimate the 90% UCL) to the SLVs listed in Table G-2. As shown in Table G-8, all of these EPC values were less than their corresponding SLVs.

In most of the 16 cases where the analyte was not detected and an SLV was available, the maximum MDL (converted to dissolved fraction concentration) did not exceed the SLV. However, in the case for benzo(a)pyrene, the maximum MDL (0.046 µg/L) was greater than the SLV of 0.014 µg/L. As previously described, this SLV is based on the Tier II SCV presented in Suter and Tsao (1996), which also presents the EC20 for fish as being greater than 2.99 µg/L. Therefore, because the maximum MDL for benzo(a)pyrene is less than four times the SLV value and is much less (by a factor of 65) than the reported EC20 for fish, it can be concluded that the potential for risk to fish from exposure to benzo(a)pyrene in the interstitial water of Scappoose Bay is negligible.

8.3 BIOACCUMULATION RISK TO FISH

The 90% UCLs of fluoranthene and pyrene in sediment (Table G-9) were compared to sediment benchmarks for bioaccumulation (DEQ, 2007). For both exposure areas (Milton Creek and Scappoose Bay), the 90% UCLs for these two PAHs were less than their respective SLVs.

9.0 2017 SEDIMENT, POREWATER, AND SURFACE WATER DATA

In September 2017, Cascadia conducted sampling of sediment, porewater, and surface water to expand upon and improve previous investigations. As with the 2012 sampling event, samples were analyzed for the full suite (34) PAHs as well as BC. Select porewater and bulk sediment samples were also analyzed for VPH and/or EPH and select VOCs. Porewater and surface water samples were also analyzed for OPAHs.

In contrast with the 2012 event, *in-situ* sampling methodology was utilized to improve the prediction of risks from porewater exposure. The direct measurement of dissolved water concentrations integrates site-specific environmental factors, including diffusion, advection, bioturbation, resuspension, and partitioning (particle- and colloid-bound).

9.1 MILTON CREEK EXPOSURE AREA

This risk assessment includes data for 2017 sampling from one sample location within the Milton Creek exposure area: PWS-090617-2. PWS-090617-2 is located near the mouth of Milton Creek, where it discharges into Scappoose Bay.

9.1.1 Sediment

Total PAHs

Total PAHs were compared to Threshold Effects Concentrations (TECs) and Probable Effects Concentrations (PECs), as shown in Table G-10 (MacDonald, Ingersoll, and Berger, 2000). Comparing concentrations to TECs and PECs allows for an examination of toxicity via the same mode of action. The only Milton Creek sample collected, PWS-090617-2, had a total PAH concentration between the TEC and PEC, indicating the possibility of toxicity to occur. The spatial distribution of PAHs in surface sediment are shown on Figure G-10.

Total Petroleum Hydrocarbons

There were no detections of VPH in the Milton Creek sample collected, PWS-090617-2. EPH was not analyzed in PWS-090617-2. No indications of risk were identified in Milton Creek from petroleum hydrocarbons, but uncertainty exists with the limited sampling efforts and high detection limits.

9.1.2 Porewater

PAHs

Sediment porewater was analyzed to determine PAH concentrations in the porewater of sediments from Milton Creek. These estimates were used to calculate ΣIWTU values (Table G-11a) to evaluate the potential for narcosis risk to benthic invertebrates. ΣIWTU values greater than 1 indicate potential risk to benthic organisms. Both the shallow and deep sample from Milton Creek (Shallow Porewater Site 2 and Deep Porewater Site 2, respectively) had ΣIWTU values greater than 1 (16.2 and 1.89, respectively). The distribution of ΣIWTUs is shown on Figure G-9.

It is important to note, that while most parent PAHs (and many of their perdeuterated analogs) are available as pure standards, few alkyl PAHs are available, so their response must be estimated rather than measured in many cases. The calibration and quantitation of the more highly alkylated PAHs is increasingly complicated by the fact that a single group can have multiple (even hundreds of C_3- and C_4-alkyl PAHs) alkylated isomers that are listed as a single PAH in the total 34 PAH list. Care must be taken to avoid including non-target compounds in the integration of a group of alkyl PAHs. For example, dibenzothiophene elutes at the end of the C_4-naphthalene cluster and frequently has a higher concentration than the total C_4-naphthalene group. Since both dibenzothiophene and C_4-naphthalenes have *m/z* 184 as their molecular ion, care must be taken not to include the peak area of dibenzothiophene in the C_4-naphthalene peak area. Similarly, the deuterated internal standard, fluorene-d10, elutes in the middle of the C_3-naphthalene cluster and has an approximately 15% ion at *m/z* 170, which is the same mass as monitored to determine the C_3-naphthalene compounds. This interfering peak from fluorene-d10 was substantially larger than the total alkyl C_3-naphthalene peaks, and therefore, care is needed to remove its peak area to avoid grossly overestimating the alkyl C_3-naphthalene concentrations (Hawthorne, et al., 2005). OSU FSES was asked to provide non-background corrected 34 PAHs. Given the above-mentioned concerns

with co-eluting non-target compounds, the background corrected 34 PAH data were used in the ecological risk assessment.

VPH and VOCs

VPH and select VOCs were measured using permeable diffusive bags to evaluate risk associated with TPH fractions. No samples had detections of any measured constituents. A comparison of VPH fraction detection limits to Portland Harbor ERA SLVs is found in Table G-11b.

Oxygenated PAHs

Total concentrations of OPAHs in the shallow and deep porewater sample collected from Milton Creek were 0.0102 and 0.0018 µg/L, respectively. No risk-based SLVs exist for OPAHs.

9.1.3 Surface Water

PAHs

Concentrations of PAHs in surface water were used to calculate ΣSWTU values (Table G-12a) to evaluate potential risk to benthic organisms. As with the porewater evaluation, a TU greater than 1 indicates potential risk to benthic organisms. The one sample analyzed for PAHs in Milton Creek had a ΣSWTU less than 1, indicating no predicted risk to benthic organisms.

For potential risk to fish in Milton Creek from direct exposure to dissolved PAHs, it was found that none of the surface water PAHs exceeded their corresponding SLVs, indicating that no unacceptable risk exists to fish for these cases. However, it should be noted that SLVs were found only for the 18 priority PAHs (including 1- and 2-methylnaphthalene) typically evaluated in environmental samples; therefore (with the exception of C_1–naphthalene, for which 1-methylnaphthalene was used as a surrogate), risk to fish could not be evaluated for the alkylated PAHs, benzo(e)pyrene, and perylene (the latter two, and six of the alkylated PAH analytes, were not detected in the porewater samples).

Oxygenated PAHs

The total concentration of OPAHs in the surface water sample collected from Milton Creek was 0.0001 µg/L. No risk-based SLVs exist for OPAHs.

9.2 SCAPPOOSE BAY EXPOSURE AREA

This risk assessment includes data for 2017 sampling from 15 sample locations within the Scappoose Bay exposure area.

9.2.1 Sediment

Total PAHs

Total PAHs were compared to TECs and PECs, as shown in Table G-9 (MacDonald, Ingersoll, and Berger, 2000). Comparing concentrations to TECs and PECs allows for an examination of toxicity via

the same mode of action. Two samples (PWS-090517-9 and PWS-090617-13) had concentrations of total PAHs greater than the PEC (22.8 mg/kg), indicating a higher probability of exhibiting toxic effects. One sample (PWS-090517-6) had a concentration of total PAHs below the TEC (1.7 mg/kg), indicating a low likelihood of exhibiting toxic effects. The remaining samples had total PAH concentrations greater than the TEC but less than the PEC, indicating the potential for toxic effects. The spatial distribution of PAHs in surface sediment are shown on Figure G-10.

Total Petroleum Hydrocarbons

TPH aliphatic and aromatic fractions were compared to sediment ecological criteria created for the Portland Harbor Baseline Ecological Risk Assessment, corrected for a solubility error and presented in Table G-10. There were no detections of VPH in the Scappoose Bay samples collected; however, the detection limits of the VPH analysis were elevated above criteria. All samples had concentrations of $C_{>16}$-C_{21} aromatics and $C_{>21}$-C_{34} aromatics greater than the Portland Harbor ERA SLVs of 0.6 and 19 mg/kg, respectively. Samples PWS-090517-10 and PWS-090617-13 exceeded Portland Harbor ERA SLVs for $C_{>10}$-C_{12} aromatics and $C_{>12}$-C_{16} aromatics. Sample PWS-090517-10 also exceeded the SLV for $C_{>12}$-C_{16} aromatics.

9.2.2 Porewater

Total PAHs

Sediment porewater was analyzed to determine PAH concentrations in the porewater of sediments from Scappoose Bay. These estimates were used to calculate ΣIWTU values (Table G-11) to evaluate the potential for narcosis risk to benthic invertebrates. ΣIWTU values greater than 1 indicate potential risk to benthic organisms. No shallow samples had ΣIWTU values greater than 1, indicating no apparent risk to benthic organisms in the biologically active zone. Five deep samples (PWS-1, PWS-5, PWS-11, PWS-14, and PWS-15) had ΣIWTU values greater than 1; however, the deep samples were collected below the biologically active zone where there is no current complete exposure pathway for benthic organisms. The distribution of ΣIWTUs is shown on Figure G-9.

The same uncertainties associated with inclusion of non-target compounds co-eluting (as described in Section 8.1.2) apply for Scappoose Bay PAH data.

VPH and VOCs

VPH and select VOCs were measured using passive diffusive bags (PBDs) to evaluate risk associated with TPH fractions. No samples had detections of any measured constituents, as shown in Table G-11b.

Oxygenated PAHs

Total concentrations of OPAHs in the porewater samples collected from Scappoose Bay ranged from 0.0 to 0.630 µg/L, as shown in Table G-11a. No risk-based SLVs exist for OPAHs.

9.2.3 Surface Water

PAHs

Concentrations of PAHs in surface water were used to calculate ΣSWTU values (Table G-12b) to evaluate potential risk to benthic organisms. As with the porewater evaluation, a TU greater than 1 indicates potential risk to benthic organisms. Samples that had a TU greater than 1 included those from PWS-09, PWS-10, PWS-12, and PWS-13 and ranged from 1.04 to 1.07. PAHs contributing to increased SWTUs are similar to those driving risk in porewater, including C-3 and C-4 naphthalenes, C-2 and C-3 fluorenes, and C-2, C-3 and C-4 phenanthracenes/anthracenes. The spatial distribution of ΣSWTUs is shown on Figure G-9.

For potential risk to fish in Scappoose Bay from direct exposure to dissolved PAHs, it was found that none of the surface water PAHs exceeded their corresponding SLVs, indicating that no unacceptable risk exists to fish for these cases. However, it should be noted that SLVs were found only for the 18 priority PAHs (including 1- and 2-methylnaphthalene) typically evaluated in environmental samples; therefore (with the exception of C_1–naphthalene, for which 1-methylnaphthalene was used as a surrogate), risk to fish could not be evaluated for the alkylated PAHs, benzo(e)pyrene, and perylene (the latter two, and six of the alkylated PAH analytes, were not detected in the porewater samples).

Oxygenated PAHs

Total concentrations of OPAHs in the surface water samples collected from Scappoose Bay ranged from 0.0008 to 0.438 µg/L, as shown in Table G-12a. No risk-based SLVs exist for OPAHs.

9.3 OTHER POREWATER AND SURFACE WATER TOXICITY INDICATORS: MILTON CREEK AND SCAPPOOSE BAY

Total of 63 C_{free} PAHs

The highest concentrations of the sum of the 63 freely dissolved PAHs were detected at porewater location PWS-090617-1 at 5 µg/L and PWS-090617-2 at 1.3 µg/L.

Hopanes and Cholestanes

The results of the analysis of hopanes and cholestanes are presented in Appendix B of the Phase 3 Offshore Data Gap Progress Report (Cascadia, 2018). The highest concentrations were found at surface water location PWS-090517-9, and porewater locations PWS-090517-14 and PWS-090617-15.

10.0 SUMMARY OF LINES OF EVIDENCE

This Updated Supplemental ERA presents several new LOEs for the evaluation of potential ecological risk from PAHs in sediment at the former Pope & Talbot wood-treating site. These LOEs

were made possible by additional sediment sampling conducted at the Site, which included the full suite of 34 PAH analytes, direct measurement of PAHs in porewater samples, and recent advances of knowledge and techniques in assessment of narcosis-based risk to benthic organisms.

10.1 MILTON CREEK EXPOSURE AREA

The multiple LOEs examined indicate a low potential for ecological risk within the Milton Creek exposure area beyond the inferred NAPL seep area. Exposure to creosote NAPL and sheen present an unacceptable risk to ecological receptors where it is observed (Figure G-2). The one sediment sample taken within the Milton Creek exposure area in the 2017 sampling event had a total PAH concentration between the TEC and the PEC, indicating the possibility of toxicity to occur. ΣIWTU values from both the shallow and deep porewater samples were greater than 1, indicating a potential risk to benthic organisms. The corresponding ΣSWTU value was less than 1, indicating no predicted risk to benthic organisms. No analyzed VPH or VOC analytes were detected in interstitial water or sediment samples.

Of the five historical sediment samples from this area, only one (SD-MC-A) showed a ΣESBTU value greater than 1 (ΣESBTU = 3.5 based on the EPA UF for 17 PAHs). This sample was used for a bioassay test and showed no significant toxic effect (see discussion below of the relationship between toxicity and ΣESBTU). Further, sample MC-03, collected from nearly the same location in 2011 and analyzed for all 34 PAH analytes, showed a ΣESBTU value of only 0.23.

The four samples collected from Milton Creek in 2012 (which included BC analysis and porewater samples) showed no ΣIWTU values exceeding 1 for either the two-carbon equilibrium partitioning (EqP) model or the direct porewater measurement. All detected porewater concentrations of PAHs from Milton Creek were less than their corresponding SLVs, although the maximum MDL for benzo(a)pyrene (which was not detected in any porewater samples) slightly exceeded the SLV in some cases. Because this exceedance did not exceed a factor of 2, it was not considered significant. Finally, the 90% UCLs for fluoranthene and pyrene at Milton Creek were less than their bioaccumulation SLVs.

10.2 SCAPPOOSE BAY EXPOSURE AREA

The multiple LOEs examined indicate a low potential for ecological risk within the Scappoose Bay exposure area beyond the inferred NAPL seep area. Exposure to creosote NAPL and sheen present an unacceptable risk to ecological receptors where it is observed (Figure G-2).

No shallow samples within the Scappoose Bay exposure unit had ΣIWTU values greater than 1, indicating no apparent risk to benthic organisms in the biologically active zone. Four deep samples (PWS-1, PWS-5, PWS-14, and PWS-15) had ΣIWTU values greater than 1; however, the deep samples were collected below the biologically active zone where there is no current complete exposure pathway for benthic organisms. Samples that had a ΣSWTU greater than 1 included those from PWS-09, PWS-10, PWS-12, and PWS-13 and ranged from 1.04 to 1.07. PAHs contributing to increased SWTUs are similar to those driving risk in porewater, including C-3 and C-4

naphthalenes, C-2 and C-3 fluorenes, and C-2, C-3 and C-4 phenanthracenes/anthracenes, indicating that site-derived sources are the likeliest source of contribution to surface water risk at the Site.

Secondary LOEs indicate a low potential for ecological risk within the Scappoose Bay exposure area. Two samples had concentrations of total PAHs in sediment greater than the PEC, indicating a higher probability of exhibiting toxic effects. The majority of sediment samples had concentrations of total PAHs less than the PEC but greater than the TEC, indicating a potential for toxic effects. No analyzed samples had detectable concentrations of VPH. All samples had concentrations of C>16-C21 Aromatics and C>21-C34 Aromatics greater than the Portland Harbor ERA SLVs. Two samples exceeded Portland Harbor ERA SLVs for C>10-C12 Aromatics and C>12-C16 Aromatics. One sample also exceeded the SLV for C>12-C16 Aromatics.

With regard to potential risk within the Scappoose Bay exposure area based on historic data, the LOEs are more varied. EPA (2009) suggests a three-tiered approach to evaluate bioavailability of PAHs in sediment:

Tier 1—Analysis of whole (bulk) sediments (using EqP methodologies),

Tier 2—Analysis of interstitial water, and

Tier 3—Analysis through toxicity testing.

Data collection and analyses have been completed for Scappoose Bay that support the first two tiers of this approach. Although bioassays have also been performed, their utility in providing definitive support to a decision of potential risk is questionable and is discussed in greater detail later in this section.

The EqP methodologies (based on the one-carbon and two-carbon models) were applied to three sets of bulk sediment data: historical data, 2011 data, and 2012 data. Maximum ΣESBTU values in the historical and 2011 datasets (22 and 39, respectively) were significantly higher than the maximum ΣIWTU value (4.1) for the 2012 dataset. It should be noted that the ΣESBTU values for the historical and 2011 data incorporate UFs for 90% confidence based on UF values from EPA (2003).

However, EPA (2009) recommends that, if possible, site-specific UF values be determined and used, since the values from the earlier publication (EPA, 2003) tend to be highly conservative. To this end, the 2012 dataset, which included data for all 34 PAH analytes, was used to derive site-specific UF values for the previous datasets. These site-specific UFs were based on the 90th percentile of the ratios between the ΣESBTUk and the corresponding ΣESBTU34 value, where k was either 16 or 17 PAHs. The resulting site-specific UFs were 3.07 for the historical data (17 PAHs analyzed) and 3.24 for the 2011 data (16 PAHs analyzed). Results of TU calculations using these site-specific UF values are shown in Tables G-3 and G-4.

Applying the site-specific UFs reduced the ΣESBTU values by approximately one-half, with a maximum ΣESBTU of 10 for the historical data and 18 for the 2011 data. It should be noted that the 2011 sample (SB-28) with the highest total PAH concentration (118 mg/kg) of all of the sediment

samples included in this Supplemental ERA was analyzed for all 34 PAHs and had a ΣESBTU value of 11.

The ΣIWTU values calculated from the 2012 sediment data using the two-carbon EqP model were generally found to be lower than the ΣESBTU value. Applying both the one-carbon and two-carbon models to the 2012 sediment data showed that, on average, the two-carbon ΣIWTU value was about 13 times lower than the one-carbon ΣESBTU value for the same sample. Of the six ΣIWTU values that exceeded 1, five were from the high-water sampling event in July. These included three samples from the former hog fuel loading hopper area of the Site (PWS-05, PWS-06, and PWS-07) and two samples that were near the delineated boundary of the inferred NAPL area (PWS-03 and PWS-16). However, none of these locations showed exceedances in the low-water (October) samples in which only one sediment-based ΣIWTU value exceeded 1 (ΣIWTU = 1.1 at PWS-13, which was one of three samples collected in triplicate). As previously noted in Section 6.2.2, both the sediment and porewater samples from PWS-13 exhibited high levels of certain PAH analytes (e.g., C2-, C3-, and C4-alkylated naphthalenes) that were not found in similar proportions in other samples, potentially indicating an off-Site source.

In general, the ΣIWTU values calculated from the 2012 porewater data (representing Tier 2 of EPA's [2009] three-tiered approach) showed a low potential for risk to benthic invertebrates. ΣIWTU exceeded 1 for only 2 of the 38 total samples. Both of these were from the low-water (October) sampling event. These were PWS-07 (ΣIWTU = 1.4), which is located in the small embayment west of the former hog fuel loading hopper (and very near SD-131 and SB-28, which showed the highest total PAH concentrations in the sediment for the historical and 2011 datasets, respectively), and PWS-13 (ΣIWTU = 2.8), previously described for its atypical PAH fingerprint. It is again noted that the porewater data used to calculate these ΣIWTU values were converted to freely dissolved concentrations based on the measured concentration of DOC in each sample. Although this type of conversion adds an element of uncertainty to the risk result, it should be noted that basing the ΣIWTU values on the raw PAH concentrations in porewater had little appreciable effect on the result. The ΣIWTU value for PWS-07 rose to 1.9, that for PWS-13 rose to 6.4, and only one additional sample (PWS-01) showed a ΣIWTU value exceeding 1 (ΣIWTU = 1.1).

As discussed in Section 5.0, the conclusion of no risk to aquatic receptors at the Site in the 2006 ERA (Bridgewater, 2006) relied heavily upon the finding of no significant toxicity to benthic invertebrates in the bioassay of 14 sediment samples. This result was obtained despite the fact that the second round of six samples were specifically selected to include samples with high total PAH concentrations (including sample SD-131, which had the highest total PAH concentration [79.9 mg/kg] of the sediment samples that had been collected up to that time). Further, the post hoc calculation of ΣESBTU values for the historical data showed that 10 of the samples used in the bioassays produced ΣESBTU values greater than 1 (based on the EPA-based UF for 17 PAHs at 90% confidence). These samples included the highest historical ΣESBTU of 22 at SD-131. This result opens the question as to whether the bioassay test design (which was based on 10-day survival of amphipods [*H. azteca*] and 10-day survival and growth of midge larva [*C. tentans*]) was stringent

enough to detect toxicity in these samples or whether the more quantitative approaches to estimating potential risk (e.g., ΣESBTU) are overly conservative in their predictions of risk.

A recent paper by McDonough et al. (2010) sheds light on this question. Researchers conducted 28-day *H. azteca* survival and growth tests on 192 PAH-contaminated sediments from 12 sites and also estimated potential risk based on the one-carbon (ΣESBTU), two-carbon (ΣIWTU), and direct porewater measurement (ΣIWTU) methods to determine the capability of each of these methods to predict toxicity. Although none of the methods was entirely accurate in discriminating between toxic and nontoxic samples, the direct measure of PAHs in porewater was found to be superior to either of the two EqP-based methods, correctly predicting 100% of toxic samples and 71% of the nontoxic samples, based on the threshold benchmark of ΣIWTU = 1. Note that this result shows a bias toward false positives, and not false negatives, so a prediction of no toxicity is more robust than a prediction of toxicity.

Surprisingly, the one-carbon EqP approach (ΣESBTU) was found to be superior to the two-carbon approach in predicting toxic sediments (100% versus 43% correct predictions, respectively); however, the one-carbon model performed poorly in its ability to discriminate between toxic and nontoxic samples (only 17% of nontoxic samples correctly predicted versus 97% by the two-carbon model). In fact, nontoxic samples showed ΣESBTU values as high as 100, which indicates that none of the ΣESBTU values calculated for the Site (including those with conservative UFs applied) exclude the possibility that all samples used for bioassay were nontoxic (as reflected in the actual empirical test results) and are consistent with the hypothesis that the potential for risk was overpredicted by ΣESBTU.

McDonough et al. (2010) used their toxicity results to optimize the benchmark ΣESBTU and ΣIWTU values for both sensitivity (the ability to predict toxic sediment) and specificity (the ability to discriminate nontoxic from toxic sediments). For the one-carbon and two-carbon EqP methods, the optimal ΣESBTU and ΣIWTU threshold values were 12 and 0.06, respectively (both maintaining a sensitivity of 95% or greater, but having specificities of only 77 and 75%, respectively). For direct porewater measurements, the optimal ΣIWTU benchmark value was 7.0, which also had a sensitivity of 95% or greater, but also had a specificity of 94%, emphasizing this method's greater ability to discriminate between toxic and nontoxic sediments. It should be noted that all ΣIWTU values calculated from the 2012 porewater samples (with or without adjustment for adsorption to DOC) were less than 7. This finding includes the outlier sample from PWS-13 and is consistent with the observed lack of toxicity in the earlier bioassay tests.

Therefore, based on the three-tiered approach to evaluating PAHs in sediment (the third tier being inferred from outside research and supported by Site-specific bioassay tests), the weight of evidence indicates that PAHs in the sediments of the non-NAPL areas of Scappoose Bay do not pose an unacceptable risk to benthic invertebrates from narcosis-based toxicity.

The potential for risk to fish in Scappoose Bay was evaluated through two LOEs. The first considered the potential for toxic effects from direct exposure to dissolved PAHs in the water

column as derived from (and being assumed to be equal to) the concentrations in porewater. The second addressed the potential of exposure to PAHs through bioaccumulation.

For the first LOE (direct exposure to dissolved PAHs), EPCs for the entire Scappoose Bay exposure area (excluding the inferred NAPL areas) were determined based on the 90% UCLs of the freely dissolved PAH concentration or maximum detected concentration for all detected PAHs in the 2012 porewater samples. These EPCs were compared to SLVs considered protective of fish. None of the EPCs for this exposure pathway exceeded their corresponding SLVs, indicating that no unacceptable risk exists to fish for these cases. For PAHs not detected, the maximum MDLs were less than their corresponding SLVs in all but one case (benzo[a]pyrene) for which the maximum MDL exceeded the SLV by a factor of about 3.

The potential for risk to fish from exposure to benzo(a)pyrene is considered low, because its area-wide average concentration is likely to be much less than the maximum MDL because none of the samples showed detectable levels of benzo(a)pyrene even when the MDLs were 20 times less than this maximum. It should also be noted that SLVs were found only for the 18 priority PAHs (including 1- and 2-methylnaphthalene) typically evaluated in environmental samples; therefore (with the exception of C1-naphthalenes, for which 1-methylnaphthalene was used as a surrogate), risk to fish could not be evaluated for the alkylated PAHs, benzo(e)pyene, and perylene (the latter two and six of the alkylated PAH analytes were not detected in the porewater samples).

The evaluation of risk to fish from bioaccumulation was evaluated based on comparison of area-wide EPCs (again as 90% UCLs) for sediment concentration to DEQ-defined SLVs for bioaccumulation risk to freshwater fish (DEQ, 2007). These SLVs, however, are limited to two PAHs—fluoranthene (SLV = 37 mg/kg) and pyrene (SLV = 1.9 mg/kg). The 90% UCLs for each exposure area were based on all available data from that area (0 to 12 inches). In all cases, the EPCs were less than the corresponding SLV for bioaccumulation. Therefore, the potential for risk to fish from fluoranthene or pyrene bioaccumulation can be considered negligible.

11.0 CONCLUSIONS

Based on the Updated Supplemental ERA, the following conclusions can be drawn:

- Presence of creosote NAPL and moderate-heavy petroleum sheen present unacceptable risk to ecological receptors where it is observed in surface sediment porewater and surface water. Areas exhibiting moderate to heavy petroleum sheen in surface sediment are shown on Figure G-2.
- Issues with the 2012 measurement of freely dissolved PAHs in sediment porewater centered around elevated detection limits, particularly high molecular weight PAHs, and a perceived low bias for detecting select low molecular weight PAHs (e.g., naphthalene and its alkylated isomers). This uncertainty to confidently assess porewater toxicity led DEQ to consider other LOEs. Subsequently, the 2017 passive samplers were deployed within offshore areas where prior efforts to assess porewater toxicity and habitat impairment posed by Site-

related contamination had been inconclusive. The quantitation of chemicals in sediment porewater using the LDPE passive sampling devices developed by the Food Safety and Environmental Stewardship (FSES) program at Oregon State University (OSU) appears to be significantly more robust and precise than the 2012 direct measurements of freely dissolved PAHs in sediment porewater. For example, naphthalene, a key component of PAHs in upland groundwater, was detected in 26 of 30 Phase 2017 porewater samples versus only 4 out of 59 porewater samples analyzed by the ASTM SPME approach in 2012.

- The 2017 porewater data demonstrate the low or nonexistent potential narcosis risk to benthic organisms outside of delineated offshore NAPL areas. Specifically, the ΣIWTU exceeded 1 in only one of the 15 Phase 3 locations, PWS-090617-2, based on porewater measurements obtained within the biologically active zone (i.e., upper 12 inches of sediment). It is important to note that the 2017 PWS-090617-2 sediment porewater sample was obtained in Milton Creek near the confluence with Scappoose Bay. A comparison of the ratio of select stable PAH isomers (e.g., C_{free} fluoranthene and pyrene) in PWS-090617-2 is markedly lower (0.29) than ratios of fluoranthene to pyrene (Fl/Py ratio) typically found in creosote (1.36 to 1.75) (Zemo, 2009). The Fl/Py ratio and other diagnostic ratios (e.g., Pyrogenic Index) provided in Appendix 6 of the FSES report support field observations (i.e., no creosote NAPL noted) that elevated concentrations of the C_3- and C_4-naphthalene at passive sampling site PWS-090617-2 are not Site related.

- Like porewater, surface water samples with a ΣSWTU ≥ 1 are considered unacceptable. Four of the eight 2017 surface water passive sampling sites (PWS-090917-9, PWS-090517-10, PWS-090617-12, and PWS-090617-13) resulted in a ΣSWTU slightly above 1 (≤1.07). Detected concentrations of alkyl PAHs C_4-naphthalene appear to be the primary risk driver in surface water and it's unclear if they are attributed to the Site-related contamination.

- The quantitation of chemicals in sediment porewater and surface water using the passive samplers developed by the FSES program at OSU is significantly more robust and precise than bulk sediment analysis of PAHs and TPH. After reviewing the 2017 LDPE PDS data, there appears to be little to no correlation of total PAHs detected in bulk sediment samples to freely dissolved concentrations in porewater and overlying surface water. Extraction and analysis of bulk sediment samples combine both the C_{free} fraction and the contaminant fraction that is bound to particulate materials and carbon in the matrix that is sampled. The standard screening benchmarks used to evaluate the potential toxicity of PAHs in bulk sediment (e.g., TEC, PEC, TPH SLVs) appear to overestimate the toxicity of creosote-derived PAH to benthic invertebrates.

- Risk to fish is negligible for the Scappoose Bay exposure area from either direct exposure to surface water or from the bioaccumulation of fluoranthene or pyrene.

- A screening of monitoring wells along Scappoose Bay indicates dissolved phase constituents may pose a risk to aquatic receptors from discharge of upland groundwater to surface water based on exceedances of select SLVs for PAHs and TPH and ΣGWTU values greater than 1.

There is still a large degree of uncertainty associated with this pathway; further evaluation is needed, including additional sampling at the Site of groundwater discharge.

These conclusions are consistent with earlier bioassay results and the multiple LOEs considered, therefore, demonstrate the low or nonexistent potential risk to ecological receptors at the Site outside of delineated NAPL areas.

12.0 REFERENCES

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13.0 LIMITATIONS

This report was prepared exclusively for the Port of Columbia County (formerly, the Port of St. Helens; the Port) by Cascadia. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Cascadia's services and based on: (i) information available at the time of preparation, (ii) data supplied by outside sources, and (iii) the assumptions, conditions, and qualifications set forth in this report. This Ecological Risk Assessment is intended to be used by the Port for the Former Pope & Talbot Wood-Treating Site in St. Helens, Oregon, only, subject to the terms and conditions of its contract with Cascadia. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

The findings contained herein are relevant to the dates of Site visits and should not be relied upon to represent conditions at later dates. In the event that changes in the nature, usage, or layout of the property or nearby properties are made, the conclusions and recommendations contained in this report may not be valid. If additional information becomes available, it should be provided to the Port so the original conclusions and recommendations can be modified as necessary.

TABLES

Table G-1
Partition Coefficients and Toxicity Benchmarks Used in Narcosis-Based Modeling of Risk to Benthic Invertebrates
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	Log K_{OC}	Log K_{BC}	Log K_{DOC}	FCV_D (µg/L)	FCV_{OC} (mg/kg OC)
Acenaphthene	3.944	5.58	3.09	55.85	491
Acenaphthylene	3.168	5.15	2.31	306.9	452
Anthracene	4.457	5.86	3.61	20.73	594
Benzo(a)anthracene	5.577	6.47	4.74	2.227	841
Benzo(a)pyrene	6.003	6.71	5.17	0.9573	965
Benzo(b)fluoranthene	6.16	6.79	5.32	0.6774	979
Benzo(e)pyrene	6.031	6.72	5.19	0.9008	967
Benzo(g,h,i)perylene	6.397	6.92	5.56	0.4391	1095
Benzo(k)fluoranthene	6.184	6.81	5.35	0.6415	981
C-1 Benz(a)anthracenes/Chrysenes	6.036	6.73	5.2	0.8557	929
C-1 Fluoranthrenes/Pyrenes	5.197	6.26	4.35	4.887	770
C-1 Fluorenes	4.64	5.96	3.79	13.99	611
C-1 Naphthalenes	3.736	5.46	2.88	81.69	444
C-1 Phenanthrenes/Anthracenes	4.955	6.13	4.11	7.436	670
C-2 Benz(a)anthracenes/Chrysenes	6.32	6.88	5.48	0.4827	1,008
C-2 Fluorenes	5.112	6.22	4.27	5.305	686
C-2 Naphthalenes	4.227	5.73	3.38	30.24	510
C-2 Phenanthrenes/Anthracenes	5.367	6.36	4.53	3.199	746
C-3 Benz(a)anthracenes/Chrysenes	6.822	7.16	5.99	0.1675	1,112
C-3 Fluorenes	5.603	6.49	4.76	1.916	769
C-3 Naphthalenes	4.719	6.00	3.87	11.1	581
C-3 Phenanthrenes/Anthracenes	5.82	6.61	4.98	1.256	829
C-4 Benz(a)anthracenes/Chrysenes	7.235	7.38	6.41	0.07062	1,214
C-4 Naphthalenes	5.21	6.27	4.37	4.048	657
C-4 Phenanthrenes/Anthracenes	6.213	6.82	5.38	0.5594	913
Chrysene	5.616	6.50	4.78	2.042	844
Dibenzo(a,h)anthracene	6.599	7.04	5.77	0.2825	1,123
Fluoranthene	4.998	6.16	4.15	7.109	707
Fluorene	4.137	5.68	3.29	39.3	538
Indeno(1,2,3-cd)pyrene	6.608	7.04	5.77	0.275	1,115
Naphthalene	3.299	5.22	2.44	193.55	385
Perylene	6.031	6.72	5.19	0.9008	967
Phenanthrene	4.494	5.88	3.65	19.13	596
Pyrene	4.839	6.07	3.99	10.11	697

Notes:
Values from United States Environmental Protection Agency (2012)
µg/L = micrograms per liter
mg/kg = milligrams per kilogram
BC = black carbon
D = dissolved
DOC = dissolved organic carbon
OC = organic carbon
FCV = final chronic value
K_x = partition coefficient between carbon component x and water

Table G-2a
Selected Surface Water Screening Level Values for the Evaluation of Potential Risk to Fish
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	Screening Level Value (µg/L)	Source[1]	DEQ Level II SLV?[2]
PAHs			
1-Methylnaphthalene	2.1	Tier II SCV Surface Water Screening Benchmark	Yes
2-Methylnaphthalene	130	EPA Region 6 FW Surface Water Screening Benchmark	No
Acenaphthene	74	LCV Fish Surface Water Screening Benchmark	No
Acenaphthylene	4,840	EPA Region 5 ESL Surface Water Screening Benchmark	No
Anthracene	0.09	LCV Fish Surface Water Screening Benchmark	No
Benz[a]anthracene	0.027	Tier II SCV Surface Water Screening Benchmark	Yes
Benzo[a]pyrene	0.014	Tier II SCV Surface Water Screening Benchmark	Yes
Benzo[b]fluoranthene	9.07	EPA Region 5 ESL Surface Water Screening Benchmark	No
Benzo[g,h,i]perylene	7.64	EPA Region 5 ESL Surface Water Screening Benchmark	No
Benzo[k]fluoranthene	9.07	Based on benzo(b)fluoranthene	No
Chrysene	7.0	EPA Region 6 FW Surface Water Screening Benchmark	No
Dibenz[a,h]anthracene	5.0	EPA Region 6 FW Surface Water Screening Benchmark	No
Fluoranthene	30	LCV Fish Surface Water Screening Benchmark	No
Fluorene	3.9	OSWER Tier II Secondary Surface Water Screening Benchmark	Yes
Indeno[1,2,3-cd]pyrene	4.31	EPA Region 5 ESL Surface Water Screening Benchmark	No
Naphthalene	620	LCV Fish Surface Water Screening Benchmark	Yes
Phenanthrene	6.3	OSWER Ambient Water Quality Criteria	Yes
Pyrene	0.3	EPA Region 5 ESL Surface Water Screening Benchmark	No

Abbreviations:
µg/L = micrograms per liter
DEQ = Oregon Department of Environmental Quality
EPA = United States Environmental Protection Agency
ESL = ecological screening level
FW = freshwater
LCV = lowest chronic value
OSWER = Office of Solid Waste and Emergency Response
SCV = secondary chronic value
SLV = screening level value
EC = equivalent carbon
NA = not applicable or not available

Notes:
[1] Based on the Oak Ridge National Laboratory Risk Assessment Information System database (ORNL, 2014).
[2] Is the selected SLV equal to the DEQ SLV as per DEQ (2001)?

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Table G-2b
Selected Sediment Screening Level Values for the Evaluation of Potential Risk to Ecological Receptors
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	Screening Level Value (µg/L)	Source[1]
TPH		
Aliphatics		
EC5-EC6	1,210	Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015
EC>6-EC8	2,140	
EC>8-EC10	6,050	
EC>10-EC12	20,900	
EC>12-EC16	560,000	
EC16>EC21	NA	
EC>21-EC34	NA	
Aromatics		
EC>8-EC10	1,900	Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015
EC>10-EC12	1,250	
EC>12-EC16	1,260	
EC16>EC21	600	
EC>21-EC34	19,000	

Abbreviations:
µg/L = micrograms per liter
DEQ = Oregon Department of Environmental Quality
EPA = United States Environmental Protection Agency
ESL = ecological screening level
FW = freshwater
LCV = lowest chronic value
OSWER = Office of Solid Waste and Emergency Response
SCV = secondary chronic value
SLV = screening level value

Note:
[1] Based on the Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015.

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Table G-2c
Selected Porewater Screening Level Values for the Evaluation of Potential Risk to Ecological Receptors
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	Screening Level Value (µg/L)	Source[1]
TPH		
Aliphatics		
EC5-EC6	121	Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015
EC>6-EC8	54	
EC>8-EC10	NA	
EC>10-EC12	2.6	
EC>12-EC16	240	
EC16>EC21	NA	
EC>21-EC34	NA	
Aromatics		
EC>8-EC10	240	Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015
EC>10-EC12	79	
EC>12-EC16	20	
EC16>EC21	4	
EC>21-EC34	15	

Abbreviations:
µg/L = micrograms per liter
DEQ = Oregon Department of Environmental Quality
EPA = United States Environmental Protection Agency
ESL = ecological screening level
FW = freshwater
LCV = lowest chronic value
OSWER = Office of Solid Waste and Emergency Response
SCV = secondary chronic value
SLV = screening level value

Note:
[1] Based on the Portland Harbor Baseline Ecological Risk Assessment TRVs (REF) corrected for solubility error March 2015

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Table G-3
Narcosis Risk to Benthic Organisms Based on ΣESBTUs Calculated from Historical (Pre-2011) Sediment PAH Concentrations and Compared to Bioassay Test Results
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample Date	No. of PAH Analytes Included	Total Organic Carbon (%)	ΣESBTU[1]		Bioassay?	Bioassay Results
				EPA UF[2]	Site-Specific UF[3]		
Milton Creek Exposure Area							
SD-MC-A	6/1/2004	17	2.0	**3.5**	**1.7**	Yes	Fail (no significant toxic effect)
SD-MC-B	6/1/2004	17	0.92	0.26	0.12	No	NA
SD-MC-C	6/1/2004	17	1.6	0.65	0.31	No	NA
SD-MC-D	6/1/2004	17	2.8	0.16	0.08	No	NA
SD-MC-E	6/1/2004	17	2.9	0.87	0.42	No	NA
Scappoose Bay Exposure Area							
SD-100	12/1/2003	17	2.2	0.42	0.20	No	NA
SD-101	12/1/2003	17	2.2	0.66	0.32	No	NA
SD-102	12/1/2003	17	2.5	0.42	0.20	No	NA
SD-103	12/1/2003	17	2.1	**1.4**	0.65	No	NA
SD-103-A	6/1/2004	17	2.9	**4.3**	**2.0**	No	NA
SD-103-B	6/1/2004	17	2.4	0.55	0.26	No	NA
SD-103-C	6/1/2004	17	2.6	**1.3**	0.64	No	NA
SD-104	12/1/2003	17	1.8	**2.4**	**1.1**	No	NA
SD-104-A	6/1/2004	17	2.3	0.24	0.12	No	NA
SD-104-B	6/1/2004	17	2.5	0.24	0.12	No	NA
SD-104-C	6/1/2004	17	2.3	0.25	0.12	No	NA
SD-105	12/1/2003	17	2.2	**1.1**	0.51	No	NA
SD-105-A	6/1/2004	17	2.7	0.41	0.20	Yes	Fail (no significant toxic effect)
SD-105-B	6/1/2004	17	2.6	**1.7**	0.83	Yes	Fail (no significant toxic effect)
SD-105-C	6/1/2004	17	2.6	0.21	0.10	No	NA
SD-106	12/1/2003	17	2.1	0.88	0.42	No	NA
SD-108	12/1/2003	17	1.4	**14**	**6.5**	No	NA
SD-110	12/1/2003	17	1.8	**6.6**	**3.2**	No	NA
SD-112	12/1/2003	17	1.0	**4.6**	**2.2**	No	NA
SD-112-A	6/1/2004	17	1.5	**2.3**	**1.1**	Yes	Fail (no significant toxic effect)
SD-112-B	6/1/2004	17	3.3	**3.0**	**1.5**	No	NA
SD-112-C	6/1/2004	17	2.6	**2.9**	**1.4**	Yes	Fail (no significant toxic effect)
SD-113	12/1/2003	17	0.22	0.60	0.29	No	NA
SD-114	12/1/2003	17	1.7	0.31	0.15	No	NA
SD-115	12/1/2003	17	0.69	0.19	0.09	No	NA
SD-116	12/1/2003	17	1.0	0.41	0.20	No	NA

Please see notes at end of table.

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Table G-3
Narcosis Risk to Benthic Organisms Based on ΣESBTUs Calculated from Historical (Pre-2011) Sediment PAH Concentrations and Compared to Bioassay Test Results
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample Date	No. of PAH Analytes Included	Total Organic Carbon (%)	ΣESBTU[1]		Bioassay?	Bioassay Results
				EPA UF[2]	Site-Specific UF[3]		
SD-117	12/1/2003	17	1.1	**2.1**	0.99	No	NA
SD-117-A	6/1/2004	17	0.18	0.51	0.25	No	NA
SD-117-B	6/1/2004	17	0.30	0.54	0.26	No	NA
SD-117-C	6/1/2004	17	0.76	**1.2**	0.56	Yes	Fail (no significant toxic effect)
SD-119	12/1/2003	17	1.1	**1.1**	0.50	No	NA
SD-119-A	6/1/2004	17	1.7	**1.5**	0.70	No	NA
SD-119-B	6/1/2004	17	2.1	0.99	0.47	Yes	Fail (no significant toxic effect)
SD-119-C	6/1/2004	17	3.0	0.74	0.36	Yes	Fail (no significant toxic effect)
SD-120	12/1/2003	17	0.19	0.53	0.26	No	NA
SD-121	6/1/2004	17	1.8	0.36	0.17	No	NA
SD-122	6/1/2004	17	1.7	**1.8**	0.86	No	NA
SD-123	6/1/2004	17	1.7	**1.5**	0.72	No	NA
SD-124	6/1/2004	17	1.2	0.39	0.19	No	NA
SD-125	4/1/2005	17	2.4	**3.4**	**1.6**	No	NA
SD-126	4/1/2005	17	3.1	**2.6**	**1.3**	No	NA
SD-127	4/1/2005	17	4.3	**4.2**	**2.0**	Yes	Fail (no significant toxic effect)
SD-128	4/1/2005	17	4.7	**2.9**	**1.4**	No	NA
SD-130	4/1/2005	17	4.0	1.0	0.48	No	NA
SD-131	4/1/2005	17	3.2	**22**	**10**	Yes	Fail (no significant toxic effect)
SD-132	4/1/2005	17	3.7	**2.8**	**1.4**	Yes	Fail (no significant toxic effect)
SD-133	4/1/2005	17	2.0	0.79	0.38	No	NA
SD-134	4/1/2005	17	0.62	**8.6**	**4.1**	No	NA
SD-135	4/1/2005	17	6.5	**6.3**	**3.0**	Yes	Fail (no significant toxic effect)
SD-135 (FD)	4/1/2005	17	6.5	**4.4**	**2.1**	No	NA
SD-136	4/1/2005	17	1.5	**6.7**	**3.2**	Yes	Fail (no significant toxic effect)

Please see notes at end of table.

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Table G-3
Narcosis Risk to Benthic Organisms Based on ΣESBTUs Calculated from Historical (Pre-2011) Sediment PAH Concentrations and Compared to Bioassay Test Results
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample Date	No. of PAH Analytes Included	Total Organic Carbon (%)	ΣESBTU[1]		Bioassay?	Bioassay Results
				EPA UF[2]	Site-Specific UF[3]		
SD-137	4/1/2005	17	0.97	0.17	0.08	No	NA
SD-139	4/1/2005	17	3.7	0.32	0.15	No	NA
SD-140	4/1/2005	17	1.2	0.83	0.40	No	NA
SD-141	4/1/2005	17	1.2	0.20	0.10	No	NA
SHID6	11/1/1996	15	2.5	0.81	NC	No	NA
SHID1	10/1/1996	15	3.9	0.46	NC	No	NA
SHID2	10/1/1996	15	0.40	0.51	NC	No	NA

Abbreviations:
EPA = United States Environmental Protection Agency
Eq-P = equilibrium partitioning
NA = Not applicable
NC = not calculated
PAH = polycyclic aromatic hydrocarbon
UF = uncertainty factor
ΣESBTU = sum of Eq-P-based sediment benchmark toxic units

Notes:
[1] Sum of Eq-P-based sediment benchmark toxic units. Calculations are presented in Appendix G-B. Individual toxic unit values based on one-carbon partitioning model for estimating dissolved fraction. Values shown in **BOLD** are greater than 1.
[2] Uncertainty factor of 6.42 (based on UFs presented in EPA [2003] for 90% confidence) used to adjust ΣESBTUs for 17 analytes. UF of 7.43 (based on EPA [2003]) used for samples with 15 analytes (1996 dataset).
[3] Uncertainty factor of 3.24 (based on UF calculated from 2012 Site data for 90% confidence) used to adjust ΣESBTUs for samples with 17 analytes. UF from 2012 Site data not determined for 1996 data (15 analytes).

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Table G-4
Narcosis Risk to Benthic Organisms Based on ΣESBTUs Calculated from 2011 Sediment PAH Concentra
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample Date	No. of PAH Analytes Included	Total Organic Carbon (%)	ΣESBTU[1]	
				EPA UF[2]	Site-Specific UF[3]
Milton Creek Exposure Area					
MC03	7/12/2011	34	0.88	0.23	0.23
MC04	7/12/2011	16	1.4	0.82	0.38
Scappoose Bay Exposure Area					
SB01	7/14/2011	16	2.4	0.38	0.18
SB02	7/14/2011	34	2.4	0.15	0.15
SB03	7/14/2011	16	2.3	0.27	0.13
SB04	7/14/2011	16	2.1	**1.1**	0.49
SB06	7/14/2011	16	2.2	0.89	0.41
SB07	7/13/2011	16	1.5	0.11	0.05
SB08	7/13/2011	34	2.9	0.17	0.17
SB09	7/14/2011	34	2.8	**5.4**	**5.4**
SB12	7/14/2011	16	2.6	**3.4**	**1.6**
SB13	7/14/2011	16	3.3	**1.9**	0.89
SB17	7/15/2011	16	2.7	**4.3**	**2.0**
SB19	7/15/2011	16	1.4	**2.4**	**1.1**
SB20	7/15/2011	16	2.1	**2.7**	**1.3**
SB21	7/15/2011	16	2.9	**1.7**	0.81
SB24	7/16/2011	16	4.4	**13**	**6.0**
SB26	7/16/2011	16	2.9	**8.4**	**3.9**
SB27	7/16/2011	16	2.7	**39**	**18**
SB28	7/16/2011	34	2.7	**11**	**11**

Abbreviations:
EPA = United States Environmental Protection Agency
Eq-P = equilibrium partitioning
PAH = polycyclic aromatic hydrocarbon
UF = uncertainty factor
ΣESBTU = sum of Eq-P-based sediment benchmark toxic units

Notes:
[1] Sum of Eq-P-based sediment benchmark toxic units. Calculations are presented in Appendix G-B. Individual toxic unit values based on one-carbon partitioning model for estimating dissolved fraction. Values shown in **BOLD** are greater than 1.
[2] Uncertainty factor of 6.93 (based on UFs presented in EPA [2003] for 90% confidence) used to adjust ΣESBTUs when data for only 16 analytes were available.
[3] Uncertainty factor of 3.24 (based on UF calculated from 2012 Site data for 90% confidence) used to adjust ΣESBTUs when data for only 16 analytes were available.

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Table G-5
Narcosis Risk to Benthic Organisms Based on ΣIWTUs Calculated from 2012 Sediment PAH Concentrations
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Depth Interval (inches)	Sample Date	Total Organic Carbon (%)	Black Carbon (%)	ΣIWTU[1]
Milton Creek Exposure Area					
PWS-27	8-11	7/13/2012	1.8	0.13	**0.015**
PWS-17	4-7	10/10/2012	0.95	0.12	0.017
PWS-27	8-11	10/9/2012	1.7	0.17	0.012
PWS-30	8-11	10/12/2012	1.1	0.13	0.0047
Scappoose Bay Exposure Area					
PWS-01	8-9	7/10/2012	0.63	0.10	0.16
PWS-03	8-11	7/12/2012	2.8	0.17	**3.5**
PWS-04	1-4	7/10/2012	1.2	0.13	0.28
PWS-04	8-11	7/10/2012	1.0	0.10	0.97
PWS-05	8-11	7/12/2012	1.8	0.14	**1.1**
PWS-06	8-11	7/12/2012	2.3	0.23	**4.1**
PWS-07	8-11	7/10/2012	2.8	0.17	**1.3**
PWS-08	8-11	7/12/2012	2.1	0.20	0.63
PWS-09	8-11	7/12/2012	2.0	0.17	0.20
PWS-12	8-11	7/12/2012	1.8	0.16	0.057
PWS-12 (FD)[2]	8-11	7/12/2012	1.8	0.15	0.036
PWS-13	1-4	7/11/2012	2.7	0.16	0.068
PWS-13	8-11	7/11/2012	2.0	0.15	0.061
PWS-15	8-11	7/12/2012	1.5	0.10	0.015
PWS-16	8-11	7/9/2012	2.0	0.15	**1.5**
PWS-16B	8-11	7/13/2012	2.2	0.17	0.18
PWS-22	8-11	7/12/2012	2.0	0.16	0.04
PWS-25	8-11	7/13/2012	1.6	0.15	0.63
PWS-26	8-11	7/13/2012	1.2	0.16	0.39
LSI-01	8-11	10/16/2012	0.19	0.21[3]	0.0074
LSI-02	8-11	10/9/2012	1.6	0.21[3]	0.019
LSI-20	8-11	10/10/2012	0.33	0.21[3]	0.15
LSI-24	8-11	10/12/2012	0.91	0.21[3]	0.024
PWS-01	8-10	10/10/2012	0.56	0.05	0.15
PWS-03	8-11	10/10/2012	2.6	0.28	0.77
PWS-04	8-11	10/10/2012	0.69	0.12	0.70
PWS-05	8-11	10/10/2012	1.2	0.19	0.19
PWS-06	8-11	10/10/2012	1.5	0.26	0.38
PWS-07	8-10	10/11/2012	1.7	0.22	0.90
PWS-07 (FD)	8-10	10/11/2012	1.7	0.23	0.70
PWS-08	8-11	10/9/2012	1.5	0.25	0.11
PWS-09	8-11	10/9/2012	1.8	0.23	0.010
PWS-12	8-11	10/9/2012	1.5	0.20	0.0027
PWS-13	8-11	10/9/2012	2.2	0.24	0.97
PWS-13 (FD1)[4]	8-11	10/9/2012	2.2	0.24	**1.1**
PWS-13 (FD2)[4]	8-11	10/9/2012	2.2	0.24	0.60
PWS-15	8-11	10/11/2012	0.81	0.12	0.0057
PWS-16	8-11	10/9/2012	1.6	0.23	0.023
PWS-25	4-8	10/11/2012	0.98	0.14	0.48
PWS-26	8-11	10/11/2012	1.0	0.21	0.25
PWS-26 (FD)	8-11	10/11/2012	1.4	0.23	0.27
PWS-28	8-11	10/10/2012	1.1	0.17	0.0069

Abbreviations:
PAH = polycyclic aromatic hydrocarbon
ΣIWTU = sum of interstitial water toxic units

Notes:
[1] Sum of interstitial water toxic units. Calculations are presented in Appendix G-B.
Individual toxic unit values based on two-carbon method of estimating dissolved fraction.
All based on 34 PAH analytes. Values shown in **BOLD** are greater than 1.
Calculated using the full detection limit for analytes not detected.

[2] (FD) indicates the sample is a field duplicate of the previous sample.

[3] Black carbon estimated as the average of Scappoose Bay samples from October 2012.

[4] Two field duplicates collected at PWS-13 in October.

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Table G-6a
Narcosis Risk to Benthic Organisms Based on ΣIWTUs Calculated from Porewater PAH Concentra
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Depth Interval (inches)	Sample Date	No. of PAH Analytes Detected[1]	ΣIWTU (1/2 DL)[2]	ΣIWTU (full DL)[3]
Milton Creek Exposure Area					
PWS-27	8-11	7/13/2012	0	0.077	**1.53**
PWS-17	4-7	10/10/2012	8	0.34	**1.43**
PWS-27	8-11	10/9/2012	2	0.10	**1.33**
PWS-30	8-11	10/12/2012	0	0.28	**1.32**
PWS-2	3-8	9/6/17 - 9/26/17	25	--	**16.2**
PWS-2	24-29	9/6/17 - 9/26/17	20	--	**1.9**
Scappoose Bay Exposure Area					
PWS-01	8-9	7/10/2012	8	0.85	**1.84**
PWS-03	8-11	7/12/2012	10	0.74	**1.72**
PWS-04	8-11	7/10/2012	3	0.54	**1.55**
PWS-05	8-11	7/12/2012	7	0.57	**1.56**
PWS-06	8-11	7/12/2012	3	0.45	**1.55**
PWS-07	8-11	7/10/2012	10	0.69	**1.67**
PWS-08	8-11	7/12/2012	10	0.69	**1.67**
PWS-09	8-11	7/12/2012	1	0.42	**1.53**
PWS-12	8-11	7/12/2012	1	0.51	**1.53**
PWS-12 (FD)[4]	8-11	7/12/2012	1	0.39	**1.53**
PWS-13	1-4	7/11/2012	0	0.40	**1.53**
PWS-13	8-11	7/11/2012	0	0.42	**1.53**
PWS-15	8-11	7/12/2012	0	0.076	**1.53**
PWS-16	8-11	7/9/2012	1	0.17	**1.53**
PWS-16B	8-11	7/13/2012	2	0.53	**1.55**
PWS-25	8-11	7/13/2012	7	0.68	**1.67**
PWS-26	8-11	7/13/2012	4	0.42	**1.55**
LSI-01	8-11	10/16/2012	1	0.16	**1.53**
LSI-02	8-11	10/9/2012	6	0.21	**1.56**
LSI-20	8-11	10/10/2012	5	0.22	**1.58**
LSI-24	8-11	10/12/2012	6	0.21	**1.57**
PWS-01	8-10	10/10/2012	8	0.62	**1.47**
PWS-03	8-11	10/10/2012	9	0.40	**1.41**
PWS-04	8-11	10/10/2012	5	0.47	**1.34**
PWS-05	8-11	10/10/2012	5	0.22	**1.35**
PWS-06	8-11	10/10/2012	9	0.28	**1.47**
PWS-07	8-10	10/11/2012	10	0.52	**2.52**
PWS-07 (FD)	8-10	10/11/2012	13	**1.4**	**1.61**
PWS-08	8-11	10/9/2012	9	0.37	**1.39**
PWS-09	8-11	10/9/2012	5	0.23	**1.34**
PWS-12	8-11	10/9/2012	2	0.11	**1.33**
PWS-13	8-11	10/9/2012	18	**2.8**	**6.92**
PWS-15	8-11	10/11/2012	3	0.25	**1.33**
PWS-16	8-11	10/9/2012	9	0.16	**1.41**
PWS-25	4-8	10/11/2012	6	0.35	**1.39**
PWS-26	8-11	10/11/2012	5	0.24	**1.35**
PWS-26 (FD)	8-11	10/11/2012	7	0.48	**1.35**
PWS-28	8-11	10/10/2012	0	0.29	**1.32**

Please see notes at end of table

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Table G-6a
Narcosis Risk to Benthic Organisms Based on ΣIWTUs Calculated from Porewater PAH Concentra
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Depth Interval (inches)	Sample Date	No. of PAH Analytes Detected[1]	ΣIWTU (1/2 DL)[2]	ΣIWTU (full DL)[3]
PWS-1	3-8	9/6/17 - 9/26/17	24	--	0.08
PWS-1	24-29	9/6/17 - 9/26/17	29	--	**3.42**
PWS-3	3-8	9/5/17 - 9/26/17	15	--	0.02
PWS-3	24-29	9/5/17 - 9/26/17	14	--	0.03
PWS-4	3-8	9/5/17 - 9/26/17	22	--	0.05
PWS-4	24-29	9/5/17 - 9/26/17	21	--	0.59
PWS-5	3-8	9/5/17 - 9/26/17	24	--	0.19
PWS-5	24-29	9/5/17 - 9/26/17	25	--	**20.3**
PWS-6	3-8	9/5/17 - 9/26/17	24	--	0.04
PWS-6	24-29	9/5/17 - 9/26/17	22	--	0.05
PWS-7	3-8	9/5/17 - 9/26/17	24	--	0.04
PWS-7	24-29	9/5/17 - 9/26/17	20	--	0.02
PWS-8	3-8	9/5/17 - 9/26/17	25	--	0.09
PWS-8	24-29	9/5/17 - 9/26/17	25	--	0.04
PWS-9	3-8	9/5/17 - 9/26/17	25	--	0.05
PWS-9	24-29	9/5/17 - 9/26/17	25	--	0.10
PWS-10	3-8	9/5/17 - 9/26/17	26	--	0.13
PWS-11	24-29	9/5/17 - 9/26/17	27	--	**0.00**
PWS-11	3-8	9/5/17 - 9/26/17	27	--	0.08
PWS-12	24-29	9/6/17 - 9/26/17	30	--	0.04
PWS-12	3-8	9/6/17 - 9/26/17	29	--	0.33
PWS-13	24-29	9/6/17 - 9/26/17	30	--	0.47
PWS-13	3-8	9/6/17 - 9/26/17	29	--	0.14
PWS-14	24-29	9/5/17 - 9/26/17	26	--	**0.74**
PWS-14	3-8	9/5/17 - 9/26/17	29	--	0.06
PWS-15	24-29	9/6/17 - 9/26/17	27	--	**1.5**
PWS-15	3-8	9/6/17 - 9/26/17	27	--	4.51

Abbreviations:
PAH = polycyclic aromatic hydrocarbon
ΣIWTU = sum of interstitial water toxic units

Notes:
[1] Number of PAH analytes (out of 34) that were detected in the sample.
[2] Sum of interstitial water toxic units, using one-half the detection limit for non-detect values.
[3] Sum of interstitial water toxic units, using the full detection limit for non-detect values.
[4] (FD) indicates the sample is a field duplicate of the previous sample.
Individual toxic unit values based on freely dissolved concentrations.
Values shown in **BOLD** are greater than 1.

Table G-6b
Narcosis Risk to Benthic Organisms Based on ΣSWTUs Calculated from Surface Water PAH Concentrations
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Period	No. of PAH Analytes Detected[1]	ΣSWTU (1/2 DL)[2]	ΣSWTU (full DL)[3]
Milton Creek Exposure Area					
PWS-2	Surface Water Site 2	9/6/17 - 9/26/17	30	0.340	0.340
Scappoose Bay Exposure Area					
PWS-03	Surface Water Site 3	9/5/17 - 9/26/17	30	0.607	0.607
PWS-04	Surface Water Site 4	9/5/17 - 9/26/17	30	0.814	0.814
PWS-09	Surface Water Site 9	9/5/17 - 9/26/17	32	**1.07**	**1.07**
PWS-10	Surface Water Site 10-1	9/5/17 - 9/26/17	32	**1.07**	**1.07**
PWS-10	Surface Water Site 10-3	9/5/17 - 9/26/17	30	0.989	0.989
PWS-12	Surface Water Site 12	9/6/17 - 9/26/17	31	**1.04**	**1.04**
PWS-13	Surface Water Site 13	9/6/17 - 9/26/17	31	**1.04**	**1.04**
PWS-14	Surface Water Site 14	9/5/17 - 9/26/17	31	0.467	0.467

Abbreviations:
PAH = polycyclic aromatic hydrocarbon
ΣSWTU = sum of surface water toxic units

Notes:
[1] Number of PAH analytes (out of 34) that were detected in the sample
[2] Sum of surface water toxic units using 1/2 the detection limit for non-detect values
[3] Sum of surface water toxic units using the full detection limit for non-detect values
Values shown in **BOLD** are greater than 1

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Table G-7
Summary of 2012 Porewater Data and Comparison to Surface Water Screening Level Values for the Milton Creek Exposure Area
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	No. of Samples	No. of Detections	FOD	Range of Detection Limits[1] (µg/L)	Range of Detections[2] (µg/L)	Location/ Depth of Maximum Sample[3]	Date of Maximum Sample	EPC[4] (µg/L)	SLV (µg/L)	EPC/ SLV[5]
1-Methylnaphthalene	4	1	25.0%	0.299 - 0.319	0.984 - 0.984	PWS-17 / 4-7	10/10/2012	0.984	2.1	4.7E-1
2-Methylnaphthalene	4	0	0.0%	0.252 - 0.269	--	--	--	<0.269	130	<2.1E-3
Acenaphthene	4	1	25.0%	0.135 - 0.149	2.69 - 2.69	PWS-17 / 4-7	10/10/2012	2.69	74	3.6E-2
Acenaphthylene	4	1	25.0%	0.118 - 0.120	0.230 - 0.230	PWS-17 / 4-7	10/10/2012	0.230	4,840	4.7E-5
Anthracene	4	2	50.0%	0.0117 - 0.0158	0.0291 - 0.0698	PWS-27 / 8-11	10/9/2012	0.0698	0.09	7.8E-1
Benzo(a)anthracene	4	0	0.0%	0.00175 - 0.00863	--	--	--	<0.00863	0.027	<3.2E-1
Benzo(a)pyrene	4	0	0.0%	0.00359 - 0.0243	--	--	--	<0.0243	0.014	**<1.7E+0**
Benzo(b)fluoranthene	4	0	0.0%	0.00259 - 0.0209	--	--	--	<0.0209	9.07	<2.3E-3
Benzo(e)pyrene	4	0	0.0%	0.00344 - 0.0239	--	--	--	<0.0239	NA	NA
Benzo(g,h,i)perylene	4	0	0.0%	0.00152 - 0.0155	--	--	--	<0.0155	7.64	<2.0E-3
Benzo(k)fluoranthene	4	0	0.0%	0.00243 - 0.0202	--	--	--	<0.0202	9.07	<2.2E-3
C-1 Benz(a)anthracenes/Chrysenes	4	0	0.0%	0.00041 - 0.00381	--	--	--	<0.00381	NA	NA
C-1 Fluoranthrenes/Pyrenes	4	0	0.0%	0.0370 - 0.104	--	--	--	<0.104	NA	NA
C-1 Fluorenes	4	1	25.0%	0.174 - 0.267	0.311 - 0.311	PWS-17 / 4-7	10/10/2012	0.311	NA	NA
C-1 Naphthalenes	4	1	25.0%	0.551 - 0.588	1.12 - 1.12	PWS-17 / 4-7	10/10/2012	1.12	2.1	5.3E-1
C-1 Phenanthrenes/Anthracenes	4	0	0.0%	0.120 - 0.249	--	--	--	<0.249	NA	NA
C-2 Benz(a)anthracenes/Chrysenes	4	0	0.0%	0.00043 - 0.0054	--	--	--	<0.00540	NA	NA
C-2 Fluorenes	4	0	0.0%	0.124 - 0.314	--	--	--	<0.314	NA	NA
C-2 Naphthalenes	4	0	0.0%	0.636 - 0.770	--	--	--	<0.770	NA	NA
C-2 Phenanthrenes/Anthracenes	4	0	0.0%	0.00089 - 0.00323	--	--	--	<0.00323	NA	NA
C-3 Benz(a)anthracenes/Chrysenes	4	0	0.0%	0.00002 - 0.00035	--	--	--	<0.00035	NA	NA
C-3 Fluorenes	4	0	0.0%	0.00949 - 0.0482	--	--	--	<0.0482	NA	NA
C-3 Naphthalenes	4	1	25.0%	0.00195 - 0.00319	0.349 - 0.349	PWS-17 / 4-7	10/10/2012	0.349	NA	NA
C-3 Phenanthrenes/Anthracenes	4	0	0.0%	0.000517 - 0.00361	--	--	--	<0.00361	NA	NA
C-4 Benz(a)anthracenes/Chrysenes	4	0	0.0%	0.000106 - 0.00209	--	--	--	<0.00209	NA	NA
C-4 Naphthalenes	4	0	0.0%	0.00144 - 0.00416	--	--	--	<0.00416	NA	NA
C-4 Phenanthrenes/Anthracenes	4	0	0.0%	0.000742 - 0.00846	--	--	--	<0.00846	NA	NA
Chrysene	4	1	25.0%	0.000606 - 0.00317	0.00159 - 0.00159	PWS-27 / 8-11	10/9/2012	0.00159	7.0	2.3E-4
Dibenzo(a,h)anthracene	4	0	0.0%	0.00095 - 0.0112	--	--	--	<0.0112	5.0	<2.2E-3
Fluoranthene	4	0	0.0%	0.0251 - 0.0547	--	--	--	<0.0547	30	<1.8E-3

Please see note at end of table.

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Table G-7
Summary of 2012 Porewater Data and Comparison to Surface Water Screening Level Values for the Milton Creek Exposure Area
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	No. of Samples	No. of Detections	FOD	Range of Detection Limits[1] (µg/L)	Range of Detections[2] (µg/L)	Location/ Depth of Maximum Sample[3]	Date of Maximum Sample	EPC[4] (µg/L)	SLV (µg/L)	EPC/ SLV[5]
Fluorene	4	1	25.0%	0.169 - 0.198	0.453 - 0.453	PWS-17 / 4-7	10/10/2012	0.453	3.9	1.2E-1
Indeno(1,2,3-cd)pyrene	4	0	0.0%	0.00095 - 0.0112	--	--	--	<0.0112	4.31	<2.6E-3
Naphthalene	4	0	0.0%	1.09 - 1.12	--	--	--	<1.12	620	<1.8E-3
Perylene	4	0	0.0%	0.00344 - 0.0239	--	--	--	<0.0239	NA	NA
Phenanthrene	4	1	25.0%	0.106 - 0.147	0.270 - 0.270	PWS-17 / 4-7	10/10/2012	0.270	6.3	4.3E-2
Pyrene	4	0	0.0%	0.0258 - 0.0473	--	--	--	<0.0473	0.3	<1.6E-1

Abbreviations:
EPC = exposure point concentration
µg/L = micrograms per liter
FOD = frequency of detection
NA = not available
SLV = screening level value

Notes:
[1] Detection limits are method detection limits (MDLs) converted to freely dissolved concentration.
[2] Detections expressed as freely dissolved concentrations.
[3] Depths in inches below sediment surface where sample with the maximum concentration was detected.
[4] Exposure point concentrations are the maximum detected concentration or maximum MDL (preceded with "<").
[5] Ratios based on maximum MDLs preceded with "<".

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Table G-8
Summary of 2012 Porewater Data and Comparison to Surface Water Screening Level Values for the Scappoose Bay Exposure Area
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	No. of Samples	No. of Detections	FOD	Range of Detection Limits[1] (µg/L)	Range of Detections[2] (µg/L)	Location/Depth of Maximum Sample[3]	Date of Maximum Sample	Statistical Evaluation				EPC[4] (µg/L)	SLV (µg/L)	EPC/SLV[5]
								Data Sufficiency/ Distribution	Arithmetic Mean (µg/L)	90% UCL (µg/L)	Basis of 90% UCL			
1-Methylnaphthalene	34	1	2.9%	0.296 - 0.320	1.36 - 1.36	PWS-01 / 8-9	7/10/2012	Insufficient detections	--	--	--	1.36	2.1	6.5E-1
2-Methylnaphthalene	34	0	0.0%	0.249 - 0.270	--	--	--	Not detected	--	--	--	<0.270	130	<2.1E-3
Acenaphthene	34	30	88.2%	0.134 - 0.150	0.174 - 9.30	PWS-01 / 8-9	7/10/2012	Lognormal	1.10	1.66	BCA bootstrap using ROS	1.66	74	2.2E-2
Acenaphthylene	34	8	23.5%	0.117 - 0.120	0.121 - 0.902	PWS-01 / 8-9	7/10/2012	Low FOD[6]	0.164	0.246	KM Chebyshev (90% UCL)	0.246	4,840	5.1E-5
Anthracene	34	12	35.3%	0.0116 - 0.0160	0.0162 - 0.834	PWS-7 / 8-10	10/11/2012	Lognormal[7]	0.0388	0.0915	KM (BCA)	0.0915	0.09	1.0E+0
Benzo(a)anthracene	34	5	14.7%	0.00153 - 0.0506	0.00316 -- 0.0192	PWS-25 / 4-8	10/11/2012	Low FOD	0.00350	0.00612	KM Chebyshev (90% UCL)	0.00612	0.027	<2.3E-1
Benzo(a)pyrene	34	0	0.0%	0.00234 - 0.0462	--	--	--	Not detected	--	--	--	<0.0462	0.014	**<3.3E+0**
Benzo(b)fluoranthene	34	0	0.0%	0.00168 - 0.0438	--	--	--	Not detected	--	--	--	<0.0438	9.07	<4.8E-3
Benzo(e)pyrene	34	0	0.0%	0.00224 - 0.0459	--	--	--	Not detected	--	--	--	<0.0459	NA	NA
Benzo(g,h,i)perylene	34	0	0.0%	0.00099 - 0.0389	--	--	--	Not detected	--	--	--	<0.0389	7.64	<5.1E-3
Benzo(k)fluoranthene	34	0	0.0%	0.00157 - 0.0433	--	--	--	Not detected	--	--	--	<0.0433	9.07	<4.8E-3
C-1 Benz(a)anthracenes/Chrysenes	34	0	0.0%	0.00035 - 0.00557	--	--	--	Not detected	--	--	--	<0.00557	NA	NA
C-1 Fluoranthrenes/Pyrenes	34	2	5.9%	0.0331 - 0.112	0.0575 -- 0.191	PWS-7 / 8-10	10/11/2012	Insufficient detections	--	--	--	0.191	NA	NA
C-1 Fluorenes	34	13	38.2%	0.174 - 0.272	0.214 - 1.26	PWS-13 / 8-11	10/9/2012	Lognormal[7]	0.256	0.364	KM (BCA)	0.364	NA	NA
C-1 Naphthalenes	34	1	2.9%	0.545 - 0.590	1.49 - 1.49	PWS-01 / 8-9	7/10/2012	Insufficient detections	--	--	--	1.49	2.1	7.1E-1
C-1 Phenanthrenes/Anthracenes	34	6	17.7%	0.109 - 0.260	0.295 -- 1.38	PWS-13 / 8-11	10/9/2012	Low FOD	0.135	0.338	KM Chebyshev (90% UCL)	0.338	NA	NA
C-2 Benz(a)anthracenes/Chrysenes	34	0	0.0%	0.00037 - 0.00960	--	--	--	Not detected	--	--	--	<0.00960	NA	NA
C-2 Fluorenes	34	1	2.9%	0.112 - 0.333	0.738 -- 0.738	PWS-13 / 8-11	10/9/2012	Insufficient detections	--	--	--	0.738	NA	NA
C-2 Naphthalenes	34	6	17.7%	0.635 - 0.776	0.816 -- 11.2	PWS-13 / 8-11	10/9/2012	Low FOD	1.07	2.10	KM Chebyshev (90% UCL)	2.097	NA	NA
C-2 Phenanthrenes/Anthracenes	34	7	20.6%	0.00079 - 0.00359	0.0560 -- 0.518	PWS-13 / 8-11	10/9/2012	Low FOD	0.0517	0.117	KM Chebyshev (90% UCL)	0.117	NA	NA
C-3 Benz(a)anthracenes/Chrysenes	34	0	0.0%	0.00002 - 0.00093	--	--	--	Not detected	--	--	--	<0.00093	NA	NA
C-3 Fluorenes	34	0	0.0%	0.00829 - 0.0570	--	--	--	Not detected	--	--	--	<0.0570	NA	NA
C-3 Naphthalenes	34	5	14.7%	0.00182 - 0.00327	0.231 - 15.0	PWS-13 / 8-11	10/9/2012	Low FOD	0.556	2.02	KM Chebyshev (90% UCL)	2.019	NA	NA
C-3 Phenanthrenes/Anthracenes	34	1	2.9%	0.00045 - 0.00466	0.042 -- 0.0422	PWS-13 / 8-11	10/9/2012	Insufficient detections	--	--	--	0.0422	NA	NA
C-4 Benz(a)anthracenes/Chrysenes	34	0	0.0%	0.00009 - 0.00714	--	--	--	Not detected	--	--	--	<0.00714	NA	NA
C-4 Naphthalenes	34	1	2.9%	0.00129 - 0.00448	1.21 -- 1.21	PWS-13 / 8-11	10/9/2012	Insufficient detections	--	--	--	1.21	NA	NA
C-4 Phenanthrenes/Anthracenes	34	0	0.0%	0.00064 - 0.01395	--	--	--	Not detected	--	--	--	<0.01395	NA	NA
Chrysene	34	14	41.2%	0.00060 - 0.03630	0.00064 - 0.0203	PWS-03 / 8-11	7/12/2012	Normal	0.00367	0.00501	KM (BCA)	0.00501	7.0	7.2E-4
Dibenzo(a,h)anthracene	34	0	0.0%	0.00061 - 0.0334	--	--	--	Not detected	--	--	--	<0.0334	5.0	<6.7E-3
Fluoranthene	34	24	70.6%	0.0250 - 0.0573	0.0597 -- 1.04	PWS-7 / 8-10	10/11/2012	Lognormal[7]	0.144	0.202	BCA bootstrap using ROS	0.202	30	6.7E-3
Fluorene	34	17	50.0%	0.169 - 0.200	0.215 - 2.76	PWS-7 / 8-10	10/11/2012	Gamma	0.333	0.505	Gamma using ROS (adjusted)	0.505	3.9	1.3E-1
Indeno(1,2,3-cd)pyrene	34	0	0.0%	0.00061 - 0.0334	--	--	--	Not detected	--	--	--	<0.0334	4.31	<7.7E-3
Naphthalene	34	0	0.0%	1.09 - 1.12	--	--	--	Not detected	--	--	--	<1.12	620	<1.8E-3
Perylene	34	0	0.0%	0.00224 - 0.0459	--	--	--	Not detected	--	--	--	<0.0459	NA	NA
Phenanthrene	34	18	52.9%	0.106 - 0.149	0.147 - 3.15	PWS-7 / 8-10	10/11/2012	Not discernible	0.293	0.576	KM Chebyshev (90% UCL)	0.576	6.3	9.1E-2
Pyrene	34	22	64.7%	0.0257 - 0.0488	0.0413 -- 0.591	PWS-7 / 8-10	10/11/2012	Lognormal	0.0912	0.123	BCA bootstrap using ROS	0.123	0.3	4.1E-1

Abbreviations:
BCA = bias-corrected accelerated
EPC = exposure point concentration
µg/L = micrograms per liter
FOD = frequency of detection
KM = Kaplan Meier
NA = not available
ROS = regression on order statistic
SLV = screening level value
UCL = upper confidence level

Notes:
[1] Detection limits are method detection limits (MDLs) converted to freely dissolved concentration.
[2] Detections expressed as freely dissolved concentrations.
[3] Depths in inches below sediment surface where sample with the maximum concentration was detected..
[4] Exposure point concentrations are selected from the following (in this order): the 90% UCL, the maximum detected concentration, the maximum MDL (shown preceded with "<").
[5] Ratios based on maximum MDLs preceded with "<".
[6] Number of detections insufficient to identify statistical distribution. UCL based on the nonparametric Chebyshev Inequality using the Kaplan-Meier method for non-detections.
[7] Distribution found to fit lognormal by Lilliefors test (5% significance level), but not by Shapiro Wilk test (5% significance level).

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Table G-9
Summary of Sediment Data for Fluoranthene and Pyrene and Comparison to Bioaccumulation Screening Level Values for the Milton Creek and Scappoose Bay Exposure Areas
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Analyte	No. of Samples	No. of Detections	FOD	Range of Detection Limits (mg/kg)	Range of Detections (mg/kg)	Location/Depth of Maximum Sample[1]	Date of Maximum Sample	Statistical Evaluation				EPC (mg/kg)	SLV (mg/kg)	EPC/ SLV
								Data Sufficiency/ Distribution	Arithmetic Mean	90% UCL (mg/kg)	Basis of 90% UCL			
Milton Creek Exposure Area														
Fluoranthene	11	9	81.8%	0.009 - 0.027	0.02 - 1.20	SD-MC-A 0-0.3	6/1/2004	Gamma	0.206	0.439	Gamma using ROS (adjusted)	0.439	37	1.2E-2
Pyrene	11	9	81.8%	0.009 - 0.027	0.017 - 1.20	SD-MC-A 0-0.3	6/1/2004	Gamma	0.199	0.431	Gamma using ROS (adjusted)	0.431	1.9	2.3E-1
Scappoose Bay Exposure Area														
Fluoranthene	112	111	99.1%	0.013 - 0.013	0.009 - 20	SD-131 0-0.3	4/1/2005	Lognormal	2.035	2.56	BCA bootstrap using ROS	2.56	37	6.9E-2
Pyrene	112	110	98.2%	0.013 - 0.383	0.015 - 15	SD-131 0-0.3	4/1/2005	Lognormal	1.44	1.81	BCA bootstrap using ROS	1.81	1.9	9.5E-1

Abbreviations:
BCA = bias -corrected accelerated
EPC = exposure point concentration
FOD = frequency of detection
mg/kg = milligrams per kilogram
ROS = regression on order statistic
SLV = screening level value
UCL = upper confidence level

Note:
[1] Depths in inches below sediment surface where sample with the maximum concentration was detected.

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Table G-10
Summary of 2017 Sediment Concentrations and Comparison to SLVs
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	Total PAHs	VPH						
							$C_{>5}$-C_6	$C_{>6}$-C_8	$C_{>8}$-C_{10}	$C_{>10}$-C_{12}	$C_{>8}$-C_{10}	$C_{>10}$-C_{12}	$C_{>12}$-C_{13}
							Concentrations in mg/kg						
SB	PWS-090617-1	09/06/2017	P	0	1	**10.0**	27.3 U	27.3 U	27.3 U	27.3 U	27.3 U	27.3 U	27.3 U
MC	PWS-090617-2	09/06/2017	P	0	1	**3.64**	33.8 U	33.8 U	33.8 U	33.8 U	33.8 U	33.8 U	33.8 U
SB	PWS-090517-3	09/05/2017	P	0	1	**4.57**	34.2 U	34.2 U	34.2 U	34.2 U	34.2 U	34.2 U	34.2 U
SB	PWS-090517-4	09/05/2017	P	0	1	**8.11**	28.7 U	28.7 U	28.7 U	28.7 U	28.7 U	28.7 U	28.7 U
SB	PWS-090517-5	09/05/2017	P	0	1	**3.39**	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U
SB	PWS-090517-6	09/05/2017	P	0	1	**1.58**	30.8 U	30.8 U	30.8 U	30.8 U	30.8 U	30.8 U	30.8 U
SB	PWS-090517-7	09/05/2017	P	0	1	**3.50**	28.1 U	28.1 U	28.1 U	28.1 U	28.1 U	28.1 U	28.1 U
SB	PWS-090517-8	09/05/2017	P	0	1	**4.56**	30.7 U	30.7 U	30.7 U	30.7 U	30.7 U	30.7 U	30.7 U
SB	PWS-090517-9	09/05/2017	P	0	1	**53.5**	31.5 U	31.5 U	31.5 U	31.5 U	31.5 U	31.5 U	31.5 U
SB	PWS-090517-10	09/05/2017	P	0	1	**11.3**	45.3 U	45.3 U	45.3 U	45.3 U	45.3 U	45.3 U	45.3 U
SB	PWS-090517-DUP	09/05/2017	FD	0	1	**9.68**	34.0 U	34.0 U	34.0 U	34.0 U	34.0 U	34.0 U	34.0 U
SB	PWS-090517-11	09/05/2017	P	0	1	**8.83**	29.1 U	29.1 U	29.1 U	29.1 U	29.1 U	29.1 U	29.1 U
SB	PWS-090617-12	09/06/2017	P	0	1	**22.7**	18.6 U	18.6 U	18.6 U	18.6 U	18.6 U	18.6 U	18.6 U
SB	PWS-090617-13	09/06/2017	P	0	1	**42.0**	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U
SB	PWS-090517-14	09/05/2017	P	0	1	**14.6**	19.2 U	19.2 U	19.2 U	19.2 U	19.2 U	19.2 U	19.2 U
SB	PWS-090617-15	09/06/2017	P	0	1	**3.15**	25.9 U	25.9 U	25.9 U	25.9 U	25.9 U	25.9 U	25.9 U
Probable Effects Concentration (PEC)						22.8	--	--	--	--	--	--	--
Threshold Effects Concentration (TEC)						1.6	--	--	--	--	--	--	--
Portland Harbor ERA SLV						--	1.21	2.14	6.05	20.9	1.9	1.25	1.26

Please see notes at end of table.

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Table G-10
Summary of 2017 Sediment Concentrations and Comparison to SLVs
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Start Depth (ft bgs)	End Depth (ft bgs)	EPH									
						$C_{>8}$-C_{10}	$C_{>10}$-C_{12}	$C_{>12}$-C_{16}	$C_{>16}$-C_{21}	$C_{>21}$-C_{34}	$C_{>8}$-C_{10}	$C_{>10}$-C_{12}	$C_{>12}$-C_{16}	$C_{>16}$-C_{21}	$C_{>21}$-C_{34}
						Concentrations in mg/kg									
SB	PWS-090617-1	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
MC	PWS-090617-2	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
SB	PWS-090517-3	09/05/2017	P	0	1	4.58 H, U	4.58 H, U	**8.15** H	**21.5** H	**72.8** H	4.58 H, U	4.58 H, U	4.58 H, U	**22.0** H	**56.4** H
SB	PWS-090517-4	09/05/2017	P	0	1	4.04 H, U	4.04 H, U	4.04 H, U	**12.4** H	**42.2** H	4.04 H, U	4.04 H, U	4.04 H, U	**27.1** H	**45.9** H
SB	PWS-090517-5	09/05/2017	P	0	1	3.24 H, U	3.24 H, U	3.24 H, U	**18.6** H	**11.0** H	3.24 H, U	3.24 H, U	3.24 H, U	**4.84** H	**54.6** H
SB	PWS-090517-6	09/05/2017	P	0	1	4.17 H, U	4.17 H, U	**8.25** H	**19.0** H	**66.8** H	4.17 H, U	4.17 H, U	**7.90** H	**42.9** H	**52.4** H
SB	PWS-090517-7	09/05/2017	P	0	1	4.05 H, U	4.05 H, U	**8.59** H	**22.1** H	**87.6** H	4.05 H, U	4.05 H, U	4.05 H, U	**24.6** H	**54.5** H
SB	PWS-090517-8	09/05/2017	P	0	1	4.46 H, U	4.46 H, U	4.46 H, U	**11.9** H	**66.3** H	4.46 H, U	4.46 H, U	4.46 H, U	**11.2** H	**44.7** H
SB	PWS-090517-9	09/05/2017	P	0	1	4.13 H, U	12.90 H	**53.4** H	**71.8** H	**191** H	4.13 H, U	**4.44** H	**39.6** H	**236** H	**176** H
SB	PWS-090517-10	09/05/2017	P	0	1	4.32 H, U	4.32 H, U	**12.3** H	**40.3** H	**68.6** H	4.32 H, U	4.32 H, U	**7.87** H	**54.3** H	**139** H
SB	PWS-090517-DUP	09/05/2017	FD	0	1	4.33 H, U	4.33 H, U	**10.3** H	**26.5** H	**117** H	4.33 H, U	4.33 H, U	**8.65** H	**64.9** H	**108** H
SB	PWS-090517-11	09/05/2017	P	0	1	4.32 H, U	4.32 H, U	4.32 H, U	**7.24** H	**39.8** H	4.32 H, U	4.32 H, U	4.32 H, U	**17.0** H	**50.7** H
SB	PWS-090617-12	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
SB	PWS-090617-13	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
SB	PWS-090517-14	09/05/2017	P	0	1	3.09 H, U	3.09 H, U	3.09 H, U	**49.8** H	**23.0** H	3.09 H, U	**3.73** H	**7.05** H	**36.4** H	**77.8** H
SB	PWS-090617-15	09/06/2017	P	0	1	--	--	--	--	--	--	--	--	--	--
Probable Effects Concentration (PEC)						--	--	--	--	--	--	--	--	--	--
Threshold Effects Concentration (TEC)						--	--	--	--	--	--	--	--	--	--
Portland Harbor ERA SLV						6.05	20.9	560	--	--	1.9	1.25	1.26	0.6	19

Notes:
Exposure Areas: MC = Milton Creek; SB = Scappoose Bay
Sample Type: P = primary; FD = field duplicate
Portland Harbor Ecological Risk Assessment (ERA) Screening Level Value (SLV) corrected for solubility error (March, 2015)
PAHs = polycyclic aromatic hydrocarbons
Total PAHs were calculated by summing the detected concentrations of Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene.
If an analyte was not detected, 1/2 the reporting or detection limit (as applicable) was included in the sum.
PAHs were analyzed using EPA Methods 8270D and 8270D-SIM
Total PAH values BOLD if greater than TEC and shaded if higher than PEC
VPH = volatile petroleum hydrocarbons
EPH = extractable petroleum hydrocarbons
TPH were analyzed using method NWTPH-Dx
VPH/EPH data **BOLDED** if higher than the detection limit and shaded if higher than the Portland Harbor ERA SLV
FD = field duplicate
U = not detected at or above the stated level
mg/kg = milligrams per kilogram

Table G-11a
Summary of 2017 Porewater Concentrations and IWTUs
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	Total OPAHs (µg/L)	Total PAHs (µg/L)	ΣIWTU
PWS-1	Shallow Porewater Site 1	9/6/17 - 9/26/17	P	0.458	1.34	0.08
PWS-1	Deep Porewater Site 1	9/6/17 - 9/26/17	P	0.0	34.2	**3.42**
PWS-2	Shallow Porewater Site 2	9/6/17 - 9/26/17	P	0.0102	116	**16.2**
PWS-2	Deep Porewater Site 2	9/6/17 - 9/26/17	P	0.0018	18.5	**1.89**
PWS-3	Shallow Porewater Site 3	9/5/17 - 9/26/17	P	0.0004	0.26	0.02
PWS-3	Deep Porewater Site 3	9/5/17 - 9/26/17	P	0.0	0.34	0.03
PWS-4	Shallow Porewater Site 4	9/5/17 - 9/26/17	P	0.0010	0.44	0.05
PWS-4	Deep Porewater Site 4	9/5/17 - 9/26/17	P	0.0002	4.51	0.59
PWS-5	Shallow Porewater Site 5	9/5/17 - 9/26/17	P	0.0	1.31	0.19
PWS-5	Deep Porewater Site 5	9/5/17 - 9/26/17	P	0.0005	111	**20.26**
PWS-6	Shallow Porewater Site 6	9/5/17 - 9/26/17	P	0.0002	0.36	0.04
PWS-6	Deep Porewater Site 6	9/5/17 - 9/26/17	P	0.0026	0.52	0.05
PWS-7	Shallow Porewater Site 7	9/5/17 - 9/26/17	P	0.0	0.38	0.04
PWS-7	Deep Porewater Site 7	9/5/17 - 9/26/17	P	0.0	0.26	0.02
PWS-8	Shallow Porewater Site 8	9/5/17 - 9/26/17	P	0.0007	0.64	0.09
PWS-8	Deep Porewater Site 8	9/5/17 - 9/26/17	P	0.0	0.38	0.04
PWS-9	Shallow Porewater Site 9	9/5/17 - 9/26/17	P	0.0011	0.41	0.05
PWS-9	Deep Porewater Site 9	9/5/17 - 9/26/17	P	0.0032	0.77	0.10
PWS-10	Shallow Porewater Site 10	9/5/17 - 9/26/17	P	0.0	0.81	0.13
PWS-11	Shallow Porewater Site 11	9/5/17 - 9/26/17	P	0.0006	0.57	0.08
PWS-11	Deep Porewater Site 11	9/5/17 - 9/26/17	P	0.0005	0.38	0.04
PWS-12	Shallow Porewater Site 12	9/6/17 - 9/26/17	P	0.630	3.29	0.33
PWS-12	Deep Porewater Site 12	9/6/17 - 9/26/17	P	0.570	3.37	0.47
PWS-13	Shallow Porewater Site 13	9/6/17 - 9/26/17	P	0.0117	0.80	0.14
PWS-13	Deep Porewater Site 13	9/6/17 - 9/26/17	P	0.0342	5.41	0.74
PWS-14	Shallow Porewater Site 14	9/5/17 - 9/26/17	P	0.0	0.54	0.06
PWS-14	Deep Porewater Site 14	9/5/17 - 9/26/17	P	0.0333	11.2	**1.49**
PWS-15	Shallow Porewater Site 15	9/6/17 - 9/26/17	P	0.0	0.51	0.07
PWS-15	Deep Porewater Site 15	9/6/17 - 9/26/17	P	0.0001	48.1	**4.51**

Notes:
Sample Type: P = primary; FD = field duplicate
IWTU = interstitial water toxic units. Calculated using final chronic values based on narcotic effects in benthic organisms.
ΣIWTU = sum of interstitial water toxic units. Calculated using the full detection limit (DL) for non-detect values.
ΣIWTU values greater than 1 are in **BOLD**
PAHs = polycyclic aromatic hydrocarbons
PAHs calculated using SOP 427.00 – Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS
OPAHs = oxygenated polycyclic aromatic hydrocarbons
OPAHs calculated using SOP 414.00 – Determination of Oxygenated PAHs (OPAHs) (a total of 22 analytes) using GC/MS
µg/L - micrograms per liter

Table G-11b
Summary of 2017 Porewater VPH Concentrations and Comparison to SLVs
Former Pope & Talbot Wood-Treating Site
St. Helens, Oregon

Sediment Porewater Sample ID	Sample Date	VPH						
		$C_{>5}$-C_6 Aliphatics	$C_{>6}$-C_8 Aliphatics	$C_{>8}$-C_{10} Aliphatics	$C_{>10}$-C_{12} Aliphatics	$C_{>8}$-C_{10} Aromatics	$C_{>10}$-C_{12} Aromatics	$C_{>12}$-C_{13} Aromatics
		Concentrations in µg/L						
PDB-92617-1	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-2	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-4	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-5	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-6	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-7	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-8	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-9	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-10	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-DUP	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-092617-11	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-92617-12	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-92617-13	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-92617-14	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PDB-92617-15	9/26/2017	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Portland Harbor ERA SLV		121	54	--	2.6	240	79	--*

Notes:
VPH = Volatile Petroleum Hydrocarbons using the Washington Ecology method where volatile aliphatic and aromatic hydrocarbons are collectively quantified within the ranges listed above by gas chromatography using a photo-ionization detector and flame ionization detector
Passive samplers PWS-3, PWS-4, PWS-5, PWS-6, PWS-7, PWS-8, PWS-9, PWS-10, PWS-11, PWS-14 were deployed on September 5, 2017.
Passive samplers PWS-1, PWS-2, PWS-12, PWS-13, and PWS-15 were deployed on September 6, 2017.
All passive samplers were removed on September 26, 2017.
DUP = Field duplicate sample collected from Phase 3 sampling location PWS-10
µg/L = micrograms per liter
U = The analyte was not detected above the applicable reporting or detection limit
*No Portland Harbor ERA SLV for C>12-C13 aromatics. Portland Harbor ERA SLV for C>12-C16 aromatics = 20 µg/L

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Table G-12a
Summary of 2017 Surface Water OPAH Concentrations and SWTU Calculations from Direct Measurements of 34 PAHs
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

NAPL or non-NAPL Area	Sampling Period	Exposure Area	Passive Sampler Location	Sample ID	Sample Type	Total OPAHs (µg/L)	ΣSWTU
Non-NAPL Areas	September 2017	MC	PWS-2	Surface Water Site 2	N	0.0001	0.340
		SB	PWS-3	Surface Water Site 3	N	0.0008	0.607
		SB	PWS-4	Surface Water Site 4	N	0.026	0.814
		SB	PWS-9	Surface Water Site 9	N	0.0017	**1.07**
		SB	PWS-10	Surface Water Site 10-1	N	0.0018	**1.07**
		SB	PWS-10	Surface Water Site 10-3	FD	0.438	0.989
		SB	PWS-12	Surface Water Site 12	N	0.414	**1.04**
		SB	PWS-13	Surface Water Site 13	N	0.391	**1.04**
		SB	PWS-14	Surface Water Site 14	N	0.0008	0.467

Notes:
Exposure Areas: MC = Milton Creek; SB = Scappoose Bay
Sample Type: N = normal; FD = field duplicate
SWTU = surface water toxic units. Calculated using final chronic values based on narcotic effects in benthic organisms.
ΣSWTU = sum of surface water toxic units. Calculated using the full detection limit (DL) for non-detect values.
ΣSWTU values greater than 1 are in **BOLD.**
PAHs calculated using SOP 427.00 – Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.
OPAHs = oxygenated polycyclic aromatic hydrocarbons
OPAHs calculated using SOP 414.00 – Determination of Oxygenated PAHs (OPAHs) (a total of 22 analytes) using GC/MS.
µg/L - micrograms per liter

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Table G-12b
Comparison of 2017 Surface Water PAH Concentrations to SLVs
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

						Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [2]																		
Sample ID	**Passive Sampler Location** [1]	**Exposure Area** [1]	**No. of Detected Analytes**	**Fl/Py Ratio**	**Total PAHs**	**Naphthalene**	**C-1 Naphthalenes**	**C-2 Naphthalenes**	**C-3 Naphthalenes**	**C-4 Naphthalenes**	**Acenaphthylene**	**Acenaphthene**	**Fluorene**	**C-1 Fluorenes**	**C-2 Fluorenes**	**C-3 Fluorenes**	**Phenanthrene**	**Anthracene**	**C-1 Phenanthrenes/ Anthracenes**	**C-2 Phenanthrenes/ Anthracenes**	**C-3 Phenanthrenes/ Anthracenes**	**C-4 Phenanthrenes/ Anthracenes**	**Fluoranthene**	**Pyrene**
						Concentrations in µg/L																		
Surface Water Site 2	PWS-2	MC	29	0.80	0.0518	**0.0107** B	**0.0396** B	**0.132** B	**0.46** B	**0.996** B	**0.0004**	**0.00952**	**0.00412**	**0.0109** B	**0.0359** B	**0.0321**	**0.0055**	**0.00058**	**0.00599** B	**0.0135**	**0.0191**	0.00028 U	**0.00363**	**0.00451**
Surface Water Site 3	PWS-3	SB	30	0.72	0.0192	**0.00223** B	**0.00758** B	**0.043** B	**0.454** B	**1.94** B	**0.0003**	**0.00267**	**0.00196**	**0.00726** B	**0.047** B	**0.0474**	**0.00135**	**0.00052**	**0.00483** B	**0.0207**	**0.0309**	**0.00951** B	**0.0025**	**0.00347**
Surface Water Site 4	PWS-4	SB	30	0.68	0.0260	**0.0034** B	**0.0102** B	**0.0618** B	**0.515** B	**2.62** B	**0.00029**	**0.00351**	**0.0022**	**0.00868** B	**0.0707** B	**0.08**	**0.00169**	**0.00056**	**0.00562** B	**0.0294**	**0.0424**	**0.00924** B	**0.00335**	**0.00494**
Surface Water Site 9	PWS-9	SB	32	0.80	0.0634	**0.00426** B	**0.0194** B	**0.105** B	**0.832** B	**3.25** B	**0.00085**	**0.0159**	**0.00683**	**0.0198** B	**0.112** B	**0.102**	**0.00627**	**0.00202**	**0.0126** B	**0.0466**	**0.0625**	**0.0244** B	**0.00694**	**0.00871**
Surface Water Site 10-1	PWS-10	SB	32	0.75	0.0797	**0.0108** B	**0.0318** B	**0.12** B	**0.815** B	**3.33** B	**0.00083**	**0.022**	**0.00805**	**0.0178** B	**0.0998** B	**0.0945**	**0.00671**	**0.00174**	**0.012** B	**0.0452**	**0.0576**	**0.0173** B	**0.00642**	**0.00856**
Surface Water Site 10-3	PWS-10	SB	30	0.73	0.0657	**0.00861** B	**0.0264** B	**0.106** B	**0.712** B	**3.23** B	**0.00088**	**0.0173**	**0.00683**	**0.0158** B	**0.0916** B	**0.0906**	**0.00556**	**0.00144**	**0.0102** B	**0.0388**	**0.0501**	0.00028 U	**0.00553**	**0.00758**
Surface Water Site 12	PWS-12	SB	31	0.72	0.0709	**0.00586** B	**0.0201** B	**0.0854** B	**0.586** B	**3.24** B	**0.00094**	**0.0128**	**0.00552**	**0.0114** B	**0.0887** B	**0.096**	**0.00563**	**0.00172**	**0.0111** B	**0.0455**	**0.0614**	**0.0236** B	**0.00665**	**0.00922**
Surface Water Site 13	PWS-13	SB	31	0.76	0.0793	**0.00942** B	**0.0277** B	**0.0968** B	**0.672** B	**3.03** B	**0.00138**	**0.0157**	**0.00669**	**0.0155** B	**0.092** B	**0.0916**	**0.00576**	**0.00268**	**0.0126** B	**0.053**	**0.0826**	**0.0393** B	**0.0102**	**0.0134**
Surface Water Site 14	PWS-14	SB	31	0.72	0.0327	**0.00475** B	**0.0093** B	**0.044** B	**0.38** B	**1.43** B	**0.00047**	**0.0093**	**0.00388**	**0.01** B	**0.0467** B	**0.0428**	**0.00241**	**0.00087**	**0.00456** B	**0.0175**	**0.0252**	**0.00987** B	**0.00259**	**0.00361**
Screening Level Value (SLV) [8]				--	--	620 [3]	--	--	--	--	4,840 [4]	74 [3]	3.9 [5]	--	--	--	6.3 [5]	0.09 [3]	--	--	--	--	30 [3]	0.3 [4]

Please see notes at end of table.

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Table G-12b
Comparison of 2017 Surface Water PAH Concentrations to SLVs
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

			Parent and Alkyl Polycyclic Aromatic Hydrocarbons (34 PAHs) by OSU FSES SOP 427.00 [2]																
Sample ID	**Passive Sampler Location [1]**	**No. of Detected Analytes**	**Total PAHs**	**Fluoranthene**	**Pyrene**	**C-1 Fluoranthrenes/ Pyrenes**	**Benzo(a)anthracene**	**Chrysene**	**C-1 Benz(a)anth/ Chrysenes**	**C-2 Benz(a)anth/ Chrysenes**	**C-3 Benz(a)anth/ Chrysenes**	**C-4 Benz(a)anth/ Chrysenes**	**Benzo(b)fluoranthene**	**Benzo(k)fluoranthene**	**Benzo(e)pyrene**	**Benzo(a)pyrene**	**Perylene**	**Indeno(1,2,3-cd)pyrene**	**Dibenzo(a,h)anthracene**	**Benzo(g,h,i)perylene**
			Concentrations in µg/L																
Surface Water Site 2	PWS-2	29	0.0518	**0.00363**	**0.00451**	**0.00146**	**0.000162**	**0.000168**	**0.000152**	**0.00000542**	0.000000252 U	0.000000252 U	**0.0000447**	**0.00002**	**0.0000408**	**0.0000161**	**0.0000425**	0.000000089 U	0.000000358 U	**0.00000534**
Surface Water Site 3	PWS-3	30	0.0192	**0.0025**	**0.00347**	**0.00345**	**0.000118**	**0.000137**	**0.000429**	**0.0000239**	0.000000899 U	0.000000899 U	**0.0000493**	**0.0000191**	**0.0000608**	**0.0000226**	**0.000129**	0.000000081 U	0.000000326 U	**0.0000106**
Surface Water Site 4	PWS-4	30	0.0260	**0.00335**	**0.00494**	**0.00208**	**0.00018**	**0.000207**	**0.000144**	**0.00000802**	0.000000246 U	0.000000246 U	**0.0000651**	**0.0000276**	**0.0000802**	**0.0000298**	**0.00015**	0.000000086 U	0.000000348 U	**0.0000123**
Surface Water Site 9	PWS-9	32	0.0634	**0.00694**	**0.00871**	**0.00382**	**0.000307**	**0.000315**	**0.000219**	**0.00001**	0.000000185 U	0.000000185 U	**0.000111**	**0.0000363**	**0.000119**	**0.0000549**	**0.000139**	**0.000013**	**0.00000346**	**0.0000166**
Surface Water Site 10-1	PWS-10	32	0.0797	**0.00642**	**0.00856**	**0.00357**	**0.000293**	**0.000288**	**0.000192**	**0.00000827**	0.00000018 U	0.00000018 U	**0.0000928**	**0.0000394**	**0.0000965**	**0.0000478**	**0.000104**	**0.0000104**	**0.00000277**	**0.0000135**
Surface Water Site 10-3	PWS-10	30	0.0657	**0.00553**	**0.00758**	**0.00315**	**0.000225**	**0.000247**	**0.000158**	**0.00000831**	0.000000171 U	0.000000171 U	**0.0000729**	**0.0000298**	**0.0000765**	**0.0000408**	**0.000102**	**0.00000881**	0.000000229 U	**0.0000111**
Surface Water Site 12	PWS-12	31	0.0709	**0.00665**	**0.00922**	**0.00447**	**0.000353**	**0.000328**	**0.000222**	**0.0000104**	0.00000017 U	0.00000017 U	**0.000118**	**0.0000491**	**0.000116**	**0.0000664**	**0.0000969**	**0.0000116**	0.000000228 U	**0.0000156**
Surface Water Site 13	PWS-13	31	0.0793	**0.0102**	**0.0134**	**0.00689**	**0.000619**	**0.000566**	**0.000372**	**0.0000155**	0.00000019 U	0.00000019 U	**0.000208**	**0.0000908**	**0.000204**	**0.000123**	**0.000126**	**0.000017**	0.000000259 U	**0.0000232**
Surface Water Site 14	PWS-14	31	0.0327	**0.00259**	**0.00361**	**0.0012**	**0.0000801**	**0.0000956**	**0.0000734**	**0.00000412**	0.000000155 U	0.000000155 U	**0.0000337**	**0.0000129**	**0.000037**	**0.0000192**	**0.0000634**	**0.00000472**	0.000000205 U	**0.00000738**
Screening Level Value (SLV) [8]			--	30[3]	0.3[4]	--	0.027[7]	7[6]	--	--	--	--	9.07[4]	9.07[4]	--	0.014[7]	--	4.31[4]	5.0[6]	7.64[4]

Notes:

[1] The term "passive sampler" refers to the sampling hardware (surface water cages) that the passive sampling media is placed inside of and deployed in. Note that this term is used to distinguish it from the term Passive Sampling Device (PSD), which is used in the OSU SOPs to refer to the prepared LDPE sampling media that is ready to deploy in the field but has not yet been placed in the "passive sampler." These *in situ* passive samplers are designed to act as a carbon sink so that PAHs sorb to the LDPE and approach equilibrium with dissolved concentrations in surface water.

[2] SOP 427.00 = Determination of Forensic Alkyl PAHs (i.e., 18 parent PAHs and 16 groups of prominent C_1 to C_4 alky PAH derivatives [so-called 34 PAHs]) using GC-MS/MS.

[3] LCV Fish Surface Water Screening Benchmark.

[4] EPA Region 5 ESL Surface Water Screening Benchmark.

[5] OSWER Ambient Water Quality Criteria.

[6] EPA Region 6 FW Surface Water Screening Benchmark.

[7] Tier II SCV Surface Water Screening Benchmark.

[8] SLVs based on the Oak Ridge National Laboratory Risk Assessment Information System database (ORNL, 2014).

Passive samplers PWS-3, PWS-4, PWS-5, PWS-6, PWS-7, PWS-8, PWS-9, PWS-10, PWS-11, PWS-14 were deployed on September 5, 2017.
Passive samplers PWS-1, PWS-2, PWS-12, PWS-13, and PWS-15 were deployed on September 6, 2017.
All passive samplers were removed on September 26, 2017.
Total PAHs represent sum of all 63 freely dissolved concentrations (Cfree ∑63) measured on the passive sampler's media.
Gas Chromatography Tandem Mass Spectrometry (GC-MS/MS).
PAHs = polycyclic aromatic hydrocarbons.
µg/L = micrograms per liter.
Bold indicates analyte was detected at or above the method detection limit.
J = estimated value.
U = The analyte was not detected above the applicable reporting or detection limit.
B = Sample was background corrected.
OSU FSES = Oregon State University Food Safety and Environmental Stewardship Program.
SOP = Standard Operating Procedure.
Fl/Py = fluoranthene/pyrene.
LDPE = low density polyethylene.

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Table G-13
Summary of Groundwater TPH and PAH Concentrations and GWTUs
Former Pope & Talbot Wood Treating Site
St Helens, Oregon

Sample Location	Sample ID	Sample Date	Sample Type	TPH			PAHs																		
				Diesel-Range Hydrocarbons	Oil-Range Hydrocarbons	Gasoline-Range Hydrocarbons	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzofluoranthenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Total PAH	ΣGWTU
				Concentrations in mg/L			Concentrations in µg/L																		
MW-3A	MW-3A-20100908-N	9/8/2010	P	**374 N**	**103 N**	**28.5 N**	**740**	19.5 U	**207**	**78.0**	19.5 U	NR	19.5 U	NR	**44.6**	**68.7**	19.5 U	**565**	**601**	19.5 U	**22800**	**1340**	**323**	**26,816**	**509**
MW-3A	MW-3A	8/9/2011	P	**57.1 N**	10.1 U	NT	**560**	**10.7**	**113**	**56.8**	**14.4**	NR	**3.10**	NR	**31.3**	**45.0**	**1.14**	**422**	**417**	**3.97**	**9470**	**898**	**218**	**12,264**	**291**
MW-3A	MW-3A_022112	2/21/2012	P	**49.1 N**	**3.26 N**	NT	**661**	37.4 U	**127**	**56.2**	37.4 U	NR	37.4 U	NR	74.8 U	**41.6**	37.4 U	**332**	**431**	37.4 U	**13000 J**	**916**	**199**	**15,895**	**452**
MW-3A	MW-3A_050412	5/4/2012	P	**113 N**	15 U	NT	**972**	**19.3**	**276**	**118**	**32.4**	NR	**7.42**	NR	**72.2**	**102**	**2.96**	**820**	**799**	**9.55**	**14700**	**1990**	**490**	**20,411**	**594**
MW-3A	MW-3A_081512	8/15/2012	P	**116 N**	3.02 U	NT	**804**	37.7 U	**204**	**91**	37.7 U	NR	37.7 U	NR	75.5 U	**73.1**	37.7 U	**591**	**621**	37.7 U	**12400**	**1500**	**347**	**16,763**	**575**
MW-3B	MW-3B-20100908-N	9/8/2010	P	**1.72 N**	0.467 U	**0.789 N**	**0.974**	0.777 U	**0.898**	**0.828**	**0.284**	NR	**0.0851**	NR	**0.526**	**0.735**	0.0388 U	**2.76**	0.777 U	**0.114**	**67.2**	**2.24**	**1.84**	**79.3**	**2.81**
MW-3B	MW-3B	8/9/2011	P	0.236 U	0.472 U	NT	**0.247 J**	0.0377 UJ	**0.422 J**	**0.111 J**	**0.0473 J**	NR	0.0377 UJ	NR	**0.0819 J**	**0.0900 J**	0.0377 UJ	**0.422 J**	**0.178 J**	0.0377 UJ	**6.83 J**	**0.436 J**	**0.268 J**	**9.21**	0.495
MW-3B	MW-3B_022112	2/21/2012	P	**0.349 N**	0.377 U	NT	**0.344**	0.189 U	**0.715**	**0.242**	0.189 U	NR	0.189 U	NR	0.377 U	0.189 U	0.189 U	**1.34**	**0.273**	0.189 U	**10.5 J**	**1.37**	**0.789**	**16.3**	**1.59**
MW-3B	MW-3B_050412	5/4/2012	P	0.187 U	**0.394**	NT	**1.37**	0.187 U	**0.567**	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	NR	0.187 U	0.187 U	**1.13**	**1.09**	0.187 U	**2.99**	**2.59**	**0.766**	**11.3**	**1.82**
MW-3B	MW-3B_081512	8/15/2012	P	**0.732**	0.374 U	NT	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	NR	0.187 U	0.187 U	0.187 U	0.187 U	0.187 U	**0.515**	0.187 U	0.187 U	**1.92**	**1.39**
MW-6A	MW-6A-20100908-N	9/8/2010	P	**4.11 N**	4.67 U	**4.79 N**	**90.2**	**1.00**	**3.59**	**0.228**	**0.0621**	NR	0.0421 U	NR	0.0947 U	**0.173**	0.0421 U	**4.24**	**43.7**	0.0421 U	**46.1**	**28.9**	**2.10**	**220**	**5.91**
MW-6A	MW-6A	8/9/2011	P	**4.28 N**	2.55 U	NT	**114 J**	**1.05 J**	**6.71 J**	**0.115 J**	0.0400 UJ	0.0400 UJ	0.0400 UJ	0.0400 UJ	NR	**0.116 J**	0.0400 UJ	**4.92 J**	**69.8 J**	0.0400 UJ	**194 J**	**62.3 J**	**2.65 J**	**456**	**9.74**
MW-6A	MW-6A_022112	2/21/2012	P	**7.69 N**	0.755 U	NT	**244**	3.77 U	**8.63**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	**5.18**	**106**	3.77 U	**331 J**	**72.3**	3.77 U	**786**	**41.2**
MW-6A	MW-6A_050312	5/3/2012	P	**8.3 N**	**0.723 NJ**	NT	**195**	3.74 U	**6.63**	3.74 U	3.74 U	3.74 U	3.74 U	3.74 U	NR	3.74 U	3.74 U	**4.16**	**88**	3.74 U	**305**	**53.1**	3.74 U	**671**	**38.2**
MW-6A	MW-6A_08142012	8/14/2012	P	**8.45 N**	**0.868 N**	NT	**158**	3.77 U	**7.01**	3.77 U	3.77 U	3.77 U	3.77 U	3.77 U	NR	3.77 U	3.77 U	**5.3**	**84.5**	3.77 U	**175**	**59.2**	3.77 U	**508**	**37.5**
MW-7	MW-7_050312	5/3/2012	P	0.19 U	0.381 U	NT	**0.548**	0.0381 U	**0.312**	0.0381 U	0.0381 U	0.0381 U	0.0381 U	0.0381 U	NR	0.0381 U	0.0381 U	0.0381 U	**0.1**	0.0381 U	**1.95**	0.0381 U	0.0381 U	**3.14**	0.319
MW-10	MW-10-20100907-N	9/7/2010	P	**0.288 N**	0.476 U	0.100 U	**10.0**	**0.121**	**2.11**	**1.73**	**0.350**	NR	**0.0942**	NR	**0.683**	**1.27**	0.0377 U	**13.5**	**5.52**	**0.113**	**0.0773 J**	**4.60**	**8.96**	**49.1**	**5.90**
MW-10	MW-10	8/8/2011	P	**0.730 N**	0.467 U	NT	**66.7**	**0.375**	**2.77**	**0.308**	**0.0492**	NR	0.0374 U	NR	**0.0930**	**0.214**	0.0374 U	**5.79**	**32.7**	0.0374 U	**0.444**	**16.8**	**3.19**	**129**	**4.64**
MW-10	MW-10_022012	2/20/2012	P	**0.771 N**	0.374 U	NT	**65.7**	0.374 U	**2.88**	**0.427**	0.374 U	0.374 U	0.374 U	0.374 U	NR	0.374 U	0.374 U	**7.09**	**27**	0.374 U	**0.906 J**	**10.9**	**4.07**	**120**	**6.79**
MW-10	MW-10_050312	5/3/2012	P	**1.45 N**	0.381 U	NT	**146**	**1.06**	**4.51**	0.762 U	0.762 U	0.762 U	0.762 U	0.762 U	NR	0.762 U	0.762 U	**9.35**	**72.4**	0.762 U	1.52 U	**34.8**	**5.15**	**277**	**13.8**
MW-10	MW-10_08142012	8/14/2012	P	**1.03 N**	0.385 U	NT	**86.8**	0.755 U	**4.25**	0.755 U	0.755 U	0.755 U	0.755 U	0.755 U	NR	0.755 U	0.755 U	**9.13**	**47**	0.755 U	**2.38**	**25.3**	**5.26**	**184**	**11.6**
MW-19	MW-19	8/8/2011	P	**12.5 N**	10.1 U	NT	**128 J**	**2.95 J**	**8.51 J**	**2.07 J**	**0.447 J**	NR	**0.0906 J**	NR	**1.00 J**	**1.69 J**	0.0408 UJ	**16.0 J**	**83.1 J**	**0.119 J**	**4710 J**	**102 J**	**7.58 J**	**5,064**	**40.4**
MW-19	MW-19_022112	2/21/2012	P	**3.66 N**	0.755 U	NT	**108**	**2.21**	**8.22**	1.89 U	1.89 U	1.89 U	1.89 U	1.89 U	NR	1.89 U	1.89 U	**9.55**	**71.1**	1.89 U	**864 J**	**82.3**	**4.77**	**1,158**	**28.4**
MW-19	MW-19_050412	5/4/2012	P	**7.64 N**	0.784 U	NT	**166**	7.84 U	**9.68**	7.84 U	7.84 U	7.84 U	7.84 U	7.84 U	NR	7.84 U	7.84 U	**8.69**	**96.6**	7.84 U	**2300**	**98.1**	7.84 U	**2,718**	**81.3**
MW-19	MW-19_081412	8/14/2012	P	**7.49 N**	0.377 U	NT	**175**	7.48 U	**11.5**	7.48 U	7.48 U	7.48 U	7.48 U	7.48 U	NR	7.48 U	7.48 U	**7.95**	**105**	7.48 U	**1710**	**88.6**	7.48 U	**2,135**	**75.5**
MW-25	MW-25	8/9/2011	P	**4.04 N**	0.510 U	NT	**92.5 J**	**1.38 J**	**8.09 J**	**0.417 J**	**0.112 J**	NR	0.0404 UJ	NR	**0.208 J**	**0.353 J**	0.0404 UJ	**8.52 J**	**66.4 J**	0.0404 UJ	**651 J**	**95.2 J**	**4.10 J**	**928**	**14.4**
MW-25	MW-25_022112	2/21/2012	P	**10.1 N**	1.55 U	NT	**188**	**10.3**	**13.8**	3.88 U	3.88 U	3.88 U	3.88 U	3.88 U	NR	3.88 U	3.88 U	**28.7**	**114**	3.88 U	**1220 J**	**143**	**15.5**	**1,749**	**54.4**
MW-25	MW-25_050312	5/3/2012	P	**7.91 N**	**0.907 NJ**	NT	**96.3**	7.77 U	**9.96**	**8.44**	7.77 U	7.77 U	7.77 U	7.77 U	NR	7.77 U	7.77 U	**53.7**	**61**	7.77 U	**811**	**87.8**	**31.2**	**1,191**	**81.5**
MW-25	MW-25_08142012	8/14/2012	P	**9.51**	**0.554**	NT	**79.4**	7.55 U	**7.61**	7.55 U	7.55 U	7.55 U	7.55 U	7.55 U	NR	7.55 U	7.55 U	**20.2**	**51.6**	7.55 U	**1350**	**52.9**	**11.7**	**1,607**	**71.5**
Freshwater Ecotox Aquatic Habitat Goal Levels[1]				0.640	--	0.443	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DEQ Level II SLVs[2]				--	--	--	520	--	13	0.027	0.014	--	--	--	--	--	--	6.16	3.9	--	620	6.3	--	--	--

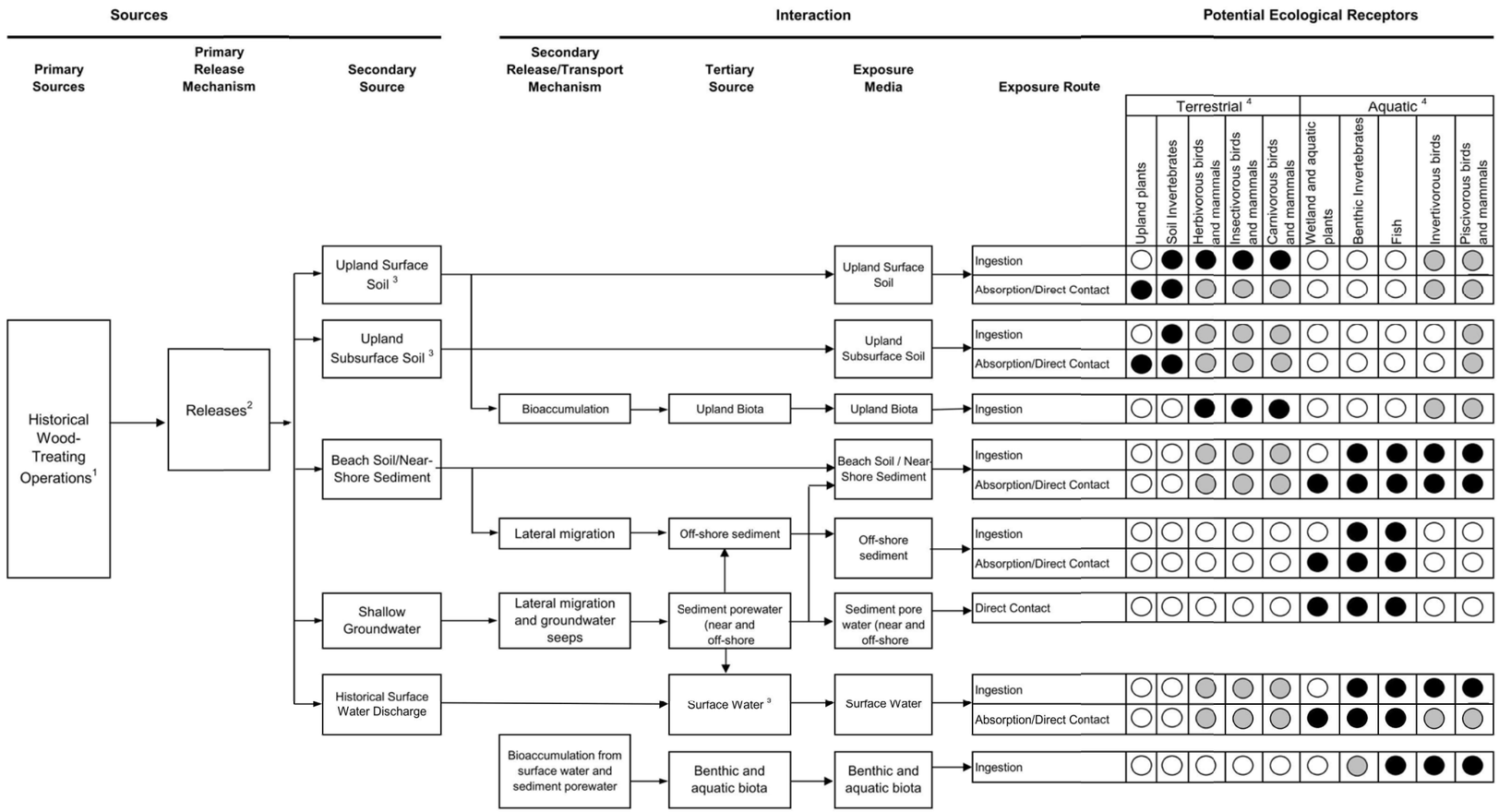
Notes:
BOLD indicates analyte was detected at or above the reporting limit.
Only nearshore monitoring well results are reported.
Data reported to reporting limit.
TPH was analyzed using methods NWTPH-Dx and NWTPH-Gx.
PAHs were analyzed using EPA Method 8270C-SIM or 8270D-SIM.
Total PAHs were calculated by summing the detected concentrations.
If an analyte was not detected, 1/2 the reporting limit was included in the sum.
[1]Freshwater Ecotox Aquatic Habitat Goal Levels from San Francisco Bay Regional Water Quality Control Board (Rev. 2, 2019).
[2]DEQ Level II Screening Level Values (SLVs) from Oregon Department of Environmental Quality (DEQ), 2007. Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment.
Shaded values indicate an exceedance of the associated screening level.
GWTU = groundwater toxic units. Calculated using final chronic values based on narcotic effects in benthic organisms.
ΣGWTU = sum of groundwater water toxic units. Calculated using half the detection limit (DL) for non-detect values.
ΣGWTU calculated using either 14 or 16 parent PAHs and may be biased low as a result.
ΣGWTU values greater than 1 are in **BOLD.**

Acronyms/Abbreviations:
µg/L = micrograms per liter
mg/L = milligrams per liter
EPA = United States Environmental Protection Agency
N = presumptively identified result
NJ = presumptively identified and estimated result
NT = not tested
P = primary sample
FD = field duplicate sample
TPH = total petroleum hydrocarbons
PAH - polycyclic aromatic hydrocarbons
U = not detected at or above the stated level
J = estimated value
-- = not analyzed or not established
NR = not reported

Cascadia Associates, LLC

FIGURES

ECOLOGICAL RISK ASSESSMENT (ERA) CONCEPTUAL SITE MODEL



Notes:

[1] The former wood-treating operations resulted in releases of contaminants of interest (mainly PAHs derived from creosote) and wastes to the historical (1919 through 1959) ground surface within Area 1.

[2] Specific releases are not documented; for the purpose of the RI, sources are defined based on knowledge of historical operations and investigation results that are indicative of creosote releases to the former ground surface (i.e., contamination near the Fill Zone/Native Soil contact). The main upland source area at the Site includes the former wood-treatment plant (i.e., retort pump house and retorts) and former creosote and fuel oil storage tanks located west of the wood treatment plant; collectively these are referred to as the "Former Operations Area" for the purposes of this report (Figure 1-2). This area generally is encompassed by the extent of DNAPL as defined through RI activities. Other ancillary operations immediately adjacent to Area 1 appear to have contributed to more localized shoreline and in-water areas of surface and/or near-surface sediment contamination, such as the historical wastewater discharge pipe, former hog fuel loading dock and hopper, and former transfer table dock.

[3] There have been no significant changes to the surface soil and subsurface soil data used in the 2006 ERA. Therefore, no revision to the ERA CSM for those exposure media has been completed.

[4] See the 2006 ERA for representative receptors.

- Complete Pathway
- Potentially Complete Pathway
- Incomplete Pathway

ECOLOGICAL RISK ASSESSMENT CONCEPTUAL SITE MODEL

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

NOVEMBER 2019

FIGURE **G-1**

DRAWN BY: BRJ/SO CHECKED BY: -

K:\11000\11200\11220\112203\dwg_SRI_Report_2019\10-2 - Ecological Risk Assessment Concept. Site Model.dwg - - - Jun 12, 2019 10:55am - brian.johnson

Observations:

- Biogenic Sheen
- Sheen - Degree Unknown
- No Sheen
- Petroleum Sheen - Slight
- Petroleum Sheen - Moderate to Heavy
- NAPL
- Area of Surface Petroleum Sheen - Slight
- Area of Surface Petroleum Sheen - Moderate to Heavy
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

INSET MAP

SEE INSET

Upper Milton Creek

Lower Milton Creek

Cove Area

Area 1 Dock

Area 2 Dock

Milton Creek

Scappoose Bay

0 50 100 Feet

N

0 100 200 Feet

NOTE:
Points labelled A & B are from visible sheen observed in surface sediment in October 2010.
2018 Imagery provided by Oregon Geospatial Enterprise Office.

SURFACE SEDIMENT EXHIBITING CREOSOTE SHEEN

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE G-2

DRAWN BY: PM CHECKED BY: JKH

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LEGEND:

- E&E Sediment Sample
- E&E Seep Solids Sample
- E&E Subsurface Soil Sample
- E&E Surface Soil Sample
- E&E Surface Water Sample
- HLA Borehole
- HLA Seep Solid Sample
- HLA Surface Soil Sample
- Near-Surface Soil Sample
- Phase II Hand-Augered Boring
- Phase II Rock Core Boring
- Phase II Soil Boring
- Phase II Surface Soil Sample
- Seep Water Sample obtained by Striplin Environmental Associates
- Surface Water Level Measurement Station
- Direct-Push Boring
- Sediment Sample (2002-2005)
- Composite Sediment Sample
- Existing Monitoring Well
- Former Site Feature
- Approximate Site Boundary

MW-16, MW-17A, SS-2, GP-01, SS-1, SS-3, BH-32, MW-15, SHI01B, BH-31, SS-6, GB-9, GB-5, GB-6, BH-29A, GB-7, GP-02, SP-1, BH-29, SS-4, SW-1, SD-1, SD-117, BH-27, BH-27A, BH-33, SHI01S, SS-7, HA-1, GP-09, MW-13A, MW-13B, SE-34, SD-119, SD-120, MW-8, MW-14, GB-8, GP-03, SHI02B, SS-9, MW-11, SS-35, SB-3, SS-8, BH-30, SS-1, SS-19, BH-23, SB-2, SS-5, SD-116, BH-24, GB-2, SS-11, GB-3, GP-07, GB-4, SS-36, MW-5, BH-26, SS-12, BH-28, GP-18, SB-1, GP-06, AREA 2, AREA 1, BH-19, BH-20, BH-22, SS-10, MW-9, GP-04, MW-18, MW-4A, GP-17, BH-21, SS-20, GB-1, BH-16, SS-13, MW-12B, MW-12A, SHI03B, MW-4B, RCB-2, BH-25, SS-17, GP-08, SD-113, SS-14, GP-05, SD-115, SS-21, BH-15, GP-20, SHI04B, GP-25, BH-13, SD-114, GP-19, SS-15, SEEP-3, SS-23, BH-17, BH-14, GP-10, SS-16, BH-18, SB-4/5, GP-26, RCB-3, MW-10, SP-2, GP-16, SS-22, BH-12, GP-11, BH-08, BH-10, SHI12B, SHI05B, MW-1, GP-24, SB-7/8/9, GP-21, BH-11, SS-18, SD-2, SW-2, BH-09, BH-07, SD-111, SD-139, MW-2, SS-24, BANK-1, BH-05A, SB-6, GP-13, BH-06, MW-7, SD-138, S-2, MW-3B, BH-04, SS-1, GP-12, SD-140, GP-15, BH-01, BH-02, BH-03, BH-05, SD-135, SD-144, SD-MC-A, SP-5, SP-3, MW-3A, MW-6A|B, SS-2, SD-112, RCB-1, SHI-06B-SEEP, SHI06B, GP-23, SP-4, GP-22, SD-136, SD-141, GP-14, SEEP-2, SHI07B, SD-134, SD-4, SW-4, SD-3, SW-3, SD-137, SD-131, SD-109, SD-118, SD-124, SD-MC-B, SD-129, SD-110, SD-103, SD-105, SD-107, SD-108, SHI09B, SD-125, S-1, SD-123, SD-6, SHI08B, SD-102, SD-128, SD-132, SD-133, SHI11B, SD-101, SD-127, SD-MC-C, SD-106, SD-126, SD-130, SD-104, SD-122, SD-MC-D, SHI10B, SD-143, SD-121, SD-MC-E, SD-100

Milton Creek

Pope & Talbot Bay

NOTE:
The locations of all features shown are approximate.
Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000).
2018 Imagery provided by Oregon Geospatial Enterprise Office.
Sample locations are from various sampling events described in the following reports:
- RI Report (GeoEngineers, 2000)
- Level II ERA (Bridgewater Group, 2003)
- ERA Summary Report (Bridgewater Group & Kennedy/Jenks Consultants, 2006)
- HHRA (Kennedy/Jenks Consultants, 2006)

Please see these reports for details regarding the sampling events and data from these sampling locations.
E&E: Ecology & Environment
HLA: Hardig Lawson Associates

N

0 100 200 Feet

RI SAMPLING LOCATIONS BEFORE INITIATING THE SUPPLEMENTAL RI IN 2010

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		G-3

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LEGEND:

- Existing Monitoring Well
- Direct-Push Boring
- Seep
- RI Sample Location
- Surface Water Level Measurement Station
- October 2011 Shoreline Observation:
- March 2011 Phase 1 TarGOST Boring
- July 2011 Phase 2 Sediment Boring

July/October 2012 Sampling Event:

- Sediment Porewater Sample Location
- Limited Sediment Investigation (LSI) Sample Location

October 2013 Dock Area Investigation:

- Hand Auger
- Pothole
- DAI Boring

September 2017 Sampling Event:

- Phase 3 Data Gap Investigation Location
- Former Site Feature
- Approximate Upland Site Boundary

Milton Creek

AREA 2
AREA 1

Scappoose Bay

NOTE:
2018 Imagery provided by Oregon Geospatial Enterprise Office.

N

0 75 150
Feet

SUPPLEMENTAL RI SAMPLING LOCATIONS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		G-4

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LEGEND:

- Existing Monitoring Well
- Nearshore Monitoring Well
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Subsurface DNAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Site Boundary
- Average Total PAH Concentration Isocontour (µg/L)* (darker shading indicates higher concentration)

Milton Creek

AREA 2
AREA 1

MW-5	
8/8/2011	0.493
2/21/2012	2.34
5/4/2012	3.96
8/15/2012	2.51

MW-22	
8/9/2011	9,924
2/20/2012	22,544
5/4/2012	13,682
8/15/2012	10,280

MW-9	
8/8/2011	245
2/20/2012	300
5/3/2012	233
8/14/2012	222

MW-18	
8/8/2011	0.541
2/20/2012	0.528
5/3/2012	0.460
8/14/2012	0.532

MW-4A	
8/8/2011	9.12
2/21/2012	24.3
5/4/2012	16.6
8/15/2012	15.1

MW-4B	
8/8/2011	1.73
2/21/2012	2.21
5/4/2012	0.62
8/15/2012	1.64

MW-21	
8/9/2011	289
2/21/2012	294
5/4/2012	356
8/15/2012	195

MW-23		
8/9/2011	267	
2/20/2012	334	
5/3/2012	255	
8/14/2012	265	

MW-10		
8/8/2011	129	**4.64**
2/20/2012	120	**6.79**
5/3/2012	277	**13.8**
8/14/2012	184	**11.6**

MW-20	
8/8/2011	84.2
2/21/2012	144
5/4/2012	266
8/15/2012	31.1

MW-1	
8/9/2011	438
2/20/2012	459
5/4/2012	635
8/14/2012	567

MW-24	
8/9/2011	5,745
2/21/2012	9,520
5/3/2012	4,628
8/14/2012	3,659

MW-7		
5/3/2012	3.14	0.319

MW-6A		
8/9/2011	456	**9.74**
2/21/2012	786	**41.2**
5/3/2012	671	**38.2**
8/14/2012	508	**37.5**

MW-19		
8/8/2011	5,064	**40.4**
2/21/2012	1,158	**28.4**
5/4/2012	2,718	**81.3**
8/14/2012	2,135	**75.5**

MW-2A	
8/9/2011	6,438
2/21/2012	11,401
5/3/2012	6,894
8/15/2012	6,672

MW-25		
8/9/2011	928	**14.4**
2/21/2012	1,749	**54.4**
5/3/2012	1,191	**81.5**
8/14/2012	1,607	**71.5**

MW-3B		
8/9/2011	9.21	0.495
2/21/2012	16.3	**1.59**
5/4/2012	11.3	**1.82**
8/15/2012	1.92	**1.39**

MW-3A		
8/9/2011	12,264	**291**
2/21/2012	15,895	**452**
5/4/2012	20,411	**594**
8/15/2012	16,763	**575**

MW-8, MW-11, MW-13A, MW-13B, MW-12B, MW-12A

1, 10, 100, 1,000, 10,000

N

0 75 150 Feet

*Isocontours estimated using average detected concentration at each well. Shallower interval "B" wells excluded from contouring.

Sample Date	Total PAH (µg/L)	ΣGWTU
8/9/2011	928	**14.4**
2/21/2012	1,749	**54.4**
5/3/2012	1,191	**81.5**
8/14/2012	1,607	**71.5**

NOTE:
Nearshore monitoring wells used to assess potential risk from discharge of groundwater to surface water.

Total PAHs were calculated by summing the detected concentrations. If an analyte was not detected, 1/2 the reporting limit was included in the sum.

GWTU = groundwater toxic units. Calculated using final chronic values based on narcotic effects in benthic organisms.

ΣGWTU = sum of groundwater water toxic units. Calculated using half the detection limit (DL) for non-detect values.

ΣGWTU calculated using either 14 or 16 parent PAHs and may be biased low as a result.

ΣGWTU values greater than 1 are in BOLD.

µg/L = micrograms per liter

2018 Imagery provided by Oregon Geospatial Enterprise Office.

Dioxin Source Area

DRAFT

TOTAL PAH DETECTED AND ΣGWTU IN GROUNDWATER 2011-2012

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-006

DECEMBER 2019

FIGURE G-5

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LEGEND:

- Existing Monitoring Well
- Nearshore Monitoring Well
- Former Site Feature
- Average Diesel Range Hydrocarbon Concentration Isocontour (mg/L)* (darker shading indicates higher concentration)
- Approximate Site Boundary
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps

Milton Creek

AREA 1
AREA 2

MW-4A

8/8/2011	0.236 U	0.472 U
2/21/2012	**0.287 N**	**0.391 N**
5/4/2012	**0.238 N**	**0.53**
8/15/2012	**0.191 N**	0.374 U

MW-5

8/8/2011	0.238 U	0.476 U
2/21/2012	0.187 U	0.374 U
5/4/2012	0.19 U	**0.477**
8/15/2012	0.187 U	0.374 U

MW-4B

8/8/2011	0.236 U	0.472 U
2/21/2012	0.189 U	0.377 U
5/4/2012	0.187 U	0.374 U
8/15/2012	0.196 U	0.392 U

MW-21

8/9/2011	**3.65 N**	0.467 U
2/21/2012	**1.38 N**	0.377 U
5/4/2012	**1.69 N**	0.374 U
8/15/2012	**3.03 N**	0.377 U

MW-20

8/8/2011	**0.870 N**	0.495 U
2/21/2012	**0.657 N**	0.377 U
5/4/2012	**1.18 N**	0.762 U
8/15/2012	**0.385 N**	0.377 U

MW-1

8/9/2011	**4.48 N**	0.472 U
2/20/2012	**4.56 N**	**0.519 N**
5/4/2012	**5.37 N**	0.755 U
8/14/2012	**8.49 N**	**0.503 N**

MW-2A

8/9/2011	**26.1 N**	9.90 U
2/21/2012	**76.3 N**	2.99 U
5/3/2012	**81.1 N**	**3.81 N**
8/15/2012	**89.9 N**	1.51 U

MW-19

8/8/2011	**12.5 N**	10.1 U
2/21/2012	**3.66 N**	0.755 U
5/4/2012	**7.64 N**	0.784 U
8/14/2012	**7.49 N**	0.377 U

MW-3B

8/9/2011	0.236 U	0.472 U
2/21/2012	**0.349 N**	0.377 U
5/4/2012	0.187 U	**0.394**
8/15/2012	**0.732**	0.374 U

MW-3A

8/9/2011	**57.1 N**	10.1 U
2/21/2012	**49.1 N**	**3.26 N**
5/4/2012	**113 N**	15 U
8/15/2012	**116 N**	3.02 U

MW-8

MW-11

MW-9

8/8/2011	**1.52 N**	0.467 U
2/20/2012	**2.55 N**	0.755 U
5/3/2012	**2.18 N**	0.374 U
8/14/2012	**2.34 N**	0.374 U

MW-13A **MW-13B**

MW-18

8/8/2011	0.234 U	0.467 U
2/20/2012	0.187 U	0.374 U
5/3/2012	0.187 U	0.374 U
8/14/2012	0.187 U	0.374 U

MW-12B **MW-12A**

MW-23

8/9/2011	**0.949 N**	0.472 U
2/20/2012	**1.1 N**	0.748 U
5/3/2012	**1.19 N**	**0.459 NJ**
8/14/2012	**1.15**	0.374 U

MW-22

8/9/2011	**23.8 N**	9.35 U
2/20/2012	**40.9 N**	1.51 U
5/4/2012	**44.6 N**	3.05 U
8/15/2012	**41.1 N**	1.51 U

MW-10

8/8/2011	**0.730 N**	0.467 U
2/20/2012	**0.771 N**	0.374 U
5/3/2012	**1.45 N**	0.381 U
8/14/2012	**1.03 N**	0.385 U

MW-24

8/9/2011	**11.5 N**	2.34 U
2/21/2012	**12.4 N**	1.5 U
5/3/2012	**10.8 N**	**0.673 NJ**
8/14/2012	**10.9**	**0.902**

MW-7

5/3/2012	0.19 U	0.381 U

MW-6A

8/9/2011	**4.28 N**	2.55 U
2/21/2012	**7.69 N**	0.755 U
5/3/2012	**8.3 N**	**0.723 NJ**
8/14/2012	**8.45 N**	**0.868 N**

MW-25

8/9/2011	**4.04 N**	0.510 U
2/21/2012	**10.1 N**	1.55 U
5/3/2012	**7.91 N**	**0.907 NJ**
8/14/2012	**9.51**	**0.554**

1

10

Scappoose Bay

*Isocontours estimated using average detected concentration at each well. Shallower interval "B" wells excluded from contouring.

Sample Date	Diesel-Range Hydrocarbons (mg/L)	Oil-Range Hydrocarbons (mg/L)
8/9/2011	**4.48 N**	0.472 U
2/20/2012	**4.56 N**	**0.519 N**
5/4/2012	**5.37 N**	0.755 U
8/14/2012	**8.49 N**	**0.503 N**

NOTE:
BOLD indicates analyte was detected at or above the reporting limit
Shading indicates an exceedance of the Freshwater Ecotox Habitat Goal Level (HGL) for diesel-range hydrocarbons (0.64 mg/L). HGL from San Francisco Bay Regional Water Quality Board (Rev. 2, 2019).
Nearshore monitoring wells used to assess potential risk from discharge of groundwater to surface water

mg/L = milligrams per liter
U = not detected at or above the stated level
N = Presumptively identified result
NJ = Presumptively identified and estimated result

2018 Imagery provided by
Oregon Geospatial Enterprise Office.

N

0 75 150
Feet

DRAWN BY: PM CHECKED BY: JKH

DRAFT

TOTAL PETROLEUM HYDROCARBONS DETECTED IN GROUNDWATER 2011-2012

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE G-6

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LEGEND:

- October 2012 Sediment Porewater Sample Location
- July 2012 Sediment Porewater Sample Location
- Sediment Porewater Attempted Sample Location
- October 2012 Limited Sediment Investigation (LSI) Sample Location
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Upper Milton Creek

Lower Milton Creek

Milton Creek

Area 1 Dock

Cove Area

Scappoose Bay

PWS-17	Jul 12	Oct 12
	-	-
	-	0.34
	-	-

PWS-14	Jul 12	Oct 12
	-	-
	-	-
	-	9.7

PWS-29	Jul 12	Oct 12
	-	-
	-	-
	-	27

PWS-30	Jul 12	Oct 12
	-	-
	-	-
	-	0.28

PWS-11B	Jul 12	Oct 12
	-	-
	-	-
	0.60	-

PWS-11	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.24

PWS-07	Jul 12	Oct 12
	-	-
	-	-
	0.69	1.4

LSI-07B / LSI-09	Oct 12
	-
	-
	1.8

PWS-16	Jul 12	Oct 12
	-	-
	-	-
	0.17	0.16

PWS-16B	Jul 12	Oct 12
	-	-
	-	-
	0.53	-

PWS-10	Jul 12	Oct 12
	-	-
	-	-
	0.60	0.40

PWS-12	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.11

LSI-01	Oct 12
	-
	-
	0.16

PWS-09	Jul 12	Oct 12
	-	-
	-	-
	0.42	0.23

PWS-08	Jul 12	Oct 12
	-	-
	-	-
	0.69	0.37

LSI-02	Oct 12
	-
	-
	0.21

PWS-06	Jul 12	Oct 12
	-	-
	-	-
	0.45	0.28

LSI-11	Oct 12
	-
	-
	3.9

PWS-22	Jul 12	Oct 12
	-	-
	-	-
	0.40	-
	-	-
	0.42	2.8

PWS-23	Jul 12	Oct 12
	-	-
	-	-
	0.077	0.10

PWS-02	Jul 12	Oct 12
	0.40	-
	-	-
	109	60

LSI 24	Oct 12
	-
	-
	0.21

PWS-01	Jul 12	Oct 12
	-	-
	-	-
	0.85	0.62

PWS-28	Jul 12	Oct 12
	-	-
	-	-
	-	0.29

PWS-15	Jul 12	Oct 12
	-	-
	-	-
	0.076	0.25

PWS-26	Jul 12	Oct 12
	-	-
	-	-
	0.42	0.48

PWS-25	Jul 12	Oct 12
	-	-
	-	0.35
	0.68	-

PWS-03	Jul 12	Oct 12
	-	-
	-	-
	0.74	0.77

LSI-20	Oct 12
	-
	-
	0.22

PWS-04	Jul 12	Oct 12
	-	-
	-	-
	0.54	0.47

PWS-05	Jul 12	Oct 12
	-	-
	-	-
	0.57	0.22

PWS-21

PWS-20	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.33

PWS-18	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.44

PWS-19	Jul 12	Oct 12
	-	-
	-	-
	0.33	0.31

PWS-20	Jul 12	Oct 12
	-	-
	-	-
	0.51	0.33

0 500 1,000 Feet

0 75 150 Feet

N

SUM OF INTERSTITIAL WATER TOXIC UNITS (ΣIWTU) RESULTS

DEPTH INTERVAL (INCHES BELOW MUDLINE)	SAMPLING EVENT Jul 12	Oct 12
1" - 4"	0.76	-
4" - 8"	-	-
8" - 11"	0.76	**6.1**

BOLD = ΣIWTU > 1

NOTE:
The locations of all features shown are approximate. Site feature locations derived from various figures in the 2000 RI Report (GeoEngineers, 2000). 2016 Imagery from live web service provided by ESRI online mapping system.

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JULY & OCTOBER 2012 ΣIWTU RESULTS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE **G-8**

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Area 1 Dock

Upper Milton Creek

Cove Area

Milton Creek

Lower Milton Creek

Scappoose Bay

PWS-090517-7	
ΣIWTU	0.04

PWS-090517-8	
ΣIWTU	0.09

PWS-090517-9	
ΣIWTU	0.05
ΣSWTU	**1.07**

PWS-090517-10	
ΣIWTU	0.13
ΣSWTU	**1.07**

PWS-090517-11	
ΣIWTU	0.08

PWS-090617-12	
ΣIWTU	0.33
ΣSWTU	**1.04**

PWS-090617-13	
ΣIWTU	0.14
ΣSWTU	**1.04**

PWS-090617-14	
ΣIWTU	0.06
ΣSWTU	0.467

PWS-090617-15	
ΣIWTU	0.07

PWS-090517-6	
ΣIWTU	0.04

PWS-090617-2	
ΣIWTU	**16.2**
ΣSWTU	0.340

PWS-090517-1	
ΣIWTU	0.08

PWS-090517-5	
ΣIWTU	0.19

PWS-090517-4	
ΣIWTU	0.05
ΣSWTU	0.814

PWS-090517-3	
ΣIWTU	0.02
ΣSWTU	0.607

N

0 75 150

Feet

DRAWN BY: PM CHECKED BY: JKH

DRAFT

LEGEND:

- Phase 3 Data Gap Investigation Location
- Former Site Feature
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Former Transfer Table Dock
- Approximate Offshore Area
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Depth in Ft.: 10, 5, 0, -5, -10

NOTES:
All values are in toxic units (TU) based on narcotic effects in benthic organisms.
ΣIWTU = Summation of Interstitial Water Toxic Units
ΣSWTU = Summation of Surface Water Toxic Units
Values in **bold** are greater than 1.
ΣIWTU calculations are for measured concentrations within the biologically active zone 3"-8" below mudline.
ΣSWTU are for water 12" above the mudline.
The ΣIWTU and ΣSWTU are based on direct measurements of 34 PAHs in sediment porewater and surface water samples.
Regarding non-detected analytes, the full detection limits were used in the ΣIWTU and ΣSWTU calculations.

SEPTEMBER 2017 ΣIWTU & ΣSWTU RESULTS

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER 0034-001-005

DECEMBER 2019

FIGURE G-9

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LEGEND:

Total PAHs including Homologues (mg/kg):

- < 1.6
- 1.7 - 10.0 (Below TEC)
- 10.1 - 50.0 (Above PEC)
- >50.1

Measured Porewater (Toxic Units):

- <1
- >1
- Surface Porewater Sample
- Area of Surface Petroleum Sheen - Slight
- Area of Surface Petroleum Sheen - Moderate to Heavy
- Areas of Significant Creosote Contaminated Wood Debris
- Inferred Extent of Upland NAPL
- Area of Intermittent Groundwater/NAPL Seeps
- Approximate Upland Site Boundary (Ordinary High Water 14 ft. NAVD 88)

Milton Creek

Upper Milton Creek

Area 1 Dock

Cove Area

Lower Milton Creek

Scappoose Bay

PWS-090517-3
PWS-090517-4
PWS-090517-5
PWS-090517-6
PWS-090517-7
PWS-090517-8
PWS-090517-9
PWS-090517-10
PWS-090517-11
PWS-090517-12
PWS-090517-14
PWS-090617-1
PWS-090617-2
PWS-090617-12
PWS-090617-13
PWS-090617-15

N

0 75 150 Feet

NOTE:
TEC = Threshold Effects Concentration
PEC = Probable Effects Concentration
mg/kg = milligrams per kilogram
PAHs = Polycyclic Aromatic Hydrocarbons
Total PAHs = Sum of 64 parent and alkylated homologues in mg/kg. Non-detects are included in the sum at the laboratory reported limit.
Porewater PAH IWTUs are in surface and subsurface.
Total PAHs in bulk sediment in surface include 34 parent and alkylated PAHs.
ΣIWTU = Summation of Interstitial Water Toxic Units
ΣSWTU = Summation of Surface Water Toxic Units
2018 Imagery provided by Oregon Geospatial Enterprise Office.

2017 DATA GAP INVESTIGATION RESULTS

COLLOCATION OF TOTAL PAHs IN SEDIMENT, ΣIWTU, ΣSWTU, AND PETROLEUM SHEEN IN SURFACE SEDIMENT

FORMER POPE & TALBOT WOOD-TREATING SITE

Cascadia Associates, LLC

PROJECT NUMBER	0034-001-005	FIGURE
DECEMBER 2019		G-10

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ATTACHMENT A

Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for 2012 Sediment Data Based on One-Carbon Partitioning Model

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes[4]
							Historical Data (1996 - 2005)														
SD-MC-A _20040601	SD-MC-A	MC	6/1/2004	N	0	4	0.0198	8.60	0.026 U	0.086	0.15	0.48	0.9	0.58	NT	0.91	0.54	NT	NT	NT	0.026 U
SD-MC-B _20040601	SD-MC-B	MC	6/1/2004	N	0	4	0.0092	0.22	0.012	0.005 U	0.005 U	0.0052	0.0095	0.0096	NT	0.014	0.0063	NT	NT	NT	0.012
SD-MC-C _20040601	SD-MC-C	MC	6/1/2004	N	0	4	0.0156	1.13	0.052	0.011	0.035	0.049	0.066	0.053	NT	0.082	0.036	NT	NT	NT	0.015
SD-MC-D _20040601	SD-MC-D	MC	6/1/2004	N	0	4	0.028	0.50	0.016	0.0055 U	0.015	0.033	0.026	0.025	NT	0.02	0.019	NT	NT	NT	0.0075
SD-MC-E _20040601	SD-MC-E	MC	6/1/2004	N	0	4	0.0285	2.98	0.041	0.037	0.27	0.15	0.31	0.3	NT	0.2	0.17	NT	NT	NT	0.02
SD-100 _20031201	SD-100	SB	12/1/2003	N	0	4	0.0217	1.06	0.013	0.0056 U	0.037	0.079	0.068	0.075	NT	0.052	0.053	NT	NT	NT	0.013
SD-101 _20031201	SD-101	SB	12/1/2003	N	0	4	0.0218	1.51	0.036	0.0067 U	0.048	0.087	0.078	0.086	NT	0.059	0.059	NT	NT	NT	0.05
SD-102 _20031201	SD-102	SB	12/1/2003	N	0	4	0.0254	1.29	0.0093	0.0078 U	0.029	0.086	0.081	0.11	NT	0.056	0.082	NT	NT	NT	0.0095
SD-103 _20031201	SD-103	SB	12/1/2003	N	0	4	0.0212	3.45	0.055	0.017	0.093	0.3	0.24	0.36	NT	0.097	0.27	NT	NT	NT	0.048
SD-103-A _20040601	SD-103-A	SB	6/1/2004	N	0	4	0.0287	12.24	0.37	0.021	0.71	0.42	0.11	0.18	NT	0.062	0.16	NT	NT	NT	0.36
SD-103-B. _20040601	SD-103-B	SB	6/1/2004	N	0	4	0.0243	1.48	0.025	0.011	0.065	0.087	0.074	0.09	NT	0.066	0.08	NT	NT	NT	0.034
SD-103-C _20040601	SD-103-C	SB	6/1/2004	N	0	4	0.0262	3.76	0.069	0.02	0.2	0.25	0.17	0.25	NT	0.096	0.2	NT	NT	NT	0.11
SD-104_20031201	SD-104	SB	12/1/2003	N	0	4	0.0176	4.48	0.092	0.017	0.21	0.25	0.17	0.23	NT	0.11	0.16	NT	NT	NT	0.14
SD-104-A _20040601	SD-104-A	SB	6/1/2004	N	0	4	0.0232	0.66	0.0075	0.0064 U	0.026	0.043	0.042	0.051	NT	0.038	0.043	NT	NT	NT	0.0093
SD-104-B _20040601	SD-104-B	SB	6/1/2004	N	0	4	0.0247	0.69	0.0087	0.0067 U	0.026	0.044	0.036	0.05	NT	0.031	0.037	NT	NT	NT	0.01
SD-104-C _20040601	SD-104-C	SB	6/1/2004	N	0	4	0.0232	0.67	0.0078	0.0066 U	0.03	0.044	0.037	0.049	NT	0.033	0.037	NT	NT	NT	0.0095
SD-105_20031201	SD-105	SB	12/1/2003	N	0	4	0.0216	2.41	0.083	0.01	0.11	0.14	0.12	0.13	NT	0.089	0.098	NT	NT	NT	0.07
SD-105-A _20040601	SD-105-A	SB	6/1/2004	N	0	4	0.0267	1.19	0.02	0.0097	0.06	0.075	0.054	0.077	NT	0.044	0.058	NT	NT	NT	0.024
SD-105-B _20040601	SD-105-B	SB	6/1/2004	N	0	4	0.026	4.08	0.93	0.022	0.29	0.052	0.036	0.05	NT	0.026	0.045	NT	NT	NT	0.02
SD-105-C _20040601	SD-105-C	SB	6/1/2004	N	0	4	0.026	0.60	0.011	0.0066 U	0.027	0.035	0.027	0.038	NT	0.022	0.031	NT	NT	NT	0.01
SD-106 _20031201	SD-106	SB	12/1/2003	N	0	4	0.021	2.17	0.027	0.0085	0.085	0.16	0.16	0.17	NT	0.099	0.13	NT	NT	NT	0.032
SD-108 _20031201	SD-108	SB	12/1/2003	N	0	4	0.0137	18.51	0.78	0.038	1.1	0.85	0.51	0.64	NT	0.24	0.45	NT	NT	NT	0.7
SD-110_20031201	SD-110	SB	12/1/2003	N	0	4	0.0175	12.43	0.56	0.029	0.52	0.75	0.56	0.73	NT	0.22	0.5	NT	NT	NT	0.22
SD-112 _20031201	SD-112	SB	12/1/2003	N	0	4	0.0103	5.10	0.15	0.017	0.23	0.27	0.26	0.31	NT	0.16	0.21	NT	NT	NT	0.11
SD-112-A _20040601	SD-112-A	SB	6/1/2004	N	0	4	0.0152	4.00	0.063	0.025	0.19	0.15	0.26	0.32	NT	0.17	0.24	NT	NT	NT	0.069
SD-112-B _20040601	SD-112-B	SB	6/1/2004	N	0	4	0.0334	12.01	0.18	0.065	0.45	0.86	0.89	1.2	NT	0.42	1	NT	NT	NT	0.19
SD-112-C _20040601	SD-112-C	SB	6/1/2004	N	0	4	0.0256	8.87	0.1	0.049	0.31	0.61	0.63	0.83	NT	0.36	0.62	NT	NT	NT	0.069
SD-113 _20031201	SD-113	SB	12/1/2003	N	0	4	0.0022	0.17	0.005 U	0.005 U	0.005 U	0.015	0.018	0.012	NT	0.012	0.012	NT	NT	NT	0.005 U
SD-114 _20031201	SD-114	SB	12/1/2003	N	0	4	0.0168	0.63	0.0063	0.0059 U	0.022	0.039	0.058	0.049	NT	0.045	0.04	NT	NT	NT	0.006
SD-115_20031201	SD-115	SB	12/1/2003	N	0	4	0.0069	0.15	0.008 U	0.007 U	0.005 U	0.009	0.012	0.011	NT	0.0091	0.0088	NT	NT	NT	0.006 U
SD-116 _20031201	SD-116	SB	12/1/2003	N	0	4	0.01	0.51	0.0053	0.0049 U	0.0079	0.031	0.059	0.039	NT	0.052	0.033	NT	NT	NT	0.0049 U
SD-117 _20031201	SD-117	SB	12/1/2003	N	0	4	0.0107	2.67	0.034	0.014	0.078	0.2	0.25	0.18	NT	0.18	0.15	NT	NT	NT	0.035
SD-117-A _20040601	SD-117-A	SB	6/1/2004	N	0	4	0.0018	0.11	0.005 U	0.005 U	0.005 U	0.0082	0.009	0.0087	NT	0.0071	0.0083	NT	NT	NT	0.005 U
SD-117-B _20040601	SD-117-B	SB	6/1/2004	N	0	4	0.003	0.16	0.0082	0.0037 U	0.0064	0.0063	0.0077	0.0091	NT	0.0071	0.006	NT	NT	NT	0.0068
SD-117-C _20040601	SD-117-C	SB	6/1/2004	N	0	4	0.0076	1.00	0.015	0.0073	0.029	0.055	0.07	0.079	NT	0.054	0.066	NT	NT	NT	0.02
SD-119_20031201	SD-119	SB	12/1/2003	N	0	4	0.011	1.40	0.017	0.0096	0.029	0.088	0.15	0.12	NT	0.11	0.099	NT	NT	NT	0.019
SD-119-A _20040601	SD-119-A	SB	6/1/2004	N	0	4	0.0169	2.38	0.27	0.0076	0.096	0.083	0.038	0.046	NT	0.021	0.035	NT	NT	NT	0.054
SD-119-B _20040601	SD-119-B	SB	6/1/2004	N	0	4	0.0207	1.95	0.089	0.017	0.064	0.084	0.079	0.066	NT	0.057	0.059	NT	NT	NT	0.094
SD-119-C _20040601	SD-119-C	SB	6/1/2004	N	0	4	0.0303	2.05	0.12	0.023	0.087	0.05	0.031	0.029	NT	0.028	0.026	NT	NT	NT	0.1
SD-120 _20031201	SD-120	SB	12/1/2003	N	0	4	0.0019	0.13	0.005 U	0.005 U	0.005 U	0.0094	0.015	0.0091	NT	0.013	0.0096	NT	NT	NT	0.005 U
SD-121 _20040601	SD-121	SB	6/1/2004	N	0	4	0.018	0.75	0.01	0.005	0.022	0.052	0.062	0.061	NT	0.041	0.05	NT	NT	NT	0.014
SD-122 _20040601	SD-122	SB	6/1/2004	N	0	4	0.0171	3.22	0.1	0.0099	0.15	0.16	0.096	0.11	NT	0.058	0.099	NT	NT	NT	0.077

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
							Historical Data (1996 - 2005)												
SD-MC-A _20040601	SD-MC-A	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.71
SD-MC-B _20040601	SD-MC-B	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0081
SD-MC-C _20040601	SD-MC-C	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.073
SD-MC-D _20040601	SD-MC-D	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.05
SD-MC-E _20040601	SD-MC-E	MC	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.26
SD-100_20031201	SD-100	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.14
SD-101 _20031201	SD-101	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.13
SD-102 _20031201	SD-102	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.14
SD-103 _20031201	SD-103	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.59
SD-103-A _20040601	SD-103-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.46
SD-103-B. _20040601	SD-103-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.13
SD-103-C _20040601	SD-103-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.47
SD-104_20031201	SD-104	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.3
SD-104-A _20040601	SD-104-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.081
SD-104-B _20040601	SD-104-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.072
SD-104-C _20040601	SD-104-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.087
SD-105_20031201	SD-105	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.19
SD-105-A _20040601	SD-105-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.13
SD-105-B _20040601	SD-105-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.097
SD-105-C _20040601	SD-105-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.058
SD-106 _20031201	SD-106	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.28
SD-108 _20031201	SD-108	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.2
SD-110_20031201	SD-110	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.1
SD-112 _20031201	SD-112	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.42
SD-112-A _20040601	SD-112-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.38
SD-112-B _20040601	SD-112-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.5
SD-112-C _20040601	SD-112-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.91
SD-113 _20031201	SD-113	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.019
SD-114 _20031201	SD-114	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.072
SD-115_20031201	SD-115	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.013
SD-116 _20031201	SD-116	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.041
SD-117 _20031201	SD-117	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.36
SD-117-A _20040601	SD-117-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0092
SD-117-B _20040601	SD-117-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.01
SD-117-C _20040601	SD-117-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.14
SD-119_20031201	SD-119	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.14
SD-119-A _20040601	SD-119-A	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.099
SD-119-B _20040601	SD-119-B	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.12
SD-119-C _20040601	SD-119-C	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.068
SD-120 _20031201	SD-120	SB	12/1/2003	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.013
SD-121 _20040601	SD-121	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.056
SD-122 _20040601	SD-122	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.29

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
							Historical Data (1996 - 2005)									
SD-MC-A _20040601	SD-MC-A	MC	6/1/2004	N	0	4	0.05	1.2	0.056	0.7	0.026 U	NT	1.0	1.2	NT	0.026 U
SD-MC-B _20040601	SD-MC-B	MC	6/1/2004	N	0	4	0.005 U	0.02	0.011	0.012	0.051	NT	0.023	0.017	NT	0.012
SD-MC-C _20040601	SD-MC-C	MC	6/1/2004	N	0	4	0.007	0.17	0.049	0.064	0.013	NT	0.19	0.16	NT	0.015
SD-MC-D _20040601	SD-MC-D	MC	6/1/2004	N	0	4	0.0055 U	0.073	0.019	0.016	0.014	NT	0.077	0.085	NT	0.0075
SD-MC-E _20040601	SD-MC-E	MC	6/1/2004	N	0	4	0.037	0.36	0.055	0.23	0.056	NT	0.17	0.31	NT	0.02
SD-100_20031201	SD-100	SB	12/1/2003	N	0	4	0.0076	0.17	0.019	0.062	0.03	NT	0.085	0.15	NT	0.013
SD-101 _20031201	SD-101	SB	12/1/2003	N	0	4	0.0082	0.23	0.048	0.07	0.14	NT	0.18	0.2	NT	0.05
SD-102 _20031201	SD-102	SB	12/1/2003	N	0	4	0.0085	0.24	0.013	0.067	0.02	NT	0.081	0.25	NT	0.0095
SD-103 _20031201	SD-103	SB	12/1/2003	N	0	4	0.02	0.41	0.063	0.14	0.044	NT	0.28	0.42	NT	0.048
SD-103-A _20040601	SD-103-A	SB	6/1/2004	N	0	4	0.012	3.5	0.48	0.065	0.33	NT	2.9	2.1	NT	0.36
SD-103-B. _20040601	SD-103-B	SB	6/1/2004	N	0	4	0.0091	0.26	0.039	0.059	0.07	NT	0.17	0.21	NT	0.034
SD-103-C _20040601	SD-103-C	SB	6/1/2004	N	0	4	0.02	0.6	0.11	0.11	0.23	NT	0.42	0.43	NT	0.11
SD-104_20031201	SD-104	SB	12/1/2003	N	0	4	0.022	0.99	0.098	0.16	0.22	NT	0.55	0.76	NT	0.14
SD-104-A _20040601	SD-104-A	SB	6/1/2004	N	0	4	0.0064 U	0.1	0.011	0.034	0.02	NT	0.056	0.09	NT	0.0093
SD-104-B _20040601	SD-104-B	SB	6/1/2004	N	0	4	0.0067 U	0.14	0.012	0.026	0.022	NT	0.058	0.11	NT	0.01
SD-104-C _20040601	SD-104-C	SB	6/1/2004	N	0	4	0.0066 U	0.11	0.012	0.028	0.02	NT	0.058	0.099	NT	0.0095
SD-105_20031201	SD-105	SB	12/1/2003	N	0	4	0.014	0.39	0.084	0.11	0.17	NT	0.31	0.29	NT	0.07
SD-105-A _20040601	SD-105-A	SB	6/1/2004	N	0	4	0.0067 U	0.22	0.03	0.038	0.061	NT	0.12	0.17	NT	0.024
SD-105-B _20040601	SD-105-B	SB	6/1/2004	N	0	4	0.0065 U	0.38	0.74	0.025	0.041	NT	1.1	0.22	NT	0.02
SD-105-C _20040601	SD-105-C	SB	6/1/2004	N	0	4	0.0064 U	0.12	0.014	0.021	0.022	NT	0.067	0.09	NT	0.01
SD-106 _20031201	SD-106	SB	12/1/2003	N	0	4	0.016	0.33	0.037	0.13	0.067	NT	0.16	0.28	NT	0.032
SD-108 _20031201	SD-108	SB	12/1/2003	N	0	4	0.05	3.5	1.1	0.35	1.3	NT	3.3	2.4	NT	0.7
SD-110_20031201	SD-110	SB	12/1/2003	N	0	4	0.055	2.5	0.59	0.34	0.36	NT	1.7	1.7	NT	0.22
SD-112 _20031201	SD-112	SB	12/1/2003	N	0	4	0.028	0.87	0.2	0.22	0.2	NT	0.76	0.68	NT	0.11
SD-112-A _20040601	SD-112-A	SB	6/1/2004	N	0	4	0.034	0.69	0.092	0.2	0.16	NT	0.47	0.49	NT	0.069
SD-112-B _20040601	SD-112-B	SB	6/1/2004	N	0	4	0.11	2.2	0.28	0.54	0.3	NT	0.85	0.97	NT	0.19
SD-112-C _20040601	SD-112-C	SB	6/1/2004	N	0	4	0.083	1.8	0.16	0.43	0.12	NT	0.83	0.96	NT	0.069
SD-113 _20031201	SD-113	SB	12/1/2003	N	0	4	0.005 U	0.02	0.005 U	0.015	0.005 U	NT	0.005 U	0.022	NT	0.005 U
SD-114 _20031201	SD-114	SB	12/1/2003	N	0	4	0.0059 U	0.081	0.0085	0.05	0.016	NT	0.039	0.091	NT	0.006
SD-115_20031201	SD-115	SB	12/1/2003	N	0	4	0.005 U	0.023	0.01 U	0.011	0.005 U	NT	0.0086	0.024	NT	0.006 U
SD-116 _20031201	SD-116	SB	12/1/2003	N	0	4	0.0061	0.057	0.0062	0.056	0.012	NT	0.033	0.07	NT	0.0049 U
SD-117 _20031201	SD-117	SB	12/1/2003	N	0	4	0.023	0.31	0.046	0.22	0.085	NT	0.2	0.3	NT	0.035
SD-117-A _20040601	SD-117-A	SB	6/1/2004	N	0	4	0.005 U	0.018	0.005 U	0.0062	0.005 U	NT	0.005 U	0.015	NT	0.005 U
SD-117-B _20040601	SD-117-B	SB	6/1/2004	N	0	4	0.0037 U	0.019	0.0094	0.0068	0.013	NT	0.029	0.016	NT	0.0068
SD-117-C _20040601	SD-117-C	SB	6/1/2004	N	0	4	0.0076	0.12	0.021	0.051	0.065	NT	0.1	0.1	NT	0.02
SD-119_20031201	SD-119	SB	12/1/2003	N	0	4	0.013	0.15	0.022	0.12	0.049	NT	0.095	0.17	NT	0.019
SD-119-A _20040601	SD-119-A	SB	6/1/2004	N	0	4	0.0044	0.51	0.14	0.022	0.14	NT	0.46	0.35	NT	0.054
SD-119-B _20040601	SD-119-B	SB	6/1/2004	N	0	4	0.0099	0.28	0.093	0.056	0.28	NT	0.27	0.23	NT	0.094
SD-119-C _20040601	SD-119-C	SB	6/1/2004	N	0	4	0.005 U	0.34	0.15	0.022	0.27	NT	0.44	0.26	NT	0.1
SD-120 _20031201	SD-120	SB	12/1/2003	N	0	4	0.005 U	0.0089	0.005 U	0.013	0.005 U	NT	0.005 U	0.016	NT	0.005 U
SD-121 _20040601	SD-121	SB	6/1/2004	N	0	4	0.0066	0.11	0.017	0.04	0.027	NT	0.091	0.088	NT	0.014
SD-122 _20040601	SD-122	SB	6/1/2004	N	0	4	0.0099	0.71	0.15	0.059	0.12	NT	0.56	0.46	NT	0.077

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes[4]
Historical Data (1996 - 2005)																					
SD-123 _20040601	SD-123	SB	6/1/2004	N	0	4	0.0166	3.00	0.04	0.013	0.12	0.31	0.22	0.21	NT	0.11	0.23	NT	NT	NT	0.026
SD-124 _20040601	SD-124	SB	6/1/2004	N	0	4	0.012	0.56	0.0049 U	0.0049 U	0.012	0.05	0.039	0.043	NT	0.025	0.038	NT	NT	NT	0.0049 U
SD-125 _20050401	SD-125	SB	4/1/2005	N	0	4	0.024	8.26	0.36	0.033 J	0.39	0.42	0.17	0.29	NT	0.07	0.11	NT	NT	NT	0.13
SD-126_20050401	SD-126	SB	4/1/2005	N	0	4	0.0314	8.93	0.3	0.062 J	0.35	0.62	0.33	0.55	NT	0.15	0.2	NT	NT	NT	0.051 J
SD-127 _20050401	SD-127	SB	4/1/2005	N	0	4	0.0427	18.07	0.93	0.068	0.92	0.83	0.31	0.59	NT	0.13	0.18	NT	NT	NT	0.26
SD-128 _20050401	SD-128	SB	4/1/2005	N	0	4	0.0466	12.68	1.1	0.03 J	0.54	0.32	0.11	0.2	NT	0.054	0.068	NT	NT	NT	0.28
SD-130 _20050401	SD-130	SB	4/1/2005	N	0	4	0.0395	4.33	0.1	0.039 J	0.2	0.27	0.17	0.37	NT	0.11	0.11	NT	NT	NT	0.072
SD-131 _20050401	SD-131	SB	4/1/2005	N	0	4	0.0317	79.88	0.69	0.32	3.5	7	3.6	6.3	NT	1.5	2.3	NT	NT	NT	0.2 J
SD-132 _20050401	SD-132	SB	4/1/2005	N	0	4	0.0374	11.45	0.24	0.078	0.29	0.39	0.25	0.58	NT	0.16	0.2	NT	NT	NT	0.066
SD-133 _20050401	SD-133	SB	4/1/2005	N	0	4	0.0203	1.93	0.012	0.02	0.039	0.1	0.12	0.21	NT	0.086	0.073	NT	NT	NT	0.0088 J
SD-134_20050401	SD-134	SB	4/1/2005	N	0	4	0.0062	6.07	0.1	0.05	0.51	0.42	0.26	0.56	NT	0.12	0.2	NT	NT	NT	0.015 J
SD-135 _20050401	SD-135	SB	4/1/2005	N	0	4	0.0647	47.66	0.32	0.31	1.4	2.3	1.9	5.2	NT	1.3	1.5	NT	NT	NT	0.16
SD-135_DUP_20050401	SD-135	SB	4/1/2005	FD	0	4	0.0647	33.99	0.24	0.25	0.74	2.3	1.8	4.2	NT	1.1	1.4	NT	NT	NT	0.11 J
SD-136 _20050401	SD-136	SB	4/1/2005	N	0	4	0.0147	12.61	0.054	0.07	0.25	1.2	1.1	2.2	NT	0.48	0.67	NT	NT	NT	0.017 J
SD-137 _20050401	SD-137	SB	4/1/2005	N	0	4	0.0097	0.21	0.0018 U	0.0036 J	0.0059 J	0.012	0.026	0.039	NT	0.02	0.01	NT	NT	NT	0.0022 U
SD-139 _20050401	SD-139	SB	4/1/2005	N	0	4	0.0367	1.24	0.12	0.018	0.052	0.051	0.07	0.1	NT	0.052	0.035	NT	NT	NT	0.017
SD-140_20050401	SD-140	SB	4/1/2005	N	0	4	0.0117	1.17	0.0072 J	0.013	0.03	0.091	0.078	0.12	NT	0.057	0.038	NT	NT	NT	0.0039 J
SD-141_20050401	SD-141	SB	4/1/2005	N	0	4	0.0118	0.30	0.0034 J	0.0048 J	0.012	0.024	0.026	0.038	NT	0.017	0.017	NT	NT	NT	0.0023 U
SHI6D_19961101	SHID6	SB	11/1/1996	N	0	4	0.025	2.01	0.028	0.022	0.13	0.14	0.1	0.27	NT	NT	0.069	NT	NT	NT	0.019 U
SHID1_19961001	SHID1	SB	10/1/1996	N	0	4	0.039	1.96	0.02 U	0.02 U	0.025	0.13	0.23	0.29	NT	NT	0.14	NT	NT	NT	0.02 U
SHID2 _19961001	SHID2	SB	10/1/1996	N	0	4	0.004	0.18	0.019 U	0.019 U	0.019 U	0.019 U	0.019	0.019 U	NT	NT	0.019 U	NT	NT	NT	0.019 U
2011 Sediment Data																					
MCO3-0-0.3	MC03	MC	7/12/2011	N	0	4	0.0088	0.31	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ
MC04-0-0.3	MC04	MC	7/12/2011	N	0	4	0.014	0.89	0.268	0.0135 U	0.0303	0.0135 U	0.0135 U	0.0135 U	NT	0.0135 U	0.0135 U	NT	NT	NT	NT
SB01-0-0.3	SB01	SB	7/14/2011	N	0	4	0.024	0.99	0.0458 U	0.0458 U	0.0474	0.0659	0.063	NT	NT	0.063	NT	NT	NT	NT	NT
SB02-0.0.3	SB02	SB	7/14/2011	N	0	4	0.024	0.99	0.0366 U	0.0366 U	0.0492	0.0557	0.0436	NT	0.039	0.0367	NT	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ
SB03_0-0.3	SB03	SB	7/14/2011	N	0	4	0.023	0.65	0.0214 U	0.0214 U	0.0386	0.0403	0.0326	NT	NT	0.0339	NT	NT	NT	NT	NT
SB04-0-0.3	SB04	SB	7/14/2011	N	0	4	0.021	2.23	0.0577 J	0.037 U	0.134 J	0.116	0.0996	NT	NT	0.0956	NT	NT	NT	NT	NT
SB06-0-0.3	SB06	SB	7/14/2011	N	0	4	0.022	2.13	0.0398 U	0.0398 U	0.119	0.157	0.131	NT	NT	0.106	NT	NT	NT	NT	NT
SB07-0-0.3	SB07	SB	7/13/2011	N	0	4	0.015	0.14	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0129 U	NT	0.0129 U	0.0129 U	NT	NT	NT	NT
SB08-0-0.3	SB08	SB	7/13/2011	N	0	4	0.029	1.79	0.0444	0.0422 U	0.0833	0.107	0.0962	NT	0.0819	0.0728	NT	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ
SB09-0-0.3	SB09	SB	7/14/2011	N	0	4	0.028	56.12	5.4	0.196 U	1.74	0.832	0.339	NT	0.265	0.215	NT	0.98 UJ	1.88 J	1.38 J	4.37 J
SB12-0-0.3	SB12	SB	7/14/2011	N	0	4	0.026	8.89	0.414 U	0.414 U	0.429	0.588	0.414 U	NT	NT	0.414 U	NT	NT	NT	NT	NT
SB13-0-0.3	SB13	SB	7/14/2011	N	0	4	0.033	5.97	0.391	0.191 U	0.275	0.338	0.191 U	NT	NT	0.191 U	NT	NT	NT	NT	NT
SB17-0-0.3	SB17	SB	7/15/2011	N	0	4	0.027	12.05	0.586 U	0.586 U	0.586 U	0.799	0.586 U	NT	NT	0.586 U	NT	NT	NT	NT	NT
SB19-0-0.3	SB19	SB	7/15/2011	N	0	4	0.014	3.31	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	0.383 U	NT	0.383 U	0.383 U	NT	NT	NT	NT
SB20-0-0.3	SB20	SB	7/15/2011	N	0	4	0.021	5.69	0.291	0.165 U	0.214	0.325	0.223	NT	NT	0.177	NT	NT	NT	NT	NT
SB21-0-0.3	SB21	SB	7/15/2011	N	0	4	0.029	5.49	0.27 U	0.27 U	0.27 U	0.462	0.428	NT	NT	0.27 U	NT	NT	NT	NT	NT
SB24-0-0.3	SB24	SB	7/16/2011	N	0	4	0.044	51.98	2.79	1.73 U	1.73 U	2.18	1.73 U	NT	NT	1.73 U	NT	NT	NT	NT	NT
SB26-0-0.3	SB26	SB	7/16/2011	N	0	4	0.029	21.17	1.19	0.826 U	0.961	0.873	0.826 U	NT	NT	0.826 U	NT	NT	NT	NT	NT
SB27-0-0.3	SB27	SB	7/16/2011	N	0	4	0.027	87.33	16.2	0.758 U	3.64	1.62	0.758 U	NT	NT	0.758 U	NT	NT	NT	NT	NT
SB28-0-0.3	SB28	SB	7/16/2011	N	0	4	0.027	118.16	7.81	0.397	4.95	2.92	1.53	2.95	1.36	0.818	0.899	1.6 J	5.41 J	1.96 J	14 J

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
Historical Data (1996 - 2005)																			
SD-123 _20040601	SD-123	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.61
SD-124 _20040601	SD-124	SB	6/1/2004	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.076
SD-125 _20050401	SD-125	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.47
SD-126_20050401	SD-126	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.71
SD-127 _20050401	SD-127	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.94
SD-128 _20050401	SD-128	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.36
SD-130 _20050401	SD-130	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.44
SD-131 _20050401	SD-131	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	11
SD-132 _20050401	SD-132	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.8
SD-133 _20050401	SD-133	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.21
SD-134_20050401	SD-134	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.63
SD-135 _20050401	SD-135	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	5.2
SD-135_DUP_20050401	SD-135	SB	4/1/2005	FD	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	4.5
SD-136 _20050401	SD-136	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	2.3
SD-137 _20050401	SD-137	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.018
SD-139 _20050401	SD-139	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.11
SD-140_20050401	SD-140	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.13
SD-141_20050401	SD-141	SB	4/1/2005	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.064
SHI6D_19961101	SHID6	SB	11/1/1996	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.2
SHID1_19961001	SHID1	SB	10/1/1996	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.24
SHID2 _19961001	SHID2	SB	10/1/1996	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.019 U
2011 Sediment Data																			
MCO3-0-0.3	MC03	MC	7/12/2011	N	0	4	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.137 UJ	0.273 UJ	0.137 UJ	0.273 UJ	0.0273 U
MC04-0-0.3	MC04	MC	7/12/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0135 U
SB01-0-0.3	SB01	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0986
SB02-0.0.3	SB02	SB	7/14/2011	N	0	4	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.183 UJ	0.366 UJ	0.183 UJ	0.366 UJ	0.0669
SB03_0-0.3	SB03	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0563
SB04-0-0.3	SB04	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.16
SB06-0-0.3	SB06	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.312
SB07-0-0.3	SB07	SB	7/13/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.0129 U
SB08-0-0.3	SB08	SB	7/13/2011	N	0	4	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.211 UJ	0.422 UJ	0.211 UJ	0.422 UJ	0.17
SB09-0-0.3	SB09	SB	7/14/2011	N	0	4	4.24 J	0.98 UJ	0.98 UJ	3.76 J	2.02 J	0.98 UJ	0.98 UJ	2.94 J	0.98 UJ	1.96 UJ	1.34 J	1.96 UJ	0.962
SB12-0-0.3	SB12	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.823
SB13-0-0.3	SB13	SB	7/14/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.328
SB17-0-0.3	SB17	SB	7/15/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.14
SB19-0-0.3	SB19	SB	7/15/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.383 U
SB20-0-0.3	SB20	SB	7/15/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.497
SB21-0-0.3	SB21	SB	7/15/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.566
SB24-0-0.3	SB24	SB	7/16/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.87
SB26-0-0.3	SB26	SB	7/16/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.826 U
SB27-0-0.3	SB27	SB	7/16/2011	N	0	4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.69
SB28-0-0.3	SB28	SB	7/16/2011	N	0	4	7.76 J	0.406 J	0.724 J	7.18 J	3.37 J	0.182 UJ	0.498 J	3.43 J	1.26 J	0.364 UJ	1.31 J	0.433 J	4.8

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
Historical Data (1996 - 2005)																
SD-123 _20040601	SD-123	SB	6/1/2004	N	0	4	0.028	0.32	0.07	0.11	0.049	NT	0.29	0.24	NT	0.026
SD-124 _20040601	SD-124	SB	6/1/2004	N	0	4	0.0049 U	0.11	0.0057	0.023	0.0068	NT	0.034	0.09	NT	0.0049 U
SD-125 _20050401	SD-125	SB	4/1/2005	N	0	4	0.07	1.9	0.45	0.078	0.32	NT	1.6	1.4	NT	0.13
SD-126_20050401	SD-126	SB	4/1/2005	N	0	4	0.041 J	1.9	0.4	0.16	0.11	NT	1.4	1.6	NT	0.051 J
SD-127 _20050401	SD-127	SB	4/1/2005	N	0	4	0.039 J	3.9	1.2	0.15	0.42	NT	4.6	2.6	NT	0.26
SD-128 _20050401	SD-128	SB	4/1/2005	N	0	4	0.022 U	2.1	1.4	0.057	0.35	NT	4.2	1.5	NT	0.28
SD-130 _20050401	SD-130	SB	4/1/2005	N	0	4	0.029 J	0.87	0.13	0.12	0.15	NT	0.51	0.64	NT	0.072
SD-131 _20050401	SD-131	SB	4/1/2005	N	0	4	0.45	20	0.78	1.7	0.44	NT	5.1	15	NT	0.2 J
SD-132 _20050401	SD-132	SB	4/1/2005	N	0	4	0.041 J	3.7	0.24	0.17	0.14	NT	1.9	2.2	NT	0.066
SD-133 _20050401	SD-133	SB	4/1/2005	N	0	4	0.017	0.39	0.016	0.087	0.017	NT	0.14	0.38	NT	0.0088 J
SD-134_20050401	SD-134	SB	4/1/2005	N	0	4	0.034	1.3	0.13	0.14	0.035	NT	0.59	0.98	NT	0.015 J
SD-135 _20050401	SD-135	SB	4/1/2005	N	0	4	0.31	12	0.5	1.5	0.36	NT	5.5	7.9	NT	0.16
SD-135_DUP_20050401	SD-135	SB	4/1/2005	FD	0	4	0.27	7.1	0.33	1.3	0.25	NT	2.2	5.9	NT	0.11 J
SD-136 _20050401	SD-136	SB	4/1/2005	N	0	4	0.14	1.6	0.13	0.56	0.025	NT	0.51	1.3	NT	0.017 J
SD-137 _20050401	SD-137	SB	4/1/2005	N	0	4	0.0041 J	0.018	0.003 U	0.021	0.0033 J	NT	0.0076 J	0.02	NT	0.0022 U
SD-139 _20050401	SD-139	SB	4/1/2005	N	0	4	0.012	0.15	0.084	0.056	0.027	NT	0.15	0.14	NT	0.017
SD-140_20050401	SD-140	SB	4/1/2005	N	0	4	0.012	0.24	0.0098 J	0.054	0.0082 J	NT	0.048	0.23	NT	0.0039 J
SD-141_20050401	SD-141	SB	4/1/2005	N	0	4	0.0041 U	0.023	0.0045 J	0.018	0.0037 J	NT	0.015	0.026	NT	0.0023 U
SHI6D_19961101	SHID6	SB	11/1/1996	N	0	4	NT	0.36	0.038	0.085	0.028	NT	0.19	0.34	NT	0.019 U
SHID1_19961001	SHID1	SB	10/1/1996	N	0	4	NT	0.33	0.02 U	0.16	0.02 U	NT	0.073	0.29	NT	0.02 U
SHID2 _19961001	SHID2	SB	10/1/1996	N	0	4	NT	0.022	0.019 U	0.019 U	0.019 U	NT	0.019 U	0.026	NT	0.019 U
2011 Sediment Data																
MCO3-0-0.3	MC03	MC	7/12/2011	N	0	4	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0273 U	0.0787	0.0273 U	0.0273 U	NT	NT
MC04-0-0.3	MC04	MC	7/12/2011	N	0	4	0.0135 U	0.0236	0.168	0.0135 U	0.0866	NT	0.235	0.0177	NT	NT
SB01-0-0.3	SB01	SB	7/14/2011	N	0	4	0.0458 U	0.141	0.0458 U	0.0581	0.0458 U	NT	0.0778	0.133	NT	NT
SB02-0.0.3	SB02	SB	7/14/2011	N	0	4	0.0366 U	0.155	0.0366 U	0.0376	0.0784	0.0404	0.0961	0.128	NT	NT
SB03_0-0.3	SB03	SB	7/14/2011	N	0	4	0.0214 U	0.119	0.0214 U	0.0329	0.0337	NT	0.0514	0.0968	NT	NT
SB04-0-0.3	SB04	SB	7/14/2011	N	0	4	0.037 U	0.432 J	0.075	0.0875	0.0837	NT	0.337 J	0.312 J	NT	NT
SB06-0-0.3	SB06	SB	7/14/2011	N	0	4	0.0398 U	0.329	0.044	0.104	0.0624	NT	0.147	0.269	NT	NT
SB07-0-0.3	SB07	SB	7/13/2011	N	0	4	0.0129 U	0.0129 U	0.0129 U	0.0129 U	0.0412	NT	0.0129 U	0.0129 U	NT	NT
SB08-0-0.3	SB08	SB	7/13/2011	N	0	4	0.0422 U	0.276	0.0422 U	0.0734	0.142	0.0422 U	0.119	0.213	NT	NT
SB09-0-0.3	SB09	SB	7/14/2011	N	0	4	0.196 U	7.3	5.92	0.216	16.1	0.196 U	11.5	4.23	NT	NT
SB12-0-0.3	SB12	SB	7/14/2011	N	0	4	0.414 U	2.17	0.414 U	0.414 U	0.414 U	NT	1.23	1.58	NT	NT
SB13-0-0.3	SB13	SB	7/14/2011	N	0	4	0.191 U	1.24	0.39	0.191 U	0.191 U	NT	1.39	0.849	NT	NT
SB17-0-0.3	SB17	SB	7/15/2011	N	0	4	0.586 U	2.85	0.586 U	0.586 U	0.586 U	NT	1.23	2.11	NT	NT
SB19-0-0.3	SB19	SB	7/15/2011	N	0	4	0.383 U	0.433	0.383 U	0.383 U	0.383 U	NT	0.383 U	0.383 U	NT	NT
SB20-0-0.3	SB20	SB	7/15/2011	N	0	4	0.165 U	0.977	0.245	0.218	0.212	NT	0.758	0.722	NT	NT
SB21-0-0.3	SB21	SB	7/15/2011	N	0	4	0.27 U	0.78	0.27 U	0.285 J	0.27 U	NT	0.372	0.757	NT	NT
SB24-0-0.3	SB24	SB	7/16/2011	N	0	4	1.73 U	10.8	2.98	1.73 U	2.89	NT	14	7.54	NT	NT
SB26-0-0.3	SB26	SB	7/16/2011	N	0	4	0.826 U	3.39	1.56	0.826 U	2.92	NT	4.68	2.29	NT	NT
SB27-0-0.3	SB27	SB	7/16/2011	N	0	4	0.758 U	13.4	12.2	0.758 U	4.36	NT	23.7	7.86	NT	NT
SB28-0-0.3	SB28	SB	7/16/2011	N	0	4	0.222	17	7.74	0.968	29.6	0.395	23.3	10.5	NT	NT

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes[4]
2012 Sediment Data																					
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.018	1.18	0.00987 J	0.00805 U	0.0179	0.0698	0.102	0.135	0.0711	0.0805 U	0.0458	0.0807	0.0849	0.0805 U	0.02203
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.0063	3.57	0.755	0.0133 J	0.114	0.0895	0.0666	0.145	0.071	0.0329	0.0461	0.0674 U	0.144	0.104	0.1736
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	0.028	92.19	1.37	0.49	2.69	5.57	3.49	7.6	3.8	1.75	2.65	3.7	9	0.763	2.601
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.012	8.63	0.161	0.0514	0.277 J	0.461	0.372	0.75	0.384	0.207	0.248	0.279	0.614	0.103	0.3125
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.01	15.29	0.521	0.0769	0.559	0.668	0.472	0.944	0.507	0.252	0.284	0.39	1.02	0.176	0.715
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	0.018	26.65	0.84	0.139	0.971	1.52	1.03	1.93	1.01	0.489	0.604	0.812	2	0.276	1.087
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	0.023	89.71	3.89	0.235	3.4	2.43	0.975	2.46	1.1	0.35	0.739	1.29	5.37	1.04	7
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	0.028	39.53	1.32	0.216	1.48	1.7	1.36	2.69	1.41	0.707	0.832	1.31	2.27	0.357	2.234
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	0.021	20.71	1.05	0.0713	0.831	0.708	0.372	0.727	0.353	0.167	0.22	0.408	1.18	0.298	1.453
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.02	8.53	0.333	0.0385	0.302	0.361	0.251	0.415	0.216	0.11	0.134	0.196	0.566	0.196	0.392
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.018	4.05	0.0793 J	0.0268	0.111	0.23	0.241 J	0.405	0.222 J	0.153 J	0.144 J	0.152	0.273	0.0979 U	0.0839
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.018	2.66	0.043 J	0.0197	0.0848	0.147	0.142 J	0.244	0.129 J	0.0792 J	0.0742 J	0.105	0.197	0.0933 U	0.0677
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.027	4.64	0.0947	0.0341	0.272	0.192	0.278	0.336	0.192	0.166	0.107	0.13	0.238	0.101 U	0.2029
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.02	3.86	0.0736	0.0238	0.108	0.238	0.25	0.464	0.218	0.126	0.152 J	0.223	0.281	0.0918 U	0.1408
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.015	0.55	0.00906 J	0.00759 U	0.0126 J	0.0179	0.0205 J	0.0265	0.0168 J	0.00759 U	0.0156 J	0.0759 U	0.0759 U	0.0759 U	0.01734
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.022	8.64	0.28	0.0597	0.336	0.439	0.254	0.54	0.283	0.148 J	0.169	0.258	0.609	0.107	0.545
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	0.02	32.15	1.3	0.158	1.55	0.932	0.436	1	0.517	0.2	0.281	0.63	1.58	0.442	3.096
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.02	2.76	0.0986	0.0194	0.0762	0.221 J	0.124 J	0.229 J	0.109 J	0.0516 J	0.0652 J	0.194	0.343	0.0725 U	0.047
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.016	18.23	0.536	0.109	0.509	0.795	0.797	1.53	0.783	0.421	0.522	0.578	1.25	0.173	0.862
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.012	11.58	0.572	0.0506	0.477	0.353	0.29	0.515	0.264	0.183	0.172	0.22	0.581	0.163	0.926
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.0095	1.12	0.149	0.00891 J	0.0238	0.0263	0.0203	0.0471 J	0.0283	0.019	0.0137 J	0.0553 U	0.0553 U	0.0553 U	0.1261
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.0170	1.26	0.0104 J	0.00934 J	0.0264	0.0645	0.0646	0.095	0.058	0.0491	0.0339	0.0697	0.0954	0.0689 U	0.01317
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.0110	0.09	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.0853 U	0.0853 U	0.0853 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0019	1.14	0.034	0.00667 J	0.0478	0.0384	0.0296	0.0497 J	0.0301	0.0243	0.015 J	0.064 U	0.064 U	0.064 U	0.0761
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.0160	2.60	0.0613	0.0182	0.131	0.112	0.0946	0.21 J	0.116	0.0641	0.0699 J	0.0834	0.137	0.0805 U	0.057
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.0033	7.82	0.127	0.0373	0.19	0.436	0.318	0.649	0.319	0.144	0.216	0.327	0.6	0.0681	0.1112
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.0091	3.05	0.114	0.0345	0.0381	0.165	0.234	0.273	0.163	0.173	0.102	0.12	0.198	0.062 U	0.0447
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.0056	1.01	0.0736	0.00625 U	0.019	0.0802	0.0485	0.0757	0.0423	0.0272	0.0286	0.0625 U	0.113	0.0625 U	0.00625 U
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.0260	43.83	0.461	0.29	1.16	2.63	1.98	4.36	2.05	0.739	1.46	1.61	3.64	0.256	0.691
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.0069	17.49	0.102	0.0787	0.868	0.765	1.46	1.99 J	1.26	0.63	0.562 J	0.555	0.987	0.0643 U	0.1345
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.0120	10.31	0.283	0.0563	0.274	0.513	0.456	0.862	0.408	0.205	0.294	0.315	0.584	0.097	0.3092
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	0.0150	17.47	0.977	0.067	0.872	0.606	0.371	0.735	0.36	0.159	0.266	0.352	0.846	0.292	1.24
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.017	34.11	0.878	0.175	2.69 J	1.78	1.49	2.68	1.28	0.45	0.873	1.01	2.06	0.381	0.996
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	0.017	31.01	0.859	0.184	0.981 J	1.38	1.62	2.69 J	1.43	0.588	0.828 J	0.933	1.76	0.338	1.313
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.0150	9.11	0.261	0.0523	0.344	0.414	0.366	0.747	0.363	0.18	0.274	0.299	0.541	0.107	0.385

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
							2012 Sediment Data												
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.0805 U	0.145	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	0.084
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.172	0.0674 U	0.0674 U	0.355	0.0862	0.0674 U	0.0674 U	0.133	0.0674 U	0.135 U	0.0674 U	0.135 U	0.127
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	4.23	1.08	0.751	1.94	3.03	0.872	0.407	1.25	1.68	0.751 U	0.609	0.751 U	9.76
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.414	0.115	0.0837	0.203	0.288	0.129	0.0708 U	0.152	0.146	0.142 U	0.0857	0.142 U	0.626
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.932	0.172	0.192	0.655	0.574	0.163	0.187	0.364	0.322	0.145 U	0.204	0.145 U	1.01
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	1.38	0.334	0.224	0.995	0.915	0.227	0.132	0.582	0.474	0.158 U	0.271	1.26	2.06
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	6.08	0.502	0.96	4.53	3.36	0.333	0.429	2.32	1.28	0.656 U	1.01	4.21	3.72
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	1.87	0.455	0.0807 U	1.42	1.12	0.334	0.397	0.789	0.553	0.161 U	0.403	0.245	2.38
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	1.55	0.191	0.301	1.26	0.824	0.173	0.152	0.745	0.405	0.178 U	0.369	0.361	0.802
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.647	0.0922	0.108	0.363	0.302	0.089 U	0.089 U	0.268	0.146	0.178 U	0.117	0.231	0.409
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.164	0.11	0.0979 U	0.0979 U	0.13	0.0979 U	0.0979 U	0.0979 U	0.0979 U	0.196 U	0.0979 U	0.196 U	0.33
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.134	0.0933 U	0.0933 U	0.0933 U	0.0963	0.0933 U	0.0933 U	0.0933 U	0.0933 U	0.187 U	0.0933 U	0.187 U	0.216
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.257	0.101 U	0.101 U	0.201	0.162	0.101 U	0.101 U	0.184	0.101 U	0.201 U	0.101 U	0.201 U	0.277
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.187	0.094	0.0918 U	0.121	0.126	0.11	0.0918 U	0.1	0.133	0.184 U	0.0918 U	0.184 U	0.314
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0896	0.0759 U	0.152 U	0.0759 U	0.238	0.0248
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.462	0.101	0.102	0.327	0.309	0.113	0.0855 U	0.208	0.221	0.171 U	0.118	0.171 U	0.554
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	2.07	0.223	0.363	1.83	1.01	0.25	0.17	0.964	0.377	0.169 U	0.388	0.232	1.11
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.164	0.13	0.0725 U	0.0725 U	0.219	0.0749	0.0725 U	0.0725 U	0.255	0.145 U	0.0783	0.145 U	0.277
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.953	0.267	0.197	0.523	0.593	0.231	0.108	0.371	0.291	0.164 U	0.207	0.275	1.25
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.752	0.137	0.133	0.556	0.341	0.114	0.0819 U	0.353	0.168	0.164 U	0.158	0.406	0.502
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.0553 U	0.0553 U	0.0553 U	0.0597	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.111 U	0.0553 U	0.111 U	0.0403
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.119	0.0705	0.0689 U	0.0689 U	0.118	0.0994	0.0689 U	0.0689 U	0.0965	0.138 U	0.0689 U	0.138 U	0.0923
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.171 U	0.0853 U	0.171 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.128 U	0.064 U	0.128 U	0.0467
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.136	0.0805 U	0.0805 U	0.0805 U	0.085	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	0.165
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.421	0.139	0.0774	0.0837	0.291	0.129	0.127	0.101	0.203	0.119 U	0.0914	0.119 U	0.593
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.122	0.0664	0.062 U	0.062 U	0.139	0.062 U	0.062 U	0.062 U	0.131	0.124 U	0.062 U	0.124 U	0.211
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.125 U	0.0625 U	1.1	0.164
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	1.96	0.605	0.227	0.522	1.3	0.543	0.618	0.422	0.684	0.26	0.268	0.346	6.36
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.531	0.279	0.0643 U	0.0937	0.296	0.239	0.13	0.081	0.159	0.129 U	0.0643 U	0.129 U	2.03
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.456	0.149	0.0849	0.257	0.318	0.133	0.147	0.217	0.144	0.15 U	0.126	0.211	1.24
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	1.29	0.19	0.179	1.04	0.638	0.184	0.193	0.765	0.294	0.165 U	0.326	1.29	0.693
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	2.01	0.521	0.29	0.915	1.18	0.488	0.551	0.963	0.665	0.167	0.536	0.378	2.07
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	1.55	0.452	0.234	0.877	0.962	0.42	0.424	0.67	0.483	0.15	0.334	0.282	2.56
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.513	0.14	0.0856	0.299	0.355	0.151	0.149	0.21	0.182	0.165 U	0.138	0.616	0.615

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
							2012 Sediment Data									
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.0805 U	0.129	0.0129 J	0.0805 U	0.0665	0.0862	0.0652	0.135	0.00805 U	0.018
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.00772 J	0.433	0.55	0.0357	0.0692	0.0255	0.489	0.321	0.14	0.0336
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	0.443	18.6	1.95	1.92	5.7	0.83	6.48	14.5	0.661	1.94
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.052	1.51	0.221	0.221	0.693	0.12	0.772	1.19	0.0865	0.226
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.0684	2.77	0.571	0.302	1.54	0.153	1.87	2.01	0.216	0.499
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	0.123 J	4.44	0.921	0.506	2.2	0.345	3.14	3.29	0.302	0.785
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	0.107 J	16.9	4.15	0.406	17.3	0.244	13.6	10.7	2.11	4.89
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	0.177	5.72	1.43	0.762	5.35	0.481	4.65	4.63	0.604	1.63
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	0.0492	3.46	1.17	0.186	2.44	0.123	4.01	2.52	0.471	0.982
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.0297	1.43	0.327	0.124	1.16	0.125	1.27	1.1	0.133	0.259
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.035	0.576	0.088	0.169 J	0.17	0.168	0.28	0.536	0.0222	0.0617
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.0191	0.386	0.0664	0.088 J	0.172	0.111	0.238	0.337	0.0168 J	0.0509
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.0275	0.596	0.142	0.162	0.359	0.0946	0.496	0.612	0.0589	0.144
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.0301	0.433	0.0971	0.126	0.255	0.101	0.341	0.37	0.0378	0.103
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.00759 U	0.0976	0.00974 J	0.00778 J	0.0233	0.086	0.0736	0.0789	0.00782 J	0.00952 J
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.0855 U	1.39	0.311	0.176	0.999	0.13	0.895	1.09	0.15	0.395
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	0.0844 U	4.9	1.56	0.229	5.44	0.173	5.75	3.48	0.896	2.2
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.0182	0.292	0.0607	0.0643 J	0.122	0.0428 J	0.277	0.267	0.0137 J	0.0333
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.117 J	2.8	0.643	0.514	1.45	0.217	2.01	2.36	0.237	0.625
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.0819 U	1.6	0.756	0.191	1.35	0.121	1.98	1.24	0.253	0.673
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.00553 U	0.0825	0.0625	0.0172	0.195	0.0162	0.124	0.0568	0.0803	0.0458
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.0103 J	0.186	0.0141	0.0436	0.0228	0.0516	0.103	0.186	0.00689 U	0.00972 J
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0064 U	0.155	0.0386	0.0243	0.188	0.00931 J	0.152	0.103	0.0212	0.0549
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.0157 J	0.388	0.0711	0.069	0.116	0.0355	0.25	0.285	0.0164	0.0406
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.0445	1.47	0.0933	0.162	0.256	0.0873	0.618	1.12	0.0304	0.0808
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.024	0.328	0.0287	0.146	0.0893	0.082	0.139	0.306	0.014	0.0307
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.00626 J	0.1	0.036	0.0292	0.0152	0.0156	0.049	0.0862	0.00625 U	0.00625 U
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.289	5.64	0.629	1.03	1.26	0.43	2.47	4.3	0.208	0.483
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.191	1.34	0.156	0.793	0.339	0.47	0.711	1.15 J	0.0375	0.097
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.0604	1.22	0.277	0.233	0.634	0.124	0.882	0.855	0.0992	0.21
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	0.0534	2.38	0.969	0.184	2.05	0.0937	2.77	1.67	0.4	0.84
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.186	4.43	1.05	0.619	1.99	0.411	3.16	3.5	0.307	0.689 J
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	0.197	3.29	0.962	0.758	2.53	0.463	2.42	2.6	0.381	0.932 J
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.0554	1.12	0.32	0.209	0.593	0.0916	0.962	0.775	0.12	0.265

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes[4]
2012 Sediment Data																					
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.0180	1.64	0.0494	0.00942 U	0.0689	0.0836	0.0548	0.0932	0.0474	0.0329	0.0373	0.0942 U	0.14	0.0942 U	0.0595
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.0150	0.36	0.00804 U	0.00804 U	0.00804 U	0.0198	0.0183	0.0303 J	0.0183	0.0165	0.0105 J	0.0804 U	0.0804 U	0.0804 U	0.00804 U
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.022	7.31	0.247	0.0297	0.215	0.496	0.28	0.271	0.241	0.0856	0.107	1.5	1.96	0.674	0.1538
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.022	11.18	0.347 J	0.0537 J	0.317 J	0.599 J	0.323 J	0.429 J	0.312 J	0.16 J	0.138 J	1.77 J	2.34 J	0.638 J	0.413
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.022	ND	0.187	0.0341	0.159	0.29	0.258	0.302	0.252	0.135	0.0906	1.22	1.33	0.396	0.1955
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.0081	0.42	0.0236	0.00668 U	0.0101 J	0.0214	0.0112 J	0.0207 J	0.0107 J	0.00872 J	0.00782 J	0.0668 U	0.0668 U	0.0668 U	0.01564
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.0160	2.88	0.0817	0.0176	0.106	0.146	0.0809	0.181 J	0.0988	0.0524	0.0553 J	0.101	0.209	0.0711 U	0.1219
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.0098	15.83	0.161	0.0476	0.367	1.33	1.14	1.74	0.836	0.439	0.613	0.578	1.21	0.0922	0.2432
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.010	10.09	0.322	0.0527	0.436	0.392 J	0.399 J	0.736 J	0.357 J	0.206	0.275 J	0.271 J	0.591 J	0.146	0.49
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.014	15.26	0.326	0.0702	0.506	0.886 J	0.776 J	1.34 J	0.631 J	0.324	0.466 J	0.548 J	1.09 J	0.161	0.545
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0110	1.03	0.00603 U	0.0165	0.0106 J	0.0418	0.0853	0.088	0.0683	0.069	0.031	0.0695	0.0603 U	0.0603 U	0.01714

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
							2012 Sediment Data												
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.124	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.188 U	0.0942 U	0.188 U	0.227
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.161 U	0.0804 U	0.161 U	0.0273
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	3.79	1.84	1.41	1.66	5.68	1.41	1.74	5.33	4.6	0.557	3.79	4.37	0.885
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	4.27 J	2.06 J	1.07 J	2.19 J	5.5 J	1.66 J	1.42 J	5.59 J	5.26 J	0.547 J	3.68 J	2.93 J	1.12 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	2.66	1.51	0.73	1.50	3.59	1.06	0.95	4.14	3.70	0.537	2.64	2.18	0.45
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.134 U	0.0668 U	0.134 U	0.0215
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.192	0.0711 U	0.0711 U	0.0916	0.143	0.0934	0.0711 U	0.0814	0.0806	0.142 U	0.0711 U	0.142 U	0.197
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.399	0.197	0.0734 U	0.17	0.3	0.146	0.118	0.113	0.153	0.147 U	0.0734 U	0.299	1.64
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.612	0.132 J	0.0903	0.346	0.356 J	0.113	0.129 J	0.251	0.18	0.149 U	0.13	2.59 J	0.711 J
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.833	0.243 J	0.123	0.361	0.599 J	0.183	0.217 J	0.253	0.297	0.151 U	0.153	0.876 J	1.32 J
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0603 U	0.0682	0.0603 U	0.0603 U	0.0603 U	0.0616	0.0603 U	0.0603 U	0.0603 U	0.121 U	0.0603 U	0.121 U	0.0658

ATTACHMENT G-A: Equilibrium Partitioning Sediment Benchmark Toxic Unit (ESBTU) Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
							2012 Sediment Data									
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.00942 U	0.203	0.0675	0.0354	0.0943	0.0208	0.179	0.149	0.0193	0.0402
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.00804 U	0.045	0.00804 U	0.017	0.0109 J	0.0113 J	0.0203	0.0421	0.00804 U	0.00804 U
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.044	0.977	0.208	0.0701	0.276	0.0965	1.24	1.01	0.0508	0.103
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.0432 J	1.63 J	0.334 J	0.127 J	0.766 J	0.123 J	1.77 J	1.6 J	0.111 J	0.302 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.0392	0.66	0.169	0.109	0.305	0.088	0.965	0.748	0.0585	0.137
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.00668 U	0.0584	0.015	0.00881 J	0.0329	0.0264	0.0405	0.048	0.00668 U	0.0123 J
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.0148	0.465	0.0989	0.0551	0.187	0.0305	0.316	0.339	0.0375	0.0844
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.14	1.56	0.268	0.516	0.473	0.274	0.667	1.11	0.0732	0.17
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.0554 J	1.22	0.435	0.221 J	0.776	0.095 J	1.09	0.854	0.154	0.336
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.0995 J	1.77	0.428	0.373 J	1	0.175 J	1.2	1.28	0.163	0.382
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0103 J	0.132	0.00635 J	0.056	0.0211	0.0287	0.0605	0.106	0.00614 J	0.011 J

Notes:

[1]All PAH concentrations in mg/kg sediment (dry weight).

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

"C-1 naphthalenes = sum of 1- and 2-methylnaphthalene. Non-detections included as 1/2 the MDL.

J = estimated value

MDL = method detection limit

mg/kg = milligrams per kilogram

ND = not determined

PAH = polycyclic aromatic hydrocarbon

U = not detected

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene		Acenaphthylene		Anthracene		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b) fluoranthene		Benzo(e)pyrene		Benzo(g,h,i)perylene		Benzo(k) fluoranthene		C-1 Benz(a)anth/ Chrysenes		C-1 Fluoranthrenes/ Pyrenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
Historical Data (1996 - 2005)																									
SD-MC-A _20040601	SD-MC-A	MC	N	0.0130	0.657	0.0860	4.34	0.150	7.58	0.480	24.2	0.900	45.5	0.580	29.3			0.910	46.0	0.540	27.3				
SD-MC-B _20040601	SD-MC-B	MC	N	0.0120	1.30	0.00250	0.272	0.00250	0.272	0.00520	0.565	0.00950	1.03	0.00960	1.04			0.0140	1.52	0.00630	0.685				
SD-MC-C _20040601	SD-MC-C	MC	N	0.0520	3.33	0.0110	0.705	0.0350	2.24	0.0490	3.14	0.0660	4.23	0.0530	3.40			0.0820	5.26	0.0360	2.31				
SD-MC-D _20040601	SD-MC-D	MC	N	0.0160	0.571	0.00275	0.0982	0.0150	0.536	0.0330	1.18	0.0260	0.929	0.0250	0.893			0.0200	0.714	0.0190	0.679				
SD-MC-E _20040601	SD-MC-E	MC	N	0.0410	1.44	0.0370	1.30	0.270	9.47	0.150	5.26	0.310	10.9	0.300	10.5			0.200	7.02	0.170	5.96				
SD-100 _20031201	SD-100	SB	N	0.0130	0.599	0.00280	0.129	0.0370	1.71	0.0790	3.64	0.0680	3.13	0.0750	3.46			0.0520	2.40	0.0530	2.44				
SD-101 _20031201	SD-101	SB	N	0.0360	1.65	0.00335	0.154	0.0480	2.20	0.0870	3.99	0.0780	3.58	0.0860	3.94			0.0590	2.71	0.0590	2.71				
SD-102 _20031201	SD-102	SB	N	0.00930	0.366	0.00390	0.154	0.0290	1.14	0.0860	3.39	0.0810	3.19	0.110	4.33			0.0560	2.20	0.0820	3.23				
SD-103 _20031201	SD-103	SB	N	0.0550	2.59	0.0170	0.802	0.0930	4.39	0.300	14.2	0.240	11.3	0.360	17.0			0.0970	4.58	0.270	12.7				
SD-103-A _20040601	SD-103-A	SB	N	0.370	12.9	0.0210	0.732	0.710	24.7	0.420	14.6	0.110	3.83	0.180	6.27			0.0620	2.16	0.160	5.57				
SD-103-B. _20040601	SD-103-B	SB	N	0.0250	1.03	0.0110	0.453	0.0650	2.67	0.0870	3.58	0.0740	3.05	0.0900	3.70			0.0660	2.72	0.0800	3.29				
SD-103-C _20040601	SD-103-C	SB	N	0.0690	2.63	0.0200	0.763	0.200	7.63	0.250	9.54	0.170	6.49	0.250	9.54			0.0960	3.66	0.200	7.63				
SD-104 _20031201	SD-104	SB	N	0.0920	5.23	0.0170	0.966	0.210	11.9	0.250	14.2	0.170	9.66	0.230	13.1			0.110	6.25	0.160	9.09				
SD-104-A _20040601	SD-104-A	SB	N	0.00750	0.323	0.00320	0.138	0.0260	1.12	0.0430	1.85	0.0420	1.81	0.0510	2.20			0.0380	1.64	0.0430	1.85				
SD-104-B _20040601	SD-104-B	SB	N	0.00870	0.352	0.00335	0.136	0.0260	1.05	0.0440	1.78	0.0360	1.46	0.0500	2.02			0.0310	1.26	0.0370	1.50				
SD-104-C _20040601	SD-104-C	SB	N	0.00780	0.336	0.00330	0.142	0.0300	1.29	0.0440	1.90	0.0370	1.59	0.0490	2.11			0.0330	1.42	0.0370	1.59				
SD-105 _20031201	SD-105	SB	N	0.0830	3.84	0.01000	0.463	0.110	5.09	0.140	6.48	0.120	5.56	0.130	6.02			0.0890	4.12	0.0980	4.54				
SD-105-A _20040601	SD-105-A	SB	N	0.0200	0.749	0.00970	0.363	0.0600	2.25	0.0750	2.81	0.0540	2.02	0.0770	2.88			0.0440	1.65	0.0580	2.17				
SD-105-B _20040601	SD-105-B	SB	N	0.930	35.8	0.0220	0.846	0.290	11.2	0.0520	2.00	0.0360	1.38	0.0500	1.92			0.0260	1.00	0.0450	1.73				
SD-105-C _20040601	SD-105-C	SB	N	0.0110	0.423	0.00330	0.127	0.0270	1.04	0.0350	1.35	0.0270	1.04	0.0380	1.46			0.0220	0.846	0.0310	1.19				
SD-106 _20031201	SD-106	SB	N	0.0270	1.29	0.00850	0.405	0.0850	4.05	0.160	7.62	0.160	7.62	0.170	8.10			0.0990	4.71	0.130	6.19				
SD-108 _20031201	SD-108	SB	N	0.780	56.9	0.0380	2.77	1.10	80.3	0.850	62.0	0.510	37.2	0.640	46.7			0.240	17.5	0.450	32.8				
SD-110 _20031201	SD-110	SB	N	0.560	32.0	0.0290	1.66	0.520	29.7	0.750	42.9	0.560	32.0	0.730	41.7			0.220	12.6	0.500	28.6				
SD-112 _20031201	SD-112	SB	N	0.150	14.6	0.0170	1.65	0.230	22.3	0.270	26.2	0.260	25.2	0.310	30.1			0.160	15.5	0.210	20.4				
SD-112-A _20040601	SD-112-A	SB	N	0.0630	4.14	0.0250	1.64	0.190	12.5	0.150	9.87	0.260	17.1	0.320	21.1			0.170	11.2	0.240	15.8				
SD-112-B _20040601	SD-112-B	SB	N	0.180	5.39	0.0650	1.95	0.450	13.5	0.860	25.7	0.890	26.6	1.20	35.9			0.420	12.6	1.00	29.9				
SD-112-C _20040601	SD-112-C	SB	N	0.100	3.91	0.0490	1.91	0.310	12.1	0.610	23.8	0.630	24.6	0.830	32.4			0.360	14.1	0.620	24.2				
SD-113 _20031201	SD-113	SB	N	0.00250	1.14	0.00250	1.14	0.00250	1.14	0.0150	6.82	0.0180	8.18	0.0120	5.45			0.0120	5.45	0.0120	5.45				
SD-114 _20031201	SD-114	SB	N	0.00630	0.375	0.00295	0.176	0.0220	1.31	0.0390	2.32	0.0580	3.45	0.0490	2.92			0.0450	2.68	0.0400	2.38				
SD-115 _20031201	SD-115	SB	N	0.00400	0.580	0.00350	0.507	0.00250	0.362	0.00900	1.30	0.0120	1.74	0.0110	1.59			0.00910	1.32	0.00880	1.28				
SD-116 _20031201	SD-116	SB	N	0.00530	0.530	0.00245	0.245	0.00790	0.790	0.0310	3.10	0.0590	5.90	0.0390	3.90			0.0520	5.20	0.0330	3.30				
SD-117 _20031201	SD-117	SB	N	0.0340	3.18	0.0140	1.31	0.0780	7.29	0.200	18.7	0.250	23.4	0.180	16.8			0.180	16.8	0.150	14.0				
SD-117-A _20040601	SD-117-A	SB	N	0.00250	1.39	0.00250	1.39	0.00250	1.39	0.00820	4.56	0.00900	5.00	0.00870	4.83			0.00710	3.94	0.00830	4.61				
SD-117-B _20040601	SD-117-B	SB	N	0.00820	2.73	0.00185	0.617	0.00640	2.13	0.00630	2.10	0.00770	2.57	0.00910	3.03			0.00710	2.37	0.00600	2.00				
SD-117-C _20040601	SD-117-C	SB	N	0.0150	1.97	0.00730	0.961	0.0290	3.82	0.0550	7.24	0.0700	9.21	0.0790	10.4			0.0540	7.11	0.0660	8.68				
SD-119 _20031201	SD-119	SB	N	0.0170	1.55	0.00960	0.873	0.0290	2.64	0.0880	8.00	0.150	13.6	0.120	10.9			0.110	10.0	0.0990	9.00				
SD-119-A _20040601	SD-119-A	SB	N	0.270	16.0	0.00760	0.450	0.0960	5.68	0.0830	4.91	0.0380	2.25	0.0460	2.72			0.0210	1.24	0.0350	2.07				
SD-119-B _20040601	SD-119-B	SB	N	0.0890	4.30	0.0170	0.821	0.0640	3.09	0.0840	4.06	0.0790	3.82	0.0660	3.19			0.0570	2.75	0.0590	2.85				
SD-119-C _20040601	SD-119-C	SB	N	0.120	3.96	0.0230	0.759	0.0870	2.87	0.0500	1.65	0.0310	1.02	0.0290	0.957			0.0280	0.924	0.0260	0.858				
SD-120 _20031201	SD-120	SB	N	0.00250	1.32	0.00250	1.32	0.00250	1.32	0.00940	4.95	0.0150	7.89	0.00910	4.79			0.0130	6.84	0.00960	5.05				
SD-121 _20040601	SD-121	SB	N	0.01000	0.556	0.00500	0.278	0.0220	1.22	0.0520	2.89	0.0620	3.44	0.0610	3.39			0.0410	2.28	0.0500	2.78				
SD-122 _20040601	SD-122	SB	N	0.100	5.85	0.00990	0.579	0.150	8.77	0.160	9.36	0.0960	5.61	0.110	6.43			0.0580	3.39	0.0990	5.79				
SD-123 _20040601	SD-123	SB	N	0.0400	2.41	0.0130	0.783	0.120	7.23	0.310	18.7	0.220	13.3	0.210	12.7			0.110	6.63	0.230	13.9				
SD-124 _20040601	SD-124	SB	N	0.00245	0.204	0.00245	0.204	0.0120	1.00	0.0500	4.17	0.0390	3.25	0.0430	3.58			0.0250	2.08	0.0380	3.17				
SD-125 _20050401	SD-125	SB	N	0.360	15.0	0.0330	1.38	0.390	16.3	0.420	17.5	0.170	7.08	0.290	12.1			0.0700	2.92	0.110	4.58				
SD-126 _20050401	SD-126	SB	N	0.300	9.55	0.0620	1.97	0.350	11.1	0.620	19.7	0.330	10.5	0.550	17.5			0.150	4.78	0.200	6.37				
SD-127 _20050401	SD-127	SB	N	0.930	21.8	0.0680	1.59	0.920	21.5	0.830	19.4	0.310	7.26	0.590	13.8			0.130	3.04	0.180	4.22				
SD-128 _20050401	SD-128	SB	N	1.10	23.6	0.0300	0.644	0.540	11.6	0.320	6.87	0.110	2.36	0.200	4.29			0.0540	1.16	0.0680	1.46				
SD-130 _20050401	SD-130	SB	N	0.100	2.53	0.0390	0.987	0.200	5.06	0.270	6.84	0.170	4.30	0.370	9.37			0.110	2.78	0.110	2.78				
SD-131 _20050401	SD-131	SB	N	0.690	21.8	0.320	10.1	3.50	110	7.00	221	3.60	114	6.30	199			1.50	47.3	2.30	72.6				
SD-132 _20050401	SD-132	SB	N	0.240	6.42	0.0780	2.09	0.290	7.75	0.390	10.4	0.250	6.68	0.580	15.5			0.160	4.28	0.200	5.35				
SD-133 _20050401	SD-133	SB	N	0.0120	0.591	0.0200	0.985	0.0390	1.92	0.100	4.93	0.120	5.91	0.210	10.3			0.0860	4.24	0.0730	3.60				
SD-134 _20050401	SD-134	SB	N	0.100	16.1	0.0500	8.06	0.510	82.3	0.420	67.7	0.260	41.9	0.560	90.3			0.120	19.4	0.200	32.3				
SD-135 _20050401	SD-135	SB	N	0.320	4.95	0.310	4.79	1.40	21.6	2.30	35.5	1.90	29.4	5.20	80.4			1.30	20.1	1.50	23.2				
SD-135_DUP_20050401	SD-135	SB	FD	0.240	3.71	0.250	3.86	0.740	11.4	2.30	35.5	1.80	27.8	4.20	64.9			1.10	17.0	1.40	21.6				
SD-136 _20050401	SD-136	SB	N	0.0540	3.67	0.0700	4.76	0.250	17.0	1.20	81.6	1.10	74.8	2.20	150			0.480	32.7	0.670	45.6				
SD-137 _20050401	SD-137	SB	N	9.00E-04	0.0928	0.00360	0.371	0.00590	0.608	0.0120	1.24	0.0260	2.68	0.0390	4.02			0.0200	2.06	0.01000	1.03				
SD-139 _20050401	SD-139	SB	N	0.120	3.27	0.0180	0.490	0.0520	1.42	0.0510	1.39	0.0700	1.91	0.100	2.72			0.0520	1.42	0.0350	0.954				
SD-140 _20050401	SD-140	SB	N	0.00720	0.615	0.0130	1.11	0.0300	2.56	0.0910	7.78	0.0780	6.67	0.120	10.3			0.0570	4.87	0.0380	3.25				
SD-141 _20050401	SD-141	SB	N	0.00340	0.288	0.00480	0.407	0.0120	1.02	0.0240	2.03	0.0260	2.20	0.0380	3.22			0.0170	1.44	0.0170	1.44				
SHI6D_19961101	SHID6	SB	N	0.0280	1.12	0.0220	0.880	0.130	5.20	0.140	5.60	0.100	4.00	0.270	10.8					0.0690	2.76				
SHID1_19961001	SHID1	SB	N	0.01000	0.256	0.01000	0.256	0.0250	0.641	0.130	3.33	0.230	5.90	0.290	7.44					0.140	3.59				
SHID2 _19961001	SHID2	SB	N	0.00950	2.38	0.00950	2.38	0.00950	2.38	0.00950	2.38	0.0190	4.75	0.00950	2.38					0.00950	2.38				

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-1 Fluorenes		C-1 Naphthalenes		C-1 Phenanthrenes/ Anthracenes		C-2 Benz(a)anth/ Chrysenes		C-2 Fluorenes		C-2 Naphthalenes		C-2 Phenanthrenes/ Anthracenes		C-3 Benz(a)anth/ Chrysenes		C-3 Fluorenes		C-3 Naphthalenes		C-3 Phenanthrenes/ Anthracenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
Historical Data (1996 - 2005)																									
SD-MC-A _20040601	SD-MC-A	MC	N			0.0130	0.657																		
SD-MC-B _20040601	SD-MC-B	MC	N			0.0120	1.30																		
SD-MC-C _20040601	SD-MC-C	MC	N			0.0150	0.962																		
SD-MC-D _20040601	SD-MC-D	MC	N			0.00750	0.268																		
SD-MC-E _20040601	SD-MC-E	MC	N			0.0200	0.702																		
SD-100_20031201	SD-100	SB	N			0.0130	0.599																		
SD-101 _20031201	SD-101	SB	N			0.0500	2.29																		
SD-102 _20031201	SD-102	SB	N			0.00950	0.374																		
SD-103 _20031201	SD-103	SB	N			0.0480	2.26																		
SD-103-A _20040601	SD-103-A	SB	N			0.360	12.5																		
SD-103-B. _20040601	SD-103-B	SB	N			0.0340	1.40																		
SD-103-C _20040601	SD-103-C	SB	N			0.110	4.20																		
SD-104_20031201	SD-104	SB	N			0.140	7.95																		
SD-104-A _20040601	SD-104-A	SB	N			0.00930	0.401																		
SD-104-B _20040601	SD-104-B	SB	N			0.01000	0.405																		
SD-104-C _20040601	SD-104-C	SB	N			0.00950	0.409																		
SD-105_20031201	SD-105	SB	N			0.0700	3.24																		
SD-105-A _20040601	SD-105-A	SB	N			0.0240	0.899																		
SD-105-B _20040601	SD-105-B	SB	N			0.0200	0.769																		
SD-105-C _20040601	SD-105-C	SB	N			0.01000	0.385																		
SD-106 _20031201	SD-106	SB	N			0.0320	1.52																		
SD-108 _20031201	SD-108	SB	N			0.700	51.1																		
SD-110_20031201	SD-110	SB	N			0.220	12.6																		
SD-112 _20031201	SD-112	SB	N			0.110	10.7																		
SD-112-A _20040601	SD-112-A	SB	N			0.0690	4.54																		
SD-112-B _20040601	SD-112-B	SB	N			0.190	5.69																		
SD-112-C _20040601	SD-112-C	SB	N			0.0690	2.70																		
SD-113 _20031201	SD-113	SB	N			0.00250	1.14																		
SD-114 _20031201	SD-114	SB	N			0.00600	0.357																		
SD-115_20031201	SD-115	SB	N			0.00300	0.435																		
SD-116 _20031201	SD-116	SB	N			0.00245	0.245																		
SD-117 _20031201	SD-117	SB	N			0.0350	3.27																		
SD-117-A _20040601	SD-117-A	SB	N			0.00250	1.39																		
SD-117-B _20040601	SD-117-B	SB	N			0.00680	2.27																		
SD-117-C _20040601	SD-117-C	SB	N			0.0200	2.63																		
SD-119_20031201	SD-119	SB	N			0.0190	1.73																		
SD-119-A _20040601	SD-119-A	SB	N			0.0540	3.20																		
SD-119-B _20040601	SD-119-B	SB	N			0.0940	4.54																		
SD-119-C _20040601	SD-119-C	SB	N			0.100	3.30																		
SD-120 _20031201	SD-120	SB	N			0.00250	1.32																		
SD-121 _20040601	SD-121	SB	N			0.0140	0.778																		
SD-122 _20040601	SD-122	SB	N			0.0770	4.50																		
SD-123 _20040601	SD-123	SB	N			0.0260	1.57																		
SD-124 _20040601	SD-124	SB	N			0.00245	0.204																		
SD-125 _20050401	SD-125	SB	N			0.130	5.42																		
SD-126_20050401	SD-126	SB	N			0.0510	1.62																		
SD-127 _20050401	SD-127	SB	N			0.260	6.09																		
SD-128 _20050401	SD-128	SB	N			0.280	6.01																		
SD-130 _20050401	SD-130	SB	N			0.0720	1.82																		
SD-131 _20050401	SD-131	SB	N			0.200	6.31																		
SD-132 _20050401	SD-132	SB	N			0.0660	1.76																		
SD-133 _20050401	SD-133	SB	N			0.00880	0.433																		
SD-134_20050401	SD-134	SB	N			0.0150	2.42																		
SD-135 _20050401	SD-135	SB	N			0.160	2.47																		
SD-135_DUP_20050401	SD-135	SB	FD			0.110	1.70																		
SD-136 _20050401	SD-136	SB	N			0.0170	1.16																		
SD-137 _20050401	SD-137	SB	N			0.00110	0.113																		
SD-139 _20050401	SD-139	SB	N			0.0170	0.463																		
SD-140_20050401	SD-140	SB	N			0.00390	0.333																		
SD-141_20050401	SD-141	SB	N			0.00115	0.0975																		
SHI6D_19961101	SHID6	SB	N			0.00950	0.380																		
SHID1_19961001	SHID1	SB	N			0.01000	0.256																		
SHID2 _19961001	SHID2	SB	N			0.00950	2.38																		

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-4 Benz(a)anth/ Chrysenes		C-4 Naphthalenes		C-4 Phenanthrenes/ Anthracenes		Chrysene		Dibenzo(a,h) anthracene		Fluoranthene		Fluorene		Indeno(1,2,3-cd) pyrene		Naphthalene		Perylene		Phenanthrene		Pyrene	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
Historical Data (1996 - 2005)																											
SD-MC-A _20040601	SD-MC-A	MC	N							0.710	35.9	0.0500	2.53	1.20	60.6	0.0560	2.83	0.700	35.4	0.0130	0.657			1.00	50.5	1.20	60.6
SD-MC-B _20040601	SD-MC-B	MC	N							0.00810	0.880	0.00250	0.272	0.0200	2.17	0.0110	1.20	0.0120	1.30	0.0510	5.54			0.0230	2.50	0.0170	1.85
SD-MC-C _20040601	SD-MC-C	MC	N							0.0730	4.68	0.00700	0.449	0.170	10.9	0.0490	3.14	0.0640	4.10	0.0130	0.833			0.190	12.2	0.160	10.3
SD-MC-D _20040601	SD-MC-D	MC	N							0.0500	1.79	0.00275	0.0982	0.0730	2.61	0.0190	0.679	0.0160	0.571	0.0140	0.500			0.0770	2.75	0.0850	3.04
SD-MC-E _20040601	SD-MC-E	MC	N							0.260	9.12	0.0370	1.30	0.360	12.6	0.0550	1.93	0.230	8.07	0.0560	1.96			0.170	5.96	0.310	10.9
SD-100_20031201	SD-100	SB	N							0.140	6.45	0.00760	0.350	0.170	7.83	0.0190	0.876	0.0620	2.86	0.0300	1.38			0.0850	3.92	0.150	6.91
SD-101 _20031201	SD-101	SB	N							0.130	5.96	0.00820	0.376	0.230	10.6	0.0480	2.20	0.0700	3.21	0.140	6.42			0.180	8.26	0.200	9.17
SD-102 _20031201	SD-102	SB	N							0.140	5.51	0.00850	0.335	0.240	9.45	0.0130	0.512	0.0670	2.64	0.0200	0.787			0.0810	3.19	0.250	9.84
SD-103 _20031201	SD-103	SB	N							0.590	27.8	0.0200	0.943	0.410	19.3	0.0630	2.97	0.140	6.60	0.0440	2.08			0.280	13.2	0.420	19.8
SD-103-A _20040601	SD-103-A	SB	N							0.460	16.0	0.0120	0.418	3.50	122	0.480	16.7	0.0650	2.26	0.330	11.5			2.90	101	2.10	73.2
SD-103-B. _20040601	SD-103-B	SB	N							0.130	5.35	0.00910	0.374	0.260	10.7	0.0390	1.60	0.0590	2.43	0.0700	2.88			0.170	7.00	0.210	8.64
SD-103-C _20040601	SD-103-C	SB	N							0.470	17.9	0.0200	0.763	0.600	22.9	0.110	4.20	0.110	4.20	0.230	8.78			0.420	16.0	0.430	16.4
SD-104_20031201	SD-104	SB	N							0.300	17.0	0.0220	1.25	0.990	56.3	0.0980	5.57	0.160	9.09	0.220	12.5			0.550	31.3	0.760	43.2
SD-104-A _20040601	SD-104-A	SB	N							0.0810	3.49	0.00320	0.138	0.100	4.31	0.0110	0.474	0.0340	1.47	0.0200	0.862			0.0560	2.41	0.0900	3.88
SD-104-B _20040601	SD-104-B	SB	N							0.0720	2.91	0.00335	0.136	0.140	5.67	0.0120	0.486	0.0260	1.05	0.0220	0.891			0.0580	2.35	0.110	4.45
SD-104-C _20040601	SD-104-C	SB	N							0.0870	3.75	0.00330	0.142	0.110	4.74	0.0120	0.517	0.0280	1.21	0.0200	0.862			0.0580	2.50	0.0990	4.27
SD-105_20031201	SD-105	SB	N							0.190	8.80	0.0140	0.648	0.390	18.1	0.0840	3.89	0.110	5.09	0.170	7.87			0.310	14.4	0.290	13.4
SD-105-A _20040601	SD-105-A	SB	N							0.130	4.87	0.00335	0.125	0.220	8.24	0.0300	1.12	0.0380	1.42	0.0610	2.28			0.120	4.49	0.170	6.37
SD-105-B _20040601	SD-105-B	SB	N							0.0970	3.73	0.00325	0.125	0.380	14.6	0.740	28.5	0.0250	0.962	0.0410	1.58			1.10	42.3	0.220	8.46
SD-105-C _20040601	SD-105-C	SB	N							0.0580	2.23	0.00320	0.123	0.120	4.62	0.0140	0.538	0.0210	0.808	0.0220	0.846			0.0670	2.58	0.0900	3.46
SD-106 _20031201	SD-106	SB	N							0.280	13.3	0.0160	0.762	0.330	15.7	0.0370	1.76	0.130	6.19	0.0670	3.19			0.160	7.62	0.280	13.3
SD-108 _20031201	SD-108	SB	N							1.20	87.6	0.0500	3.65	3.50	255	1.10	80.3	0.350	25.5	1.30	94.9			3.30	241	2.40	175
SD-110_20031201	SD-110	SB	N							1.10	62.9	0.0550	3.14	2.50	143	0.590	33.7	0.340	19.4	0.360	20.6			1.70	97.1	1.70	97.1
SD-112 _20031201	SD-112	SB	N							0.420	40.8	0.0280	2.72	0.870	84.5	0.200	19.4	0.220	21.4	0.200	19.4			0.760	73.8	0.680	66.0
SD-112-A _20040601	SD-112-A	SB	N							0.380	25.0	0.0340	2.24	0.690	45.4	0.0920	6.05	0.200	13.2	0.160	10.5			0.470	30.9	0.490	32.2
SD-112-B _20040601	SD-112-B	SB	N							1.50	44.9	0.110	3.29	2.20	65.9	0.280	8.38	0.540	16.2	0.300	8.98			0.850	25.4	0.970	29.0
SD-112-C _20040601	SD-112-C	SB	N							0.910	35.5	0.0830	3.24	1.80	70.3	0.160	6.25	0.430	16.8	0.120	4.69			0.830	32.4	0.960	37.5
SD-113 _20031201	SD-113	SB	N							0.0190	8.64	0.00250	1.14	0.0200	9.09	0.00250	1.14	0.0150	6.82	0.00250	1.14			0.00250	1.14	0.0220	10.0
SD-114 _20031201	SD-114	SB	N							0.0720	4.29	0.00295	0.176	0.0810	4.82	0.00850	0.506	0.0500	2.98	0.0160	0.952			0.0390	2.32	0.0910	5.42
SD-115_20031201	SD-115	SB	N							0.0130	1.88	0.00250	0.362	0.0230	3.33	0.00500	0.725	0.0110	1.59	0.00250	0.362			0.00860	1.25	0.0240	3.48
SD-116 _20031201	SD-116	SB	N							0.0410	4.10	0.00610	0.610	0.0570	5.70	0.00620	0.620	0.0560	5.60	0.0120	1.20			0.0330	3.30	0.0700	7.00
SD-117 _20031201	SD-117	SB	N							0.360	33.6	0.0230	2.15	0.310	29.0	0.0460	4.30	0.220	20.6	0.0850	7.94			0.200	18.7	0.300	28.0
SD-117-A _20040601	SD-117-A	SB	N							0.00920	5.11	0.00250	1.39	0.0180	10.0	0.00250	1.39	0.00620	3.44	0.00250	1.39			0.00250	1.39	0.0150	8.33
SD-117-B _20040601	SD-117-B	SB	N							0.01000	3.33	0.00185	0.617	0.0190	6.33	0.00940	3.13	0.00680	2.27	0.0130	4.33			0.0290	9.67	0.0160	5.33
SD-117-C _20040601	SD-117-C	SB	N							0.140	18.4	0.00760	1.00	0.120	15.8	0.0210	2.76	0.0510	6.71	0.0650	8.55			0.100	13.2	0.100	13.2
SD-119_20031201	SD-119	SB	N							0.140	12.7	0.0130	1.18	0.150	13.6	0.0220	2.00	0.120	10.9	0.0490	4.45			0.0950	8.64	0.170	15.5
SD-119-A _20040601	SD-119-A	SB	N							0.0990	5.86	0.00440	0.260	0.510	30.2	0.140	8.28	0.0220	1.30	0.140	8.28			0.460	27.2	0.350	20.7
SD-119-B _20040601	SD-119-B	SB	N							0.120	5.80	0.00990	0.478	0.280	13.5	0.0930	4.49	0.0560	2.71	0.280	13.5			0.270	13.0	0.230	11.1
SD-119-C _20040601	SD-119-C	SB	N							0.0680	2.24	0.00250	0.0825	0.340	11.2	0.150	4.95	0.0220	0.726	0.270	8.91			0.440	14.5	0.260	8.58
SD-120 _20031201	SD-120	SB	N							0.0130	6.84	0.00250	1.32	0.00890	4.68	0.00250	1.32	0.0130	6.84	0.00250	1.32			0.00250	1.32	0.0160	8.42
SD-121 _20040601	SD-121	SB	N							0.0560	3.11	0.00660	0.367	0.110	6.11	0.0170	0.944	0.0400	2.22	0.0270	1.50			0.0910	5.06	0.0880	4.89
SD-122 _20040601	SD-122	SB	N							0.290	17.0	0.00990	0.579	0.710	41.5	0.150	8.77	0.0590	3.45	0.120	7.02			0.560	32.7	0.460	26.9
SD-123 _20040601	SD-123	SB	N							0.610	36.7	0.0280	1.69	0.320	19.3	0.0700	4.22	0.110	6.63	0.0490	2.95			0.290	17.5	0.240	14.5
SD-124 _20040601	SD-124	SB	N							0.0760	6.33	0.00245	0.204	0.110	9.17	0.00570	0.475	0.0230	1.92	0.00680	0.567			0.0340	2.83	0.0900	7.50
SD-125 _20050401	SD-125	SB	N							0.470	19.6	0.0700	2.92	1.90	79.2	0.450	18.8	0.0780	3.25	0.320	13.3			1.60	66.7	1.40	58.3
SD-126 _20050401	SD-126	SB	N							0.710	22.6	0.0410	1.31	1.90	60.5	0.400	12.7	0.160	5.10	0.110	3.50			1.40	44.6	1.60	51.0
SD-127 _20050401	SD-127	SB	N							0.940	22.0	0.0390	0.913	3.90	91.3	1.20	28.1	0.150	3.51	0.420	9.84			4.60	108	2.60	60.9
SD-128 _20050401	SD-128	SB	N							0.360	7.73	0.0110	0.236	2.10	45.1	1.40	30.0	0.0570	1.22	0.350	7.51			4.20	90.1	1.50	32.2
SD-130 _20050401	SD-130	SB	N							0.440	11.1	0.0290	0.734	0.870	22.0	0.130	3.29	0.120	3.04	0.150	3.80			0.510	12.9	0.640	16.2
SD-131 _20050401	SD-131	SB	N							11.0	347	0.450	14.2	20.0	631	0.780	24.6	1.70	53.6	0.440	13.9			5.10	161	15.0	473
SD-132 _20050401	SD-132	SB	N							0.800	21.4	0.0410	1.10	3.70	98.9	0.240	6.42	0.170	4.55	0.140	3.74			1.90	50.8	2.20	58.8
SD-133 _20050401	SD-133	SB	N							0.210	10.3	0.0170	0.837	0.390	19.2	0.0160	0.788	0.0870	4.29	0.0170	0.837			0.140	6.90	0.380	18.7
SD-134_20050401	SD-134	SB	N							0.630	102	0.0340	5.48	1.30	210	0.130	21.0	0.140	22.6	0.0350	5.65			0.590	95.2	0.980	158
SD-135 _20050401	SD-135	SB	N							5.20	80.4	0.310	4.79	12.0	185	0.500	7.73	1.50	23.2	0.360	5.56			5.50	85.0	7.90	122
SD-135_DUP_20050401	SD-135	SB	FD							4.50	69.6	0.270	4.17	7.10	110	0.330	5.10	1.30	20.1	0.250	3.86			2.20	34.0	5.90	91.2
SD-136 _20050401	SD-136	SB	N							2.30	156	0.140	9.52	1.60	109	0.130	8.84	0.560	38.1	0.0250	1.70			0.510	34.7	1.30	88.4
SD-137 _20050401	SD-137	SB	N							0.0180	1.86	0.00410	0.423	0.0180	1.86	0.00150	0.155	0.0210	2.16	0.00330	0.340			0.00760	0.784	0.0200	2.06
SD-139 _20050401	SD-139	SB	N							0.110	3.00	0.0120	0.327	0.150	4.09	0.0840	2.29	0.0560	1.53	0.0270	0.736			0.150	4.09	0.140	3.81
SD-140_20050401	SD-140	SB	N							0.130	11.1	0.0120	1.03	0.240	20.5	0.00980	0.838	0.0540	4.62	0.00820	0.701			0.0480	4.10	0.230	19.7
SD-141_20050401	SD-141	SB	N							0.0640	5.42	0.00205	0.174	0.0230	1.95	0.00450	0.381	0.0180	1.53	0.00370	0.314			0.0150	1.27	0.0260	2.20
SHI6D_19961101	SHID6	SB	N							0.200	8.00			0.360	14.4	0.0380	1.52	0.0850	3.40	0.0280	1.12			0.190	7.60	0.340	13.6
SHID1_19961001	SHID1	SB	N							0.240	6.15			0.330	8.46	0.01000	0.256	0.160	4.10	0.01000	0.256			0.0730	1.87	0.290	7.44
SHID2 _19961001	SHID2	SB	N							0.00950	2.38			0.0220	5.50	0.00950	2.38	0.00950	2.38	0.00950	2.38			0.00950	2.38	0.0260	6.50

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene		Acenaphthylene		Anthracene		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b) fluoranthene		Benzo(e)pyrene		Benzo(g,h,i)perylene		Benzo(k) fluoranthene		C-1 Benz(a)anth/ Chrysenes		C-1 Fluoranthrenes/ Pyrenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2011 Sediment Data																									
MCO3-0-0.3	MC03	MC	N	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0685	7.78	0.0685	7.78
MC04-0-0.3	MC04	MC	N	0.268	19.1	0.00675	0.482	0.0303	2.16	0.00675	0.482	0.00675	0.482	0.00675	0.482			0.00675	0.482	0.00675	0.482				
SB01-0-0.3	SB01	SB	N	0.0229	0.954	0.0229	0.954	0.0474	1.98	0.0659	2.75	0.0630	2.63	0.0660	2.75			0.0630	2.63	0.0660	2.75				
SB02-0.0.3	SB02	SB	N	0.0183	0.763	0.0183	0.763	0.0492	2.05	0.0557	2.32	0.0436	1.82	0.0470	1.96	0.0390	1.63	0.0367	1.53	0.0470	1.96	0.0915	3.81	0.0915	3.81
SB03_0-0.3	SB03	SB	N	0.0107	0.465	0.0107	0.465	0.0386	1.68	0.0403	1.75	0.0326	1.42	0.0360	1.57			0.0339	1.47	0.0360	1.57				
SB04-0-0.3	SB04	SB	N	0.0577	2.75	0.0185	0.881	0.134	6.38	0.116	5.52	0.0996	4.74	0.102	4.86			0.0956	4.55	0.102	4.86				
SB06-0-0.3	SB06	SB	N	0.0199	0.905	0.0199	0.905	0.119	5.41	0.157	7.14	0.131	5.95	0.143	6.50			0.106	4.82	0.143	6.50				
SB07-0-0.3	SB07	SB	N	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430			0.00645	0.430	0.00645	0.430				
SB08-0-0.3	SB08	SB	N	0.0444	1.53	0.0211	0.728	0.0833	2.87	0.107	3.69	0.0962	3.32	0.113	3.90	0.0819	2.82	0.0728	2.51	0.113	3.90	0.106	3.64	0.106	3.64
SB09-0-0.3	SB09	SB	N	5.40	193	0.0980	3.50	1.74	62.1	0.832	29.7	0.339	12.1	0.405	14.5	0.265	9.46	0.215	7.68	0.405	14.5	0.490	17.5	1.88	67.1
SB12-0-0.3	SB12	SB	N	0.207	7.96	0.207	7.96	0.429	16.5	0.588	22.6	0.207	7.96	0.207	7.96			0.207	7.96	0.207	7.96				
SB13-0-0.3	SB13	SB	N	0.391	11.8	0.0955	2.89	0.275	8.33	0.338	10.2	0.0955	2.89	0.0958	2.90			0.0955	2.89	0.0958	2.90				
SB17-0-0.3	SB17	SB	N	0.293	10.9	0.293	10.9	0.293	10.9	0.799	29.6	0.293	10.9	0.640	23.7			0.293	10.9	0.640	23.7				
SB19-0-0.3	SB19	SB	N	0.192	13.7	0.192	13.7	0.192	13.7	0.192	13.7	0.192	13.7	0.192	13.7			0.192	13.7	0.192	13.7				
SB20-0-0.3	SB20	SB	N	0.291	13.9	0.0825	3.93	0.214	10.2	0.325	15.5	0.223	10.6	0.333	15.8			0.177	8.43	0.333	15.8				
SB21-0-0.3	SB21	SB	N	0.135	4.66	0.135	4.66	0.135	4.66	0.462	15.9	0.428	14.8	0.428	14.8			0.135	4.66	0.428	14.8				
SB24-0-0.3	SB24	SB	N	2.79	63.4	0.865	19.7	0.865	19.7	2.18	49.5	0.865	19.7	0.868	19.7			0.865	19.7	0.868	19.7				
SB26-0-0.3	SB26	SB	N	1.19	41.0	0.413	14.2	0.961	33.1	0.873	30.1	0.413	14.2	0.413	14.2			0.413	14.2	0.413	14.2				
SB27-0-0.3	SB27	SB	N	16.2	600	0.379	14.0	3.64	135	1.62	60.0	0.379	14.0	0.380	14.1			0.379	14.0	0.380	14.1				
SB28-0-0.3	SB28	SB	N	7.81	289	0.397	14.7	4.95	183	2.92	108	1.53	56.7	2.95	109	1.36	50.4	0.818	30.3	0.899	33.3	1.60	59.3	5.41	200

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-1 Fluorenes		C-1 Naphthalenes		C-1 Phenanthrenes/ Anthracenes		C-2 Benz(a)anth/ Chrysenes		C-2 Fluorenes		C-2 Naphthalenes		C-2 Phenanthrenes/ Anthracenes		C-3 Benz(a)anth/ Chrysenes		C-3 Fluorenes		C-3 Naphthalenes		C-3 Phenanthrenes/ Anthracenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2011 Sediment Data																									
MCO3-0-0.3	MC03	MC	N	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78	0.0685	7.78
MC04-0-0.3	MC04	MC	N																						
SB01-0-0.3	SB01	SB	N																						
SB02-0.0.3	SB02	SB	N	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81	0.0915	3.81
SB03_0-0.3	SB03	SB	N																						
SB04-0-0.3	SB04	SB	N																						
SB06-0-0.3	SB06	SB	N																						
SB07-0-0.3	SB07	SB	N																						
SB08-0-0.3	SB08	SB	N	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64	0.106	3.64
SB09-0-0.3	SB09	SB	N	1.38	49.3	4.37	156	4.24	151	0.490	17.5	0.490	17.5	3.76	134	2.02	72.1	0.490	17.5	0.490	17.5	2.94	105	0.490	17.5
SB12-0-0.3	SB12	SB	N																						
SB13-0-0.3	SB13	SB	N																						
SB17-0-0.3	SB17	SB	N																						
SB19-0-0.3	SB19	SB	N																						
SB20-0-0.3	SB20	SB	N																						
SB21-0-0.3	SB21	SB	N																						
SB24-0-0.3	SB24	SB	N																						
SB26-0-0.3	SB26	SB	N																						
SB27-0-0.3	SB27	SB	N																						
SB28-0-0.3	SB28	SB	N	1.96	72.6	14.0	519	7.76	287	0.406	15.0	0.724	26.8	7.18	266	3.37	125	0.0910	3.37	0.498	18.4	3.43	127	1.26	46.7

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-4 Benz(a)anth/ Chrysenes		C-4 Naphthalenes		C-4 Phenanthrenes/ Anthracenes		Chrysene		Dibenzo(a,h) anthracene		Fluoranthene		Fluorene		Indeno(1,2,3-cd) pyrene		Naphthalene		Perylene		Phenanthrene		Pyrene	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2011 Sediment Data																											
MCO3-0-0.3	MC03	MC	N	0.137	15.5	0.0685	7.78	0.137	15.5	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0137	1.55	0.0787	8.94	0.0137	1.55	0.0137	1.55
MC04-0-0.3	MC04	MC	N							0.00675	0.482	0.00675	0.482	0.0236	1.69	0.168	12.0	0.00675	0.482	0.0866	6.19			0.235	16.8	0.0177	1.26
SB01-0-0.3	SB01	SB	N							0.0986	4.11	0.0229	0.954	0.141	5.88	0.0229	0.954	0.0581	2.42	0.0229	0.954			0.0778	3.24	0.133	5.54
SB02-0.0.3	SB02	SB	N	0.183	7.63	0.0915	3.81	0.183	7.63	0.0669	2.79	0.0183	0.763	0.155	6.46	0.0183	0.763	0.0376	1.57	0.0784	3.27	0.0404	1.68	0.0961	4.00	0.128	5.33
SB03_0-0.3	SB03	SB	N							0.0563	2.45	0.0107	0.465	0.119	5.17	0.0107	0.465	0.0329	1.43	0.0337	1.47			0.0514	2.23	0.0968	4.21
SB04-0-0.3	SB04	SB	N							0.160	7.62	0.0185	0.881	0.432	20.6	0.0750	3.57	0.0875	4.17	0.0837	3.99			0.337	16.0	0.312	14.9
SB06-0-0.3	SB06	SB	N							0.312	14.2	0.0199	0.905	0.329	15.0	0.0440	2.00	0.104	4.73	0.0624	2.84			0.147	6.68	0.269	12.2
SB07-0-0.3	SB07	SB	N							0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.00645	0.430	0.0412	2.75			0.00645	0.430	0.00645	0.430
SB08-0-0.3	SB08	SB	N	0.211	7.28	0.106	3.64	0.211	7.28	0.170	5.86	0.0211	0.728	0.276	9.52	0.0211	0.728	0.0734	2.53	0.142	4.90	0.0211	0.728	0.119	4.10	0.213	7.34
SB09-0-0.3	SB09	SB	N	0.980	35.0	1.34	47.9	0.980	35.0	0.962	34.4	0.0980	3.50	7.30	261	5.92	211	0.216	7.71	16.1	575	0.0980	3.50	11.5	411	4.23	151
SB12-0-0.3	SB12	SB	N							0.823	31.7	0.207	7.96	2.17	83.5	0.207	7.96	0.207	7.96	0.207	7.96			1.23	47.3	1.58	60.8
SB13-0-0.3	SB13	SB	N							0.328	9.94	0.0955	2.89	1.24	37.6	0.390	11.8	0.0955	2.89	0.0955	2.89			1.39	42.1	0.849	25.7
SB17-0-0.3	SB17	SB	N							1.14	42.2	0.293	10.9	2.85	106	0.293	10.9	0.293	10.9	0.293	10.9			1.23	45.6	2.11	78.1
SB19-0-0.3	SB19	SB	N							0.192	13.7	0.192	13.7	0.433	30.9	0.192	13.7	0.192	13.7	0.192	13.7			0.192	13.7	0.192	13.7
SB20-0-0.3	SB20	SB	N							0.497	23.7	0.0825	3.93	0.977	46.5	0.245	11.7	0.218	10.4	0.212	10.1			0.758	36.1	0.722	34.4
SB21-0-0.3	SB21	SB	N							0.566	19.5	0.135	4.66	0.780	26.9	0.135	4.66	0.285	9.83	0.135	4.66			0.372	12.8	0.757	26.1
SB24-0-0.3	SB24	SB	N							1.87	42.5	0.865	19.7	10.8	245	2.98	67.7	0.865	19.7	2.89	65.7			14.0	318	7.54	171
SB26-0-0.3	SB26	SB	N							0.413	14.2	0.413	14.2	3.39	117	1.56	53.8	0.413	14.2	2.92	101			4.68	161	2.29	79.0
SB27-0-0.3	SB27	SB	N							1.69	62.6	0.379	14.0	13.4	496	12.2	452	0.379	14.0	4.36	161			23.7	878	7.86	291
SB28-0-0.3	SB28	SB	N	0.182	6.74	1.31	48.5	0.433	16.0	4.80	178	0.222	8.22	17.0	630	7.74	287	0.968	35.9	29.6	1096	0.395	14.6	23.3	863	10.5	389

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene		Acenaphthylene		Anthracene		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b) fluoranthene		Benzo(e)pyrene		Benzo(g,h,i)perylene		Benzo(k) fluoranthene		C-1 Benz(a)anth/ Chrysenes		C-1 Fluoranthrenes/ Pyrenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2012 Sediment Data																									
PWS-27_8-11_SE	PWS-27	MC	N	0.00987	0.548	0.00403	0.224	0.0179	0.994	0.0698	3.88	0.102	5.67	0.135	7.50	0.0711	3.95	0.0403	2.24	0.0458	2.54	0.0807	4.48	0.0849	4.72
PWS-01_8-9_SE	PWS-01	SB	N	0.755	120	0.0133	2.11	0.114	18.1	0.0895	14.2	0.0666	10.6	0.145	23.0	0.0710	11.3	0.0329	5.22	0.0461	7.32	0.0337	5.35	0.144	22.9
PWS-03_8-11_SE	PWS-03	SB	N	1.37	48.9	0.490	17.5	2.69	96.1	5.57	199	3.49	125	7.60	271	3.80	136	1.75	62.5	2.65	94.6	3.70	132	9.00	321
PWS-04_1-4_SE	PWS-04	SB	N	0.161	13.4	0.0514	4.28	0.277	23.1	0.461	38.4	0.372	31.0	0.750	62.5	0.384	32.0	0.207	17.3	0.248	20.7	0.279	23.3	0.614	51.2
PWS-04_8-11_SE	PWS-04	SB	N	0.521	52.1	0.0769	7.69	0.559	55.9	0.668	66.8	0.472	47.2	0.944	94.4	0.507	50.7	0.252	25.2	0.284	28.4	0.390	39.0	1.02	102
PWS-05_8-11_SE	PWS-05	SB	N	0.840	46.7	0.139	7.72	0.971	53.9	1.52	84.4	1.03	57.2	1.93	107	1.01	56.1	0.489	27.2	0.604	33.6	0.812	45.1	2.00	111
PWS-06_8-11_SE	PWS-06	SB	N	3.89	169	0.235	10.2	3.40	148	2.43	106	0.975	42.4	2.46	107	1.10	47.8	0.350	15.2	0.739	32.1	1.29	56.1	5.37	233
PWS-07_8-11_SE	PWS-07	SB	N	1.32	47.1	0.216	7.71	1.48	52.9	1.70	60.7	1.36	48.6	2.69	96.1	1.41	50.4	0.707	25.3	0.832	29.7	1.31	46.8	2.27	81.1
PWS-08_8-11_SE	PWS-08	SB	N	1.05	50.0	0.0713	3.40	0.831	39.6	0.708	33.7	0.372	17.7	0.727	34.6	0.353	16.8	0.167	7.95	0.220	10.5	0.408	19.4	1.18	56.2
PWS-09_8-11_SE	PWS-09	SB	N	0.333	16.7	0.0385	1.93	0.302	15.1	0.361	18.1	0.251	12.6	0.415	20.8	0.216	10.8	0.110	5.50	0.134	6.70	0.196	9.80	0.566	28.3
PWS-12_8-11_SE	PWS-12	SB	N	0.0793	4.41	0.0268	1.49	0.111	6.17	0.230	12.8	0.241	13.4	0.405	22.5	0.222	12.3	0.153	8.50	0.144	8.00	0.152	8.44	0.273	15.2
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0430	2.39	0.0197	1.09	0.0848	4.71	0.147	8.17	0.142	7.89	0.244	13.6	0.129	7.17	0.0792	4.40	0.0742	4.12	0.105	5.83	0.197	10.9
PWS-13_1-4_SE	PWS-13	SB	N	0.0947	3.51	0.0341	1.26	0.272	10.1	0.192	7.11	0.278	10.3	0.336	12.4	0.192	7.11	0.166	6.15	0.107	3.96	0.130	4.81	0.238	8.81
PWS-13_8-11_SE	PWS-13	SB	N	0.0736	3.68	0.0238	1.19	0.108	5.40	0.238	11.9	0.250	12.5	0.464	23.2	0.218	10.9	0.126	6.30	0.152	7.60	0.223	11.2	0.281	14.1
PWS-15_8-11_SE	PWS-15	SB	N	0.00906	0.604	0.00380	0.253	0.0126	0.840	0.0179	1.19	0.0205	1.37	0.0265	1.77	0.0168	1.12	0.00380	0.253	0.0156	1.04	0.0380	2.53	0.0380	2.53
PWS-16B_8-11_SE	PWS-16	SB	N	0.280	12.7	0.0597	2.71	0.336	15.3	0.439	20.0	0.254	11.5	0.540	24.5	0.283	12.9	0.148	6.73	0.169	7.68	0.258	11.7	0.609	27.7
PWS-16_8-11_SE	PWS-16	SB	N	1.30	65.0	0.158	7.90	1.55	77.5	0.932	46.6	0.436	21.8	1.00	50.0	0.517	25.9	0.200	10.0	0.281	14.1	0.630	31.5	1.58	79.0
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0986	4.93	0.0194	0.970	0.0762	3.81	0.221	11.1	0.124	6.20	0.229	11.5	0.109	5.45	0.0516	2.58	0.0652	3.26	0.194	9.70	0.343	17.2
PWS-25_8-11_SE	PWS-25	SB	N	0.536	33.5	0.109	6.81	0.509	31.8	0.795	49.7	0.797	49.8	1.53	95.6	0.783	48.9	0.421	26.3	0.522	32.6	0.578	36.1	1.25	78.1
PWS-26_8-11_SE	PWS-26	SB	N	0.572	47.7	0.0506	4.22	0.477	39.8	0.353	29.4	0.290	24.2	0.515	42.9	0.264	22.0	0.183	15.3	0.172	14.3	0.220	18.3	0.581	48.4
PWS-17_4-7	PWS-17	MC	N	0.149	15.7	0.00891	0.938	0.0238	2.51	0.0263	2.77	0.0203	2.14	0.0471	4.96	0.0283	2.98	0.0190	2.00	0.0137	1.44	0.0277	2.91	0.0277	2.91
PWS-27_8-11	PWS-27	MC	N	0.0104	0.612	0.00934	0.549	0.0264	1.55	0.0645	3.79	0.0646	3.80	0.0950	5.59	0.0580	3.41	0.0491	2.89	0.0339	1.99	0.0697	4.10	0.0954	5.61
PWS-30_8-11	PWS-30	MC	N	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.0427	3.88	0.0427	3.88
LSI-01_8-11	LSI-01	SB	N	0.0340	17.9	0.00667	3.51	0.0478	25.2	0.0384	20.2	0.0296	15.6	0.0497	26.2	0.0301	15.8	0.0243	12.8	0.0150	7.89	0.0320	16.8	0.0320	16.8
LSI-02_8-11	LSI-02	SB	N	0.0613	3.83	0.0182	1.14	0.131	8.19	0.112	7.00	0.0946	5.91	0.210	13.1	0.116	7.25	0.0641	4.01	0.0699	4.37	0.0834	5.21	0.137	8.56
LSI-20_8-11	LSI-20	SB	N	0.127	38.5	0.0373	11.3	0.190	57.6	0.436	132	0.318	96.4	0.649	197	0.319	96.7	0.144	43.6	0.216	65.5	0.327	99.1	0.600	182
LSI-24_8-11	LSI-24	SB	N	0.114	12.5	0.0345	3.79	0.0381	4.19	0.165	18.1	0.234	25.7	0.273	30.0	0.163	17.9	0.173	19.0	0.102	11.2	0.120	13.2	0.198	21.8
PWS-1_8-10	PWS-01	SB	N	0.0736	13.1	0.00313	0.558	0.0190	3.39	0.0802	14.3	0.0485	8.66	0.0757	13.5	0.0423	7.55	0.0272	4.86	0.0286	5.11	0.0313	5.58	0.113	20.2
PWS-3_8-11	PWS-03	SB	N	0.461	17.7	0.290	11.2	1.16	44.6	2.63	101	1.98	76.2	4.36	168	2.05	78.8	0.739	28.4	1.46	56.2	1.61	61.9	3.64	140
PWS-4_8-11	PWS-04	SB	N	0.102	14.8	0.0787	11.4	0.868	126	0.765	111	1.46	212	1.99	288	1.26	183	0.630	91.3	0.562	81.4	0.555	80.4	0.987	143
PWS-5_8-11	PWS-05	SB	N	0.283	23.6	0.0563	4.69	0.274	22.8	0.513	42.8	0.456	38.0	0.862	71.8	0.408	34.0	0.205	17.1	0.294	24.5	0.315	26.3	0.584	48.7
PWS-6_8-11	PWS-06	SB	N	0.977	65.1	0.0670	4.47	0.872	58.1	0.606	40.4	0.371	24.7	0.735	49.0	0.360	24.0	0.159	10.6	0.266	17.7	0.352	23.5	0.846	56.4
PWS-7_8-10	PWS-07	SB	N	0.878	51.6	0.175	10.3	2.69	158	1.78	105	1.49	87.6	2.68	158	1.28	75.3	0.450	26.5	0.873	51.4	1.01	59.4	2.06	121
PWS-7_8-10 DUP	PWS-07	SB	FD	0.859	50.5	0.184	10.8	0.981	57.7	1.38	81.2	1.62	95.3	2.69	158	1.43	84.1	0.588	34.6	0.828	48.7	0.933	54.9	1.76	104
PWS-8_8-11	PWS-08	SB	N	0.261	17.4	0.0523	3.49	0.344	22.9	0.414	27.6	0.366	24.4	0.747	49.8	0.363	24.2	0.180	12.0	0.274	18.3	0.299	19.9	0.541	36.1
PWS-9_8-11	PWS-09	SB	N	0.0494	2.74	0.00471	0.262	0.0689	3.83	0.0836	4.64	0.0548	3.04	0.0932	5.18	0.0474	2.63	0.0329	1.83	0.0373	2.07	0.0471	2.62	0.140	7.78
PWS-12_8-11	PWS-12	SB	N	0.00402	0.268	0.00402	0.268	0.00402	0.268	0.0198	1.32	0.0183	1.22	0.0303	2.02	0.0183	1.22	0.0165	1.10	0.0105	0.700	0.0402	2.68	0.0402	2.68
PWS-13_8-11	PWS-13	SB	N	0.247	11.2	0.0297	1.35	0.215	9.77	0.496	22.5	0.280	12.7	0.271	12.3	0.241	11.0	0.0856	3.89	0.107	4.86	1.50	68.2	1.96	89.1
PWS-13_8-11_1	PWS-13	SB	FD	0.347	15.8	0.0537	2.44	0.317	14.4	0.599	27.2	0.323	14.7	0.429	19.5	0.312	14.2	0.160	7.27	0.138	6.27	1.77	80.5	2.34	106
PWS-13_8-11_2	PWS-13	SB	FT	0.187	8.50	0.0341	1.55	0.159	7.23	0.290	13.2	0.258	11.7	0.302	13.7	0.252	11.5	0.135	6.14	0.0906	4.12	1.22	55.5	1.33	60.5
PWS-15_8-11	PWS-15	SB	N	0.0236	2.91	0.00334	0.412	0.0101	1.25	0.0214	2.64	0.0112	1.38	0.0207	2.56	0.0107	1.32	0.00872	1.08	0.00782	0.965	0.0334	4.12	0.0334	4.12
PWS-16_8-11	PWS-16	SB	N	0.0817	5.11	0.0176	1.10	0.106	6.63	0.146	9.13	0.0809	5.06	0.181	11.3	0.0988	6.18	0.0524	3.28	0.0553	3.46	0.101	6.31	0.209	13.1
PWS-25_4-8	PWS-25	SB	N	0.161	16.4	0.0476	4.86	0.367	37.4	1.33	136	1.14	116	1.74	178	0.836	85.3	0.439	44.8	0.613	62.6	0.578	59.0	1.21	123
PWS-26_8-11	PWS-26	SB	N	0.322	32.2	0.0527	5.27	0.436	43.6	0.392	39.2	0.399	39.9	0.736	73.6	0.357	35.7	0.206	20.6	0.275	27.5	0.271	27.1	0.591	59.1
PWS-26_8-11_DUP	PWS-26	SB	FD	0.326	23.3	0.0702	5.01	0.506	36.1	0.886	63.3	0.776	55.4	1.34	95.7	0.631	45.1	0.324	23.1	0.466	33.3	0.548	39.1	1.09	77.9
PWS-28_8-11	PWS-28	SB	N	0.00302	0.274	0.0165	1.50	0.0106	0.964	0.0418	3.80	0.0853	7.75	0.0880	8.00	0.0683	6.21	0.0690	6.27	0.0310	2.82	0.0695	6.32	0.0302	2.74

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-1 Fluorenes		C-1 Naphthalenes		C-1 Phenanthrenes/ Anthracenes		C-2 Benz(a)anth/ Chrysenes		C-2 Fluorenes		C-2 Naphthalenes		C-2 Phenanthrenes/ Anthracenes		C-3 Benz(a)anth/ Chrysenes		C-3 Fluorenes		C-3 Naphthalenes		C-3 Phenanthrenes/ Anthracenes	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2012 Sediment Data																									
PWS-27_8-11_SE	PWS-27	MC	N	0.0403	2.24	0.0220	1.22	0.0403	2.24	0.145	8.06	0.0403	2.24	0.0403	2.24	0.0403	2.24	0.0403	2.24	0.0403	2.24	0.0403	2.24	0.0403	2.24
PWS-01_8-9_SE	PWS-01	SB	N	0.104	16.5	0.174	27.6	0.172	27.3	0.0337	5.35	0.0337	5.35	0.355	56.3	0.0862	13.7	0.0337	5.35	0.0337	5.35	0.133	21.1	0.0337	5.35
PWS-03_8-11_SE	PWS-03	SB	N	0.763	27.3	2.60	92.9	4.23	151	1.08	38.6	0.751	26.8	1.94	69.3	3.03	108	0.872	31.1	0.407	14.5	1.25	44.6	1.68	60.0
PWS-04_1-4_SE	PWS-04	SB	N	0.103	8.58	0.313	26.0	0.414	34.5	0.115	9.58	0.0837	6.98	0.203	16.9	0.288	24.0	0.129	10.8	0.0354	2.95	0.152	12.7	0.146	12.2
PWS-04_8-11_SE	PWS-04	SB	N	0.176	17.6	0.715	71.5	0.932	93.2	0.172	17.2	0.192	19.2	0.655	65.5	0.574	57.4	0.163	16.3	0.187	18.7	0.364	36.4	0.322	32.2
PWS-05_8-11_SE	PWS-05	SB	N	0.276	15.3	1.09	60.4	1.38	76.7	0.334	18.6	0.224	12.4	0.995	55.3	0.915	50.8	0.227	12.6	0.132	7.33	0.582	32.3	0.474	26.3
PWS-06_8-11_SE	PWS-06	SB	N	1.04	45.2	7.00	304	6.08	264	0.502	21.8	0.960	41.7	4.53	197	3.36	146	0.333	14.5	0.429	18.7	2.32	101	1.28	55.7
PWS-07_8-11_SE	PWS-07	SB	N	0.357	12.8	2.23	79.8	1.87	66.8	0.455	16.3	0.0404	1.44	1.42	50.7	1.12	40.0	0.334	11.9	0.397	14.2	0.789	28.2	0.553	19.8
PWS-08_8-11_SE	PWS-08	SB	N	0.298	14.2	1.45	69.2	1.55	73.8	0.191	9.10	0.301	14.3	1.26	60.0	0.824	39.2	0.173	8.24	0.152	7.24	0.745	35.5	0.405	19.3
PWS-09_8-11_SE	PWS-09	SB	N	0.196	9.80	0.392	19.6	0.647	32.4	0.0922	4.61	0.108	5.40	0.363	18.2	0.302	15.1	0.0445	2.23	0.0445	2.23	0.268	13.4	0.146	7.30
PWS-12_8-11_SE	PWS-12	SB	N	0.0490	2.72	0.0839	4.66	0.164	9.11	0.110	6.11	0.0490	2.72	0.0490	2.72	0.130	7.22	0.0490	2.72	0.0490	2.72	0.0490	2.72	0.0490	2.72
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0467	2.59	0.0677	3.76	0.134	7.44	0.0467	2.59	0.0467	2.59	0.0467	2.59	0.0963	5.35	0.0467	2.59	0.0467	2.59	0.0467	2.59	0.0467	2.59
PWS-13_1-4_SE	PWS-13	SB	N	0.0505	1.87	0.203	7.51	0.257	9.52	0.0505	1.87	0.0505	1.87	0.201	7.44	0.162	6.00	0.0505	1.87	0.0505	1.87	0.184	6.81	0.0505	1.87
PWS-13_8-11_SE	PWS-13	SB	N	0.0459	2.30	0.141	7.04	0.187	9.35	0.0940	4.70	0.0459	2.30	0.121	6.05	0.126	6.30	0.110	5.50	0.0459	2.30	0.100	5.00	0.133	6.65
PWS-15_8-11_SE	PWS-15	SB	N	0.0380	2.53	0.0173	1.16	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0380	2.53	0.0896	5.97	0.0380	2.53
PWS-16B_8-11_SE	PWS-16	SB	N	0.107	4.86	0.545	24.8	0.462	21.0	0.101	4.59	0.102	4.64	0.327	14.9	0.309	14.0	0.113	5.14	0.0428	1.94	0.208	9.45	0.221	10.0
PWS-16_8-11_SE	PWS-16	SB	N	0.442	22.1	3.10	155	2.07	104	0.223	11.2	0.363	18.2	1.83	91.5	1.01	50.5	0.250	12.5	0.170	8.50	0.964	48.2	0.377	18.9
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0363	1.81	0.0470	2.35	0.164	8.20	0.130	6.50	0.0363	1.81	0.0363	1.81	0.219	11.0	0.0749	3.75	0.0363	1.81	0.0363	1.81	0.255	12.8
PWS-25_8-11_SE	PWS-25	SB	N	0.173	10.8	0.862	53.9	0.953	59.6	0.267	16.7	0.197	12.3	0.523	32.7	0.593	37.1	0.231	14.4	0.108	6.75	0.371	23.2	0.291	18.2
PWS-26_8-11_SE	PWS-26	SB	N	0.163	13.6	0.926	77.2	0.752	62.7	0.137	11.4	0.133	11.1	0.556	46.3	0.341	28.4	0.114	9.50	0.0410	3.41	0.353	29.4	0.168	14.0
PWS-17_4-7	PWS-17	MC	N	0.0277	2.91	0.126	13.3	0.0277	2.91	0.0277	2.91	0.0277	2.91	0.0597	6.28	0.0277	2.91	0.0277	2.91	0.0277	2.91	0.0277	2.91	0.0277	2.91
PWS-27_8-11	PWS-27	MC	N	0.0345	2.03	0.0132	0.774	0.119	7.00	0.0705	4.15	0.0345	2.03	0.0345	2.03	0.118	6.94	0.0994	5.85	0.0345	2.03	0.0345	2.03	0.0965	5.68
PWS-30_8-11	PWS-30	MC	N	0.0427	3.88	0.00853	0.775	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88	0.0427	3.88
LSI-01_8-11	LSI-01	SB	N	0.0320	16.8	0.0761	40.1	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8	0.0320	16.8
LSI-02_8-11	LSI-02	SB	N	0.0403	2.52	0.0570	3.56	0.136	8.50	0.0403	2.52	0.0403	2.52	0.0403	2.52	0.0850	5.31	0.0403	2.52	0.0403	2.52	0.0403	2.52	0.0403	2.52
LSI-20_8-11	LSI-20	SB	N	0.0681	20.6	0.111	33.7	0.421	128	0.139	42.1	0.0774	23.5	0.0837	25.4	0.291	88.2	0.129	39.1	0.127	38.5	0.101	30.6	0.203	61.5
LSI-24_8-11	LSI-24	SB	N	0.0310	3.41	0.0447	4.91	0.122	13.4	0.0664	7.30	0.0310	3.41	0.0310	3.41	0.139	15.3	0.0310	3.41	0.0310	3.41	0.0310	3.41	0.131	14.4
PWS-1_8-10	PWS-01	SB	N	0.0313	5.58	0.00625	1.12	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58	0.0313	5.58
PWS-3_8-11	PWS-03	SB	N	0.256	9.85	0.691	26.6	1.96	75.4	0.605	23.3	0.227	8.73	0.522	20.1	1.30	50.0	0.543	20.9	0.618	23.8	0.422	16.2	0.684	26.3
PWS-4_8-11	PWS-04	SB	N	0.0322	4.66	0.135	19.5	0.531	77.0	0.279	40.4	0.0322	4.66	0.0937	13.6	0.296	42.9	0.239	34.6	0.130	18.8	0.0810	11.7	0.159	23.0
PWS-5_8-11	PWS-05	SB	N	0.0970	8.08	0.309	25.8	0.456	38.0	0.149	12.4	0.0849	7.08	0.257	21.4	0.318	26.5	0.133	11.1	0.147	12.3	0.217	18.1	0.144	12.0
PWS-6_8-11	PWS-06	SB	N	0.292	19.5	1.24	82.7	1.29	86.0	0.190	12.7	0.179	11.9	1.04	69.3	0.638	42.5	0.184	12.3	0.193	12.9	0.765	51.0	0.294	19.6
PWS-7_8-10	PWS-07	SB	N	0.381	22.4	0.996	58.6	2.01	118	0.521	30.6	0.290	17.1	0.915	53.8	1.18	69.4	0.488	28.7	0.551	32.4	0.963	56.6	0.665	39.1
PWS-7_8-10 DUP	PWS-07	SB	FD	0.338	19.9	1.31	77.2	1.55	91.2	0.452	26.6	0.234	13.8	0.877	51.6	0.962	56.6	0.420	24.7	0.424	24.9	0.670	39.4	0.483	28.4
PWS-8_8-11	PWS-08	SB	N	0.107	7.13	0.385	25.7	0.513	34.2	0.140	9.33	0.0856	5.71	0.299	19.9	0.355	23.7	0.151	10.1	0.149	9.93	0.210	14.0	0.182	12.1
PWS-9_8-11	PWS-09	SB	N	0.0471	2.62	0.0595	3.31	0.124	6.89	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62	0.0471	2.62
PWS-12_8-11	PWS-12	SB	N	0.0402	2.68	0.00804	0.536	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68	0.0402	2.68
PWS-13_8-11	PWS-13	SB	N	0.674	30.6	0.154	6.99	3.79	172	1.84	83.6	1.41	64.1	1.66	75.5	5.68	258	1.41	64.1	1.74	79.1	5.33	242	4.60	209
PWS-13_8-11_1	PWS-13	SB	FD	0.638	29.0	0.413	18.8	4.27	194	2.06	93.6	1.07	48.6	2.19	99.5	5.50	250	1.66	75.5	1.42	64.5	5.59	254	5.26	239
PWS-13_8-11_2	PWS-13	SB	FT	0.396	18.0	0.196	8.89	2.66	121	1.51	68.6	0.726	33.0	1.50	68.2	3.59	163	1.06	48.2	0.951	43.2	4.14	188	3.70	168
PWS-15_8-11	PWS-15	SB	N	0.0334	4.12	0.0156	1.93	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12	0.0334	4.12
PWS-16_8-11	PWS-16	SB	N	0.0356	2.22	0.122	7.62	0.192	12.0	0.0356	2.22	0.0356	2.22	0.0916	5.73	0.143	8.94	0.0934	5.84	0.0356	2.22	0.0814	5.09	0.0806	5.04
PWS-25_4-8	PWS-25	SB	N	0.0922	9.41	0.243	24.8	0.399	40.7	0.197	20.1	0.0367	3.74	0.170	17.3	0.300	30.6	0.146	14.9	0.118	12.0	0.113	11.5	0.153	15.6
PWS-26_8-11	PWS-26	SB	N	0.146	14.6	0.490	49.0	0.612	61.2	0.132	13.2	0.0903	9.03	0.346	34.6	0.356	35.6	0.113	11.3	0.129	12.9	0.251	25.1	0.180	18.0
PWS-26_8-11_DUP	PWS-26	SB	FD	0.161	11.5	0.545	38.9	0.833	59.5	0.243	17.4	0.123	8.79	0.361	25.8	0.599	42.8	0.183	13.1	0.217	15.5	0.253	18.1	0.297	21.2
PWS-28_8-11	PWS-28	SB	N	0.0302	2.74	0.0171	1.56	0.0302	2.74	0.0682	6.20	0.0302	2.74	0.0302	2.74	0.0302	2.74	0.0616	5.60	0.0302	2.74	0.0302	2.74	0.0302	2.74

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 2: Conversion of Bulk Sediment Concentrations to Organic-Carbon-Normalized Concentrations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-4 Benz(a)anth/ Chrysenes		C-4 Naphthalenes		C-4 Phenanthrenes/ Anthracenes		Chrysene		Dibenzo(a,h) anthracene		Fluoranthene		Fluorene		Indeno(1,2,3-cd) pyrene		Naphthalene		Perylene		Phenanthrene		Pyrene	
				mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC	mg/kg bulk sediment	mg/kg sediment OC
2012 Sediment Data																											
PWS-27_8-11_SE	PWS-27	MC	N	0.0805	4.47	0.0403	2.24	0.0805	4.47	0.0840	4.67	0.0403	2.24	0.129	7.17	0.0129	0.717	0.0403	2.24	0.0665	3.69	0.0862	4.79	0.0652	3.62	0.135	7.50
PWS-01_8-9_SE	PWS-01	SB	N	0.0675	10.7	0.0337	5.35	0.0675	10.7	0.127	20.2	0.00772	1.23	0.433	68.7	0.550	87.3	0.0357	5.67	0.0692	11.0	0.0255	4.05	0.489	77.6	0.321	51.0
PWS-03_8-11_SE	PWS-03	SB	N	0.376	13.4	0.609	21.8	0.376	13.4	9.76	349	0.443	15.8	18.6	664	1.95	69.6	1.92	68.6	5.70	204	0.830	29.6	6.48	231	14.5	518
PWS-04_1-4_SE	PWS-04	SB	N	0.0710	5.92	0.0857	7.14	0.0710	5.92	0.626	52.2	0.0520	4.33	1.51	126	0.221	18.4	0.221	18.4	0.693	57.8	0.120	10.0	0.772	64.3	1.19	99.2
PWS-04_8-11_SE	PWS-04	SB	N	0.0725	7.25	0.204	20.4	0.0725	7.25	1.01	101	0.0684	6.84	2.77	277	0.571	57.1	0.302	30.2	1.54	154	0.153	15.3	1.87	187	2.01	201
PWS-05_8-11_SE	PWS-05	SB	N	0.0790	4.39	0.271	15.1	1.26	70.0	2.06	114	0.123	6.83	4.44	247	0.921	51.2	0.506	28.1	2.20	122	0.345	19.2	3.14	174	3.29	183
PWS-06_8-11_SE	PWS-06	SB	N	0.328	14.3	1.01	43.9	4.21	183	3.72	162	0.107	4.65	16.9	735	4.15	180	0.406	17.7	17.3	752	0.244	10.6	13.6	591	10.7	465
PWS-07_8-11_SE	PWS-07	SB	N	0.0805	2.88	0.403	14.4	0.245	8.75	2.38	85.0	0.177	6.32	5.72	204	1.43	51.1	0.762	27.2	5.35	191	0.481	17.2	4.65	166	4.63	165
PWS-08_8-11_SE	PWS-08	SB	N	0.0890	4.24	0.369	17.6	0.361	17.2	0.802	38.2	0.0492	2.34	3.46	165	1.17	55.7	0.186	8.86	2.44	116	0.123	5.86	4.01	191	2.52	120
PWS-09_8-11_SE	PWS-09	SB	N	0.0890	4.45	0.117	5.85	0.231	11.6	0.409	20.5	0.0297	1.49	1.43	71.5	0.327	16.4	0.124	6.20	1.16	58.0	0.125	6.25	1.27	63.5	1.10	55.0
PWS-12_8-11_SE	PWS-12	SB	N	0.0980	5.44	0.0490	2.72	0.0980	5.44	0.330	18.3	0.0350	1.94	0.576	32.0	0.0880	4.89	0.169	9.39	0.170	9.44	0.168	9.33	0.280	15.6	0.536	29.8
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0935	5.19	0.0467	2.59	0.0935	5.19	0.216	12.0	0.0191	1.06	0.386	21.4	0.0664	3.69	0.0880	4.89	0.172	9.56	0.111	6.17	0.238	13.2	0.337	18.7
PWS-13_1-4_SE	PWS-13	SB	N	0.101	3.72	0.0505	1.87	0.101	3.72	0.277	10.3	0.0275	1.02	0.596	22.1	0.142	5.26	0.162	6.00	0.359	13.3	0.0946	3.50	0.496	18.4	0.612	22.7
PWS-13_8-11_SE	PWS-13	SB	N	0.0920	4.60	0.0459	2.30	0.0920	4.60	0.314	15.7	0.0301	1.51	0.433	21.7	0.0971	4.86	0.126	6.30	0.255	12.8	0.101	5.05	0.341	17.1	0.370	18.5
PWS-15_8-11_SE	PWS-15	SB	N	0.0760	5.07	0.0380	2.53	0.238	15.9	0.0248	1.65	0.00380	0.253	0.0976	6.51	0.00974	0.649	0.00778	0.519	0.0233	1.55	0.0860	5.73	0.0736	4.91	0.0789	5.26
PWS-16B_8-11_SE	PWS-16	SB	N	0.0855	3.89	0.118	5.36	0.0855	3.89	0.554	25.2	0.0428	1.94	1.39	63.2	0.311	14.1	0.176	8.00	0.999	45.4	0.130	5.91	0.895	40.7	1.09	49.5
PWS-16_8-11_SE	PWS-16	SB	N	0.0845	4.23	0.388	19.4	0.232	11.6	1.11	55.5	0.0422	2.11	4.90	245	1.56	78.0	0.229	11.5	5.44	272	0.173	8.65	5.75	288	3.48	174
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0725	3.63	0.0783	3.92	0.0725	3.63	0.277	13.9	0.0182	0.910	0.292	14.6	0.0607	3.04	0.0643	3.22	0.122	6.10	0.0428	2.14	0.277	13.9	0.267	13.4
PWS-25_8-11_SE	PWS-25	SB	N	0.0820	5.13	0.207	12.9	0.275	17.2	1.25	78.1	0.117	7.31	2.80	175	0.643	40.2	0.514	32.1	1.45	90.6	0.217	13.6	2.01	126	2.36	148
PWS-26_8-11_SE	PWS-26	SB	N	0.0820	6.83	0.158	13.2	0.406	33.8	0.502	41.8	0.0410	3.41	1.60	133	0.756	63.0	0.191	15.9	1.35	113	0.121	10.1	1.98	165	1.24	103
PWS-17_4-7	PWS-17	MC	N	0.0555	5.84	0.0277	2.91	0.0555	5.84	0.0403	4.24	0.00277	0.291	0.0825	8.68	0.0625	6.58	0.0172	1.81	0.195	20.5	0.0162	1.71	0.124	13.1	0.0568	5.98
PWS-27_8-11	PWS-27	MC	N	0.0690	4.06	0.0345	2.03	0.0690	4.06	0.0923	5.43	0.0103	0.606	0.186	10.9	0.0141	0.829	0.0436	2.56	0.0228	1.34	0.0516	3.04	0.103	6.06	0.186	10.9
PWS-30_8-11	PWS-30	MC	N	0.0855	7.77	0.0427	3.88	0.0855	7.77	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388	0.00427	0.388
LSI-01_8-11	LSI-01	SB	N	0.0640	33.7	0.0320	16.8	0.0640	33.7	0.0467	24.6	0.00320	1.68	0.155	81.6	0.0386	20.3	0.0243	12.8	0.188	98.9	0.00931	4.90	0.152	80.0	0.103	54.2
LSI-02_8-11	LSI-02	SB	N	0.0805	5.03	0.0403	2.52	0.0805	5.03	0.165	10.3	0.0157	0.981	0.388	24.3	0.0711	4.44	0.0690	4.31	0.116	7.25	0.0355	2.22	0.250	15.6	0.285	17.8
LSI-20_8-11	LSI-20	SB	N	0.0595	18.0	0.0914	27.7	0.0595	18.0	0.593	180	0.0445	13.5	1.47	445	0.0933	28.3	0.162	49.1	0.256	77.6	0.0873	26.5	0.618	187	1.12	339
LSI-24_8-11	LSI-24	SB	N	0.0620	6.81	0.0310	3.41	0.0620	6.81	0.211	23.2	0.0240	2.64	0.328	36.0	0.0287	3.15	0.146	16.0	0.0893	9.81	0.0820	9.01	0.139	15.3	0.306	33.6
PWS-1_8-10	PWS-01	SB	N	0.0625	11.2	0.0313	5.58	1.10	196	0.164	29.3	0.00626	1.12	0.100	17.9	0.0360	6.43	0.0292	5.21	0.0152	2.71	0.0156	2.79	0.0490	8.75	0.0862	15.4
PWS-3_8-11	PWS-03	SB	N	0.260	10.0	0.268	10.3	0.346	13.3	6.36	245	0.289	11.1	5.64	217	0.629	24.2	1.03	39.6	1.26	48.5	0.430	16.5	2.47	95.0	4.30	165
PWS-4_8-11	PWS-04	SB	N	0.0645	9.35	0.0322	4.66	0.0645	9.35	2.03	294	0.191	27.7	1.34	194	0.156	22.6	0.793	115	0.339	49.1	0.470	68.1	0.711	103	1.15	167
PWS-5_8-11	PWS-05	SB	N	0.0750	6.25	0.126	10.5	0.211	17.6	1.24	103	0.0604	5.03	1.22	102	0.277	23.1	0.233	19.4	0.634	52.8	0.124	10.3	0.882	73.5	0.855	71.3
PWS-6_8-11	PWS-06	SB	N	0.0825	5.50	0.326	21.7	1.29	86.0	0.693	46.2	0.0534	3.56	2.38	159	0.969	64.6	0.184	12.3	2.05	137	0.0937	6.25	2.77	185	1.67	111
PWS-7_8-10	PWS-07	SB	N	0.167	9.82	0.536	31.5	0.378	22.2	2.07	122	0.186	10.9	4.43	261	1.05	61.8	0.619	36.4	1.99	117	0.411	24.2	3.16	186	3.50	206
PWS-7_8-10 DUP	PWS-07	SB	FD	0.150	8.82	0.334	19.6	0.282	16.6	2.56	151	0.197	11.6	3.29	194	0.962	56.6	0.758	44.6	2.53	149	0.463	27.2	2.42	142	2.60	153
PWS-8_8-11	PWS-08	SB	N	0.0825	5.50	0.138	9.20	0.616	41.1	0.615	41.0	0.0554	3.69	1.12	74.7	0.320	21.3	0.209	13.9	0.593	39.5	0.0916	6.11	0.962	64.1	0.775	51.7
PWS-9_8-11	PWS-09	SB	N	0.0940	5.22	0.0471	2.62	0.0940	5.22	0.227	12.6	0.00471	0.262	0.203	11.3	0.0675	3.75	0.0354	1.97	0.0943	5.24	0.0208	1.16	0.179	9.94	0.149	8.28
PWS-12_8-11	PWS-12	SB	N	0.0805	5.37	0.0402	2.68	0.0805	5.37	0.0273	1.82	0.00402	0.268	0.0450	3.00	0.00402	0.268	0.0170	1.13	0.0109	0.727	0.0113	0.753	0.0203	1.35	0.0421	2.81
PWS-13_8-11	PWS-13	SB	N	0.557	25.3	3.79	172	4.37	199	0.885	40.2	0.0440	2.00	0.977	44.4	0.208	9.45	0.0701	3.19	0.276	12.5	0.0965	4.39	1.24	56.4	1.01	45.9
PWS-13_8-11_1	PWS-13	SB	FD	0.547	24.9	3.68	167	2.93	133	1.12	50.9	0.0432	1.96	1.63	74.1	0.334	15.2	0.127	5.77	0.766	34.8	0.123	5.59	1.77	80.5	1.60	72.7
PWS-13_8-11_2	PWS-13	SB	FT	0.537	24.4	2.64	120	2.18	99.1	0.449	20.4	0.0392	1.78	0.662	30.1	0.169	7.68	0.109	4.95	0.305	13.9	0.0880	4.00	0.965	43.9	0.748	34.0
PWS-15_8-11	PWS-15	SB	N	0.0670	8.27	0.0334	4.12	0.0670	8.27	0.0215	2.65	0.00334	0.412	0.0584	7.21	0.0150	1.85	0.00881	1.09	0.0329	4.06	0.0264	3.26	0.0405	5.00	0.0480	5.93
PWS-16_8-11	PWS-16	SB	N	0.0710	4.44	0.0356	2.22	0.0710	4.44	0.197	12.3	0.0148	0.925	0.465	29.1	0.0989	6.18	0.0551	3.44	0.187	11.7	0.0305	1.91	0.316	19.8	0.339	21.2
PWS-25_4-8	PWS-25	SB	N	0.0735	7.50	0.0367	3.74	0.299	30.5	1.64	167	0.140	14.3	1.56	159	0.268	27.3	0.516	52.7	0.473	48.3	0.274	28.0	0.667	68.1	1.11	113
PWS-26_8-11	PWS-26	SB	N	0.0745	7.45	0.130	13.0	2.59	259	0.711	71.1	0.0554	5.54	1.22	122	0.435	43.5	0.221	22.1	0.776	77.6	0.0950	9.50	1.09	109	0.854	85.4
PWS-26_8-11_DUP	PWS-26	SB	FD	0.0755	5.39	0.153	10.9	0.876	62.6	1.32	94.3	0.0995	7.11	1.77	126	0.428	30.6	0.373	26.6	1.00	71.4	0.175	12.5	1.20	85.7	1.28	91.4
PWS-28_8-11	PWS-28	SB	N	0.0605	5.50	0.0302	2.74	0.0605	5.50	0.0658	5.98	0.0103	0.936	0.132	12.0	0.00635	0.577	0.0560	5.09	0.0211	1.92	0.0287	2.61	0.0605	5.50	0.106	9.64

Notes:

[1]Normalization based on total organic carbon (TOC).

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

mg/kg = milligrams per kilogram

OC = organic carbon

PAH = polycyclic aromatic hydrocarbon

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracene	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracene	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracene	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracene	Chrysene	Dibenzo(a,h)anthracene
Final Chronic Value (mg/kg OC)				491	452	594	841	965	979	967	1,095	981	929	770	611	444	670	1,008	686	510	746	1,112	769	581	829	1,214	657	913	844	1,123
Historical Data (1996 - 2005)																														
SD-MC-A _20040601	SD-MC-A	MC	N	0.00134	0.00961	0.0128	0.0288	0.0471	0.0299		0.0420	0.0278				0.00148													0.0425	0.00225
SD-MC-B _20040601	SD-MC-B	MC	N	0.00266	6.01E-04	4.57E-04	6.72E-04	0.00107	0.00107		0.00139	6.98E-04				0.00294													0.00104	2.42E-04
SD-MC-C _20040601	SD-MC-C	MC	N	0.00679	0.00156	0.00378	0.00373	0.00438	0.00347		0.00480	0.00235				0.00217													0.00554	4.00E-04
SD-MC-D _20040601	SD-MC-D	MC	N	0.00116	2.17E-04	9.02E-04	0.00140	9.62E-04	9.12E-04		6.52E-04	6.92E-04				6.03E-04													0.00212	8.75E-05
SD-MC-E _20040601	SD-MC-E	MC	N	0.00293	0.00287	0.0159	0.00626	0.0113	0.0108		0.00641	0.00608				0.00158													0.0108	0.00116
SD-100_20031201	SD-100	SB	N	0.00122	2.85E-04	0.00287	0.00433	0.00325	0.00353		0.00219	0.00249				0.00135													0.00764	3.12E-04
SD-101 _20031201	SD-101	SB	N	0.00336	3.40E-04	0.00371	0.00475	0.00371	0.00403		0.00247	0.00276				0.00517													0.00707	3.35E-04
SD-102 _20031201	SD-102	SB	N	7.46E-04	3.40E-04	0.00192	0.00403	0.00330	0.00442		0.00201	0.00329				8.42E-04													0.00653	2.98E-04
SD-103 _20031201	SD-103	SB	N	0.00528	0.00177	0.00739	0.0168	0.0117	0.0173		0.00418	0.0130				0.00510													0.0330	8.40E-04
SD-103-A _20040601	SD-103-A	SB	N	0.0263	0.00162	0.0416	0.0174	0.00397	0.00641		0.00197	0.00568				0.0283													0.0190	3.72E-04
SD-103-B._20040601	SD-103-B	SB	N	0.00210	0.00100	0.00450	0.00426	0.00316	0.00378		0.00248	0.00336				0.00315													0.00634	3.33E-04
SD-103-C _20040601	SD-103-C	SB	N	0.00536	0.00169	0.0129	0.0113	0.00672	0.00975		0.00335	0.00778				0.00946													0.0213	6.80E-04
SD-104_20031201	SD-104	SB	N	0.0106	0.00214	0.0201	0.0169	0.0100	0.0133		0.00571	0.00927				0.0179													0.0202	0.00111
SD-104-A _20040601	SD-104-A	SB	N	6.58E-04	3.05E-04	0.00189	0.00220	0.00188	0.00225		0.00150	0.00189				9.03E-04													0.00414	1.23E-04
SD-104-B _20040601	SD-104-B	SB	N	7.17E-04	3.00E-04	0.00177	0.00212	0.00151	0.00207		0.00115	0.00153				9.12E-04													0.00345	1.21E-04
SD-104-C _20040601	SD-104-C	SB	N	6.85E-04	3.15E-04	0.00218	0.00226	0.00165	0.00216		0.00130	0.00163				9.22E-04													0.00444	1.27E-04
SD-105_20031201	SD-105	SB	N	0.00783	0.00102	0.00857	0.00771	0.00576	0.00615		0.00376	0.00462				0.00730													0.0104	5.77E-04
SD-105-A _20040601	SD-105-A	SB	N	0.00153	8.04E-04	0.00378	0.00334	0.00210	0.00295		0.00150	0.00221				0.00202													0.00577	1.12E-04
SD-105-B _20040601	SD-105-B	SB	N	0.0728	0.00187	0.0188	0.00238	0.00143	0.00196		9.13E-04	0.00176				0.00173													0.00442	1.11E-04
SD-105-C _20040601	SD-105-C	SB	N	8.62E-04	2.81E-04	0.00175	0.00160	0.00108	0.00149		7.73E-04	0.00122				8.66E-04													0.00264	1.10E-04
SD-106 _20031201	SD-106	SB	N	0.00262	8.95E-04	0.00681	0.00906	0.00790	0.00827		0.00431	0.00631				0.00343													0.0158	6.78E-04
SD-108 _20031201	SD-108	SB	N	0.116	0.00614	0.135	0.0738	0.0386	0.0477		0.0160	0.0335				0.115													0.104	0.00325
SD-110_20031201	SD-110	SB	N	0.0652	0.00367	0.0500	0.0510	0.0332	0.0426		0.0115	0.0291				0.0283													0.0745	0.00280
SD-112 _20031201	SD-112	SB	N	0.0297	0.00365	0.0376	0.0312	0.0262	0.0307		0.0142	0.0208				0.0241													0.0483	0.00242
SD-112-A _20040601	SD-112-A	SB	N	0.00844	0.00364	0.0210	0.0117	0.0177	0.0215		0.0102	0.0161				0.0102													0.0296	0.00199
SD-112-B _20040601	SD-112-B	SB	N	0.0110	0.00431	0.0227	0.0306	0.0276	0.0367		0.0115	0.0305				0.0128													0.0532	0.00293
SD-112-C _20040601	SD-112-C	SB	N	0.00796	0.00423	0.0204	0.0283	0.0255	0.0331		0.0128	0.0247				0.00607													0.0421	0.00289
SD-113 _20031201	SD-113	SB	N	0.00231	0.00251	0.00191	0.00811	0.00848	0.00557		0.00498	0.00556				0.00256													0.0102	0.00101
SD-114 _20031201	SD-114	SB	N	7.64E-04	3.88E-04	0.00220	0.00276	0.00358	0.00298		0.00245	0.00243				8.04E-04													0.00508	1.56E-04
SD-115_20031201	SD-115	SB	N	0.00118	0.00112	6.10E-04	0.00155	0.00180	0.00163		0.00120	0.00130				9.79E-04													0.00223	3.23E-04
SD-116 _20031201	SD-116	SB	N	0.00108	5.42E-04	0.00133	0.00369	0.00611	0.00398		0.00475	0.00336				5.52E-04													0.00486	5.43E-04
SD-117 _20031201	SD-117	SB	N	0.00647	0.00289	0.0123	0.0222	0.0242	0.0172		0.0154	0.0143				0.00737													0.0399	0.00191
SD-117-A _20040601	SD-117-A	SB	N	0.00283	0.00307	0.00234	0.00542	0.00518	0.00494		0.00360	0.00470				0.00313													0.00606	0.00124
SD-117-B _20040601	SD-117-B	SB	N	0.00557	0.00136	0.00359	0.00250	0.00266	0.00310		0.00216	0.00204				0.00511													0.00395	5.49E-04
SD-117-C _20040601	SD-117-C	SB	N	0.00402	0.00213	0.00642	0.00861	0.00954	0.0106		0.00649	0.00885				0.00593													0.0218	8.90E-04
SD-119_20031201	SD-119	SB	N	0.00315	0.00193	0.00444	0.00951	0.0141	0.0111		0.00913	0.00917				0.00389													0.0151	0.00105
SD-119-A _20040601	SD-119-A	SB	N	0.0325	9.95E-04	0.00956	0.00584	0.00233	0.00278		0.00113	0.00211				0.00720													0.00694	2.32E-04
SD-119-B _20040601	SD-119-B	SB	N	0.00876	0.00182	0.00521	0.00483	0.00395	0.00326		0.00251	0.00291				0.0102													0.00687	4.26E-04
SD-119-C _20040601	SD-119-C	SB	N	0.00807	0.00168	0.00483	0.00196	0.00106	9.78E-04		8.44E-04	8.75E-04				0.00743													0.00266	7.35E-05
SD-120 _20031201	SD-120	SB	N	0.00268	0.00291	0.00222	0.00588	0.00818	0.00489		0.00625	0.00515				0.00296													0.00811	0.00117
SD-121 _20040601	SD-121	SB	N	0.00113	6.15E-04	0.00206	0.00344	0.00357	0.00346		0.00208	0.00283				0.00175													0.00369	3.27E-04
SD-122 _20040601	SD-122	SB	N	0.0119	0.00128	0.0148	0.0111	0.00582	0.00657		0.00310	0.00590				0.0101													0.0201	5.16E-04
SD-123 _20040601	SD-123	SB	N	0.00491	0.00173	0.0122	0.0222	0.0137	0.0129		0.00605	0.0141				0.00353													0.0435	0.00150
SD-124 _20040601	SD-124	SB	N	4.16E-04	4.52E-04	0.00168	0.00495	0.00337	0.00366		0.00190	0.00323				4.60E-04													0.00750	1.82E-04
SD-125 _20050401	SD-125	SB	N	0.0305	0.00304	0.0274	0.0208	0.00734	0.0123		0.00266	0.00467				0.0122													0.0232	0.00260
SD-126_20050401	SD-126	SB	N	0.0195	0.00437	0.0188	0.0235	0.0109	0.0179		0.00436	0.00649				0.00366													0.0268	0.00116
SD-127 _20050401	SD-127	SB	N	0.0444	0.00352	0.0363	0.0231	0.00752	0.0141		0.00278	0.00430				0.0137													0.0261	8.13E-04
SD-128 _20050401	SD-128	SB	N	0.0481	0.00142	0.0195	0.00817	0.00245	0.00438		0.00106	0.00149				0.0135													0.00915	2.10E-04
SD-130 _20050401	SD-130	SB	N	0.00516	0.00218	0.00852	0.00813	0.00446	0.00957		0.00254	0.00284				0.00411													0.0132	6.54E-04
SD-131 _20050401	SD-131	SB	N	0.0443	0.0223	0.186	0.263	0.118	0.203		0.0432	0.0740				0.0142													0.411	0.0126
SD-132 _20050401	SD-132	SB	N	0.0131	0.00461	0.0131	0.0124	0.00693	0.0158		0.00391	0.00545				0.00397													0.0253	9.76E-04
SD-133 _20050401	SD-133	SB	N	0.00120	0.00218	0.00323	0.00586	0.00613	0.0106		0.00387	0.00367				9.76E-04													0.0123	7.46E-04
SD-134_20050401	SD-134	SB	N	0.0328	0.0178	0.138	0.0805	0.0435	0.0923		0.0177	0.0329				0.00545													0.120	0.00488
SD-135 _20050401	SD-135	SB	N	0.0101	0.0106	0.0364	0.0423	0.0304	0.0821		0.0183	0.0236				0.00557													0.0952	0.00427
SD-135_DUP_20050401	SD-135	SB	FD	0.00755	0.00855	0.0193	0.0423	0.0288	0.0663		0.0155	0.0221				0.00383													0.0824	0.00372
SD-136 _20050401	SD-136	SB	N	0.00748	0.0105	0.0286	0.0971	0.0775	0.153		0.0298	0.0465				0.00260													0.185	0.00848
SD-137 _20050401	SD-137	SB	N	1.89E-04	8.21E-04	0.00102	0.00147	0.00278	0.00411		0.00188	0.00105				2.55E-04													0.00220	3.76E-04
SD-139 _20050401	SD-139	SB	N	0.00666	0.00109	0.00239	0.00165	0.00198	0.00278		0.00129	9.72E-04				0.00104													0.00355	2.91E-04
SD-140_20050401	SD-140	SB	N	0.00125	0.00246	0.00432	0.00925	0.00691	0.0105		0.00445	0.00331				7.51E-04													0.0132	9.13E-04
SD-141_20050401	SD-141	SB	N	5.87E-04	9.00E-04	0.00171	0.00242	0.00228	0.00329		0.00132	0.00147				2.19E-04													0.00643	1.55E-04
SHI6D_19961101	SHID6	SB	N	0.00228	0.00195	0.00875	0.00666	0.00415	0.0110			0.00281				8.56E-04													0.00948	
SHID1_19961001	SHID1	SB	N	5.22E-04	5.67E-04	0.00108	0.00396	0.00611	0.00760			0.00366				5.78E-04													0.00729	
SHID2 _19961001	SHID2	SB	N	0.00484	0.00525	0.00400	0.00282	0.00492	0.00243			0.00242				0.00535													0.00281	

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	No. of PAH analytes available	ΣESBTU	Adjusted ΣESBTU based on UF from USEPA (2003) for fewer than 34 PAH analytes[4]	Adjusted ΣESBTU based on site-specific UF for fewer than 34 PAH analytes[5]	Sample used in bioassay?
Final Chronic Value (mg/kg OC)				707	538	1,115	385	967	596	697	--	--	--	--	--
Historical Data (1996 - 2005)															
SD-MC-A _20040601	SD-MC-A	MC	N	0.0857	0.00526	0.0317	0.00171		0.0847	0.0870	17	0.54	**3.48**	**1.66**	Y
SD-MC-B _20040601	SD-MC-B	MC	N	0.00307	0.00222	0.00117	0.0144		0.00419	0.00265	17	0.04	0.26	0.12	N
SD-MC-C _20040601	SD-MC-C	MC	N	0.0154	0.00584	0.00368	0.00216		0.0204	0.0147	17	0.10	0.65	0.31	N
SD-MC-D _20040601	SD-MC-D	MC	N	0.00369	0.00126	5.12E-04	0.00130		0.00461	0.00436	17	0.03	0.16	0.08	N
SD-MC-E _20040601	SD-MC-E	MC	N	0.0179	0.00359	0.00724	0.00510		0.0100	0.0156	17	0.14	0.87	0.42	N
SD-100_20031201	SD-100	SB	N	0.0111	0.00163	0.00256	0.00359		0.00657	0.00992	17	0.06	0.42	0.20	N
SD-101 _20031201	SD-101	SB	N	0.0149	0.00409	0.00288	0.0167		0.0139	0.0132	17	0.10	0.66	0.32	N
SD-102 _20031201	SD-102	SB	N	0.0134	9.51E-04	0.00237	0.00205		0.00535	0.0141	17	0.07	0.42	0.20	N
SD-103 _20031201	SD-103	SB	N	0.0274	0.00552	0.00592	0.00539		0.0222	0.0284	17	0.21	**1.36**	0.65	N
SD-103-A _20040601	SD-103-A	SB	N	0.172	0.0311	0.00203	0.0299		0.170	0.105	17	0.66	**4.25**	**2.03**	N
SD-103-B _20040601	SD-103-B	SB	N	0.0151	0.00298	0.00218	0.00748		0.0117	0.0124	17	0.09	0.55	0.26	N
SD-103-C _20040601	SD-103-C	SB	N	0.0324	0.00780	0.00377	0.0228		0.0269	0.0235	17	0.21	**1.33**	0.64	N
SD-104_20031201	SD-104	SB	N	0.0796	0.0103	0.00815	0.0325		0.0524	0.0620	17	0.37	**2.39**	**1.14**	N
SD-104-A _20040601	SD-104-A	SB	N	0.00610	8.81E-04	0.00131	0.00224		0.00405	0.00557	17	0.04	0.24	0.12	N
SD-104-B _20040601	SD-104-B	SB	N	0.00802	9.03E-04	9.44E-04	0.00231		0.00394	0.00639	17	0.04	0.24	0.12	N
SD-104-C _20040601	SD-104-C	SB	N	0.00671	9.61E-04	0.00108	0.00224		0.00419	0.00612	17	0.04	0.25	0.12	N
SD-105_20031201	SD-105	SB	N	0.0255	0.00723	0.00457	0.0204		0.0241	0.0193	17	0.16	**1.06**	0.51	N
SD-105-A _20040601	SD-105-A	SB	N	0.0117	0.00209	0.00128	0.00593		0.00754	0.00913	17	0.06	0.41	0.20	Y
SD-105-B _20040601	SD-105-B	SB	N	0.0207	0.0529	8.62E-04	0.00410		0.0710	0.0121	17	0.27	**1.73**	0.83	Y
SD-105-C _20040601	SD-105-C	SB	N	0.00653	0.00100	7.24E-04	0.00220		0.00432	0.00497	17	0.03	0.21	0.10	N
SD-106 _20031201	SD-106	SB	N	0.0222	0.00327	0.00555	0.00829		0.0128	0.0191	17	0.14	0.88	0.42	N
SD-108 _20031201	SD-108	SB	N	0.361	0.149	0.0229	0.246		0.404	0.251	17	**2.12**	**13.64**	**6.51**	N
SD-110_20031201	SD-110	SB	N	0.202	0.0627	0.0174	0.0534		0.163	0.139	17	**1.03**	**6.61**	**3.16**	N
SD-112 _20031201	SD-112	SB	N	0.119	0.0361	0.0192	0.0504		0.124	0.0947	17	0.71	**4.57**	**2.18**	N
SD-112-A _20040601	SD-112-A	SB	N	0.0642	0.0113	0.0118	0.0273		0.0519	0.0463	17	0.36	**2.34**	**1.12**	Y
SD-112-B _20040601	SD-112-B	SB	N	0.0932	0.0156	0.0145	0.0233		0.0427	0.0417	17	0.47	**3.05**	**1.46**	N
SD-112-C _20040601	SD-112-C	SB	N	0.0995	0.0116	0.0151	0.0122		0.0544	0.0538	17	0.45	**2.92**	**1.39**	Y
SD-113 _20031201	SD-113	SB	N	0.0129	0.00211	0.00611	0.00295		0.00191	0.0143	17	0.09	0.60	0.29	N
SD-114 _20031201	SD-114	SB	N	0.00682	9.40E-04	0.00267	0.00247		0.00390	0.00777	17	0.05	0.31	0.15	N
SD-115_20031201	SD-115	SB	N	0.00471	0.00135	0.00143	9.41E-04		0.00209	0.00499	17	0.03	0.19	0.09	N
SD-116 _20031201	SD-116	SB	N	0.00806	0.00115	0.00502	0.00312		0.00554	0.0100	17	0.06	0.41	0.20	N
SD-117 _20031201	SD-117	SB	N	0.0410	0.00799	0.0184	0.0206		0.0314	0.0402	17	0.32	**2.08**	0.99	N
SD-117-A _20040601	SD-117-A	SB	N	0.0141	0.00258	0.00309	0.00361		0.00233	0.0120	17	0.08	0.51	0.25	N
SD-117-B _20040601	SD-117-B	SB	N	0.00896	0.00582	0.00203	0.0113		0.0162	0.00765	17	0.08	0.54	0.26	N
SD-117-C _20040601	SD-117-C	SB	N	0.0223	0.00514	0.00602	0.0222		0.0221	0.0189	17	0.18	**1.2**	0.56	Y
SD-119_20031201	SD-119	SB	N	0.0193	0.00372	0.00978	0.0116		0.0145	0.0222	17	0.16	**1.05**	0.50	N
SD-119-A _20040601	SD-119-A	SB	N	0.0427	0.0154	0.00117	0.0215		0.0457	0.0297	17	0.23	**1.46**	0.70	N
SD-119-B _20040601	SD-119-B	SB	N	0.0191	0.00835	0.00243	0.0351		0.0219	0.0159	17	0.15	0.99	0.47	Y
SD-119-C _20040601	SD-119-C	SB	N	0.0159	0.00920	6.51E-04	0.0231		0.0244	0.0123	17	0.12	0.74	0.36	Y
SD-120 _20031201	SD-120	SB	N	0.00663	0.00245	0.00614	0.00342		0.00221	0.0121	17	0.08	0.53	0.26	N
SD-121 _20040601	SD-121	SB	N	0.00864	0.00176	0.00199	0.00390		0.00848	0.00701	17	0.06	0.36	0.17	N
SD-122 _20040601	SD-122	SB	N	0.0587	0.0163	0.00309	0.0182		0.0549	0.0386	17	0.28	**1.80**	0.86	N
SD-123 _20040601	SD-123	SB	N	0.0273	0.00784	0.00594	0.00767		0.0293	0.0207	17	0.24	**1.51**	0.72	N
SD-124 _20040601	SD-124	SB	N	0.0130	8.83E-04	0.00172	0.00147		0.00475	0.0108	17	0.06	0.39	0.19	N
SD-125 _20050401	SD-125	SB	N	0.112	0.0349	0.00291	0.0346		0.112	0.0837	17	0.53	**3.38**	**1.62**	N
SD-126_20050401	SD-126	SB	N	0.0856	0.0237	0.00457	0.00910		0.0748	0.0731	17	0.41	**2.62**	**1.25**	N
SD-127 _20050401	SD-127	SB	N	0.129	0.0522	0.00315	0.0255		0.181	0.0874	17	0.65	**4.20**	**2.01**	Y
SD-128 _20050401	SD-128	SB	N	0.0637	0.0558	0.00110	0.0195		0.151	0.0462	17	0.45	**2.87**	**1.37**	N
SD-130 _20050401	SD-130	SB	N	0.0312	0.00612	0.00272	0.00986		0.0217	0.0232	17	0.16	1.00	0.48	N
SD-131 _20050401	SD-131	SB	N	0.892	0.0457	0.0481	0.0361		0.270	0.679	17	**3.36**	**21.6**	**10.31**	Y
SD-132 _20050401	SD-132	SB	N	0.140	0.0119	0.00408	0.00972		0.0852	0.0844	17	0.44	**2.83**	**1.35**	Y
SD-133 _20050401	SD-133	SB	N	0.0272	0.00147	0.00384	0.00218		0.0116	0.0269	17	0.12	0.79	0.38	N
SD-134_20050401	SD-134	SB	N	0.297	0.0390	0.0203	0.0147		0.160	0.227	17	**1.34**	**8.63**	**4.12**	N
SD-135 _20050401	SD-135	SB	N	0.262	0.0144	0.0208	0.0145		0.143	0.175	17	0.99	**6.35**	**3.03**	Y
SD-135_DUP_20050401	SD-135	SB	FD	0.155	0.00948	0.0180	0.0100		0.0571	0.131	17	0.68	**4.37**	**2.09**	N
SD-136 _20050401	SD-136	SB	N	0.154	0.0164	0.0342	0.00442		0.0582	0.127	17	1.04	**6.68**	**3.19**	Y
SD-137 _20050401	SD-137	SB	N	0.00262	2.87E-04	0.00194	8.84E-04		0.00131	0.00296	17	0.03	0.17	0.08	N
SD-139 _20050401	SD-139	SB	N	0.00578	0.00425	0.00137	0.00191		0.00686	0.00547	17	0.05	0.32	0.15	N
SD-140_20050401	SD-140	SB	N	0.0290	0.00156	0.00414	0.00182		0.00688	0.0282	17	0.13	0.83	0.40	N
SD-141_20050401	SD-141	SB	N	0.00276	7.09E-04	0.00137	8.14E-04		0.00213	0.00316	17	0.03	0.20	0.10	N
SHI6D_19961101	SHID6	SB	N	0.0204	0.00283	0.00305	0.00291		0.0128	0.0195	15	0.11	0.81	NC	N
SHID1_19961001	SHID1	SB	N	0.0120	4.77E-04	0.00368	6.66E-04		0.00314	0.0107	15	0.06	0.46	NC	N
SHID2 _19961001	SHID2	SB	N	0.00778	0.00441	0.00213	0.00617		0.00398	0.00933	15	0.07	0.51	NC	N

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracene	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracene	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracene	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracene	Chrysene	Dibenzo(a,h)anthracene
Final Chronic Value (mg/kg OC)				491	452	594	841	965	979	967	1,095	981	929	770	611	444	670	1,008	686	510	746	1,112	769	581	829	1,214	657	913	844	1,123
2011 Sediment Data																														
MCO3-0-0.3	MC03	MC	N	0.00316	0.00343	0.00261	0.00184	0.00161	0.00158	0.00160	0.00142	0.00158	0.00838	0.0101	0.0127	0.0175	0.0116	0.00772	0.0113	0.0153	0.0104	0.00700	0.0101	0.0134	0.00939	0.0128	0.0118	0.0170	0.00184	0.00138
MC04-0-0.3	MC04	MC	N	0.0390	0.00107	0.00364	5.73E-04	5.00E-04	4.92E-04		4.40E-04	4.91E-04																	5.71E-04	4.29E-04
SB01-0-0.3	SB01	SB	N	0.00194	0.00211	0.00332	0.00326	0.00272	0.00281		0.00240	0.00280																	0.00487	8.50E-04
SB02-0.0.3	SB02	SB	N	0.00155	0.00169	0.00345	0.00276	0.00188	0.00200	0.00168	0.00140	0.00199	0.00410	0.00495	0.00624	0.00859	0.00569	0.00378	0.00556	0.00748	0.00511	0.00343	0.00496	0.00656	0.00460	0.00628	0.00580	0.00835	0.00330	6.79E-04
SB03_0-0.3	SB03	SB	N	9.47E-04	0.00103	0.00283	0.00208	0.00147	0.00160		0.00135	0.00160																	0.00290	4.14E-04
SB04-0-0.3	SB04	SB	N	0.00560	0.00195	0.0107	0.00657	0.00491	0.00496		0.00416	0.00495																	0.00903	7.84E-04
SB06-0-0.3	SB06	SB	N	0.00184	0.00200	0.00911	0.00849	0.00617	0.00664		0.00440	0.00663																	0.0168	8.05E-04
SB07-0-0.3	SB07	SB	N	8.76E-04	9.51E-04	7.24E-04	5.11E-04	4.46E-04	4.39E-04		3.93E-04	4.38E-04																	5.09E-04	3.83E-04
SB08-0-0.3	SB08	SB	N	0.00312	0.00161	0.00484	0.00439	0.00344	0.00398	0.00292	0.00229	0.00397	0.00392	0.00472	0.00595	0.00819	0.00543	0.00361	0.00530	0.00713	0.00488	0.00327	0.00473	0.00626	0.00439	0.00599	0.00554	0.00797	0.00695	6.48E-04
SB09-0-0.3	SB09	SB	N	0.393	0.00774	0.105	0.0353	0.0125	0.0148	0.00979	0.00701	0.0147	0.0188	0.0872	0.0807	0.352	0.226	0.0174	0.0255	0.263	0.0967	0.0157	0.0228	0.181	0.0211	0.0288	0.0728	0.0383	0.0407	0.00312
SB12-0-0.3	SB12	SB	N	0.0162	0.0176	0.0278	0.0269	0.00825	0.00813		0.00727	0.00812																	0.0375	0.00709
SB13-0-0.3	SB13	SB	N	0.0241	0.00640	0.0140	0.0122	0.00300	0.00296		0.00264	0.00296																	0.0118	0.00258
SB17-0-0.3	SB17	SB	N	0.0221	0.0240	0.0183	0.0352	0.0112	0.0242		0.00991	0.0242																	0.0500	0.00966
SB19-0-0.3	SB19	SB	N	0.0279	0.0303	0.0230	0.0163	0.0142	0.0140		0.0125	0.0139																	0.0162	0.0122

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	No. of PAH analytes available	ΣESBTU	Adjusted ΣESBTU based on UF from USEPA (2003) for fewer than 34 PAH analytes[4]	Adjusted ΣESBTU based on site-specific UF for fewer than 34 PAH analytes[5]	Sample used in bioassay?
Final Chronic Value (mg/kg OC)				707	538	1,115	385	967	596	697	--	--	--	--	--
2011 Sediment Data															
MCO3-0-0.3	MC03	MC	N	0.00219	0.00288	0.00139	0.00403	0.00925	0.00260	0.00223	34	0.23	NC	NC	N
MC04-0-0.3	MC04	MC	N	0.00238	0.0223	4.32E-04	0.0161		0.0282	0.00181	16	0.12	0.82	0.36	N
SB01-0-0.3	SB01	SB	N	0.00831	0.00177	0.00217	0.00248		0.00544	0.00795	16	0.06	0.38	0.17	N
SB02-0.0.3	SB02	SB	N	0.00913	0.00142	0.00141	0.00848	0.00174	0.00672	0.00765	34	0.15	NC	NC	N
SB03_0-0.3	SB03	SB	N	0.00732	8.65E-04	0.00128	0.00381		0.00375	0.00604	16	0.04	0.27	0.12	N
SB04-0-0.3	SB04	SB	N	0.0291	0.00664	0.00374	0.0104		0.0269	0.0213	16	0.15	**1.05**	0.47	N
SB06-0-0.3	SB06	SB	N	0.0212	0.00372	0.00424	0.00737		0.0112	0.0175	16	0.13	0.89	0.39	N
SB07-0-0.3	SB07	SB	N	6.08E-04	7.99E-04	3.86E-04	0.00713		7.21E-04	6.17E-04	16	0.02	0.11	0.05	N
SB08-0-0.3	SB08	SB	N	0.0135	0.00135	0.00227	0.0127	7.52E-04	0.00688	0.0105	34	0.17	NC	NC	N
SB09-0-0.3	SB09	SB	N	0.369	0.393	0.00692	1.49	0.00362	0.689	0.217	34	**5.36**	NC	NC	N
SB12-0-0.3	SB12	SB	N	0.118	0.0148	0.00714	0.0207		0.0794	0.0872	16	0.49	**3.41**	**1.51**	N
SB13-0-0.3	SB13	SB	N	0.0531	0.0220	0.00260	0.00752		0.0707	0.0369	16	0.28	**1.91**	0.84	N
SB17-0-0.3	SB17	SB	N	0.149	0.0202	0.00973	0.0282		0.0764	0.112	16	0.62	**4.33**	**1.92**	N
SB19-0-0.3	SB19	SB	N	0.0437	0.0254	0.0123	0.0355		0.0230	0.0196	16	0.34	**2.36**	**1.04**	N

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracene	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracene	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracene	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracene	Chrysene	Dibenzo(a,h)anthracene
Final Chronic Value (mg/kg OC)				491	452	594	841	965	979	967	1,095	981	929	770	611	444	670	1,008	686	510	746	1,112	769	581	829	1,214	657	913	844	1,123
SB20-0-0.3	SB20	SB	N	0.0282	0.00869	0.0172	0.0184	0.0110	0.0162		0.00770	0.0161																	0.0280	0.00350
SB21-0-0.3	SB21	SB	N	0.00948	0.0103	0.00784	0.0189	0.0153	0.0151		0.00425	0.0150																	0.0231	0.00415
SB24-0-0.3	SB24	SB	N	0.129	0.0435	0.0331	0.0589	0.0204	0.0201		0.0180	0.0201																	0.0504	0.0175
SB26-0-0.3	SB26	SB	N	0.0836	0.0315	0.0558	0.0358	0.0148	0.0145		0.0130	0.0145																	0.0169	0.0127
SB27-0-0.3	SB27	SB	N	1.22	0.0311	0.227	0.0713	0.0145	0.0144		0.0128	0.0143																	0.0742	0.0125
SB28-0-0.3	SB28	SB	N	0.589	0.0325	0.309	0.129	0.0587	0.112	0.0521	0.0277	0.0339	0.0638	0.260	0.119	1.17	0.429	0.0149	0.0391	0.521	0.167	0.00303	0.0240	0.219	0.0563	0.00555	0.0738	0.0176	0.211	0.00732
2012 Sediment Data																														
PWS-27_8-11_SE	PWS-27	MC	N	0.00112	4.95E-04	0.00167	0.00461	0.00587	0.00766	0.00408	0.00204	0.00259	0.00483	0.00613	0.00366	0.00276	0.00334	0.00799	0.00326	0.00438	0.00300	0.00201	0.00291	0.00385	0.00270	0.00368	0.00340	0.00490	0.00553	0.00199
PWS-01_8-9_SE	PWS-01	SB	N	0.244	0.00467	0.0305	0.0169	0.0110	0.0235	0.0117	0.00477	0.00746	0.00576	0.0297	0.0270	0.0621	0.0407	0.00531	0.00780	0.110	0.0183	0.00481	0.00696	0.0363	0.00645	0.00883	0.00814	0.0117	0.0239	0.00109
PWS-03_8-11_SE	PWS-03	SB	N	0.0997	0.0387	0.162	0.237	0.129	0.277	0.140	0.0571	0.0965	0.142	0.417	0.0446	0.209	0.225	0.0383	0.0391	0.136	0.145	0.0280	0.0189	0.0768	0.0724	0.0110	0.0331	0.0147	0.413	0.0141
PWS-04_1-4_SE	PWS-04	SB	N	0.0273	0.00948	0.0389	0.0457	0.0321	0.0638	0.0331	0.0158	0.0211	0.0250	0.0665	0.0140	0.0587	0.0515	0.00951	0.0102	0.0332	0.0322	0.00967	0.00384	0.0218	0.0147	0.00487	0.0109	0.00648	0.0618	0.00386
PWS-04_8-11_SE	PWS-04	SB	N	0.106	0.0170	0.0941	0.0794	0.0489	0.0964	0.0524	0.0230	0.0290	0.0420	0.132	0.0288	0.161	0.139	0.0171	0.0280	0.128	0.0769	0.0147	0.0243	0.0627	0.0388	0.00597	0.0311	0.00794	0.120	0.00609
PWS-05_8-11_SE	PWS-05	SB	N	0.0950	0.0171	0.0908	0.100	0.0593	0.110	0.0580	0.0248	0.0342	0.0486	0.144	0.0251	0.136	0.114	0.0184	0.0181	0.108	0.0681	0.0113	0.00954	0.0557	0.0318	0.00362	0.0229	0.0767	0.136	0.00608
PWS-06_8-11_SE	PWS-06	SB	N	0.344	0.0226	0.249	0.126	0.0439	0.109	0.0495	0.0139	0.0328	0.0604	0.303	0.0740	0.685	0.395	0.0217	0.0608	0.386	0.196	0.0130	0.0243	0.174	0.0671	0.0117	0.0668	0.200	0.192	0.00414
PWS-07_8-11_SE	PWS-07	SB	N	0.0960	0.0171	0.0890	0.0722	0.0503	0.0981	0.0521	0.0231	0.0303	0.0504	0.105	0.0209	0.180	0.0997	0.0161	0.00210	0.0994	0.0536	0.0107	0.0184	0.0485	0.0238	0.00237	0.0219	0.00958	0.101	0.00563
PWS-08_8-11_SE	PWS-08	SB	N	0.102	0.00751	0.0666	0.0401	0.0184	0.0354	0.0174	0.00726	0.0107	0.0209	0.0730	0.0232	0.156	0.110	0.00902	0.0209	0.118	0.0526	0.00741	0.00941	0.0611	0.0233	0.00349	0.0267	0.0188	0.0452	0.00209
PWS-09_8-11_SE	PWS-09	SB	N	0.0339	0.00426	0.0254	0.0215	0.0130	0.0212	0.0112	0.00502	0.00683	0.0105	0.0368	0.0160	0.0441	0.0483	0.00457	0.00787	0.0356	0.0202	0.00200	0.00289	0.0231	0.00881	0.00367	0.00890	0.0127	0.0242	0.00132
PWS-12_8-11_SE	PWS-12	SB	N	0.00897	0.00329	0.0104	0.0152	0.0139	0.0230	0.0128	0.00776	0.00815	0.00909	0.0197	0.00445	0.0105	0.0136	0.00606	0.00396	0.00533	0.00968	0.00245	0.00354	0.00468	0.00328	0.00448	0.00414	0.00596	0.0217	0.00173
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.00487	0.00242	0.00793	0.00971	0.00818	0.0138	0.00741	0.00402	0.00420	0.00628	0.0142	0.00424	0.00847	0.0111	0.00257	0.00378	0.00508	0.00717	0.00233	0.00337	0.00446	0.00313	0.00428	0.00394	0.00569	0.0142	9.45E-04
PWS-13_1-4_SE	PWS-13	SB	N	0.00714	0.00279	0.0170	0.00846	0.0107	0.0127	0.00735	0.00561	0.00404	0.00518	0.0114	0.00306	0.0169	0.0142	0.00186	0.00273	0.0146	0.00804	0.00168	0.00243	0.0117	0.00226	0.00307	0.00285	0.00408	0.0122	9.07E-04
PWS-13_8-11_SE	PWS-13	SB	N	0.00749	0.00263	0.00909	0.0141	0.0130	0.0237	0.0113	0.00575	0.00775	0.0120	0.0182	0.00376	0.0159	0.0140	0.00466	0.00335	0.0119	0.00845	0.00495	0.00298	0.00861	0.00802	0.00379	0.00349	0.00504	0.0186	0.00134
PWS-15_8-11_SE	PWS-15	SB	N	0.00123	5.60E-04	0.00141	0.00142	0.00142	0.00180	0.00116	2.31E-04	0.00106	0.00272	0.00329	0.00414	0.00260	0.00378	0.00251	0.00369	0.00496	0.00339	0.00228	0.00329	0.0103	0.00305	0.00417	0.00385	0.0174	0.00196	2.25E-04
PWS-16B_8-11_SE	PWS-16	SB	N	0.0259	0.00600	0.0257	0.0237	0.0120	0.0251	0.0133	0.00614	0.00783	0.0126	0.0360	0.00796	0.0558	0.0313	0.00455	0.00676	0.0291	0.0188	0.00462	0.00253	0.0163	0.0121	0.00320	0.00816	0.00426	0.0298	0.00173
PWS-16_8-11_SE	PWS-16	SB	N	0.132	0.0175	0.130	0.0554	0.0226	0.0511	0.0267	0.00913	0.0143	0.0339	0.103	0.0362	0.349	0.154	0.0111	0.0265	0.179	0.0677	0.0112	0.0111	0.0830	0.0227	0.00348	0.0295	0.0127	0.0658	0.00188
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0100	0.00215	0.00641	0.0131	0.00642	0.0117	0.00564	0.00236	0.00332	0.0104	0.0223	0.00297	0.00529	0.0122	0.00645	0.00264	0.00355	0.0147	0.00337	0.00236	0.00312	0.0154	0.00299	0.00596	0.00397	0.0164	8.10E-04
PWS-25_8-11_SE	PWS-25	SB	N	0.0682	0.0151	0.0536	0.0591	0.0516	0.0977	0.0506	0.0240	0.0333	0.0389	0.101	0.0177	0.121	0.0889	0.0166	0.0179	0.0641	0.0497	0.0130	0.00878	0.0399	0.0219	0.00422	0.0197	0.0188	0.0926	0.00651
PWS-26_8-11_SE	PWS-26	SB	N	0.0971	0.00933	0.0669	0.0350	0.0250	0.0438	0.0228	0.0139	0.0146	0.0197	0.0629	0.0222	0.174	0.0935	0.0113	0.0162	0.0908	0.0381	0.00854	0.00444	0.0506	0.0169	0.00563	0.0200	0.0371	0.0496	0.00304
PWS-17_4-7	PWS-17	MC	N	0.0319	0.00207	0.00422	0.00329	0.00221	0.00506	0.00308	0.00183	0.00147	0.00313	0.00378	0.00476	0.0299	0.00434	0.00289	0.00424	0.0123	0.00390	0.00262	0.00378	0.00501	0.00351	0.00481	0.00443	0.00640	0.00503	2.59E-04
PWS-27_8-11	PWS-27	MC	N	0.00125	0.00122	0.00261	0.00451	0.00394	0.00571	0.00353	0.00264	0.00203	0.00441	0.00729	0.00332	0.00174	0.0104	0.00411	0.00295	0.00397	0.00930	0.00526	0.00264	0.00349	0.00685	0.00334	0.00308	0.00445	0.00643	5.40E-04
PWS-30_8-11	PWS-30	MC	N	7.90E-04	8.58E-04	6.53E-04	4.61E-04	4.02E-04	3.96E-04	4.01E-04	3.54E-04	3.95E-04	0.00417	0.00504	0.00635	0.00175	0.00579	0.00385	0.00565	0.00760	0.00520	0.00349	0.00504	0.00667	0.00468	0.00640	0.00590	0.00851	4.59E-04	3.45E-04
LSI-01_8-11	LSI-01	SB	N	0.0364	0.00777	0.0424	0.0240	0.0161	0.0267	0.0164	0.0117	0.00805	0.0181	0.0219	0.0276	0.0902	0.0251	0.0167	0.0246	0.0330	0.0226	0.0151	0.0219	0.0290	0.0203	0.0277	0.0256	0.0369	0.0291	0.00150
LSI-02_8-11	LSI-02	SB	N	0.00780	0.00252	0.0138	0.00832	0.00613	0.0134	0.00750	0.00366	0.00445	0.00561	0.0111	0.00412	0.00802	0.0127	0.00250	0.00367	0.00493	0.00712	0.00226	0.00327	0.00433	0.00303	0.00414	0.00383	0.00551	0.0122	8.74E-04
LSI-20_8-11	LSI-20	SB	N	0.0784	0.0250	0.0969	0.157	0.0999	0.201	0.1000	0.0399	0.0667	0.107	0.236	0.0338	0.0759	0.190	0.0418	0.0342	0.0497	0.118	0.0352	0.0500	0.0527	0.0742	0.0149	0.0422	0.0197	0.213	0.0120
LSI-24_8-11	LSI-24	SB	N	0.0255	0.00839	0.00705	0.0216	0.0266	0.0306	0.0185	0.0174	0.0114	0.0142	0.0283	0.00558	0.0111	0.0200	0.00724	0.00497	0.00668	0.0205	0.00306	0.00443	0.00586	0.0174	0.00561	0.00519	0.00746	0.0275	0.00235
PWS-1_8-10	PWS-01	SB	N	0.0268	0.00123	0.00571	0.0170	0.00897	0.0138	0.00781	0.00444	0.00521	0.00601	0.0262	0.00913	0.00251	0.00833	0.00554	0.00813	0.0109	0.00748	0.00502	0.00726	0.00960	0.00673	0.00919	0.00849	0.215	0.0347	9.95E-04
PWS-3_8-11	PWS-03	SB	N	0.0361	0.0247	0.0751	0.120	0.0789	0.171	0.0815	0.0260	0.0572	0.0667	0.182	0.0161	0.0599	0.113	0.0231	0.0127	0.0394	0.0670	0.0188	0.0309	0.0279	0.0317	0.00824	0.0157	0.0146	0.290	0.00990
PWS-4_8-11	PWS-04	SB	N	0.0301	0.0252	0.212	0.132	0.219	0.295	0.189	0.0834	0.0830	0.0866	0.186	0.00763	0.0439	0.115	0.0401	0.00679	0.0266	0.0575	0.0311	0.0245	0.0202	0.0278	0.00770	0.00709	0.0102	0.349	0.0246
PWS-5_8-11	PWS-05	SB	N	0.0480	0.0104	0.0384	0.0508	0.0394	0.0734	0.0352	0.0156	0.0250	0.0283	0.0632	0.0132	0.0580	0.0567	0.0123	0.0103	0.0420	0.0355	0.00997	0.0159	0.0311	0.0145	0.00515	0.0160	0.0193	0.122	0.00448
PWS-6_8-11	PWS-06	SB	N	0.133	0.00988	0.0979	0.0480	0.0256	0.0501	0.0248	0.00968	0.0181	0.0253	0.0732	0.0319	0.186	0.128	0.0126	0.0174	0.136	0.0570	0.0110	0.0167	0.0878	0.0236	0.00453	0.0331	0.0942	0.0547	0.00317
PWS-7_8-10	PWS-07	SB	N	0.105	0.0228	0.266	0.125	0.0908	0.161	0.0779	0.0242	0.0523	0.0640	0.157	0.0367	0.132	0.176	0.0304	0.0249	0.106	0.0930	0.0258	0.0421	0.0975	0.0472	0.00809	0.0480	0.0244	0.144	0.00974
PWS-7_8-10 DUP	PWS-07	SB	FD	0.103	0.0239	0.0971	0.0965	0.0988	0.162	0.0870	0.0316	0.0496	0.0591	0.134	0.0325	0.174	0.136	0.0264	0.0201	0.101	0.0759	0.0222	0.0324	0.0678	0.0343	0.00727	0.0299	0.0182	0.178	0.0103
PWS-8_8-11	PWS-08	SB	N	0.0354	0.00771	0.0386	0.0328	0.0253	0.0509	0.0250	0.0110	0.0186	0.0215	0.0468	0.0117	0.0578	0.0510	0.00926	0.00832	0.0391	0.0317	0.00905	0.0129	0.0241	0.0146	0.00453	0.0140	0.0450	0.0486	0.00329
PWS-9_8-11	PWS-09	SB	N	0.00559	5.79E-04	0.00644	0.00552	0.00315	0.00529	0.00272	0.00167	0.00211	0.00282	0.0101	0.00428	0.00744	0.0103	0.00260	0.00381	0.00513	0.00351	0.00235	0.00340	0.00450	0.00316	0.00430	0.00398	0.00572	0.0149	2.33E-04
PWS-12_8-11	PWS-12	SB	N	5.46E-04	5.93E-04	4.51E-04	0.00157	0.00126	0.00206	0.00126	0.00100	7.14E-04	0.00288	0.00348	0.00439	0.00121	0.00400	0.00266	0.00391	0.00525	0.00359	0.00241	0.00349	0.00461	0.00323	0.00442	0.00408	0.00588	0.00216	2.39E-04
PWS-13_8-11	PWS-13	SB	N	0.0229	0.00299	0.0165	0.0268	0.0132	0.0126	0.0113	0.00355	0.00496	0.0734	0.116	0.0501	0.0157	0.257	0.0830	0.0934	0.148	0.346	0.0576	0.103	0.417	0.252	0.0209	0.262	0.218	0.0477	0.00178
PWS-13_8-11_1	PWS-13	SB	FD	0.0321	0.00540	0.0243	0.0324	0.0152	0.0199	0.0147	0.00664	0.00639	0.0866	0.138	0.0475	0.0423	0.290	0.0929	0.0709	0.195	0.335	0.0679	0.0839	0.437	0.288	0.0205	0.255	0.146	0.0603	0.00175
PWS-13_8-11_2	PWS-13	SB	FT	0.0173	0.00343	0.0122	0.0157	0.0122	0.0140	0.0118	0.00560	0.00420	0.0597	0.0785	0.0295	0.0200	0.180	0.0681	0.0481	0.134	0.219	0.0433	0.0562	0.324	0.203	0.0201	0.183	0.109	0.0242	0.00159
PWS-15_8-11	PWS-15	SB	N	0.00593	9.12E-04	0.00210	0.00314	0.00143	0.00261	0.00137	9.83E-04	9.84E-04	0.00444	0.00536	0.00675	0.00435	0.00615	0.00409	0.00601	0.00809	0.00553	0.00371	0.00536	0.00710	0.00497	0.00681	0.00628	0.00906	0.00314	3.67E-04
PWS-16_8-11	PWS-16	SB	N	0.0104	0.00243	0.0112	0.0109	0.00524	0.0116	0.00639	0.00299	0.00352	0.00679	0.0170	0.00364	0.0172	0.0179	0.00220	0.00324	0.0112	0.0120	0.00525	0.00289	0.00876	0.00608	0.00366	0.00338	0.00486	0.0146	8.24E-04
PWS-25_4-8	PWS-25	SB	N	0.0335	0.0107	0.0630	0.161	0.121	0.181	0.0882	0.0409	0.0638	0.0635	0.160	0.0154	0.0559	0.0608	0.0199	0.00546	0.0340	0.0410	0.0134	0.0157	0.0198	0.0188	0.00618	0.00570	0.0334	0.198	0.0127
PWS-26_8-11	PWS-26	SB	N	0.0656	0.0117	0.0734	0.0466	0.0413	0.0752	0.0369	0.0188	0.0280	0.0292	0.0768	0.0239	0.110	0.0913	0.0131	0.0132	0.0678	0.0477	0.0102	0.0168	0.0432	0.0217	0.00614	0.0198	0.284	0.0842	0.00493
PWS-26_8-11_DUP	PWS-26	SB	FD	0.0474	0.0111	0.0608	0.0753	0.0574	0.0978	0.0466	0.0211	0.0339	0.0421	0.101	0.0188	0.0877	0.0888	0.0172	0.0128	0.0506	0.0574	0.0118	0.0202	0.0311	0.0256	0.00444	0.0166	0.0685	0.112	0.00633
PWS-28_8-11	PWS-28	SB	N	5.58E-04	0.00332	0.00162	0.00452	0.00804	0.00817	0.00642	0.00573	0.00287	0.00680	0.00356	0.00449	0.00351	0.00409	0.00615	0.00400	0.00537	0.00367	0.00504	0.00356	0.00472	0.00331	0.00453	0.00417	0.00602	0.00709	8.34E-04

ATTACHMENT G-A: ESBTU Calculation for Sediment Data Based on 1-Carbon Partitioning Model

Table 3: ESBTU and ΣESBTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	No. of PAH analytes available	ΣESBTU	Adjusted ΣESBTU based on UF from USEPA (2003) for fewer than 34 PAH analytes[4]	Adjusted ΣESBTU based on site-specific UF for fewer than 34 PAH analytes[5]	Sample used in bioassay?	Calculation of Site-Specific Uncertainty Factors (UFs) for ΣESBTUs based on 16 and 17 PAHs				Comparison of $\Sigma ESBTU_{34}$ to $\Sigma IWTU_{sed}$	
																$\Sigma ESBTU_{16}$ based on 16 priority PAHs	Ratio of $\Sigma ESBTU_{34}$ to $\Sigma ESBTU_{16}$	$\Sigma ESBTU_{17}$ based on 16 priority PAHs plus C-1 naphthalenes	Ratio of $\Sigma ESBTU_{34}$ to $\Sigma ESBTU_{17}$	$\Sigma IWTU_{sed}$	Ratio of $\Sigma ESBTU_{34}$ to $\Sigma IWTU_{sed}$
Final Chronic Value (mg/kg OC)				707	538	1,115	385	967	596	697	--	--	--	--	--						
SB20-0-0.3	SB20	SB	N	0.0658	0.0217	0.00931	0.0262		0.0606	0.0493	16	0.39	**2.69**	**1.19**	N						
SB21-0-0.3	SB21	SB	N	0.0380	0.00865	0.00881	0.0121		0.0215	0.0375	16	0.25	**1.73**	0.77	N						
SB24-0-0.3	SB24	SB	N	0.347	0.126	0.0176	0.171		0.534	0.246	16	**1.85**	**12.8**	**5.68**	N						
SB26-0-0.3	SB26	SB	N	0.165	0.1000	0.0128	0.262		0.271	0.113	16	**1.22**	**8.43**	**3.73**	N						
SB27-0-0.3	SB27	SB	N	0.702	0.840	0.0126	0.419		1.47	0.418	16	**5.56**	**38.5**	**17.0**	N						
SB28-0-0.3	SB28	SB	N	0.891	0.533	0.0322	2.85	0.0151	1.45	0.558	34	**11.1**	NC	NC	N						
2012 Sediment Data																					
PWS-27_8-11_SE	PWS-27	MC	N	0.0101	0.00133	0.00201	0.00960	0.00495	0.00608	0.0108	34	0.15	NC	NC	N	0.0735	1.98	0.0762	1.91	0.015	9.65
PWS-01_8-9_SE	PWS-01	SB	N	0.0972	0.162	0.00508	0.0285	0.00419	0.130	0.0731	34	**1.27**	NC	NC	N	0.864	1.47	0.926	1.37	0.158	8.04
PWS-03_8-11_SE	PWS-03	SB	N	0.940	0.129	0.0615	0.529	0.0307	0.388	0.743	34	**6.14**	NC	NC	N	4.31	1.42	4.52	1.36	3.48	1.76
PWS-04_1-4_SE	PWS-04	SB	N	0.178	0.0342	0.0165	0.150	0.0103	0.108	0.142	34	**1.37**	NC	NC	N	0.949	1.44	1.01	1.36	0.278	4.92
PWS-04_8-11_SE	PWS-04	SB	N	0.392	0.106	0.0271	0.400	0.0158	0.314	0.288	34	**3.15**	NC	NC	N	2.15	1.47	2.31	1.37	0.971	3.25
PWS-05_8-11_SE	PWS-05	SB	N	0.349	0.0951	0.0252	0.317	0.0198	0.293	0.262	34	**2.99**	NC	NC	N	2.01	1.48	2.15	1.39	1.12	2.65
PWS-06_8-11_SE	PWS-06	SB	N	1.04	0.335	0.0158	1.95	0.0110	0.992	0.667	34	**8.94**	NC	NC	N	6.14	1.46	6.83	1.31	4.08	2.19
PWS-07_8-11_SE	PWS-07	SB	N	0.289	0.0949	0.0244	0.496	0.0178	0.279	0.237	34	**2.84**	NC	NC	N	2.00	1.42	2.18	1.30	1.27	2.24
PWS-08_8-11_SE	PWS-08	SB	N	0.233	0.104	0.00794	0.302	0.00606	0.320	0.172	34	**2.23**	NC	NC	N	1.47	1.51	1.63	1.37	0.629	3.55
PWS-09_8-11_SE	PWS-09	SB	N	0.101	0.0304	0.00556	0.151	0.00646	0.107	0.0789	34	0.93	NC	NC	N	0.630	1.48	0.674	1.39	0.202	4.63
PWS-12_8-11_SE	PWS-12	SB	N	0.0453	0.00909	0.00842	0.0245	0.00965	0.0261	0.0427	34	0.40	NC	NC	N	0.270	1.49	0.281	1.44	0.057	7.03
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0303	0.00686	0.00438	0.0248	0.00638	0.0222	0.0269	34	0.29	NC	NC	N	0.186	1.56	0.194	1.49	0.036	8.10
PWS-13_1-4_SE	PWS-13	SB	N	0.0312	0.00978	0.00538	0.0345	0.00362	0.0308	0.0325	34	0.34	NC	NC	N	0.226	1.52	0.243	1.41	0.068	5.04
PWS-13_8-11_SE	PWS-13	SB	N	0.0306	0.00902	0.00565	0.0331	0.00522	0.0286	0.0265	34	0.38	NC	NC	N	0.237	1.61	0.253	1.51	0.061	6.27
PWS-15_8-11_SE	PWS-15	SB	N	0.00920	0.00121	4.65E-04	0.00403	0.00593	0.00823	0.00755	34	0.12	NC	NC	N	0.0420	2.96	0.0446	2.79	0.015	8.29
PWS-16B_8-11_SE	PWS-16	SB	N	0.0894	0.0263	0.00717	0.118	0.00611	0.0683	0.0711	34	0.82	NC	NC	N	0.544	1.50	0.600	1.36	0.181	4.51
PWS-16_8-11_SE	PWS-16	SB	N	0.347	0.145	0.0103	0.706	0.00895	0.482	0.250	34	**3.61**	NC	NC	N	2.44	1.48	2.79	1.29	1.51	2.39
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0207	0.00564	0.00288	0.0158	0.00221	0.0232	0.0192	34	0.29	NC	NC	N	0.160	1.78	0.165	1.73	0.038	7.56
PWS-25_8-11_SE	PWS-25	SB	N	0.248	0.0747	0.0288	0.235	0.0140	0.211	0.212	34	**2.22**	NC	NC	N	1.51	1.47	1.63	1.36	0.630	3.52
PWS-26_8-11_SE	PWS-26	SB	N	0.189	0.117	0.0143	0.292	0.0104	0.277	0.148	34	**2.10**	NC	NC	N	1.40	1.51	1.57	1.34	0.389	5.41
PWS-17_4-7	PWS-17	MC	N	0.0123	0.0122	0.00162	0.0533	0.00176	0.0219	0.00858	34	0.27	NC	NC	N	0.167	1.63	0.197	1.38	0.017	16.3
PWS-27_8-11	PWS-27	MC	N	0.0155	0.00154	0.00230	0.00348	0.00314	0.0102	0.0157	34	0.16	NC	NC	N	0.0795	2.05	0.0813	2.00	0.012	13.8
PWS-30_8-11	PWS-30	MC	N	5.48E-04	7.21E-04	3.48E-04	0.00101	4.01E-04	6.51E-04	5.56E-04	34	0.10	NC	NC	N	0.00894	10.7	0.0107	8.96	0.005	20.2
LSI-01_8-11	LSI-01	SB	N	0.115	0.0378	0.0115	0.257	0.00507	0.134	0.0778	34	**1.32**	NC	NC	N	0.837	1.57	0.928	1.42	0.007	179
LSI-02_8-11	LSI-02	SB	N	0.0343	0.00826	0.00387	0.0188	0.00229	0.0262	0.0256	34	0.29	NC	NC	N	0.190	1.50	0.198	1.44	0.019	14.9
LSI-20_8-11	LSI-20	SB	N	0.630	0.0526	0.0440	0.201	0.0274	0.314	0.487	34	**4.02**	NC	NC	N	2.72	1.48	2.79	1.44	0.148	27.2
LSI-24_8-11	LSI-24	SB	N	0.0510	0.00586	0.0144	0.0255	0.00932	0.0256	0.0482	34	0.54	NC	NC	N	0.349	1.56	0.360	1.51	0.024	22.6
PWS-1_8-10	PWS-01	SB	N	0.0253	0.0119	0.00468	0.00705	0.00288	0.0147	0.0221	34	0.56	NC	NC	N	0.205	2.74	0.207	2.71	0.150	3.73
PWS-3_8-11	PWS-03	SB	N	0.307	0.0450	0.0355	0.126	0.0171	0.159	0.237	34	**2.62**	NC	NC	N	1.80	1.46	1.86	1.41	0.771	3.40
PWS-4_8-11	PWS-04	SB	N	0.275	0.0420	0.103	0.128	0.0704	0.173	0.239	34	**3.37**	NC	NC	N	2.41	1.40	2.46	1.37	0.704	4.79
PWS-5_8-11	PWS-05	SB	N	0.144	0.0429	0.0174	0.137	0.0107	0.123	0.102	34	**1.47**	NC	NC	N	0.995	1.48	1.05	1.40	0.187	7.88
PWS-6_8-11	PWS-06	SB	N	0.224	0.120	0.0110	0.355	0.00646	0.310	0.160	34	**2.60**	NC	NC	N	1.63	1.60	1.82	1.43	0.381	6.82
PWS-7_8-10	PWS-07	SB	N	0.369	0.115	0.0327	0.304	0.0250	0.312	0.295	34	**3.64**	NC	NC	N	2.43	1.50	2.56	1.42	0.904	4.03
PWS-7_8-10 DUP	PWS-07	SB	FD	0.274	0.105	0.0400	0.387	0.0282	0.239	0.219	34	**3.20**	NC	NC	N	2.11	1.51	2.29	1.40	0.703	4.55
PWS-8_8-11	PWS-08	SB	N	0.106	0.0397	0.0125	0.103	0.00632	0.108	0.0741	34	**1.15**	NC	NC	N	0.714	1.61	0.772	1.49	0.112	10.2
PWS-9_8-11	PWS-09	SB	N	0.0160	0.00697	0.00176	0.0136	0.00119	0.0167	0.0119	34	0.19	NC	NC	N	0.112	1.72	0.120	1.62	0.010	19.8
PWS-12_8-11	PWS-12	SB	N	0.00424	4.98E-04	0.00102	0.00189	7.79E-04	0.00227	0.00403	34	0.09	NC	NC	N	0.0245	3.51	0.0258	3.34	0.003	31.8
PWS-13_8-11	PWS-13	SB	N	0.0628	0.0176	0.00286	0.0326	0.00454	0.0946	0.0659	34	**2.96**	NC	NC	N	0.429	6.89	0.445	6.65	0.967	3.06
PWS-13_8-11_1	PWS-13	SB	FD	0.105	0.0282	0.00518	0.0904	0.00578	0.135	0.104	34	**3.29**	NC	NC	N	0.672	4.89	0.715	4.60	1.06	3.11
PWS-13_8-11_2	PWS-13	SB	FT	0.0426	0.0143	0.00444	0.0360	0.00414	0.0736	0.0488	34	**2.12**	NC	NC	N	0.330	6.43	0.350	6.06	0.596	3.56
PWS-15_8-11	PWS-15	SB	N	0.0102	0.00344	9.75E-04	0.0105	0.00337	0.00839	0.00850	34	0.16	NC	NC	N	0.0637	2.55	0.0680	2.39	0.006	28.5
PWS-16_8-11	PWS-16	SB	N	0.0411	0.0115	0.00309	0.0304	0.00197	0.0331	0.0304	34	0.36	NC	NC	N	0.223	1.60	0.240	1.49	0.023	15.8
PWS-25_4-8	PWS-25	SB	N	0.225	0.0508	0.0472	0.125	0.0289	0.114	0.163	34	**2.30**	NC	NC	N	1.61	1.43	1.67	1.38	0.477	4.82
PWS-26_8-11	PWS-26	SB	N	0.173	0.0809	0.0198	0.202	0.00982	0.183	0.123	34	**2.15**	NC	NC	N	1.23	1.75	1.34	1.61	0.249	8.65
PWS-26_8-11_DUP	PWS-26	SB	FD	0.179	0.0568	0.0239	0.186	0.0129	0.144	0.131	34	**1.96**	NC	NC	N	1.24	1.57	1.33	1.47	0.271	7.21
PWS-28_8-11	PWS-28	SB	N	0.0170	0.00107	0.00457	0.00498	0.00270	0.00923	0.0138	34	0.18	NC	NC	N	0.0934	1.88	0.0969	1.81	0.007	25.5
												Site-specific Uncertainty Factors[6]:				UF_{16} =	3.24	UF_{17} =	3.07	mean =	12.9

Notes:

[1]All values in toxic units (TUs) based on narcotic effects in benthic invertebrates. **BOLD** indicates value greater than 1.

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

[4]Uncertainty factors based on linear interpolation of 90% confidence UFs presented in USEPA (2003): 7.43 for 15 PAHs, 6.93 for 16 PAHs, and 6.42 for 17 PAHs.

[5]Uncertainty factors based on 90th percentiles of site-specific data presented in this table: 3.24 for 16 PAHs and 3.07 for 17 PAHs (a UF for 15 PAHs was not calculated).

[6]Uncertainty factors based on 90th percentiles of the ratios between $\Sigma ESBTU_{34}$ and $\Sigma ESBTU_{16\ or\ 17}$

ESBTU = equilibrium partitioning sediment benchmark toxic units

$\Sigma ESBTU_n$ = sum of equilibrium partitioning sediment benchmark toxic units based on n PAHs

$\Sigma IWTU_{sed}$ = sum of interstitial water toxic units based on sediment data (see Appendix G-B)

mg/kg = milligrams per kilogram

NC = not calculated

OC = organic carbon

PAH = polycyclic aromatic hydrocarbon

UF_n = uncertainty factor for n PAHs

ATTACHMENT B

Interstitial Water Toxic Unit (IWTU) Calculation for 2012 Sediment Data Based on Two-Carbon Partitioning Model (2012 Sediment Data)

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Total Organic Carbon[3] (g/g)	Black Carbon[3] (g/g)	Total PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.018	0.0013	1.18	0.00987 J	0.00805 U	0.0179	0.0698	0.102	0.135	0.0711	0.0805 U	0.0458	0.0807	0.0849	0.0805 U
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.0063	0.001	3.57	0.755	0.0133 J	0.114	0.0895	0.0666	0.145	0.071	0.0329	0.0461	0.0674 U	0.144	0.104
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	0.028	0.0017	92.19	1.37	0.49	2.69	5.57	3.49	7.6	3.8	1.75	2.65	3.7	9	0.763
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.012	0.0013	8.63	0.161	0.0514	0.277 J	0.461	0.372	0.75	0.384	0.207	0.248	0.279	0.614	0.103
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.01	0.001	15.29	0.521	0.0769	0.559	0.668	0.472	0.944	0.507	0.252	0.284	0.39	1.02	0.176
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	0.018	0.0014	26.65	0.84	0.139	0.971	1.52	1.03	1.93	1.01	0.489	0.604	0.812	2	0.276
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	0.023	0.0023	89.71	3.89	0.235	3.4	2.43	0.975	2.46	1.1	0.35	0.739	1.29	5.37	1.04
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	0.028	0.0017	39.53	1.32	0.216	1.48	1.7	1.36	2.69	1.41	0.707	0.832	1.31	2.27	0.357
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	0.021	0.002	20.71	1.05	0.0713	0.831	0.708	0.372	0.727	0.353	0.167	0.22	0.408	1.18	0.298
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.02	0.0017	8.53	0.333	0.0385	0.302	0.361	0.251	0.415	0.216	0.11	0.134	0.196	0.566	0.196
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.018	0.0016	4.05	0.0793 J	0.0268	0.111	0.23	0.241 J	0.405	0.222 J	0.153 J	0.144 J	0.152	0.273	0.0979 U
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.018	0.0015	2.66	0.043 J	0.0197	0.0848	0.147	0.142 J	0.244	0.129 J	0.0792 J	0.0742 J	0.105	0.197	0.0933 U
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.027	0.0016	4.64	0.0947	0.0341	0.272	0.192	0.278	0.336	0.192	0.166	0.107	0.13	0.238	0.101 U
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.02	0.0015	3.86	0.0736	0.0238	0.108	0.238	0.25	0.464	0.218	0.126	0.152 J	0.223	0.281	0.0918 U
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.015	0.001	0.55	0.00906 J	0.00759 U	0.0126 J	0.0179	0.0205 J	0.0265	0.0168 J	0.00759 U	0.0156 J	0.0759 U	0.0759 U	0.0759 U
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.022	0.0017	8.64	0.28	0.0597	0.336	0.439	0.254	0.54	0.283	0.148 J	0.169	0.258	0.609	0.107
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	0.02	0.0015	32.15	1.3	0.158	1.55	0.932	0.436	1	0.517	0.2	0.281	0.63	1.58	0.442
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.02	0.0016	2.76	0.0986	0.0194	0.0762	0.221 J	0.124 J	0.229 J	0.109 J	0.0516 J	0.0652 J	0.194	0.343	0.0725 U
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.016	0.0015	18.23	0.536	0.109	0.509	0.795	0.797	1.53	0.783	0.421	0.522	0.578	1.25	0.173
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.012	0.0016	11.58	0.572	0.0506	0.477	0.353	0.29	0.515	0.264	0.183	0.172	0.22	0.581	0.163
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.0095	0.0012	1.12	0.149	0.00891 J	0.0238	0.0263	0.0203	0.0471 J	0.0283	0.019	0.0137 J	0.0553 U	0.0553 U	0.0553 U
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.0170	0.0017	1.26	0.0104 J	0.00934 J	0.0264	0.0645	0.0646	0.095	0.058	0.0491	0.0339	0.0697	0.0954	0.0689 U
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.0110	0.0013	0.09	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.0853 U	0.0853 U	0.0853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0019	0.0021	1.14	0.034	0.00667 J	0.0478	0.0384	0.0296	0.0497 J	0.0301	0.0243	0.015 J	0.064 U	0.064 U	0.064 U
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.0160	0.0021	2.60	0.0613	0.0182	0.131	0.112	0.0946	0.21 J	0.116	0.0641	0.0699 J	0.0834	0.137	0.0805 U
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.0033	0.0021	7.82	0.127	0.0373	0.19	0.436	0.318	0.649	0.319	0.144	0.216	0.327	0.6	0.0681
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.0091	0.0021	3.05	0.114	0.0345	0.0381	0.165	0.234	0.273	0.163	0.173	0.102	0.12	0.198	0.062 U
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.0056	0.0005	1.01	0.0736	0.00625 U	0.019	0.0802	0.0485	0.0757	0.0423	0.0272	0.0286	0.0625 U	0.113	0.0625 U
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.0260	0.0028	43.83	0.461	0.29	1.16	2.63	1.98	4.36	2.05	0.739	1.46	1.61	3.64	0.256
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.0069	0.0012	17.49	0.102	0.0787	0.868	0.765	1.46	1.99 J	1.26	0.63	0.562 J	0.555	0.987	0.0643 U
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.0120	0.0019	10.31	0.283	0.0563	0.274	0.513	0.456	0.862	0.408	0.205	0.294	0.315	0.584	0.097
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	0.0150	0.0026	17.47	0.977	0.067	0.872	0.606	0.371	0.735	0.36	0.159	0.266	0.352	0.846	0.292
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.017	0.0022	34.11	0.878	0.175	2.69 J	1.78	1.49	2.68	1.28	0.45	0.873	1.01	2.06	0.381
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	0.017	0.0023	31.01	0.859	0.184	0.981 J	1.38	1.62	2.69 J	1.43	0.588	0.828 J	0.933	1.76	0.338
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.0150	0.0025	9.11	0.261	0.0523	0.344	0.414	0.366	0.747	0.363	0.18	0.274	0.299	0.541	0.107
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.0180	0.0023	1.64	0.0494	0.00942 U	0.0689	0.0836	0.0548	0.0932	0.0474	0.0329	0.0373	0.0942 U	0.14	0.0942 U
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.0150	0.0020	0.36	0.00804 U	0.00804 U	0.00804 U	0.0198	0.0183	0.0303 J	0.0183	0.0165	0.0105 J	0.0804 U	0.0804 U	0.0804 U
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.022	0.0024	7.31	0.247	0.0297	0.215	0.496	0.28	0.271	0.241	0.0856	0.107	1.5	1.96	0.674
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.022	0.0024	11.18	0.347 J	0.0537 J	0.317 J	0.599 J	0.323 J	0.429 J	0.312 J	0.16 J	0.138 J	1.77 J	2.34 J	0.638 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.022	0.0024		0.187	0.0341	0.159	0.29	0.258	0.302	0.252	0.135	0.0906	1.22	1.33	0.396
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.0081	0.0012	0.42	0.0236	0.00668 U	0.0101 J	0.0214	0.0112 J	0.0207 J	0.0107 J	0.00872 J	0.00782 J	0.0668 U	0.0668 U	0.0668 U
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.0160	0.0023	2.88	0.0817	0.0176	0.106	0.146	0.0809	0.181 J	0.0988	0.0524	0.0553 J	0.101	0.209	0.0711 U
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.0098	0.0014	15.83	0.161	0.0476	0.367	1.33	1.14	1.74	0.836	0.439	0.613	0.578	1.21	0.0922
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.010	0.0021	10.09	0.322	0.0527	0.436	0.392 J	0.399 J	0.736 J	0.357 J	0.206	0.275 J	0.271 J	0.591 J	0.146
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.014	0.0023	15.26	0.326	0.0702	0.506	0.886 J	0.776 J	1.34 J	0.631 J	0.324	0.466 J	0.548 J	1.09 J	0.161
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0110	0.0017	1.03	0.00603 U	0.0165	0.0106 J	0.0418	0.0853	0.088	0.0683	0.069	0.031	0.0695	0.0603 U	0.0603 U

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	C-1 Naphthalenes[4]	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.0220	0.0805 U	0.145	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	0.084
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.1736	0.172	0.0674 U	0.0674 U	0.355	0.0862	0.0674 U	0.0674 U	0.133	0.0674 U	0.135 U	0.0674 U	0.135 U	0.127
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	2.601	4.23	1.08	0.751	1.94	3.03	0.872	0.407	1.25	1.68	0.751 U	0.609	0.751 U	9.76
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.3125	0.414	0.115	0.0837	0.203	0.288	0.129	0.0708 U	0.152	0.146	0.142 U	0.0857	0.142 U	0.626
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.715	0.932	0.172	0.192	0.655	0.574	0.163	0.187	0.364	0.322	0.145 U	0.204	0.145 U	1.01
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	1.087	1.38	0.334	0.224	0.995	0.915	0.227	0.132	0.582	0.474	0.158 U	0.271	1.26	2.06
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	7.0	6.08	0.502	0.96	4.53	3.36	0.333	0.429	2.32	1.28	0.656 U	1.01	4.21	3.72
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	2.234	1.87	0.455	0.0807 U	1.42	1.12	0.334	0.397	0.789	0.553	0.161 U	0.403	0.245	2.38
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	1.453	1.55	0.191	0.301	1.26	0.824	0.173	0.152	0.745	0.405	0.178 U	0.369	0.361	0.802
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.392	0.647	0.0922	0.108	0.363	0.302	0.089 U	0.089 U	0.268	0.146	0.178 U	0.117	0.231	0.409
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.0839	0.164	0.11	0.0979 U	0.0979 U	0.13	0.0979 U	0.0979 U	0.0979 U	0.0979 U	0.196 U	0.0979 U	0.196 U	0.33
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.0677	0.134	0.0933 U	0.0933 U	0.0933 U	0.0963	0.0933 U	0.0933 U	0.0933 U	0.0933 U	0.187 U	0.0933 U	0.187 U	0.216
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.2029	0.257	0.101 U	0.101 U	0.201	0.162	0.101 U	0.101 U	0.184	0.101 U	0.201 U	0.101 U	0.201 U	0.277
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.1408	0.187	0.094	0.0918 U	0.121	0.126	0.11	0.0918 U	0.1	0.133	0.184 U	0.0918 U	0.184 U	0.314
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.01734	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0759 U	0.0896	0.0759 U	0.152 U	0.0759 U	0.238	0.0248
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.545	0.462	0.101	0.102	0.327	0.309	0.113	0.0855 U	0.208	0.221	0.171 U	0.118	0.171 U	0.554
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	3.096	2.07	0.223	0.363	1.83	1.01	0.25	0.17	0.964	0.377	0.169 U	0.388	0.232	1.11
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.047	0.164	0.13	0.0725 U	0.0725 U	0.219	0.0749	0.0725 U	0.0725 U	0.255	0.145 U	0.0783	0.145 U	0.277
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.862	0.953	0.267	0.197	0.523	0.593	0.231	0.108	0.371	0.291	0.164 U	0.207	0.275	1.25
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.926	0.752	0.137	0.133	0.556	0.341	0.114	0.0819 U	0.353	0.168	0.164 U	0.158	0.406	0.502
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.1261	0.0553 U	0.0553 U	0.0553 U	0.0597	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.0553 U	0.111 U	0.0553 U	0.111 U	0.0403
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.01317	0.119	0.0705	0.0689 U	0.0689 U	0.118	0.0994	0.0689 U	0.0689 U	0.0965	0.138 U	0.0689 U	0.138 U	0.0923
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.00853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.0853 U	0.171 U	0.0853 U	0.171 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0761	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.064 U	0.128 U	0.064 U	0.128 U	0.0467
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.057	0.136	0.0805 U	0.0805 U	0.0805 U	0.085	0.0805 U	0.0805 U	0.0805 U	0.0805 U	0.161 U	0.0805 U	0.161 U	0.165
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.1112	0.421	0.139	0.0774	0.0837	0.291	0.129	0.127	0.101	0.203	0.119 U	0.0914	0.119 U	0.593
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.0447	0.122	0.0664	0.062 U	0.062 U	0.139	0.062 U	0.062 U	0.062 U	0.131	0.124 U	0.062 U	0.124 U	0.211
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.00625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.0625 U	0.125 U	0.0625 U	1.1	0.164
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.691	1.96	0.605	0.227	0.522	1.3	0.543	0.618	0.422	0.684	0.26	0.268	0.346	6.36
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.1345	0.531	0.279	0.0643 U	0.0937	0.296	0.239	0.13	0.081	0.159	0.129 U	0.0643 U	0.129 U	2.03
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.3092	0.456	0.149	0.0849	0.257	0.318	0.133	0.147	0.217	0.144	0.15 U	0.126	0.211	1.24
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	1.24	1.29	0.19	0.179	1.04	0.638	0.184	0.193	0.765	0.294	0.165 U	0.326	1.29	0.693
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.996	2.01	0.521	0.29	0.915	1.18	0.488	0.551	0.963	0.665	0.167	0.536	0.378	2.07
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	1.313	1.55	0.452	0.234	0.877	0.962	0.42	0.424	0.67	0.483	0.15	0.334	0.282	2.56
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.385	0.513	0.14	0.0856	0.299	0.355	0.151	0.149	0.21	0.182	0.165 U	0.138	0.616	0.615
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.0595	0.124	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.0942 U	0.188 U	0.0942 U	0.188 U	0.227
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.00804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.0804 U	0.161 U	0.0804 U	0.161 U	0.0273
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.1538	3.79	1.84	1.41	1.66	5.68	1.41	1.74	5.33	4.6	0.557	3.79	4.37	0.885
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.413	4.27 J	2.06 J	1.07 J	2.19 J	5.5 J	1.66 J	1.42 J	5.59 J	5.26 J	0.547 J	3.68 J	2.93 J	1.12 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.1955	2.66	1.51	0.73	1.50	3.59	1.06	0.95	4.14	3.70	0.537	2.64	2.18	0.45
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.01564	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.0668 U	0.134 U	0.0668 U	0.134 U	0.0215
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.1219	0.192	0.0711 U	0.0711 U	0.0916	0.143	0.0934	0.0711 U	0.0814	0.0806	0.142 U	0.0711 U	0.142 U	0.197
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.2432	0.399	0.197	0.0734 U	0.17	0.3	0.146	0.118	0.113	0.153	0.147 U	0.0734 U	0.299	1.64
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.49	0.612	0.132 J	0.0903	0.346	0.356 J	0.113	0.129 J	0.251	0.18	0.149 U	0.13	2.59 J	0.711 J
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.545	0.833	0.243 J	0.123	0.361	0.599 J	0.183	0.217 J	0.253	0.297	0.151 U	0.153	0.876 J	1.32 J
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.01714	0.0603 U	0.0682	0.0603 U	0.0603 U	0.0603 U	0.0616	0.0603 U	0.0603 U	0.0603 U	0.121 U	0.0603 U	0.121 U	0.0658

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene
PWS-27_8-11_SE	PWS-27	MC	7/13/2012	N	8	11	0.0805 U	0.129	0.0129 J	0.0805 U	0.0665	0.0862	0.0652	0.135	0.00805 U	0.018
PWS-01_8-9_SE	PWS-01	SB	7/10/2012	N	8	9	0.00772 J	0.433	0.55	0.0357	0.0692	0.0255	0.489	0.321	0.14	0.0336
PWS-03_8-11_SE	PWS-03	SB	7/12/2012	N	8	11	0.443	18.6	1.95	1.92	5.7	0.83	6.48	14.5	0.661	1.94
PWS-04_1-4_SE	PWS-04	SB	7/10/2012	N	1	4	0.052	1.51	0.221	0.221	0.693	0.12	0.772	1.19	0.0865	0.226
PWS-04_8-11_SE	PWS-04	SB	7/10/2012	N	8	11	0.0684	2.77	0.571	0.302	1.54	0.153	1.87	2.01	0.216	0.499
PWS-05_8-11_SE	PWS-05	SB	7/12/2012	N	8	11	0.123 J	4.44	0.921	0.506	2.2	0.345	3.14	3.29	0.302	0.785
PWS-06_8-11_SE	PWS-06	SB	7/12/2012	N	8	11	0.107 J	16.9	4.15	0.406	17.3	0.244	13.6	10.7	2.11	4.89
PWS-07_8-11_SE	PWS-07	SB	7/10/2012	N	8	11	0.177	5.72	1.43	0.762	5.35	0.481	4.65	4.63	0.604	1.63
PWS-08_8-11_SE	PWS-08	SB	7/12/2012	N	8	11	0.0492	3.46	1.17	0.186	2.44	0.123	4.01	2.52	0.471	0.982
PWS-09_8-11_SE	PWS-09	SB	7/12/2012	N	8	11	0.0297	1.43	0.327	0.124	1.16	0.125	1.27	1.1	0.133	0.259
PWS-12_8-11_SE	PWS-12	SB	7/12/2012	N	8	11	0.035	0.576	0.088	0.169 J	0.17	0.168	0.28	0.536	0.0222	0.0617
PWS-12_8-11 DUP_SE	PWS-12	SB	7/12/2012	FD	8	11	0.0191	0.386	0.0664	0.088 J	0.172	0.111	0.238	0.337	0.0168 J	0.0509
PWS-13_1-4_SE	PWS-13	SB	7/11/2012	N	1	4	0.0275	0.596	0.142	0.162	0.359	0.0946	0.496	0.612	0.0589	0.144
PWS-13_8-11_SE	PWS-13	SB	7/11/2012	N	8	11	0.0301	0.433	0.0971	0.126	0.255	0.101	0.341	0.37	0.0378	0.103
PWS-15_8-11_SE	PWS-15	SB	7/12/2012	N	8	11	0.00759 U	0.0976	0.00974 J	0.00778 J	0.0233	0.086	0.0736	0.0789	0.00782 J	0.00952 J
PWS-16B_8-11_SE	PWS-16	SB	7/13/2012	N	8	11	0.0855 U	1.39	0.311	0.176	0.999	0.13	0.895	1.09	0.15	0.395
PWS-16_8-11_SE	PWS-16	SB	7/9/2012	N	8	11	0.0844 U	4.9	1.56	0.229	5.44	0.173	5.75	3.48	0.896	2.2
PWS-22_8-11 SEDIMENT	PWS-22	SB	7/12/2012	N	8	11	0.0182	0.292	0.0607	0.0643 J	0.122	0.0428 J	0.277	0.267	0.0137 J	0.0333
PWS-25_8-11_SE	PWS-25	SB	7/13/2012	N	8	11	0.117 J	2.8	0.643	0.514	1.45	0.217	2.01	2.36	0.237	0.625
PWS-26_8-11_SE	PWS-26	SB	7/13/2012	N	8	11	0.0819 U	1.6	0.756	0.191	1.35	0.121	1.98	1.24	0.253	0.673
PWS-17_4-7	PWS-17	MC	10/10/2012	N	4	7	0.00553 U	0.0825	0.0625	0.0172	0.195	0.0162	0.124	0.0568	0.0803	0.0458
PWS-27_8-11	PWS-27	MC	10/9/2012	N	8	11	0.0103 J	0.186	0.0141	0.0436	0.0228	0.0516	0.103	0.186	0.00689 U	0.00972 J
PWS-30_8-11	PWS-30	MC	10/12/2012	N	8	11	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U	0.00853 U
LSI-01_8-11	LSI-01	SB	10/16/2012	N	8	11	0.0064 U	0.155	0.0386	0.0243	0.188	0.00931 J	0.152	0.103	0.0212	0.0549
LSI-02_8-11	LSI-02	SB	10/9/2012	N	8	11	0.0157 J	0.388	0.0711	0.069	0.116	0.0355	0.25	0.285	0.0164	0.0406
LSI-20_8-11	LSI-20	SB	10/10/2012	N	8	11	0.0445	1.47	0.0933	0.162	0.256	0.0873	0.618	1.12	0.0304	0.0808
LSI-24_8-11	LSI-24	SB	10/12/2012	N	8	11	0.024	0.328	0.0287	0.146	0.0893	0.082	0.139	0.306	0.014	0.0307
PWS-1_8-10	PWS-01	SB	10/10/2012	N	8	10	0.00626 J	0.1	0.036	0.0292	0.0152	0.0156	0.049	0.0862	0.00625 U	0.00625 U
PWS-3_8-11	PWS-03	SB	10/10/2012	N	8	11	0.289	5.64	0.629	1.03	1.26	0.43	2.47	4.3	0.208	0.483
PWS-4_8-11	PWS-04	SB	10/10/2012	N	8	11	0.191	1.34	0.156	0.793	0.339	0.47	0.711	1.15 J	0.0375	0.097
PWS-5_8-11	PWS-05	SB	10/10/2012	N	8	11	0.0604	1.22	0.277	0.233	0.634	0.124	0.882	0.855	0.0992	0.21
PWS-6_8-11	PWS-06	SB	10/10/2012	N	8	11	0.0534	2.38	0.969	0.184	2.05	0.0937	2.77	1.67	0.4	0.84
PWS-7_8-10	PWS-07	SB	10/11/2012	N	8	10	0.186	4.43	1.05	0.619	1.99	0.411	3.16	3.5	0.307	0.689 J
PWS-7_8-10 DUP	PWS-07	SB	10/11/2012	FD	8	10	0.197	3.29	0.962	0.758	2.53	0.463	2.42	2.6	0.381	0.932 J
PWS-8_8-11	PWS-08	SB	10/9/2012	N	8	11	0.0554	1.12	0.32	0.209	0.593	0.0916	0.962	0.775	0.12	0.265
PWS-9_8-11	PWS-09	SB	10/9/2012	N	8	11	0.00942 U	0.203	0.0675	0.0354	0.0943	0.0208	0.179	0.149	0.0193	0.0402
PWS-12_8-11	PWS-12	SB	10/9/2012	N	8	11	0.00804 U	0.045	0.00804 U	0.017	0.0109 J	0.0113 J	0.0203	0.0421	0.00804 U	0.00804 U
PWS-13_8-11	PWS-13	SB	10/9/2012	N	8	11	0.044	0.977	0.208	0.0701	0.276	0.0965	1.24	1.01	0.0508	0.103
PWS-13_8-11_1	PWS-13	SB	10/9/2012	FD	8	11	0.0432 J	1.63 J	0.334 J	0.127 J	0.766 J	0.123 J	1.77 J	1.6 J	0.111 J	0.302 J
PWS-13_8-11_2	PWS-13	SB	10/9/2012	FT	8	11	0.0392	0.66	0.169	0.109	0.305	0.088	0.965	0.748	0.0585	0.137
PWS-15_8-11	PWS-15	SB	10/11/2012	N	8	11	0.00668 U	0.0584	0.015	0.00881 J	0.0329	0.0264	0.0405	0.048	0.00668 U	0.0123 J
PWS-16_8-11	PWS-16	SB	10/9/2012	N	8	11	0.0148	0.465	0.0989	0.0551	0.187	0.0305	0.316	0.339	0.0375	0.0844
PWS-25_4-8	PWS-25	SB	10/11/2012	N	4	8	0.14	1.56	0.268	0.516	0.473	0.274	0.667	1.11	0.0732	0.17
PWS-26_8-11	PWS-26	SB	10/11/2012	N	8	11	0.0554 J	1.22	0.435	0.221 J	0.776	0.095 J	1.09	0.854	0.154	0.336
PWS-26_8-11_DUP	PWS-26	SB	10/11/2012	FD	8	11	0.0995 J	1.77	0.428	0.373 J	1	0.175 J	1.2	1.28	0.163	0.382
PWS-28_8-11	PWS-28	SB	10/10/2012	N	8	11	0.0103 J	0.132	0.00635 J	0.056	0.0211	0.0287	0.0605	0.106	0.00614 J	0.011 J

Notes:

[1]All PAH concentrations in mg/kg sediment (dry weight).

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

[4]C-1 naphthalenes = sum of 1- and 2-methylnaphthalene. Non-detections included as 1/2 the MDL.

g/g = grams per gram
J = estimated value
MDL = method detection limit
mg/kg = milligrams per kilogram
PAH = polycyclic aromatic hydrocarbon
U = not detected

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 2: Conversion of Sediment Concentrations to Pore Water Concentrations [1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene		Acenaphthylene		Anthracene		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b) fluoranthene		Benzo(e)pyrene		Benzo(g,h,i)perylene		Benzo(k) fluoranthene		C-1 Benz(a)anth/ Chrysenes	
				Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)
PWS-27_8-11_SE	PWS-27	MC	N	0.00987	0.00141858	0.004025	0.00168735	0.0179	0.00127754	0.0698	0.00106351	0.102	0.00075538	0.135	0.00084285	0.0711	0.00041377	0.04025	7.7742E-05	0.0458	0.00014672	0.0807	0.00048708
PWS-01_8-9_SE	PWS-01	SB	N	0.755	2.40151012	0.0133	0.01912429	0.114	0.04170184	0.0895	0.00266244	0.0666	0.00065573	0.145	0.00165692	0.071	0.00069784	0.0329	9.2855E-05	0.0461	0.00024597	0.0337	0.00020139
PWS-03_8-11_SE	PWS-03	SB	N	1.37	1.86393445	0.49	2.33622117	2.69	1.49229071	5.57	0.31047496	3.49	0.06684361	7.6	0.12191488	3.8	0.07030858	1.75	0.011718	2.65	0.03158879	3.7	0.06660221
PWS-04_1-4_SE	PWS-04	SB	N	0.161	0.1345495	0.0514	0.1129447	0.277	0.10572643	0.461	0.02088874	0.372	0.00594572	0.75	0.01200414	0.384	0.00595868	0.207	0.00106973	0.248	0.00218047	0.279	0.00357126
PWS-04_8-11_SE	PWS-04	SB	N	0.521	1.20661987	0.0769	0.32930184	0.559	0.44339021	0.668	0.05097465	0.472	0.01208307	0.944	0.02311878	0.507	0.01277402	0.252	0.002089	0.284	0.00387644	0.39	0.00848493
PWS-05_8-11_SE	PWS-05	SB	N	0.84	1.3633786	0.139	0.4797582	0.971	0.55079405	1.52	0.08856458	1.03	0.02024237	1.93	0.03352684	1.01	0.01874363	0.489	0.00307106	0.604	0.00648102	0.812	0.0135129
PWS-06_8-11_SE	PWS-06	SB	N	3.89	6.54417899	0.235	0.51896024	3.4	1.7725938	2.43	0.09687544	0.975	0.01034203	2.46	0.02742938	1.1	0.01174694	0.35	0.00097936	0.739	0.00465121	1.29	0.0143399
PWS-07_8-11_SE	PWS-07	SB	N	1.32	1.77075014	0.216	0.67586142	1.48	0.67420884	1.7	0.06932783	1.36	0.01993292	2.69	0.0343084	1.41	0.01984874	0.707	0.00351468	0.832	0.00690538	1.31	0.0175728
PWS-08_8-11_SE	PWS-08	SB	N	1.05	1.20220612	0.0713	0.0946338	0.831	0.2818066	0.708	0.0200018	0.372	0.00300409	0.727	0.00587676	0.353	0.00265457	0.167	0.00038519	0.22	0.00091121	0.408	0.00319848
PWS-09_8-11_SE	PWS-09	SB	N	0.333	0.26382382	0.0385	0.04486707	0.302	0.07591571	0.361	0.00906185	0.251	0.00205813	0.415	0.00316093	0.216	0.00156773	0.11	0.00025373	0.134	0.00053203	0.196	0.00130809
PWS-12_8-11_SE	PWS-12	SB	N	0.0793	0.03047869	0.0268	0.02745137	0.111	0.01761678	0.23	0.00508336	0.241	0.002145	0.405	0.00338228	0.222	0.00181163	0.153	0.00046853	0.144	0.00065906	0.152	0.00097998
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.043	0.0125234	0.0197	0.01836717	0.0848	0.01261988	0.147	0.00278312	0.142	0.0010388	0.244	0.00172021	0.129	0.00085784	0.0792	0.00018406	0.0742	0.00025588	0.105	0.00060247
PWS-13_1-4_SE	PWS-13	SB	N	0.0947	0.03845279	0.0341	0.03970393	0.272	0.06495552	0.192	0.00349293	0.278	0.00235921	0.336	0.00224086	0.192	0.00130773	0.166	0.00047913	0.107	0.00038347	0.13	0.00070606
PWS-13_8-11_SE	PWS-13	SB	N	0.0736	0.02946161	0.0238	0.02491917	0.108	0.01824015	0.238	0.00565839	0.25	0.00238755	0.464	0.00426463	0.218	0.00185992	0.126	0.00037013	0.152	0.00076253	0.223	0.00186437
PWS-15_8-11_SE	PWS-15	SB	N	0.00906	0.0018897	0.003795	0.00235877	0.0126	0.00110024	0.0179	0.00018381	0.0205	9.0457E-05	0.0265	9.9579E-05	0.0168	6.3111E-05	0.003795	2.5979E-06	0.0156	3.9638E-05	0.03795	0.00022268
PWS-16B_8-11_SE	PWS-16	SB	N	0.28	0.19807972	0.0597	0.09095155	0.336	0.08734005	0.439	0.01175879	0.254	0.00204428	0.54	0.00448028	0.283	0.00229741	0.148	0.00039355	0.169	0.00074569	0.258	0.00193855
PWS-16_8-11_SE	PWS-16	SB	N	1.3	2.26567495	0.158	0.52374047	1.55	0.94406481	0.932	0.04065768	0.436	0.00540063	1	0.01247569	0.517	0.00657769	0.2	0.00074441	0.281	0.00191715	0.63	0.00846422
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0986	0.04269458	0.0194	0.0160828	0.0762	0.00955515	0.221	0.00466624	0.124	0.00075632	0.229	0.00140396	0.109	0.00059315	0.0516	8.4067E-05	0.0652	0.00018733	0.194	0.00139308
PWS-25_8-11_SE	PWS-25	SB	N	0.536	0.6740298	0.109	0.29871364	0.509	0.20741534	0.795	0.03571181	0.797	0.01396551	1.53	0.02488477	0.783	0.01298059	0.421	0.00239854	0.522	0.00511514	0.578	0.0081511
PWS-26_8-11_SE	PWS-26	SB	N	0.572	0.73323203	0.0506	0.07927597	0.477	0.18545494	0.353	0.01073314	0.29	0.00311874	0.515	0.00545959	0.264	0.00258258	0.183	0.00066856	0.172	0.00093406	0.22	0.00187823
PWS-17_4-7	PWS-17	MC	N	0.149	0.1378548	0.00891	0.00725421	0.0238	0.0023888	0.0263	0.0002678	0.0203	6.9632E-05	0.0471	0.00020036	0.0283	0.00011507	0.019	2.7779E-05	0.0137	2.4873E-05	0.02765	0.00010679
PWS-27_8-11	PWS-27	MC	N	0.0104	0.00100351	0.00934	0.00438663	0.0264	0.00158243	0.0645	0.00063948	0.0646	0.00025378	0.095	0.00034295	0.058	0.00020496	0.0491	7.2308E-05	0.0339	6.0977E-05	0.0697	0.00026544
PWS-30_8-11	PWS-30	MC	N	0.004265	0.00035872	0.004265	0.00187101	0.004265	0.00012232	0.004265	1.1731E-05	0.004265	4.6657E-06	0.004265	3.429E-06	0.004265	4.4879E-06	0.004265	2.0805E-06	0.004265	3.177E-06	0.04265	0.00018855
LSI-01_8-11	LSI-01	SB	N	0.034	0.00536751	0.00667	0.001851	0.0478	0.00323409	0.0384	0.00021608	0.0296	5.5743E-05	0.0497	9.7291E-05	0.0301	5.5164E-05	0.0243	1.7922E-05	0.015	1.2231E-05	0.032	5.879E-05
LSI-02_8-11	LSI-02	SB	N	0.0613	0.01368279	0.0182	0.00968248	0.131	0.01596467	0.112	0.00117014	0.0946	0.00035319	0.21	0.0009203	0.116	0.0004705	0.0641	8.3501E-05	0.0699	0.00014725	0.0834	0.00026697
LSI-20_8-11	LSI-20	SB	N	0.127	0.04791848	0.0373	0.0325219	0.19	0.03192051	0.436	0.01211914	0.318	0.00285988	0.649	0.00682001	0.319	0.00276518	0.144	0.00034334	0.216	0.00102649	0.327	0.00277377
LSI-24_8-11	LSI-24	SB	N	0.114	0.0388934	0.0345	0.02822808	0.0381	0.00217263	0.165	0.0023028	0.234	0.00160824	0.273	0.00150949	0.163	0.0008603	0.173	0.00043753	0.102	0.00028368	0.12	0.00050369
PWS-1_8-10	PWS-01	SB	N	0.0736	0.17118811	0.003125	0.00541567	0.019	0.00672767	0.0802	0.00601361	0.0485	0.00109363	0.0757	0.00157244	0.0423	0.00084751	0.0272	0.00019503	0.0286	0.00032501	0.03125	0.0005103
PWS-3_8-11	PWS-03	SB	N	0.461	0.21059786	0.29	0.5349268	1.16	0.2908058	2.63	0.08511816	1.98	0.0221891	4.36	0.04739347	2.05	0.02221103	0.739	0.00228838	1.46	0.009664	1.61	0.01529758
PWS-4_8-11	PWS-04	SB	N	0.102	0.07721635	0.0787	0.26538515	0.868	0.76884527	0.765	0.05784231	1.46	0.05870762	1.99	0.06589547	1.26	0.04524968	0.63	0.00738416	0.562	0.00963594	0.555	0.01294894
PWS-5_8-11	PWS-05	SB	N	0.283	0.18940113	0.0563	0.07173728	0.274	0.06076693	0.513	0.01520891	0.456	0.00499176	0.862	0.00960921	0.408	0.00402363	0.205	0.00062661	0.294	0.00170416	0.315	0.00259438
PWS-6_8-11	PWS-06	SB	N	0.977	0.83347347	0.067	0.05716611	0.872	0.23439387	0.606	0.01230768	0.371	0.0022416	0.735	0.00477748	0.36	0.00205018	0.159	0.00025536	0.266	0.00089566	0.352	0.00190989
PWS-7_8-10	PWS-07	SB	N	0.878	0.86312035	0.175	0.35606904	2.69	1.5173531	1.78	0.07431043	1.49	0.0224264	2.68	0.0372317	1.28	0.01716002	0.45	0.00163563	0.873	0.00689592	1.01	0.01174789
PWS-7_8-10 DUP	PWS-07	SB	FD	0.859	0.78689922	0.184	0.36066655	0.981	0.3226194	1.38	0.04882776	1.62	0.02413521	2.69	0.03591178	1.43	0.01920855	0.588	0.00232335	0.828	0.0060398	0.933	0.00990376
PWS-8_8-11	PWS-08	SB	N	0.261	0.1074015	0.0523	0.04047796	0.344	0.05671045	0.414	0.00713927	0.366	0.00232107	0.747	0.00515831	0.363	0.00219748	0.18	0.00033076	0.274	0.00099469	0.299	0.00155968
PWS-9_8-11	PWS-09	SB	N	0.0494	0.00800973	0.00471	0.00085594	0.0689	0.0046949	0.0836	0.00061017	0.0548	0.00012186	0.0932	0.00021116	0.0474	9.2445E-05	0.0329	2.3544E-05	0.0373	4.4234E-05	0.0471	8.8173E-05
PWS-12_8-11	PWS-12	SB	N	0.00402	0.00015924	0.00402	0.00083009	0.00402	5.4327E-05	0.0198	7.2922E-05	0.0183	2.5453E-05	0.0303	4.2779E-05	0.0183	2.4476E-05	0.0165	9.5586E-06	0.0105	6.9304E-06	0.0402	8.5741E-05
PWS-13_8-11	PWS-13	SB	N	0.247	0.10037048	0.0297	0.01681331	0.215	0.02715298	0.496	0.00928049	0.28	0.00151333	0.271	0.00104849	0.241	0.00114782	0.0856	0.00010237	0.107	0.00022471	1.5	0.01732841
PWS-13_8-11_1	PWS-13	SB	FD	0.347	0.17201864	0.0537	0.04453864	0.317	0.05019867	0.599	0.01236146	0.323	0.00188893	0.429	0.00212603	0.312	0.00171489	0.16	0.00027701	0.138	0.00033713	1.77	0.02193622
PWS-13_8-11_2	PWS-13	SB	FT	0.187	0.06434065	0.0341	0.0211117	0.159	0.01676761	0.29	0.00405439	0.258	0.00133215	0.302	0.00124014	0.252	0.00123064	0.135	0.00021173	0.0906	0.00017211	1.22	0.01286695
PWS-15_8-11	PWS-15	SB	N	0.0236	0.00696847	0.00334	0.00142712	0.0101	0.00058466	0.0214	0.0001927	0.0112	2.6391E-05	0.0207	5.3194E-05	0.0107	2.3539E-05	0.00872	7.7814E-06	0.00782	9.9308E-06	0.0334	0.00014679
PWS-16_8-11	PWS-16	SB	N	0.0817	0.01837721	0.0176	0.00764316	0.106	0.00954809	0.146	0.00151722	0.0809	0.0002315	0.181	0.00062002	0.0988	0.00030746	0.0524	5.07E-05	0.0553	8.4737E-05	0.101	0.00030722
PWS-25_4-8	PWS-25	SB	N	0.161	0.12366179	0.0476	0.08955512	0.367	0.15390362	1.33	0.09734999	1.14	0.0304035	1.74	0.04009788	0.836	0.01845296	0.439	0.00321192	0.613	0.00822952	0.578	0.01033041
PWS-26_8-11	PWS-26	SB	N	0.322	0.20423187	0.0527	0.0550144	0.436	0.11267603	0.392	0.00892984	0.399	0.00363227	0.736	0.00694813	0.357	0.00291984	0.206	0.00055769	0.275	0.00136125	0.271	0.00181319
PWS-26_8-11_DUP	PWS-26	SB	FD	0.326	0.17561473	0.0702	0.07542129	0.506	0.11957822	0.886	0.02651733	0.776	0.00851251	1.34	0.01412958	0.631	0.00592801	0.324	0.00096055	0.466	0.00261734	0.548	0.00460583
PWS-28_8-11	PWS-28	SB	N	0.003015	0.00012948	0.0165	0.0113469	0.0106	0.00035611	0.0418	0.00032688	0.0853	0.00041415	0.088	0.00031907	0.0683	0.00027752	0.069	0.00013029	0.031	5.4119E-05	0.0695	0.00027521
Partition Coefficients (Log K_{OC} | K_{OC})				3.944	8790	3.168	1472	4.457	28642	5.577	377572	6.003	1006932	6.160	1445440	6.031	1073989	6.397	2494595	6.184	1527566	6.036	1086426
Partition Coefficients (Log K_{BC} | K_{BC})				5.58	380189	5.15	141254	5.86	724436	6.47	2951209	6.71	5128614	6.79	6165950	6.72	5248075	6.92	8317638	6.81	6456542	6.73	5370318

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 2: Conversion of Sediment Concentrations to Pore Water Concentrations [1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-1 Fluoranthrenes/ Pyrenes		C-1 Fluorenes		C-1 Naphthalenes		C-1 Phenanthrenes/ Anthracenes		C-2 Benz(a)anth/ Chrysenes		C-2 Fluorenes		C-2 Naphthalenes		C-2 Phenanthrenes/ Anthracenes		C-3 Benz(a)anth/ Chrysenes		C-3 Fluorenes	
				Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)
PWS-27_8-11_SE	PWS-27	MC	N	0.0849	0.00326872	0.04025	0.00322015	0.022025	0.00837195	0.04025	0.00166527	0.145	0.00066114	0.04025	0.00117701	0.04025	0.00783255	0.04025	0.00068424	0.04025	3.0719E-05	0.04025	0.00041349
PWS-01_8-9_SE	PWS-01	SB	N	0.144	0.01282499	0.104	0.02443099	0.1736	0.38440178	0.172	0.02819513	0.0337	0.00011274	0.0337	0.00143839	0.355	0.41696042	0.0862	0.00384478	0.0337	3.8299E-05	0.0337	0.00050795
PWS-03_8-11_SE	PWS-03	SB	N	9	1.29959832	0.763	0.18074239	2.601	7.08183346	4.23	0.88510321	1.08	0.00734729	0.751	0.06293745	1.94	1.62222802	3.03	0.23089967	0.872	0.00181017	0.407	0.00903029
PWS-04_1-4_SE	PWS-04	SB	N	0.614	0.07284082	0.103	0.01513632	0.3125	0.60476538	0.414	0.06772858	0.115	0.00050484	0.0837	0.00397003	0.203	0.10788124	0.288	0.01591718	0.129	0.00020344	0.0354	0.00034975
PWS-04_8-11_SE	PWS-04	SB	N	1.02	0.21264359	0.176	0.05238207	0.715	3.06529005	0.932	0.31590567	0.172	0.00138236	0.192	0.02170819	0.655	0.92934979	0.574	0.06394267	0.163	0.00042703	0.187	0.00725439
PWS-05_8-11_SE	PWS-05	SB	N	2	0.2958907	0.276	0.05885756	1.087	3.14401249	1.38	0.30419502	0.334	0.00208605	0.224	0.01550113	0.995	0.94996271	0.915	0.06937207	0.227	0.00039446	0.132	0.00240235
PWS-06_8-11_SE	PWS-06	SB	N	5.37	0.65323351	1.04	0.2186238	7	23.2427387	6.08	1.30630006	0.502	0.00197859	0.96	0.06982716	4.53	4.38577166	3.36	0.23668566	0.333	0.00035691	0.429	0.00722613
PWS-07_8-11_SE	PWS-07	SB	N	2.27	0.23496684	0.357	0.06036797	2.234	5.78521949	1.87	0.30983434	0.455	0.00224228	0.04035	0.00075512	1.42	1.06448354	1.12	0.06245873	0.334	0.00047895	0.397	0.0087119
PWS-08_8-11_SE	PWS-08	SB	N	1.18	0.09609904	0.298	0.04008804	1.453	3.08474688	1.55	0.23846275	0.191	0.00055535	0.301	0.01477297	1.26	0.86326706	0.824	0.03881729	0.173	0.00016035	0.152	0.00177993
PWS-09_8-11_SE	PWS-09	SB	N	0.566	0.04024634	0.196	0.02634993	0.392	0.53881913	0.647	0.08206268	0.0922	0.00022532	0.108	0.00376615	0.363	0.1666585	0.302	0.01072733	0.0445	2.403E-05	0.0445	0.00032145
PWS-12_8-11_SE	PWS-12	SB	N	0.273	0.01499822	0.04895	0.00321966	0.0839	0.05297405	0.164	0.01138092	0.11	0.000329	0.04895	0.00117873	0.04895	0.00782227	0.13	0.00324073	0.04895	3.0979E-05	0.04895	0.00041485
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.197	0.00990782	0.04665	0.00328771	0.0677	0.0413647	0.134	0.00908052	0.04665	9.3239E-05	0.04665	0.00120301	0.04665	0.00799065	0.0963	0.002216	0.04665	3.1544E-05	0.04665	0.00042314
PWS-13_1-4_SE	PWS-13	SB	N	0.238	0.01096625	0.0505	0.0032488	0.2029	0.19932844	0.257	0.02056663	0.0505	9.1028E-05	0.0505	0.00118531	0.201	0.06832092	0.162	0.00418974	0.0505	3.0693E-05	0.0505	0.00041554
PWS-13_8-11_SE	PWS-13	SB	N	0.281	0.01653248	0.0459	0.0031718	0.1408	0.13074728	0.187	0.01489586	0.094	0.00027615	0.0459	0.00115976	0.121	0.03607102	0.126	0.00331247	0.11	0.0001183	0.0459	0.00040759
PWS-15_8-11_SE	PWS-15	SB	N	0.03795	0.00137543	0.03795	0.00441837	0.01734	0.00865007	0.03795	0.00228156	0.03795	0.00012381	0.03795	0.00161207	0.03795	0.01076114	0.03795	0.00093616	0.03795	4.1748E-05	0.03795	0.00056517
PWS-16B_8-11_SE	PWS-16	SB	N	0.609	0.0433396	0.107	0.01004651	0.545	0.86490919	0.462	0.04851191	0.101	0.00025562	0.102	0.00339395	0.327	0.13899376	0.309	0.01083268	0.113	0.00010237	0.04275	0.00029862
PWS-16_8-11_SE	PWS-16	SB	N	1.58	0.19312582	0.442	0.10619242	3.096	11.8268847	2.07	0.46992782	0.223	0.0010274	0.363	0.02853755	1.83	1.97790288	1.01	0.07113488	0.25	0.00040616	0.17	0.00316122
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.343	0.02059223	0.03625	0.00196387	0.047	0.0206114	0.164	0.01116371	0.13	0.00041776	0.03625	0.00071935	0.03625	0.0047695	0.219	0.00711363	0.0749	5.9759E-05	0.03625	0.00025332
PWS-25_8-11_SE	PWS-25	SB	N	1.25	0.15576782	0.173	0.02682225	0.862	2.17769688	0.953	0.17852119	0.267	0.00143138	0.197	0.01192998	0.523	0.35853358	0.593	0.03634745	0.231	0.00038535	0.108	0.00163078
PWS-26_8-11_SE	PWS-26	SB	N	0.581	0.05225707	0.163	0.02318126	0.926	2.43910878	0.752	0.12884499	0.137	0.00049555	0.133	0.00611818	0.556	0.38915048	0.341	0.01568825	0.114	0.00012519	0.04095	0.00032077
PWS-17_4-7	PWS-17	MC	N	0.02765	0.0006529	0.02765	0.00207752	0.1261	0.16763852	0.02765	0.00107833	0.02765	5.9777E-05	0.02765	0.00076281	0.0597	0.01767468	0.02765	0.00044464	0.02765	2.0307E-05	0.02765	0.00026936
PWS-27_8-11	PWS-27	MC	N	0.0954	0.00269653	0.03445	0.00166284	0.013165	0.00234846	0.119	0.00635493	0.0705	0.00015077	0.03445	0.00061009	0.03445	0.00403361	0.118	0.00257348	0.0994	8.7808E-05	0.03445	0.00021525
PWS-30_8-11	PWS-30	MC	N	0.04265	0.00115537	0.04265	0.00368403	0.00853	0.00179306	0.04265	0.00191003	0.04265	0.00010538	0.04265	0.00135081	0.04265	0.00894062	0.04265	0.00078674	0.04265	3.574E-05	0.04265	0.00047624
LSI-01_8-11	LSI-01	SB	N	0.032	0.00035695	0.032	0.00112869	0.0761	0.03258803	0.032	0.00058784	0.032	3.3061E-05	0.032	0.00041616	0.032	0.00272833	0.032	0.00024318	0.032	1.129E-05	0.032	0.00014767
LSI-02_8-11	LSI-02	SB	N	0.137	0.00364331	0.04025	0.00158794	0.057	0.01926606	0.136	0.00596157	0.04025	4.5784E-05	0.04025	0.00058333	0.04025	0.00384858	0.085	0.00114913	0.04025	1.5562E-05	0.04025	0.0002061
LSI-20_8-11	LSI-20	SB	N	0.6	0.0460403	0.0681	0.00395168	0.1112	0.06090315	0.421	0.04227739	0.139	0.00037762	0.0774	0.00180166	0.0837	0.01346634	0.291	0.00947967	0.129	0.00011381	0.127	0.00145441
LSI-24_8-11	LSI-24	SB	N	0.198	0.00696331	0.031	0.00105156	0.0447	0.01316562	0.122	0.00522168	0.0664	0.00010716	0.031	0.00038708	0.031	0.00254484	0.139	0.00266517	0.031	1.0423E-05	0.031	0.00013709
PWS-1_8-10	PWS-01	SB	N	0.113	0.02297311	0.03125	0.01012948	0.00625	0.00514568	0.03125	0.00523006	0.03125	0.00028368	0.03125	0.00369527	0.03125	0.02467335	0.03125	0.00214574	0.03125	9.564E-05	0.03125	0.00129531
PWS-3_8-11	PWS-03	SB	N	3.64	0.3082035	0.256	0.01899327	0.691	0.62915427	1.96	0.21634848	0.605	0.00198917	0.227	0.00572508	0.522	0.14211965	1.3	0.04818781	0.543	0.00056595	0.618	0.00950559
PWS-4_8-11	PWS-04	SB	N	0.987	0.19301459	0.03215	0.0027001	0.1345	0.19191764	0.531	0.12569186	0.279	0.00248922	0.03215	0.00099234	0.0937	0.03764877	0.296	0.02071567	0.239	0.00065908	0.13	0.00338956
PWS-5_8-11	PWS-05	SB	N	0.584	0.04213041	0.097	0.00771819	0.3092	0.34654617	0.456	0.04764206	0.149	0.00044064	0.0849	0.00227896	0.257	0.09060224	0.318	0.01107357	0.133	0.00012444	0.147	0.00195389
PWS-6_8-11	PWS-06	SB	N	0.846	0.04689418	0.292	0.02789847	1.24	1.92315773	1.29	0.14976227	0.19	0.00039747	0.179	0.00463197	1.04	0.51086462	0.638	0.02053483	0.184	0.00012796	0.193	0.00184397
PWS-7_8-10	PWS-07	SB	N	2.06	0.21019546	0.381	0.05353327	0.996	1.66574685	2.01	0.34069547	0.521	0.00239677	0.29	0.01268498	0.915	0.50906856	1.18	0.06327582	0.488	0.00072778	0.551	0.01204194
PWS-7_8-10 DUP	PWS-07	SB	FD	1.76	0.15946994	0.338	0.04160055	1.313	2.39793799	1.55	0.2216169	0.452	0.00182021	0.234	0.00846339	0.877	0.45035121	0.962	0.04418674	0.42	0.00054651	0.424	0.00756764
PWS-8_8-11	PWS-08	SB	N	0.541	0.02459946	0.107	0.00580738	0.385	0.31904073	0.513	0.03755277	0.14	0.00025781	0.0856	0.00148031	0.299	0.07476308	0.355	0.00859529	0.151	9.8781E-05	0.149	0.0012883
PWS-9_8-11	PWS-09	SB	N	0.14	0.00315627	0.0471	0.00171348	0.0595	0.01723835	0.124	0.00429627	0.0471	4.9374E-05	0.0471	0.00062936	0.0471	0.00415325	0.0471	0.00036693	0.0471	1.678E-05	0.0471	0.00022233
PWS-12_8-11	PWS-12	SB	N	0.0402	0.00052373	0.0402	0.00166511	0.00804	0.00079789	0.0402	0.00086466	0.0402	4.8024E-05	0.0402	0.00061172	0.0402	0.00403538	0.0402	0.00035669	0.0402	1.6325E-05	0.0402	0.00021615
PWS-13_8-11	PWS-13	SB	N	1.96	0.16140702	0.674	0.10943513	0.1538	0.07460463	3.79	0.68487973	1.84	0.01264293	1.41	0.1187037	1.66	1.03693001	5.68	0.47445613	1.41	0.00287471	1.74	0.05529091
PWS-13_8-11_1	PWS-13	SB	FD	2.34	0.20749577	0.638	0.10063482	0.413	0.35947142	4.27	0.806307	2.06	0.01480594	1.07	0.07911733	2.19	1.55112238	5.5	0.45455831	1.66	0.00361806	1.42	0.04128235
PWS-13_8-11_2	PWS-13	SB	FT	1.33	0.09227309	0.396	0.04818404	0.1955	0.10969721	2.66	0.41867674	1.51	0.00956362	0.726	0.04428065	1.5	0.89347459	3.59	0.25545191	1.06	0.00191228	0.951	0.02296232
PWS-15_8-11	PWS-15	SB	N	0.0334	0.00089711	0.0334	0.00285368	0.01564	0.00560548	0.0334	0.00148146	0.0334	8.2187E-05	0.0334	0.00104802	0.0334	0.00691751	0.0334	0.00061097	0.0334	2.7927E-05	0.0334	0.00037017
PWS-16_8-11	PWS-16	SB	N	0.209	0.00607876	0.03555	0.00108441	0.1219	0.05604447	0.192	0.00878695	0.03555	3.1381E-05	0.03555	0.0003987	0.0916	0.01241417	0.143	0.00224951	0.0934	5.1354E-05	0.03555	0.00014101
PWS-25_4-8	PWS-25	SB	N	1.21	0.19426398	0.0922	0.01157597	0.2432	0.37969404	0.399	0.06103978	0.197	0.0010954	0.0367	0.00094829	0.17	0.07532563	0.3	0.01603523	0.146	0.00023096	0.118	0.00221632
PWS-26_8-11	PWS-26	SB	N	0.591	0.03868148	0.146	0.01301058	0.49	0.6381172	0.612	0.06782247	0.132	0.00031718	0.0903	0.00217631	0.346	0.12826194	0.356	0.01175043	0.113	8.3707E-05	0.129	0.00137738
PWS-26_8-11_DUP	PWS-26	SB	FD	1.09	0.08265859	0.161	0.01292769	0.545	0.63394496	0.833	0.09109201	0.243	0.00071228	0.123	0.00306075	0.361	0.11546328	0.599	0.02232014	0.183	0.0001534	0.217	0.00269812
PWS-28_8-11	PWS-28	SB	N	0.03015	0.00042936	0.03015	0.00136349	0.01714	0.00367038	0.03015	0.00070848	0.0682	0.00014931	0.03015	0.0005013	0.03015	0.00330258	0.03015	0.00029244	0.0616	4.2989E-05	0.03015	0.00017729
Partition Coefficients (Log K_{OC} | K_{OC})				5.197	157398	4.640	43652	3.736	5445	4.955	90157	6.320	2089296	5.112	129420	4.227	16866	5.367	232809	6.822	6637431	5.603	400867
Partition Coefficients (Log K_{BC} | K_{BC})				6.26	1819701	5.96	912011	5.46	288403	6.13	1348963	6.88	7585776	6.22	1659587	5.73	537032	6.36	2290868	7.16	14454398	6.49	3090295

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 2: Conversion of Sediment Concentrations to Pore Water Concentrations [1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-3 Naphthalenes		C-3 Phenanthrenes/ Anthracenes		C-4 Benz(a)anth/ Chrysenes		C-4 Naphthalenes		C-4 Phenanthrenes/ Anthracenes		Chrysene		Dibenzo(a,h) anthracene		Fluoranthene		Fluorene		Indeno(1,2,3-cd) pyrene	
				Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)
PWS-27_8-11_SE	PWS-27	MC	N	0.04025	0.00275449	0.04025	0.00025976	0.0805	3.8091E-05	0.04025	0.00096815	0.0805	0.0003398	0.084	0.0012709	0.04025	4.9023E-05	0.129	0.00930341	0.0129	0.00149601	0.04025	4.8893E-05
PWS-01_8-9_SE	PWS-01	SB	N	0.133	0.03099933	0.0337	0.00031983	0.0675	4.9932E-05	0.0337	0.0011853	0.0675	0.00043696	0.127	0.00416046	0.00772	5.4359E-06	0.433	0.10640761	0.55	0.99642589	0.0357	6.6795E-05
PWS-03_8-11_SE	PWS-03	SB	N	1.25	0.30376013	1.68	0.03941695	0.3755	0.00023347	0.609	0.03817353	0.3755	0.00216134	9.76	0.55199093	0.443	0.00115589	18.6	4.72256746	1.95	1.99400801	1.92	0.00820761
PWS-04_1-4_SE	PWS-04	SB	N	0.152	0.02396425	0.146	0.00210344	0.071	3.3822E-05	0.0857	0.00339039	0.071	0.0002977	0.626	0.02944601	0.052	7.7517E-05	1.51	0.39984837	0.221	0.14963541	0.221	0.00074162
PWS-04_8-11_SE	PWS-04	SB	N	0.364	0.13479885	0.322	0.01025825	0.0725	5.1949E-05	0.204	0.01952054	0.0725	0.00046026	1.01	0.08200112	0.0684	0.0001794	2.77	1.24860982	0.571	0.92527947	0.302	0.00170851
PWS-05_8-11_SE	PWS-05	SB	N	0.582	0.15116614	0.474	0.01031752	0.079	3.3553E-05	0.271	0.01691407	1.26	0.01694122	2.06	0.11973933	0.123	0.00025193	4.44	1.27211319	0.921	1.03726281	0.506	0.00201468
PWS-06_8-11_SE	PWS-06	SB	N	2.32	0.59167258	1.28	0.02276966	0.328	0.0001463	1.01	0.06149209	4.21	0.05002308	3.72	0.15603158	0.107	9.7643E-05	16.9	4.32000346	4.15	4.74733541	0.406	0.0007691
PWS-07_8-11_SE	PWS-07	SB	N	0.789	0.16072402	0.553	0.0086975	0.0805	2.4323E-05	0.403	0.02112887	0.245	0.00116409	2.38	0.09701945	0.177	0.00030565	5.72	1.15927826	1.43	1.31114058	0.762	0.0024281
PWS-08_8-11_SE	PWS-08	SB	N	0.745	0.13751593	0.405	0.00505772	0.089	2.4018E-05	0.369	0.01655608	0.361	0.00185522	0.802	0.02156267	0.0492	3.5066E-05	3.46	0.64955557	1.17	0.94328373	0.186	0.00028591
PWS-09_8-11_SE	PWS-09	SB	N	0.268	0.03645296	0.146	0.00132541	0.089	3.0389E-05	0.117	0.00351062	0.231	0.00117337	0.409	0.00979346	0.0297	1.9993E-05	1.43	0.22858184	0.327	0.17269789	0.124	0.00019199
PWS-12_8-11_SE	PWS-12	SB	N	0.04895	0.00275545	0.04895	0.00026082	0.098	3.9102E-05	0.04895	0.00097019	0.098	0.00034659	0.33	0.00787656	0.035	2.884E-05	0.576	0.06871564	0.088	0.02439791	0.169	0.0003426
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.04665	0.00281323	0.04665	0.00026596	0.0935	3.967E-05	0.04665	0.00098996	0.0935	0.00035239	0.216	0.00449905	0.0191	1.1965E-05	0.386	0.04094965	0.0664	0.01711272	0.088	0.00013638
PWS-13_1-4_SE	PWS-13	SB	N	0.184	0.02074483	0.0505	0.00026081	0.1005	3.7116E-05	0.0505	0.00097427	0.1005	0.00033337	0.277	0.00539347	0.0275	1.878E-05	0.596	0.0624709	0.142	0.04876408	0.162	0.00028955
PWS-13_8-11_SE	PWS-13	SB	N	0.1	0.00935588	0.133	0.00135854	0.092	3.7851E-05	0.0459	0.00095409	0.092	0.0003372	0.314	0.00767504	0.0301	2.4688E-05	0.433	0.04703694	0.0971	0.03096283	0.126	0.0002323
PWS-15_8-11_SE	PWS-15	SB	N	0.0896	0.0145294	0.03795	0.00035473	0.076	5.0975E-05	0.03795	0.00132506	0.238	0.00249082	0.0248	0.00027697	0.003795	1.6391E-06	0.0976	0.00892178	0.00974	0.00144549	0.00778	5.287E-06
PWS-16B_8-11_SE	PWS-16	SB	N	0.208	0.02419964	0.221	0.00245389	0.0855	2.805E-05	0.118	0.00350417	0.0855	0.00024876	0.554	0.01482937	0.04275	3.5531E-05	1.39	0.21048549	0.311	0.15653848	0.176	0.00032149
PWS-16_8-11_SE	PWS-16	SB	N	0.964	0.27753795	0.377	0.00649522	0.0845	3.3217E-05	0.388	0.02573889	0.232	0.00137782	1.11	0.04661978	0.0422	4.2328E-05	4.9	1.28946849	1.56	1.93913717	0.229	0.00057072
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.03625	0.00168099	0.255	0.00336785	0.0725	2.4007E-05	0.0783	0.00203119	0.0725	0.00021233	0.277	0.00588555	0.0182	9.9345E-06	0.292	0.02416252	0.0607	0.01330307	0.0643	7.4879E-05
PWS-25_8-11_SE	PWS-25	SB	N	0.371	0.0740939	0.291	0.0047213	0.082	3.3079E-05	0.207	0.01056594	0.275	0.00189123	1.25	0.06092888	0.117	0.00021781	2.8	0.71334625	0.643	0.59356061	0.514	0.00200734
PWS-26_8-11_SE	PWS-26	SB	N	0.353	0.06713603	0.168	0.00195702	0.082	3.1482E-05	0.158	0.00662434	0.406	0.00338867	0.502	0.01649945	0.04095	3.8453E-05	1.6	0.35184878	0.756	0.75710589	0.191	0.00044933
PWS-17_4-7	PWS-17	MC	N	0.02765	0.0017796	0.02765	0.0001696	0.0555	2.655E-05	0.02765	0.00062858	0.0555	0.0002324	0.0403	0.00047875	0.002765	7.3266E-07	0.0825	0.00566477	0.0625	0.02308947	0.0172	1.4878E-05
PWS-27_8-11	PWS-27	MC	N	0.03445	0.00142405	0.0965	0.00070942	0.069	2.092E-05	0.03445	0.00050259	0.069	0.00018373	0.0923	0.00101359	0.0103	3.5911E-06	0.186	0.01148856	0.0141	0.00112815	0.0436	3.7606E-05
PWS-30_8-11	PWS-30	MC	N	0.04265	0.00315437	0.04265	0.00029965	0.0855	4.5936E-05	0.04265	0.00111249	0.0855	0.00040456	0.004265	1.0459E-05	0.004265	1.3128E-06	0.004265	3.8632E-05	0.004265	0.00024421	0.004265	1.3123E-06
LSI-01_8-11	LSI-01	SB	N	0.032	0.00096809	0.032	9.3173E-05	0.064	1.5415E-05	0.032	0.00034351	0.064	0.00013218	0.0467	0.00026686	0.0032	3.8595E-07	0.155	0.00727064	0.0386	0.00451834	0.0243	1.1308E-05
LSI-02_8-11	LSI-02	SB	N	0.04025	0.00136043	0.04025	0.0001298	0.0805	2.0338E-05	0.04025	0.00048078	0.0805	0.00017763	0.165	0.0019443	0.0157	5.2894E-06	0.388	0.02809079	0.0711	0.01184437	0.069	5.9233E-05
LSI-20_8-11	LSI-20	SB	N	0.101	0.00652588	0.203	0.00199732	0.0595	1.3526E-05	0.0914	0.00196003	0.0595	0.00011618	0.593	0.01795773	0.0445	3.0805E-05	1.47	0.29588487	0.0933	0.01954493	0.162	0.00026327
LSI-24_8-11	LSI-24	SB	N	0.031	0.00090147	0.131	0.00092289	0.062	1.3948E-05	0.031	0.00031929	0.062	0.00012062	0.211	0.00306465	0.024	1.0839E-05	0.328	0.02326475	0.0287	0.00271423	0.146	0.00020932
PWS-1_8-10	PWS-01	SB	N	0.03125	0.00865941	0.03125	0.00081295	0.0625	0.00011639	0.03125	0.0030372	1.1	0.05927616	0.164	0.01572207	0.00626	1.1698E-05	0.1	0.02852139	0.036	0.03750942	0.0292	0.00013702
PWS-3_8-11	PWS-03	SB	N	0.422	0.03563791	0.684	0.00693329	0.26	7.7333E-05	0.268	0.00611816	0.346	0.00107056	6.36	0.2558667	0.289	0.00034548	5.64	0.8511937	0.629	0.23055262	1.03	0.00233828
PWS-4_8-11	PWS-04	SB	N	0.081	0.01047942	0.159	0.00293861	0.0645	3.5028E-05	0.03215	0.00081803	0.0645	0.00030527	2.03	0.21728278	0.191	0.00074109	1.34	0.4552194	0.156	0.10417888	0.793	0.00652011
PWS-5_8-11	PWS-05	SB	N	0.217	0.0242857	0.144	0.00118853	0.075	2.1101E-05	0.126	0.00356212	0.211	0.00096745	1.24	0.05222869	0.0604	5.538E-05	1.22	0.19358904	0.277	0.12395049	0.233	0.00048252
PWS-6_8-11	PWS-06	SB	N	0.765	0.11046496	0.294	0.00228083	0.0825	1.4929E-05	0.326	0.01002047	1.29	0.01004272	0.693	0.01358377	0.0534	2.728E-05	2.38	0.33853086	0.969	0.55552032	0.184	0.0002034
PWS-7_8-10	PWS-07	SB	N	0.963	0.19106125	0.665	0.01003961	0.167	5.8402E-05	0.536	0.02716539	0.378	0.00185054	2.07	0.08299623	0.186	0.00026075	4.43	0.93449681	1.05	0.7629546	0.619	0.0016648
PWS-7_8-10 DUP	PWS-07	SB	FD	0.67	0.10363231	0.483	0.0058056	0.15	4.6265E-05	0.334	0.01222565	0.282	0.00110356	2.56	0.10745848	0.197	0.00026792	3.29	0.59110117	0.962	0.63072654	0.758	0.00213794
PWS-8_8-11	PWS-08	SB	N	0.21	0.014885	0.182	0.0011198	0.0825	1.5862E-05	0.138	0.00265712	0.616	0.00340904	0.615	0.01189599	0.0554	3.0833E-05	1.12	0.1134109	0.32	0.10116609	0.209	0.00026446
PWS-9_8-11	PWS-09	SB	N	0.0471	0.00146792	0.0471	0.00014001	0.094	2.1821E-05	0.0471	0.00051868	0.094	0.00019069	0.227	0.00270564	0.00471	6.0279E-07	0.203	0.00846284	0.0675	0.00907884	0.0354	1.6725E-05
PWS-12_8-11	PWS-12	SB	N	0.0402	0.00142658	0.0402	0.00013613	0.0805	2.1396E-05	0.0402	0.00050419	0.0805	0.0001868	0.0273	0.00011033	0.00402	5.8483E-07	0.045	0.00092768	0.00402	0.00010844	0.017	6.3299E-06
PWS-13_8-11	PWS-13	SB	N	5.33	1.8314093	4.6	0.13160226	0.557	0.00031061	3.79	0.39143895	4.37	0.05224144	0.885	0.01990849	0.044	2.2044E-05	0.977	0.08776688	0.208	0.05165378	0.0701	4.6748E-05
PWS-13_8-11_1	PWS-13	SB	FD	5.59	1.95278205	5.26	0.15730464	0.547	0.00030238	3.68	0.37597268	2.93	0.03050514	1.12	0.02818925	0.0432	2.1396E-05	1.63	0.18643372	0.334	0.10944174	0.127	0.00012089
PWS-13_8-11_2	PWS-13	SB	FT	4.14	1.29857993	3.7	0.09816643	0.537	0.00029421	2.64	0.23734308	2.18	0.02030233	0.449	0.00713923	0.0392	1.8269E-05	0.662	0.04882344	0.169	0.03705459	0.109	9.4808E-05
PWS-15_8-11	PWS-15	SB	N	0.0334	0.00244462	0.0334	0.0002331	0.067	3.6567E-05	0.0334	0.00086368	0.067	0.00031975	0.0215	0.00017323	0.00334	1.0044E-06	0.0584	0.00328735	0.015	0.0022449	0.00881	4.9906E-06
PWS-16_8-11	PWS-16	SB	N	0.0814	0.00361462	0.0806	0.00033855	0.071	1.4061E-05	0.03555	0.00032872	0.071	0.0001223	0.197	0.00219193	0.0148	4.0136E-06	0.465	0.03198293	0.0989	0.01705865	0.0551	3.467E-05
PWS-25_4-8	PWS-25	SB	N	0.113	0.0137539	0.153	0.00210583	0.0735	3.2996E-05	0.0367	0.00078149	0.299	0.00264421	1.64	0.11824927	0.14	0.00034506	1.56	0.42248504	0.268	0.18858708	0.516	0.00256869
PWS-26_8-11	PWS-26	SB	N	0.251	0.02689144	0.18	0.00148979	0.0745	1.8151E-05	0.13	0.00325539	2.59	0.04146447	0.711	0.02047898	0.0554	4.1521E-05	1.22	0.1785416	0.435	0.22494076	0.221	0.00039309
PWS-26_8-11_DUP	PWS-26	SB	FD	0.253	0.02295741	0.297	0.00279878	0.0755	1.5708E-05	0.153	0.00359162	0.876	0.00663065	1.32	0.04355272	0.0995	9.159E-05	1.77	0.25687768	0.428	0.18387203	0.373	0.00075344
PWS-28_8-11	PWS-28	SB	N	0.03015	0.00116844	0.03015	0.0001117	0.0605	1.781E-05	0.03015	0.00041331	0.0605	0.00015493	0.0658	0.00061184	0.0103	3.6409E-06	0.132	0.00702986	0.00635	0.00030393	0.056	5.8499E-05
Partition Coefficients (Log K_{OC} | K_{OC})				4.719	52360	5.820	660693	7.235	17179084	5.210	162181	6.213	1633052	5.616	413048	6.599	3971915	4.998	99541	4.137	13709	6.608	4055085
Partition Coefficients (Log K_{BC} | K_{BC})				6.00	1000000	6.61	4073803	7.38	23988329	6.27	1862087	6.82	6606934	6.50	3162278	7.04	10964782	6.16	1445440	5.68	478630	7.04	10964782

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 2: Conversion of Sediment Concentrations to Pore Water Concentrations [1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Naphthalene		Perylene		Phenanthrene		Pyrene	
				Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)	Sediment Conc. (mg/kg)	Pore Water Conc. (µg/L)
PWS-27_8-11_SE	PWS-27	MC	N	0.0665	0.1261743	0.0862	0.00055797	0.0652	0.00948056	0.135	0.01415063
PWS-01_8-9_SE	PWS-01	SB	N	0.0692	0.21986863	0.0255	0.00013258	0.489	0.38202785	0.321	0.09503212
PWS-03_8-11_SE	PWS-03	SB	N	5.7	51.5101345	0.83	0.00975266	6.48	4.1874092	14.5	5.07257956
PWS-04_1-4_SE	PWS-04	SB	N	0.693	5.22361258	0.12	0.00100497	0.772	0.45966717	1.19	0.40640152
PWS-04_8-11_SE	PWS-04	SB	N	1.54	23.8436285	0.153	0.00216198	1.87	2.25728556	2.01	1.16394147
PWS-05_8-11_SE	PWS-05	SB	N	2.2	21.8437433	0.345	0.00410672	3.14	2.50557368	3.29	1.23890239
PWS-06_8-11_SE	PWS-06	SB	N	17.3	198.387268	0.244	0.00123038	13.6	10.1866569	10.7	3.48715807
PWS-07_8-11_SE	PWS-07	SB	N	5.35	47.5282415	0.481	0.00457044	4.65	2.77102129	4.63	1.27661668
PWS-08_8-11_SE	PWS-08	SB	N	2.44	16.806496	0.123	0.00052016	4.01	2.41814846	2.52	0.60119263
PWS-09_8-11_SE	PWS-09	SB	N	1.16	6.98425956	0.125	0.00067533	1.27	0.5858214	1.1	0.22490274
PWS-12_8-11_SE	PWS-12	SB	N	0.17	0.41420851	0.168	0.00118259	0.28	0.06926004	0.536	0.0877702
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.172	0.46282373	0.111	0.00067961	0.238	0.05876435	0.337	0.04743497
PWS-13_1-4_SE	PWS-13	SB	N	0.359	1.21055591	0.0946	0.00044928	0.496	0.14504958	0.612	0.09233191
PWS-13_8-11_SE	PWS-13	SB	N	0.255	0.83925357	0.101	0.00057554	0.341	0.09890292	0.37	0.0529723
PWS-15_8-11_SE	PWS-15	SB	N	0.0233	0.0352944	0.086	0.00081756	0.0736	0.01713444	0.0789	0.00910961
PWS-16B_8-11_SE	PWS-16	SB	N	0.999	5.43746871	0.13	0.00070486	0.895	0.3425698	1.09	0.21350232
PWS-16_8-11_SE	PWS-16	SB	N	5.44	64.991503	0.173	0.00131303	5.75	4.86815528	3.48	1.19186005
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.122	0.24133654	0.0428	0.00013555	0.277	0.06655829	0.267	0.02993253
PWS-25_8-11_SE	PWS-25	SB	N	1.45	11.9764492	0.217	0.00195516	2.01	1.38519635	2.36	0.80826869
PWS-26_8-11_SE	PWS-26	SB	N	1.35	11.0360211	0.121	0.00075635	1.98	1.44247166	1.24	0.34485968
PWS-17_4-7	PWS-17	MC	N	0.195	0.85213948	0.0162	4.6263E-05	0.124	0.03212342	0.0568	0.00439031
PWS-27_8-11	PWS-27	MC	N	0.0228	0.01461738	0.0516	0.00016986	0.103	0.01332104	0.186	0.0162773
PWS-30_8-11	PWS-30	MC	N	0.004265	0.00142975	0.004265	4.4879E-06	0.004265	0.00011327	0.004265	5.4584E-05
LSI-01_8-11	LSI-01	SB	N	0.188	0.36971111	0.00931	7.802E-06	0.152	0.02060827	0.103	0.00519531
LSI-02_8-11	LSI-02	SB	N	0.116	0.15507681	0.0355	6.9097E-05	0.25	0.0416222	0.285	0.02451115
LSI-20_8-11	LSI-20	SB	N	0.256	0.61178175	0.0873	0.00032255	0.618	0.20858338	1.12	0.26763632
LSI-24_8-11	LSI-24	SB	N	0.0893	0.10391185	0.082	0.00028046	0.139	0.01695087	0.306	0.02942454
PWS-1_8-10	PWS-01	SB	N	0.0152	0.05547851	0.0156	0.00017548	0.049	0.02814271	0.0862	0.03225871
PWS-3_8-11	PWS-03	SB	N	1.26	4.03738105	0.43	0.0022111	2.47	0.8157602	4.3	0.83782243
PWS-4_8-11	PWS-04	SB	N	0.339	2.143581	0.47	0.01038361	0.711	0.52415996	1.15	0.51537699
PWS-5_8-11	PWS-05	SB	N	0.634	2.75097476	0.124	0.00060926	0.882	0.35248104	0.855	0.16001494
PWS-6_8-11	PWS-06	SB	N	2.05	10.6752506	0.0937	0.00023447	2.77	1.27164203	1.67	0.28183036
PWS-7_8-10	PWS-07	SB	N	1.99	12.1350364	0.411	0.00311106	3.16	1.76382425	3.5	0.95887351
PWS-7_8-10 DUP	PWS-07	SB	FD	2.53	16.451595	0.463	0.00352437	2.42	1.1468292	2.6	0.60076011
PWS-8_8-11	PWS-08	SB	N	0.593	1.61353535	0.0916	0.00024024	0.962	0.2666537	0.775	0.09086692
PWS-9_8-11	PWS-09	SB	N	0.0943	0.09235723	0.0208	2.3972E-05	0.179	0.02042914	0.149	0.00729416
PWS-12_8-11	PWS-12	SB	N	0.0109	0.00332348	0.0113	1.1053E-05	0.0203	0.00073575	0.0421	0.00117593
PWS-13_8-11	PWS-13	SB	N	0.276	0.48236431	0.0965	0.00026919	1.24	0.37501957	1.01	0.13098262
PWS-13_8-11_1	PWS-13	SB	FD	0.766	2.39449619	0.123	0.00039681	1.77	0.63264061	1.6	0.25804069
PWS-13_8-11_2	PWS-13	SB	FT	0.305	0.56553276	0.088	0.00023215	0.965	0.25788296	0.748	0.08339495
PWS-15_8-11	PWS-15	SB	N	0.0329	0.04808528	0.0264	0.00010375	0.0405	0.00532532	0.048	0.00337872
PWS-16_8-11	PWS-16	SB	N	0.187	0.28374765	0.0305	4.5186E-05	0.316	0.051417	0.339	0.0275195
PWS-25_4-8	PWS-25	SB	N	0.473	2.75641208	0.274	0.00341269	0.667	0.35784346	1.11	0.36495241
PWS-26_8-11	PWS-26	SB	N	0.776	3.37394868	0.095	0.00034402	1.09	0.44521345	0.854	0.1451066
PWS-26_8-11_DUP	PWS-26	SB	FD	1	4.19474666	0.175	0.00078279	1.2	0.4254173	1.28	0.22343478
PWS-28_8-11	PWS-28	SB	N	0.0211	0.01302378	0.0287	6.7383E-05	0.0605	0.00582133	0.106	0.00697468
Partition Coefficients (Log K_{OC} | K_{OC})				3.299	1991	6.031	1073989	4.494	31189	4.839	69024
Partition Coefficients (Log K_{BC} | K_{BC})				5.22	165959	6.72	5248075	5.88	758578	6.07	1174898

Notes:

[1]Non-detections included at 1/2 the MDL.

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

K_{OC} = organic carbon partition coefficient

K_{BC} = black carbon partition coefficient

Log = logarithm base 10
MDL = method detection limit
mg/kg = milligrams per kilogram
PAH = polycyclic aromatic hydrocarbon
µg/L = micrograms per liter

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 3: IWTU and ΣIWTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)Anthracene	Benzo(a)Pyrene	Benzo(b)Fluoranthene	Benzo(e)pyrene	Benzo(g,h,i)Perylene	Benzo(k)Fluoranthene	C-1 Benz(a)anth/Chrysenes	C-1 Fluoranthrenes/Pyrenes	C-1 Fluorenes	C-1 Naphthalenes	C-1 Phenanthrenes/Anthracenes	C-2 Benz(a)anth/Chrysenes	C-2 Fluorenes	C-2 Naphthalenes	C-2 Phenanthrenes/Anthracenes	C-3 Benz(a)anth/Chrysenes
Final Chronic Value (µg/L)				55.85	306.9	20.73	2.227	0.9573	0.6774	0.9008	0.4391	0.6415	0.8557	4.887	13.99	81.690	7.436	0.4827	5.305	30.24	3.199	0.1675
PWS-27_8-11_SE	PWS-27	MC	N	2.54E-05	5.498E-06	6.163E-05	0.0004776	0.0007891	0.0012442	0.0004593	0.000177	0.0002287	0.0005692	0.0006689	0.0002302	0.0001025	0.0002239	0.0013697	0.0002219	0.000259	0.0002139	0.0001834
PWS-01_8-9_SE	PWS-01	SB	N	0.0429993	6.231E-05	0.0020117	0.0011955	0.000685	0.002446	0.0007747	0.0002115	0.0003834	0.0002354	0.0026243	0.0017463	0.0047056	0.0037917	0.0002336	0.0002711	0.0137884	0.0012019	0.0002287
PWS-03_8-11_SE	PWS-03	SB	N	0.0333739	0.0076123	0.071987	0.139414	0.0698251	0.1799747	0.0780513	0.0266864	0.0492421	0.0778336	0.2659297	0.0129194	0.0866916	0.1190295	0.0152212	0.0118638	0.0536451	0.0721787	0.010807
PWS-04_1-4_SE	PWS-04	SB	N	0.0024091	0.000368	0.0051002	0.0093798	0.0062109	0.0177209	0.0066149	0.0024362	0.003399	0.0041735	0.014905	0.0010819	0.0074032	0.0091082	0.0010459	0.0007484	0.0035675	0.0049757	0.0012146
PWS-04_8-11_SE	PWS-04	SB	N	0.0216047	0.001073	0.0213888	0.0228894	0.012622	0.0341287	0.0141808	0.0047575	0.0060428	0.0099158	0.0435121	0.0037443	0.0375234	0.0424833	0.0028638	0.004092	0.0307325	0.0199883	0.0025494
PWS-05_8-11_SE	PWS-05	SB	N	0.0244114	0.0015632	0.0265699	0.0397686	0.0211453	0.0494934	0.0208078	0.006994	0.0101029	0.0157916	0.0605465	0.0042071	0.0384871	0.0409084	0.0043216	0.002922	0.0314141	0.0216855	0.002355
PWS-06_8-11_SE	PWS-06	SB	N	0.1171742	0.001691	0.0855086	0.0435004	0.0108033	0.0404922	0.0130406	0.0022304	0.0072505	0.0167581	0.1336676	0.0156271	0.2845237	0.1756724	0.004099	0.0131625	0.1450321	0.0739874	0.0021308
PWS-07_8-11_SE	PWS-07	SB	N	0.0317055	0.0022022	0.0325233	0.0311306	0.020822	0.0506472	0.0220346	0.0080043	0.0107644	0.0205362	0.04808	0.0043151	0.0708192	0.0416668	0.0046453	0.0001423	0.0352012	0.0195245	0.0028594
PWS-08_8-11_SE	PWS-08	SB	N	0.0215256	0.0003084	0.0135941	0.0089815	0.0031381	0.0086755	0.0029469	0.0008772	0.0014204	0.0037379	0.0196642	0.0028655	0.0377616	0.0320687	0.0011505	0.0027847	0.0285472	0.0121342	0.0009573
PWS-09_8-11_SE	PWS-09	SB	N	0.0047238	0.0001462	0.0036621	0.0040691	0.0021499	0.0046663	0.0017404	0.0005778	0.0008294	0.0015287	0.0082354	0.0018835	0.0065959	0.0110359	0.0004668	0.0007099	0.0055112	0.0033533	0.0001435
PWS-12_8-11_SE	PWS-12	SB	N	0.0005457	8.945E-05	0.0008498	0.0022826	0.0022407	0.004993	0.0020111	0.001067	0.0010274	0.0011452	0.003069	0.0002301	0.0006485	0.0015305	0.0006816	0.0002222	0.0002587	0.001013	0.0001849
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0002242	5.985E-05	0.0006088	0.0012497	0.0010851	0.0025394	0.0009523	0.0004192	0.0003989	0.0007041	0.0020274	0.000235	0.0005064	0.0012212	0.0001932	0.0002268	0.0002642	0.0006927	0.0001883
PWS-13_1-4_SE	PWS-13	SB	N	0.0006885	0.0001294	0.0031334	0.0015684	0.0024644	0.003308	0.0014517	0.0010912	0.0005978	0.0008251	0.002244	0.0002322	0.0024401	0.0027658	0.0001886	0.0002234	0.0022593	0.0013097	0.0001832
PWS-13_8-11_SE	PWS-13	SB	N	0.0005275	8.12E-05	0.0008799	0.0025408	0.002494	0.0062956	0.0020647	0.0008429	0.0011887	0.0021788	0.003383	0.0002267	0.0016005	0.0020032	0.0005721	0.0002186	0.0011928	0.0010355	0.0007063
PWS-15_8-11_SE	PWS-15	SB	N	3.384E-05	7.686E-06	5.307E-05	8.254E-05	9.449E-05	0.000147	7.006E-05	5.916E-06	6.179E-05	0.0002602	0.0002814	0.0003158	0.0001059	0.0003068	0.0002565	0.0003039	0.0003559	0.0002926	0.0002492
PWS-16B_8-11_SE	PWS-16	SB	N	0.0035466	0.0002964	0.0042132	0.0052801	0.0021355	0.0066139	0.0025504	0.0008963	0.0011624	0.0022655	0.0088683	0.0007181	0.0105877	0.0065239	0.0005296	0.0006398	0.0045964	0.0033863	0.0006111
PWS-16_8-11_SE	PWS-16	SB	N	0.0405671	0.0017066	0.045541	0.0182567	0.0056415	0.018417	0.007302	0.0016953	0.0029885	0.0098916	0.0395183	0.0075906	0.1447776	0.0631963	0.0021285	0.0053794	0.0654068	0.0222366	0.0024248
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0007645	5.24E-05	0.0004609	0.0020953	0.0007901	0.0020726	0.0006585	0.0001915	0.000292	0.001628	0.0042137	0.0001404	0.0002523	0.0015013	0.0008655	0.0001356	0.0001577	0.0022237	0.0003568
PWS-25_8-11_SE	PWS-25	SB	N	0.0120686	0.0009733	0.0100056	0.0160358	0.0145884	0.0367357	0.0144101	0.0054624	0.0079737	0.0095256	0.0318739	0.0019172	0.0266581	0.0240077	0.0029654	0.0022488	0.0118563	0.0113621	0.0023006
PWS-26_8-11_SE	PWS-26	SB	N	0.0131286	0.0002583	0.0089462	0.0048195	0.0032579	0.0080596	0.002867	0.0015226	0.0014561	0.002195	0.0106931	0.001657	0.0298581	0.0173272	0.0010266	0.0011533	0.0128687	0.0049041	0.0007474
PWS-17_4-7	PWS-17	MC	N	0.0024683	2.364E-05	0.0001152	0.0001203	7.274E-05	0.0002958	0.0001277	6.326E-05	3.877E-05	0.0001248	0.0001336	0.0001485	0.0020521	0.000145	0.0001238	0.0001438	0.0005845	0.000139	0.0001212
PWS-27_8-11	PWS-27	MC	N	1.797E-05	1.429E-05	7.634E-05	0.0002871	0.0002651	0.0005063	0.0002275	0.0001647	9.505E-05	0.0003102	0.0005518	0.0001189	2.875E-05	0.0008546	0.0003123	0.000115	0.0001334	0.0008045	0.0005242
PWS-30_8-11	PWS-30	MC	N	6.423E-06	6.096E-06	5.901E-06	5.267E-06	4.874E-06	5.062E-06	4.982E-06	4.738E-06	4.952E-06	0.0002203	0.0002364	0.0002633	2.195E-05	0.0002569	0.0002183	0.0002546	0.0002957	0.0002459	0.0002134
LSI-01_8-11	LSI-01	SB	N	9.611E-05	6.031E-06	0.000156	9.703E-05	5.823E-05	0.0001436	6.124E-05	4.082E-05	1.907E-05	6.87E-05	7.304E-05	8.068E-05	0.0003989	7.905E-05	6.849E-05	7.845E-05	9.022E-05	7.602E-05	6.74E-05
LSI-02_8-11	LSI-02	SB	N	0.000245	3.155E-05	0.0007701	0.0005254	0.0003689	0.0013586	0.0005223	0.0001902	0.0002295	0.000312	0.0007455	0.0001135	0.0002358	0.0008017	9.485E-05	0.00011	0.0001273	0.0003592	9.291E-05
LSI-20_8-11	LSI-20	SB	N	0.000858	0.000106	0.0015398	0.0054419	0.0029874	0.0100679	0.0030697	0.0007819	0.0016001	0.0032415	0.009421	0.0002825	0.0007455	0.0056855	0.0007823	0.0003396	0.0004453	0.0029633	0.0006795
LSI-24_8-11	LSI-24	SB	N	0.0006964	9.198E-05	0.0001048	0.001034	0.00168	0.0022284	0.000955	0.0009964	0.0004422	0.0005886	0.0014249	7.516E-05	0.0001612	0.0007022	0.000222	7.297E-05	8.415E-05	0.0008331	6.223E-05
PWS-1_8-10	PWS-01	SB	N	0.0030651	1.765E-05	0.0003245	0.0027003	0.0011424	0.0023213	0.0009408	0.0004442	0.0005066	0.0005963	0.0047009	0.0007241	6.299E-05	0.0007033	0.0005877	0.0006966	0.0008159	0.0006708	0.000571
PWS-3_8-11	PWS-03	SB	N	0.0037708	0.001743	0.0140283	0.038221	0.0231788	0.0699638	0.024657	0.0052115	0.0150647	0.0178773	0.063066	0.0013576	0.0077017	0.0290947	0.0041209	0.0010792	0.0046997	0.0150634	0.0033788
PWS-4_8-11	PWS-04	SB	N	0.0013826	0.0008647	0.0370885	0.0259732	0.0613263	0.097277	0.0502328	0.0168166	0.0150209	0.0151326	0.0394955	0.000193	0.0023493	0.0169032	0.0051569	0.0001871	0.001245	0.0064757	0.0039348
PWS-5_8-11	PWS-05	SB	N	0.0033912	0.0002337	0.0029314	0.0068293	0.0052144	0.0141854	0.0044667	0.001427	0.0026565	0.0030319	0.0086209	0.0005517	0.0042422	0.0064069	0.0009129	0.0004296	0.0029961	0.0034616	0.0007429
PWS-6_8-11	PWS-06	SB	N	0.0149234	0.0001863	0.011307	0.0055266	0.0023416	0.0070527	0.002276	0.0005816	0.0013962	0.002232	0.0095957	0.0019942	0.0235421	0.0201402	0.0008234	0.0008731	0.0168937	0.0064191	0.000764
PWS-7_8-10	PWS-07	SB	N	0.0154543	0.0011602	0.073196	0.033368	0.0234267	0.0549626	0.0190498	0.003725	0.0107497	0.013729	0.0430111	0.0038265	0.0203911	0.045817	0.0049653	0.0023911	0.0168343	0.0197799	0.004345
PWS-7_8-10 DUP	PWS-07	SB	FD	0.0140895	0.0011752	0.0155629	0.0219254	0.0252118	0.0530141	0.0213239	0.0052912	0.0094151	0.0115739	0.0326315	0.0029736	0.0293541	0.0298032	0.0037709	0.0015954	0.0148926	0.0138127	0.0032627
PWS-8_8-11	PWS-08	SB	N	0.001923	0.0001319	0.0027357	0.0032058	0.0024246	0.0076149	0.0024395	0.0007533	0.0015506	0.0018227	0.0050337	0.0004151	0.0039055	0.0050501	0.0005341	0.000279	0.0024723	0.0026869	0.0005897
PWS-9_8-11	PWS-09	SB	N	0.0001434	2.789E-06	0.0002265	0.000274	0.0001273	0.0003117	0.0001026	5.362E-05	6.895E-05	0.000103	0.0006459	0.0001225	0.000211	0.0005778	0.0001023	0.0001186	0.0001373	0.0001147	0.0001002
PWS-12_8-11	PWS-12	SB	N	2.851E-06	2.705E-06	2.621E-06	3.274E-05	2.659E-05	6.315E-05	2.717E-05	2.177E-05	1.08E-05	0.0001002	0.0001072	0.000119	9.767E-06	0.0001163	9.949E-05	0.0001153	0.0001334	0.0001115	9.746E-05
PWS-13_8-11	PWS-13	SB	N	0.0017971	5.478E-05	0.0013098	0.0041673	0.0015808	0.0015478	0.0012742	0.0002331	0.0003503	0.0202506	0.0330278	0.0078224	0.0009133	0.0921032	0.0261921	0.0223758	0.03429	0.1483139	0.0171624
PWS-13_8-11_1	PWS-13	SB	FD	0.00308	0.0001451	0.0024215	0.0055507	0.0019732	0.0031385	0.0019037	0.0006309	0.0005255	0.0256354	0.0424587	0.0071933	0.0044004	0.1084329	0.0306732	0.0149137	0.0512937	0.1420939	0.0216003
PWS-13_8-11_2	PWS-13	SB	FT	0.001152	6.879E-05	0.0008089	0.0018206	0.0013916	0.0018307	0.0013662	0.0004822	0.0002683	0.0150368	0.0188813	0.0034442	0.0013428	0.056304	0.0198128	0.008347	0.0295461	0.0798537	0.0114166
PWS-15_8-11	PWS-15	SB	N	0.0001248	4.65E-06	2.82E-05	8.653E-05	2.757E-05	7.853E-05	2.613E-05	1.772E-05	1.548E-05	0.0001715	0.0001836	0.000204	6.862E-05	0.0001992	0.0001703	0.0001976	0.0002288	0.000191	0.0001667
PWS-16_8-11	PWS-16	SB	N	0.000329	2.49E-05	0.0004606	0.0006813	0.0002418	0.0009153	0.0003413	0.0001155	0.0001321	0.000359	0.0012439	7.751E-05	0.0006861	0.0011817	6.501E-05	7.516E-05	0.0004105	0.0007032	0.0003066
PWS-25_4-8	PWS-25	SB	N	0.0022142	0.0002918	0.0074242	0.0437135	0.0317596	0.0591938	0.0204851	0.0073148	0.0128286	0.0120725	0.0397512	0.0008274	0.004648	0.0082087	0.0022693	0.0001788	0.0024909	0.0050126	0.0013789
PWS-26_8-11	PWS-26	SB	N	0.0036568	0.0001793	0.0054354	0.0040098	0.0037943	0.0102571	0.0032414	0.0012701	0.002122	0.002119	0.0079152	0.00093	0.0078114	0.0091208	0.0006571	0.0004102	0.0042415	0.0036732	0.0004997
PWS-26_8-11_DUP	PWS-26	SB	FD	0.0031444	0.0002458	0.0057684	0.0119072	0.0088922	0.0208585	0.0065808	0.0021875	0.00408	0.0053825	0.016914	0.0009241	0.0077604	0.0122501	0.0014756	0.000577	0.0038182	0.0069772	0.0009158
PWS-28_8-11	PWS-28	SB	N	2.318E-06	3.697E-05	1.718E-05	0.0001468	0.0004326	0.000471	0.0003081	0.0002967	8.436E-05	0.0003216	8.786E-05	9.746E-05	4.493E-05	9.528E-05	0.0003093	9.45E-05	0.0001092	9.142E-05	0.0002566

ATTACHMENT G-B: IWTU Calculation for Sediment Data Based on 2-Carbon Partitioning Model (2012 sediment data)

Table 3: IWTU and ΣIWTU Calculations[1]

Sample ID	Location	Exposure Area[2]	Sample Type[3]	C-3 Fluorenes	C-3 Naphthalenes	C-3 Phenanthrenes/Anthracenes	C-4 Benz(a)anth/Chrysenes	C-4 Naphthalenes	C-4 Phenanthrenes/Anthracenes	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Perylene	Phenanthrene	Pyrene	ΣIWTU
Final Chronic Value (µg/L)				1.916	11.1	1.256	0.07062	4.048	0.5594	2.042	0.2825	7.109	39.3	0.275	193.6	0.9008	19.13	10.11	--
PWS-27_8-11_SE	PWS-27	MC	N	0.0002158	0.0002482	0.0002068	0.0005394	0.0002392	0.0006074	0.0006224	0.0001735	0.0013087	3.807E-05	0.0001778	0.0006519	0.0006194	0.0004956	0.0013997	0.015
PWS-01_8-9_SE	PWS-01	SB	N	0.0002651	0.0027927	0.0002546	0.000707	0.0002928	0.0007811	0.0020374	1.924E-05	0.014968	0.0253543	0.0002429	0.001136	0.0001472	0.0199701	0.0093998	0.16
PWS-03_8-11_SE	PWS-03	SB	N	0.0047131	0.0273658	0.0313829	0.003306	0.0094302	0.0038637	0.2703188	0.0040916	0.6643083	0.0507381	0.0298458	0.2661335	0.0108267	0.2188923	0.5017388	**3.5**
PWS-04_1-4_SE	PWS-04	SB	N	0.0001825	0.0021589	0.0016747	0.0004789	0.0008375	0.0005322	0.0144202	0.0002744	0.0562454	0.0038075	0.0026968	0.0269884	0.0011156	0.0240286	0.040198	0.28
PWS-04_8-11_SE	PWS-04	SB	N	0.0037862	0.012144	0.0081674	0.0007356	0.0048223	0.0008228	0.0401573	0.0006351	0.1756379	0.023544	0.0062128	0.1231911	0.0024001	0.1179972	0.1151277	0.97
PWS-05_8-11_SE	PWS-05	SB	N	0.0012538	0.0136186	0.0080713	0.0004751	0.0041784	0.0302846	0.0586383	0.0008918	0.178944	0.0263935	0.0073261	0.1128584	0.004559	0.1309761	0.1225423	**1.1**
PWS-06_8-11_SE	PWS-06	SB	N	0.0037715	0.0533038	0.0181287	0.0020716	0.0151907	0.0894227	0.0764112	0.0003456	0.6076809	0.1207973	0.0027967	1.0249923	0.0013659	0.5324964	0.3449217	**4.1**
PWS-07_8-11_SE	PWS-07	SB	N	0.0045469	0.0144796	0.0069248	0.0003444	0.0052196	0.002081	0.047512	0.0010819	0.1630719	0.0333624	0.0088294	0.2455605	0.0050738	0.1448521	0.1262727	**1.3**
PWS-08_8-11_SE	PWS-08	SB	N	0.000929	0.0123888	0.0040268	0.0003401	0.0040899	0.0033164	0.0105596	0.0001241	0.0913709	0.0240021	0.0010397	0.0868328	0.0005774	0.1264061	0.0594651	0.63
PWS-09_8-11_SE	PWS-09	SB	N	0.0001678	0.0032841	0.0010553	0.0004303	0.0008672	0.0020976	0.004796	7.077E-05	0.0321539	0.0043943	0.0006981	0.036085	0.0007497	0.0306232	0.0222456	0.20
PWS-12_8-11_SE	PWS-12	SB	N	0.0002165	0.0002482	0.0002077	0.0005537	0.0002397	0.0006196	0.0038573	0.0001021	0.009666	0.0006208	0.0012458	0.0021401	0.0013128	0.0036205	0.0086815	0.057
PWS-12_8-11 DUP_SE	PWS-12	SB	FD	0.0002208	0.0002534	0.0002118	0.0005617	0.0002446	0.0006299	0.0022033	4.235E-05	0.0057603	0.0004354	0.0004959	0.0023912	0.0007544	0.0030718	0.0046919	0.036
PWS-13_1-4_SE	PWS-13	SB	N	0.0002169	0.0018689	0.0002077	0.0005256	0.0002407	0.0005959	0.0026413	6.648E-05	0.0087876	0.0012408	0.0010529	0.0062545	0.0004988	0.0075823	0.0091327	0.068
PWS-13_8-11_SE	PWS-13	SB	N	0.0002127	0.0008429	0.0010816	0.000536	0.0002357	0.0006028	0.0037586	8.739E-05	0.0066165	0.0007879	0.0008447	0.0043361	0.0006389	0.00517	0.0052396	0.061
PWS-15_8-11_SE	PWS-15	SB	N	0.000295	0.001309	0.0002824	0.0007218	0.0003273	0.0044527	0.0001356	5.802E-06	0.001255	3.678E-05	1.923E-05	0.0001824	0.0009076	0.0008957	0.000901	0.015
PWS-16B_8-11_SE	PWS-16	SB	N	0.0001559	0.0021801	0.0019537	0.0003972	0.0008657	0.0004447	0.0072622	0.0001258	0.0296083	0.0039832	0.001169	0.0280934	0.0007825	0.0179075	0.0211179	0.18
PWS-16_8-11_SE	PWS-16	SB	N	0.0016499	0.0250034	0.0051714	0.0004704	0.0063584	0.002463	0.0228305	0.0001498	0.1813854	0.0493419	0.0020753	0.3357866	0.0014576	0.2544775	0.1178892	**1.5**
PWS-22_8-11 SEDIMENT	PWS-22	SB	N	0.0001322	0.0001514	0.0026814	0.00034	0.0005018	0.0003796	0.0028822	3.517E-05	0.0033989	0.0003385	0.0002723	0.0012469	0.0001505	0.0034793	0.0029607	0.038
PWS-25_8-11_SE	PWS-25	SB	N	0.0008511	0.0066751	0.003759	0.0004684	0.0026102	0.0033808	0.0298378	0.000771	0.1003441	0.0151033	0.0072994	0.0618778	0.0021705	0.0724096	0.0799474	0.63
PWS-26_8-11_SE	PWS-26	SB	N	0.0001674	0.0060483	0.0015581	0.0004458	0.0016364	0.0060577	0.00808	0.0001361	0.0494934	0.0192648	0.0016339	0.057019	0.0008396	0.0754036	0.0341107	0.39
PWS-17_4-7	PWS-17	MC	N	0.0001406	0.0001603	0.000135	0.000376	0.0001553	0.0004154	0.0002345	2.593E-06	0.0007968	0.0005875	5.41E-05	0.0044027	5.136E-05	0.0016792	0.0004343	0.017
PWS-27_8-11	PWS-27	MC	N	0.0001123	0.0001283	0.0005648	0.0002962	0.0001242	0.0003284	0.0004964	1.271E-05	0.0016161	2.871E-05	0.0001368	7.552E-05	0.0001886	0.0006963	0.00161	0.012
PWS-30_8-11	PWS-30	MC	N	0.0002486	0.0002842	0.0002386	0.0006505	0.0002748	0.0007232	5.122E-06	4.647E-06	5.434E-06	6.214E-06	4.772E-06	7.387E-06	4.982E-06	5.921E-06	5.399E-06	0.0047
LSI-01_8-11	LSI-01	SB	N	7.707E-05	8.722E-05	7.418E-05	0.0002183	8.486E-05	0.0002363	0.0001307	1.366E-06	0.0010227	0.000115	4.112E-05	0.0019102	8.661E-06	0.0010773	0.0005139	0.0074
LSI-02_8-11	LSI-02	SB	N	0.0001076	0.0001226	0.0001033	0.000288	0.0001188	0.0003175	0.0009522	1.872E-05	0.0039514	0.0003014	0.0002154	0.0008012	7.671E-05	0.0021758	0.0024244	0.019
LSI-20_8-11	LSI-20	SB	N	0.0007591	0.0005879	0.0015902	0.0001915	0.0004842	0.0002077	0.0087942	0.000109	0.0416212	0.0004973	0.0009573	0.0031608	0.0003581	0.0109035	0.0264724	0.15
LSI-24_8-11	LSI-24	SB	N	7.155E-05	8.121E-05	0.0007348	0.0001975	7.888E-05	0.0002156	0.0015008	3.837E-05	0.0032726	6.906E-05	0.0007612	0.0005369	0.0003113	0.0008861	0.0029104	0.024
PWS-1_8-10	PWS-01	SB	N	0.000676	0.0007801	0.0006473	0.0016481	0.0007503	0.1059638	0.0076994	4.141E-05	0.004012	0.0009544	0.0004983	0.0002866	0.0001948	0.0014711	0.0031908	0.15
PWS-3_8-11	PWS-03	SB	N	0.0049612	0.0032106	0.0055201	0.0010951	0.0015114	0.0019138	0.125302	0.0012229	0.1197347	0.0058665	0.0085028	0.0208596	0.0024546	0.042643	0.0828707	0.77
PWS-4_8-11	PWS-04	SB	N	0.0017691	0.0009441	0.0023397	0.000496	0.0002021	0.0005457	0.1064068	0.0026233	0.0640342	0.0026509	0.0237095	0.0110751	0.0115271	0.0273999	0.050977	0.70
PWS-5_8-11	PWS-05	SB	N	0.0010198	0.0021879	0.0009463	0.0002988	0.00088	0.0017294	0.0255772	0.000196	0.0272315	0.003154	0.0017546	0.0142133	0.0006764	0.0184256	0.0158274	0.19
PWS-6_8-11	PWS-06	SB	N	0.0009624	0.0099518	0.0018159	0.0002114	0.0024754	0.0179527	0.0066522	9.657E-05	0.04762	0.0141354	0.0007396	0.055155	0.0002603	0.0664737	0.0278764	0.38
PWS-7_8-10	PWS-07	SB	N	0.0062849	0.0172127	0.0079933	0.000827	0.0067108	0.0033081	0.0406446	0.000923	0.1314526	0.0194136	0.0060538	0.0626972	0.0034537	0.092202	0.0948441	0.90
PWS-7_8-10 DUP	PWS-07	SB	FD	0.0039497	0.0093362	0.0046223	0.0006551	0.0030202	0.0019728	0.0526241	0.0009484	0.0831483	0.016049	0.0077743	0.0849992	0.0039125	0.0599493	0.0594224	0.70
PWS-8_8-11	PWS-08	SB	N	0.0006724	0.001341	0.0008916	0.0002246	0.0006564	0.0060941	0.0058257	0.0001091	0.0159531	0.0025742	0.0009617	0.0083365	0.0002667	0.013939	0.0089878	0.11
PWS-9_8-11	PWS-09	SB	N	0.000116	0.0001322	0.0001115	0.000309	0.0001281	0.0003409	0.001325	2.134E-06	0.0011904	0.000231	6.082E-05	0.0004772	2.661E-05	0.0010679	0.0007215	0.010
PWS-12_8-11	PWS-12	SB	N	0.0001128	0.0001285	0.0001084	0.000303	0.0001246	0.0003339	5.403E-05	2.07E-06	0.0001305	2.759E-06	2.302E-05	1.717E-05	1.227E-05	3.846E-05	0.0001163	0.00
PWS-13_8-11	PWS-13	SB	N	0.0288575	0.1649918	0.1047789	0.0043983	0.0966993	0.0933883	0.0097495	7.803E-05	0.0123459	0.0013143	0.00017	0.0024922	0.0002988	0.0196037	0.0129557	0.97
PWS-13_8-11_1	PWS-13	SB	FD	0.0215461	0.1759263	0.1252425	0.0042818	0.0928786	0.0545319	0.0138047	7.574E-05	0.026225	0.0027848	0.0004396	0.0123715	0.0004405	0.0330706	0.0255233	**1.1**
PWS-13_8-11_2	PWS-13	SB	FT	0.0119845	0.1169892	0.078158	0.0041662	0.0586322	0.036293	0.0034962	6.467E-05	0.0068678	0.0009429	0.0003448	0.0029219	0.0002577	0.0134806	0.0082488	0.60
PWS-15_8-11	PWS-15	SB	N	0.0001932	0.0002202	0.0001856	0.0005178	0.0002134	0.0005716	8.483E-05	3.555E-06	0.0004624	5.712E-05	1.815E-05	0.0002484	0.0001152	0.0002784	0.0003342	0.0057
PWS-16_8-11	PWS-16	SB	N	7.36E-05	0.0003256	0.0002695	0.0001991	8.121E-05	0.0002186	0.0010734	1.421E-05	0.0044989	0.0004341	0.0001261	0.001466	5.016E-05	0.0026878	0.002722	0.023
PWS-25_4-8	PWS-25	SB	N	0.0011567	0.0012391	0.0016766	0.0004672	0.0001931	0.0047269	0.0579086	0.0012214	0.0594296	0.0047987	0.0093407	0.0142413	0.0037885	0.0187059	0.0360982	0.48
PWS-26_8-11	PWS-26	SB	N	0.0007189	0.0024227	0.0011861	0.000257	0.0008042	0.0741231	0.0100289	0.000147	0.0251149	0.0057237	0.0014294	0.0174319	0.0003819	0.0232731	0.0143528	0.25
PWS-26_8-11_DUP	PWS-26	SB	FD	0.0014082	0.0020682	0.0022283	0.0002224	0.0008873	0.0118532	0.0213285	0.0003242	0.0361342	0.0046787	0.0027398	0.0216727	0.000869	0.0222382	0.0221004	0.27
PWS-28_8-11	PWS-28	SB	N	9.253E-05	0.0001053	8.894E-05	0.0002522	0.0001021	0.000277	0.0002996	1.289E-05	0.0009889	7.734E-06	0.0002127	6.729E-05	7.48E-05	0.0003043	0.0006899	0.0069

Notes:

[1]All values in toxic units (TUs) based on narcotic effects in benthic invertebrates. **BOLD** indicates value greater than 1.

[2]Exposure Areas: MC = Milton Creek; SB = Scappoose Bay

[3]Sample Type: N = normal; FD = field duplicate; FT = field triplicate

IWTU = interstitial water toxic units

ΣIWTU = sum of interstitial water toxic units

µg/L = micrograms per liter

ATTACHMENT C

Interstitial Water Toxic Unit (IWTU) Calculation for 2012 and 2017 Porewater Data (Direct Measurement)

ATTACHMENT G-C: IWTU Calculation for Pore Water Data (direct measurement)

Table 1: Analytical Data[1]

Sample ID	Location	Exposure Area[2]	NAPL or non-NAPL Area	Sample Date	Sample Type[3]	Start Depth (inches)	End Depth (inches)	No. of Detected Analytes	Total PAHs	Naphthalene	C1-Naphthalenes[4]	C2-Naphthalenes	C3-Naphthalenes	C4-Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C1-Fluorenes	C2-Fluorenes	C3-Fluorenes	Phenanthrene	Anthracene	C1-Phenanthrenes/Anth	C2-Phenanthrenes/Anth	C3-Phenanthrenes/Anth	C4-Phenanthrenes/Anth	Fluoranthene	Pyrene	C1-Fluoranthenes/Pyre	Benzo(a)anthracene	Chrysene	C1-Benz(a)anth/Chryser	C2-Benz(a)anth/Chryser	C3-Benz(a)anth/Chryser	C4-Benz(a)anth/Chryser	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	1-Methylnaphthalene	2-Methylnaphthalene
PWS-27_8-11_PW	PWS-27	MC	non-NAPL	7/13/2012	N	8	11	8	2.41	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.15 U	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-01_8-9_PW	PWS-01	SB	non-NAPL	7/10/2012	N	8	9	8	17.7	1.12 U	1.50	1.63	0.479 J	0.0046 U	0.902	9.31	2.05	0.466	0.339 U	0.0603 U	0.15 U	0.0447	2.63	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	1.36	0.27 U
PWS-03_8-11_PW	PWS-03	SB	non-NAPL	7/12/2012	N	8	11	10	5.46	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.14	0.916	0.71	0.274 U	0.339 U	0.0603 U	0.401	0.097 J	0.387	0.165 J	0.0051 U	0.0173 U	0.468	0.252	0.114 U	0.0107 UJ	0.0215 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-04_8-11_PW	PWS-04	SB	non-NAPL	7/10/2012	N	8	11	3	2.80	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.281	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.145	0.0955	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-05_8-11_PW	PWS-05	SB	non-NAPL	7/12/2012	N	8	11	7	3.91	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.853	0.254	0.493	0.339 U	0.0603 U	0.183	0.021 J	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0938	0.0551	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-06_8-11_PW	PWS-06	SB	non-NAPL	7/12/2012	N	8	11	3	3.36	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.902	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.113	0.0608	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-07_8-11_PW	PWS-07	SB	non-NAPL	7/10/2012	N	8	11	10	4.89	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.121	0.993	0.365	0.304	0.339 U	0.0603 U	0.342	0.0589	0.367	0.205 J	0.0051 U	0.0173 U	0.226	0.137	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-08_8-11_PW	PWS-08	SB	non-NAPL	7/12/2012	N	8	11	10	4.42	1.12 U	0.59 U	0.778 U	0.233 J	0.0046 U	0.12 U	0.718	0.215	0.309	0.339 U	0.0603 U	0.226	0.0168	0.35	0.21 J	0.0051 U	0.0173 U	0.193	0.118	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-09_8-11_PW	PWS-09	SB	non-NAPL	7/12/2012	N	8	11	1	2.52	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.185	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-12_8-11 DUP_PW	PWS-12	SB	non-NAPL	7/12/2012	FD	8	11	1	2.51	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.175	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-12_8-11_PW	PWS-12	SB	non-NAPL	7/12/2012	N	8	11	1	2.43	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.0973 J	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-13_1-4_PW	PWS-13	SB	non-NAPL	7/11/2012	N	1	4	0	2.41	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.15 U	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-13_8-11_PW	PWS-13	SB	non-NAPL	7/11/2012	N	8	11	0	2.41	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.15 U	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-15_8-11 PW	PWS-15	SB	non-NAPL	7/12/2012	N	8	11	0	2.41	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.15 U	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-16_8-11_PW	PWS-16	SB	non-NAPL	7/9/2012	N	8	11	1	2.65	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.262	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.0581 U	0.0493 U	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-16B_8-11_PW	PWS-16	SB	non-NAPL	7/13/2012	N	8	11	2	2.62	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.233	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0579 J	0.0051 U	0.0173 U	0.0581 U	0.0493 UJ	0.114 U	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-25_8-11_PW	PWS-25	SB	non-NAPL	7/13/2012	N	8	11	7	3.89	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.647	0.2 U	0.274 U	0.339 U	0.0603 U	0.178	0.0161 U	0.299	0.315 J	0.0051 U	0.0173 U	0.209	0.163 J	0.114 U	0.0107 UJ	0.0092 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-26_8-11_PW	PWS-26	SB	non-NAPL	7/13/2012	N	8	11	4	2.77	1.12 U	0.59 U	0.778 U	0.00329 U	0.0046 U	0.12 U	0.23	0.2 U	0.274 U	0.339 U	0.0603 U	0.15 U	0.0161 U	0.263 U	0.0037 U	0.0051 U	0.0173 U	0.151	0.101 J	0.114 U	0.0107 UJ	0.00636 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U	0.32 U	0.27 U
PWS-17_4-7 POREWATER	PWS-17	MC	non-NAPL	10/10/2012	N	4	7	8	7.18	1.12 U	1.13	0.778 U	0.37 J	0.0046 U	0.23	2.72	0.46	3.27 J	0.339 UJ	0.0603 UJ	0.28	0.0301	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.99	0.27 U
PWS-27_8-11 POREWATER	PWS-27	MC	non-NAPL	10/9/2012	N	8	11	2	2.47	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.15 U	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 U	0.0834	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.00616 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
PWS-30_8-11 POREWATER	PWS-30	MC	non-NAPL	10/12/2012	N	8	11	0	2.39	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.15 U	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 U	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
LSI-01_8-11 POREWATER	LSI-01	SB	non-NAPL	10/16/2012	N	8	11	1	2.56	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.18	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 U	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.32 U	0.27 U
LSI-02_8-11 POREWATER	LSI-02	SB	non-NAPL	10/9/2012	N	8	11	5	3.63	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.76	0.26	0.274 UJ	0.339 UJ	0.0603 UJ	0.17	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.165 J	0.114 J	0.114 UJ	0.0107 UJ	0.00893 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.32 U	0.27 U
LSI-20_8-11 POREWATER	LSI-20	SB	non-NAPL	10/10/2012	N	8	11	5	4.31	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	1.49	0.2 U	0.38 J	0.339 UJ	0.0603 UJ	0.15 U	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.133 J	0.113 J	0.114 UJ	0.0107 UJ	0.0084 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.32 U	0.27 U
LSI-24-8-11 POREWATER	LSI-24	SB	non-NAPL	10/12/2012	N	8	11	6	4.42	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.18	1.66	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.16	0.022	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.117 J	0.0947 J	0.114 UJ	0.0107 UJ	0.00855 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.053 UJ	0.32 U	0.27 U
PWS-1_8-10 POREWATER	PWS-01	SB	non-NAPL	10/10/2012	N	8	10	8	10.1	1.12 UJ	0.59 UJ	1.35 J	0.00329 UJ	0.0046 UJ	0.35 J	4.89 J	1.16 J	0.36 J	0.339 UJ	0.0603 UJ	0.32 J	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0969 J	0.0511 J	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-3_8-11 POREWATER	PWS-03	SB	non-NAPL	10/10/2012	N	8	11	9	4.19	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.64 J	0.52 J	0.292 J	0.339 UJ	0.0603 UJ	0.2 J	0.0428	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.328 J	0.198 J	0.114 UJ	0.0122 J	0.0206 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-4_8-11 POREWATER	PWS-04	SB	non-NAPL	10/10/2012	N	8	11	5	3.13	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.54 J	0.23 J	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 UJ	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.12 J	0.0714 J	0.114 UJ	0.0107 UJ	0.00764 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-5_8-11 POREWATER	PWS-05	SB	non-NAPL	10/10/2012	N	8	11	5	3.40	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.68 J	0.23 J	0.274 UJ	0.339 UJ	0.0603 UJ	0.23 J	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.114 J	0.0619 J	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-6_8-11 POREWATER	PWS-06	SB	non-NAPL	10/10/2012	N	8	11	8	6.30	1.12 UJ	0.59 UJ	0.778 J	1.11 J	0.0046 UJ	0.13 J	1.68 J	0.33 J	0.279 J	0.339 UJ	0.0603 UJ	0.2 J	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.126 J	0.0726 J	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-7_8-10 DUP POREWATER	PWS-07	SB	non-NAPL	10/11/2012	FD	8	10	13	23.2	1.12 U	0.59 U	2.82 J	2.4 J	0.0046 UJ	0.48 J	4.57 J	2.8 J	1.2 J	0.339 UJ	0.0603 UJ	3.27 J	0.862 J	0.946 J	0.377 J	0.0051 UJ	0.0173 UJ	1.16 J	0.638 J	0.226 J	0.0735 UJ	0.0543 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
PWS-7_8-10 POREWATER	PWS-07	SB	non-NAPL	10/11/2012	N	8	10	10	6.68	1.12 U	0.59 U	0.778 UJ	0.815 J	0.0046 UJ	0.13 J	1.21 J	0.54 J	0.6 J	0.339 UJ	0.0603 UJ	0.5 J	0.0853 UJ	0.358 J	0.298 J	0.0051 UJ	0.0173 UJ	0.239 J	0.141 J	0.114 UJ	0.0107 UJ	0.0167 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-8_8-11 POREWATER	PWS-08	SB	non-NAPL	10/9/2012	N	8	11	9	4.26	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.7 J	0.5 J	0.3 J	0.339 UJ	0.0603 UJ	0.45 J	0.0454	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.187 J	0.113 J	0.114 UJ	0.017 J	0.00931 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-9_8-11 POREWATER	PWS-09	SB	non-NAPL	10/9/2012	N	8	11	5	3.13	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.45 J	0.27 J	0.284 J	0.339 UJ	0.0603 UJ	0.15 UJ	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0722 J	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-12_8-11 POREWATER	PWS-12	SB	non-NAPL	10/9/2012	N	8	11	2	2.41	1.12 UJ	0.59 UJ	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 UJ	0.15 UJ	0.2 UJ	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 UJ	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0176 J	0.0144 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-13_8-11 POREWATER	PWS-13	SB	non-NAPL	10/9/2012	N	8	11	18	57.9	1.12 U	0.59 U	13.7 J	25.1 J	3.8 J	0.24	1.39	0.59	1.97 J	1.99 J	0.0603 UJ	1.7	0.0796	3.01 J	2.12 J	0.41 J	0.0173 UJ	0.266 J	0.216 J	0.175 J	0.019 J	0.0233 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
PWS-15_8-11 POREWATER	PWS-15	SB	non-NAPL	10/11/2012	N	8	11	3	2.91	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.46	0.2 U	0.274 U	0.339 UJ	0.0603 UJ	0.17	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0655 J	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-16_8-11 POREWATER	PWS-16	SB	non-NAPL	10/9/2012	N	8	11	9	5.87	1.12 U	0.59 U	1.17 J	0.00329 UJ	0.0046 UJ	0.12 U	1.23	0.78	0.357 J	0.339 UJ	0.0603 UJ	0.5	0.0342	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.159 J	0.0852 J	0.114 UJ	0.0107 UJ	0.00481 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 UJ
PWS-25 4-8 POREWATER	PWS-25	SB	non-NAPL	10/11/2012	N	4	8	6	3.13	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.19	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.17	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.334 J	0.217 J	0.114 UJ	0.024 J	0.0154 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-26_8-11 POREWATER	PWS-26	SB	non-NAPL	10/11/2012	N	8	11	5	3.17	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.55	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.21	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.137 J	0.0828 J	0.114 UJ	0.0107 UJ	0.00431 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 UJ	0.27 U
PWS-26_8-11 DUP POREWATER	PWS-26	SB	non-NAPL	10/11/2012	FD	8	11	7	3.29	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.56	0.22	0.274 UJ	0.339 UJ	0.0603 UJ	0.19	0.0163	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.138 J	0.0836 J	0.114 UJ	0.0107 UJ	0.00634 J	0.00645 UJ	0.0125 UJ	0.00183 UJ	0.0255 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.04 UJ	0.32 U	0.27 U
PWS-28_8-11 POREWATER	PWS-28	SB	non-NAPL	10/10/2012	N	8	11	0	2.39	1.12 U	0.59 U	0.778 UJ	0.00329 UJ	0.0046 UJ	0.12 U	0.15 U	0.2 U	0.274 UJ	0.339 UJ	0.0603 UJ	0.15 U	0.0161 U	0.263 UJ	0.0037 UJ	0.0051 UJ	0.0173 UJ	0.0581 UJ	0.0493 UJ	0.114 UJ	0.0107 UJ	0.004 UJ

ATTACHMENT G-C: IWTU Calculation for Pore Water Data (direct measurement)
Table 2: Calculation of Percent Freely Dissolved PAH in Pore Water

Sample ID	Location	Exposure Area[1]	NAPL or non-NAPL Area	Sample Type[2]	Dissolved Organic Carbon[3] (mg/L)	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/Anthracenes	C-2 Phenanthrenes/Anthracenes	C-3 Phenanthrenes/Anthracenes	C-4 Phenanthrenes/Anthracenes	Fluoranthene	Pyrene	C-1 Fluoranthrenes/Pyrenes	Benzo(a)anthracene	Chrysene	C-1 Benz(a)anth/Chrysenes	C-2 Benz(a)anth/Chrysenes	C-3 Benz(a)anth/Chrysenes	C-4 Benz(a)anth/Chrysenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
Log K_{DOC}						2.44	2.88	3.38	3.87	4.37	2.31	3.09	3.29	3.79	4.27	4.76	3.65	3.61	4.11	4.53	4.98	5.38	4.15	3.99	4.35	4.74	4.78	5.20	5.48	5.99	6.41	5.32	5.35	5.19	5.17	5.19	5.77	5.77	5.56
PWS-27_8-11_PW	PWS-27	MC	non-NAPL	N	93.0	97.5%	93.4%	81.8%	59.2%	31.4%	98.1%	89.7%	84.6%	63.6%	36.6%	15.7%	70.7%	72.5%	45.5%	24.1%	10.1%	4.3%	43.2%	52.4%	32.4%	16.4%	15.1%	6.4%	3.4%	1.1%	0.4%	4.9%	4.6%	6.5%	6.8%	6.5%	1.8%	1.8%	2.9%
PWS-01_8-9_PW	PWS-01	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-03_8-11_PW	PWS-03	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-04_8-11_PW	PWS-04	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-05_8-11_PW	PWS-05	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-06_8-11_PW	PWS-06	SB	non-NAPL	N	2.06	99.9%	99.8%	99.5%	98.5%	95.4%	100.0%	99.7%	99.6%	98.7%	96.3%	89.4%	99.1%	99.2%	97.4%	93.5%	83.6%	66.9%	97.2%	98.0%	95.6%	89.8%	89.0%	75.4%	61.6%	33.2%	15.9%	69.9%	68.4%	75.8%	76.6%	75.8%	45.2%	45.2%	57.2%
PWS-07_8-11_PW	PWS-07	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-08_8-11_PW	PWS-08	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-09_8-11_PW	PWS-09	SB	non-NAPL	N	2.10	99.9%	99.8%	99.5%	98.5%	95.3%	100.0%	99.7%	99.6%	98.7%	96.2%	89.2%	99.1%	99.2%	97.4%	93.4%	83.3%	66.5%	97.1%	98.0%	95.5%	89.7%	88.8%	75.0%	61.2%	32.8%	15.6%	69.5%	68.0%	75.5%	76.3%	75.5%	44.7%	44.7%	56.7%
PWS-12_8-11 DUP_PW	PWS-12	SB	non-NAPL	FD	2.57	99.9%	99.8%	99.4%	98.1%	94.3%	99.9%	99.7%	99.5%	98.4%	95.4%	87.1%	98.9%	99.0%	96.8%	92.0%	80.3%	61.9%	96.5%	97.6%	94.6%	87.6%	86.6%	71.1%	56.3%	28.5%	13.1%	65.1%	63.5%	71.5%	72.5%	71.5%	39.8%	39.8%	51.7%
PWS-12_8-11_PW	PWS-12	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-13_1-4_PW	PWS-13	SB	non-NAPL	N	2.31	99.9%	99.8%	99.4%	98.3%	94.9%	100.0%	99.7%	99.6%	98.6%	95.9%	88.3%	99.0%	99.1%	97.1%	92.7%	81.9%	64.3%	96.8%	97.8%	95.1%	88.7%	87.8%	73.2%	58.9%	30.7%	14.4%	67.4%	65.9%	73.6%	74.5%	73.6%	42.4%	42.4%	54.4%
PWS-13_8-11_PW	PWS-13	SB	non-NAPL	N	2.08	99.9%	99.8%	99.5%	98.5%	95.4%	100.0%	99.7%	99.6%	98.7%	96.3%	89.3%	99.1%	99.2%	97.4%	93.4%	83.4%	66.7%	97.1%	98.0%	95.6%	89.7%	88.9%	75.2%	61.4%	33.0%	15.8%	69.7%	68.2%	75.6%	76.5%	75.6%	44.9%	44.9%	57.0%
PWS-15_8-11_PW	PWS-15	SB	non-NAPL	N	93.8	97.5%	93.4%	81.6%	59.0%	31.3%	98.1%	89.7%	84.5%	63.4%	36.4%	15.6%	70.5%	72.4%	45.3%	23.9%	10.0%	4.3%	43.0%	52.2%	32.3%	16.2%	15.0%	6.3%	3.4%	1.1%	0.4%	4.9%	4.5%	6.4%	6.7%	6.4%	1.8%	1.8%	2.9%
PWS-16_8-11_PW	PWS-16	SB	non-NAPL	N	19.1	99.5%	98.6%	95.6%	87.6%	69.1%	99.6%	97.7%	96.4%	89.5%	73.8%	47.6%	92.1%	92.8%	80.3%	60.7%	35.4%	17.9%	78.8%	84.3%	70.0%	48.8%	46.5%	24.8%	14.8%	5.1%	2.0%	20.0%	19.0%	25.3%	26.1%	25.3%	8.2%	8.2%	12.6%
PWS-16B_8-11_PW	PWS-16	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-25_8-11_PW	PWS-25	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-26_8-11_PW	PWS-26	SB	non-NAPL	N	2.51	99.9%	99.8%	99.4%	98.2%	94.4%	99.9%	99.7%	99.5%	98.5%	95.5%	87.4%	98.9%	99.0%	96.9%	92.2%	80.7%	62.4%	96.6%	97.6%	94.7%	87.9%	86.9%	71.5%	56.9%	29.0%	13.4%	65.6%	64.0%	72.0%	72.9%	72.0%	40.4%	40.4%	52.3%
PWS-17_4-7 POREWATER	PWS-17	MC	non-NAPL	N	8.09	99.8%	99.4%	98.1%	94.3%	84.1%	99.8%	99.0%	98.4%	95.2%	86.9%	68.2%	96.5%	96.8%	90.6%	78.5%	56.4%	34.0%	89.7%	92.7%	84.7%	69.2%	67.2%	43.8%	29.0%	11.2%	4.6%	37.2%	35.6%	44.4%	45.5%	44.4%	17.3%	17.3%	25.4%
PWS-27_8-11 POREWATER	PWS-27	MC	non-NAPL	N	47.8	98.7%	96.5%	89.7%	73.8%	47.2%	99.0%	94.4%	91.5%	77.2%	52.9%	26.7%	82.4%	83.7%	61.9%	38.2%	18.0%	8.0%	59.7%	68.2%	48.3%	27.6%	25.8%	11.7%	6.5%	2.1%	0.8%	9.1%	8.5%	11.9%	12.4%	11.9%	3.4%	3.4%	5.4%
PWS-30_8-11 POREWATER	PWS-30	MC	non-NAPL	N	4.36	99.9%	99.7%	99.0%	96.9%	90.7%	99.9%	99.5%	99.2%	97.4%	92.5%	79.9%	98.1%	98.3%	94.7%	87.1%	70.6%	48.9%	94.2%	95.9%	91.1%	80.7%	79.2%	59.1%	43.2%	19.0%	8.2%	52.3%	50.6%	59.7%	60.8%	59.7%	28.0%	28.0%	38.7%
LSI-01_8-11 POREWATER	LSI-01	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
LSI-02_8-11 POREWATER	LSI-02	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
LSI-20_8-11 POREWATER	LSI-20	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
LSI-24-8-11 POREWATER	LSI-24	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
PWS-1_8-10 POREWATER	PWS-01	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-3_8-11 POREWATER	PWS-03	SB	non-NAPL	N	3.69	99.9%	99.7%	99.1%	97.3%	92.0%	99.9%	99.5%	99.3%	97.8%	93.6%	82.5%	98.4%	98.5%	95.5%	88.9%	73.9%	53.0%	95.0%	96.5%	92.4%	83.1%	81.8%	63.1%	47.3%	21.7%	9.5%	56.5%	54.8%	63.6%	64.7%	63.6%	31.5%	31.5%	42.7%
PWS-4_8-11 POREWATER	PWS-04	SB	non-NAPL	N	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-5_8-11 POREWATER	PWS-05	SB	non-NAPL	N	12.4	99.7%	99.1%	97.1%	91.6%	77.5%	99.7%	98.5%	97.6%	92.9%	81.2%	58.4%	94.8%	95.2%	86.2%	70.4%	45.8%	25.2%	85.1%	89.2%	78.3%	59.5%	57.2%	33.7%	21.1%	7.6%	3.0%	27.8%	26.5%	34.2%	35.3%	34.2%	12.0%	12.0%	18.2%
PWS-6_8-11 POREWATER	PWS-06	SB	non-NAPL	N	30.4	99.2%	97.7%	93.2%	81.6%	58.4%	99.4%	96.4%	94.4%	84.2%	63.9%	36.4%	88.0%	89.0%	71.9%	49.3%	25.6%	12.1%	70.0%	77.1%	59.5%	37.4%	35.3%	17.2%	9.8%	3.3%	1.3%	13.6%	12.8%	17.5%	18.2%	17.5%	5.3%	5.3%	8.3%
PWS-7_8-10 DUP POREWATER	PWS-07	SB	non-NAPL	FD	8.22	99.8%	99.4%	98.1%	94.3%	83.8%	99.8%	99.0%	98.4%	95.2%	86.7%	67.9%	96.5%	96.8%	90.4%	78.2%	56.0%	33.6%	89.6%	92.6%	84.5%	68.9%	66.9%	43.4%	28.7%	11.1%	4.5%	36.8%	35.2%	44.0%	45.1%	44.0%	17.1%	17.1%	25.1%
PWS-7_8-10 POREWATER	PWS-07	SB	non-NAPL	N	7.68	99.8%	99.4%	98.2%	94.6%	84.7%	99.8%	99.1%	98.5%	95.5%	87.5%	69.4%	96.7%	97.0%	91.0%	79.4%	57.7%	35.2%	90.2%	93.0%	85.3%	70.3%	68.4%	45.1%	30.1%	11.8%	4.8%	38.4%	36.8%	45.7%	46.8%	45.7%	18.1%	18.1%	26.4%
PWS-8_8-11 POREWATER	PWS-08	SB	non-NAPL	N	4.1	99.9%	99.7%	99.0%	97.1%	91.2%	99.9%	99.5%	99.2%	97.5%	92.9%	80.9%	98.2%	98.4%	95.0%	87.8%	71.9%	50.4%	94.5%	96.1%	91.6%	81.6%	80.2%	60.6%	44.7%	20.0%	8.7%	53.9%	52.1%	61.2%	62.2%	61.2%	29.3%	29.3%	40.2%
PWS-9_8-11 POREWATER	PWS-09	SB	non-NAPL	N	9.46	99.7%	99.3%	97.8%	93.4%	81.8%	99.8%	98.8%	98.2%	94.5%	85.0%	64.8%	95.9%	96.3%	89.1%	75.7%	52.5%	30.6%	88.2%	91.5%	82.5%	65.8%	63.7%	40.0%	25.9%	9.8%	4.0%	33.6%	32.1%	40.6%	41.7%	40.6%	15.2%	15.2%	22.5%
PWS-12_8-11 POREWATER	PWS-12	SB	non-NAPL	N	41.2	98.9%	97.0%	91.0%	76.6%	50.9%	99.2%	95.2%	92.6%	79.7%	56.6%	29.7%	84.5%	85.6%	65.3%	41.7%	20.3%	9.2%	63.2%	71.3%	52.0%	30.6%	28.7%	13.3%	7.4%	2.4%	0.9%	10.4%	9.8%	13.5%	14.1%	13.5%	4.0%	4.0%	6.3%
PWS-13_8-11 POREWATER	PWS-13	SB	non-NAPL	N	91.2	97.5%	93.5%	82.0%	59.7%	31.9%	98.2%	89.9%	84.9%	64.0%	37.1%	16.0%	71.1%	72.9%	46.0%	24.4%	10.3%	4.4%	43.7%	52.9%	32.9%	16.6%	15.4%	6.5%	3.5%	1.1%	0.4%	5.0%	4.7%	6.6%	6.9%	6.6%	1.8%	1.8%	2.9%
PWS-15_8-11 POREWATER	PWS-15	SB	non-NAPL	N	6.83	99.8%	99.5%	98.4%	95.2%	86.2%	99.9%	99.2%	98.7%	96.0%	88.7%	71.8%	97.0%	97.3%	91.9%	81.2%	60.5%	37.9%	91.2%	93.7%	86.7%	72.7%	70.8%	48.0%	32.7%	13.0%	5.4%	41.2%	39.5%	48.6%	49.7%	48.6%	19.9%	19.9%	28.7%
PWS-16_8-11 POREWATER	PWS-16	SB	non-NAPL	N	109	97.1%	92.4%	79.3%	55.3%	28.1%	97.8%	88.2%	82.5%	59.8%	33.0%	13.8%	67.3%	69.2%	41.6%	21.3%	8.8%	3.7%	39.4%	48.4%	29.1%	14.3%	13.2%	5.5%	2.9%	0.9%	0.4%	4.2%	3.9%	5.6%	5.8%	5.6%	1.5%	1.5%	2.5%
PWS-25_4-8 POREWATER	PWS-25	SB	non-NAPL	N	4.55	99.9%	99.7%	98.9%	96.7%	90.4%	99.9%	99.4%	99.1%	97.3%	92.2%	79.3%	98.0%	98.2%	94.5%	86.6%	69.7%	47.8%	94.0%	95.7%	90.8%	80.0%	78.5%	58.1%	42.1%	18.4%	7.9%	51.3%	49.5%	58.7%	59.8%	58.7%	27.2%	27.2%	37.7%
PWS-26_8-11 POREWATER	PWS-26	SB	non-NAPL	N	8.95	99.8%	99.3%	97.9%	93.8%	82.7%	99.8%	98.9%	98.3%	94.8%	85.7%	66.0%	96.2%	96.5%	89.7%	76.7%	53.9%	31.8%	88.8%	92.0%	83.3%	67.0%	65.0%	41.3%	27.0%	10.3%	4.2%	34.8%	33.3%	41.9%	43.0%	41.9%	15.9%	15.9%	23.5%
PWS-26_8-11_DUP POREWATER	PWS-26	SB	non-NAPL	FD	1.00	100.0%	99.9%	99.8%	99.3%	97.7%	100.0%	99.9%	99.8%	99.4%	98.2%	94.6%	99.6%	99.6%	98.7%	96.7%	91.3%	80.7%	98.6%	99.0%	97.8%	94.8%	94.3%	86.3%	76.8%	50.6%	28.0%	82.7%	81.7%	86.6%	87.1%	86.6%	62.9%	62.9%	73.4%
PWS-28_8-11 POREWATER	PWS-28	SB	non-NAPL	N	4.01	99.9%	99.7%	99.0%	97.1%	91.4%	99.9%	99.5%	99.2%	97.6%	93.1%	81.3%	98.2%	98.4%	95.1%	88.0%	72.3%	51.0%	94.6%	96.2%	91.8%	81.9%	80.5%	61.1%	45.2%	20.3%	8.8%	54.4%	52.7%	61.7%	62.8%	61.7%	29.8%	29.8%	40.7%
Shallow Porewater Site 1	PWS-1	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 1	PWS-1	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 2	PWS-2	MC	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 2	PWS-2	MC	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 3	PWS-3	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 3	PWS-3	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 4	PWS-4	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 4	PWS-4	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 5	PWS-5	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 5	PWS-5	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 6	PWS-6	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 6	PWS-6	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 7	PWS-7	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 7	PWS-7	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 8	PWS-8	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 8	PWS-8	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 9	PWS-9	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 9	PWS-9	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Shallow Porewater Site 10	PWS-10	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%	17.1%	77.7%	83.5%	68.8%	47.3%	45.0%	23.7%	14.0%	4.8%	1.9%	19.1%	18.1%	24.2%	25.0%	24.2%	7.7%	7.7%	12.0%
Deep Porewater Site 10	PWS-10	SB	non-NAPL	N	*20.3*	99.4%	98.5%	95.4%	86.9%	67.8%	99.6%	97.6%	96.2%	88.9%	72.6%	46.2%	91.7%	92.4%	79.3%	59.3%	34.1%

ATTACHMENT G-C: IWTU Calculation for Pore Water Data (direct measurement)

Table 3: Analytical Data Converted to Freely Dissolved Concentration[1]

Sample ID	Location	Exposure Area[2]	NAPL or non-NAPL Area	Sample Type[3]	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/Anthracenes	C-2 Phenanthrenes/Anthracenes	C-3 Phenanthrenes/Anthracenes	C-4 Phenanthrenes/Anthracenes	Fluoranthene	Pyrene	C-1 Fluoranthrenes/Pyrenes	Benzo(a)anthracene	Chrysene	C-1 Benz(a)anth/Chrysenes	C-2 Benz(a)anth/Chrysenes	C-3 Benz(a)anth/Chrysenes	C-4 Benz(a)anth/Chrysenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
PWS-27_8-11_PW	PWS-27	MC	non-NAPL	N	1.09E+00	5.51E-01	6.36E-01	1.95E-03	1.44E-03	1.18E-01	1.35E-01	1.69E-01	1.74E-01	1.24E-01	9.49E-03	1.06E-01	1.17E-02	1.20E-01	8.94E-04	5.17E-04	7.42E-04	2.51E-02	2.58E-02	3.70E-02	1.75E-03	6.06E-04	4.10E-04	4.30E-04	1.99E-05	1.06E-04	2.59E-03	2.43E-03	3.44E-03	3.59E-03	3.44E-03	9.50E-04	9.50E-04	1.52E-03
PWS-01_8-9_PW	PWS-01	SB	non-NAPL	N	1.12E+00	1.49E+00	1.63E+00	4.75E-01	4.48E-03	9.02E-01	9.30E+00	2.05E+00	4.63E-01	3.33E-01	5.70E-02	1.49E-01	4.45E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	5.73E-02	4.88E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-03_8-11_PW	PWS-03	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.40E-01	9.15E-01	7.09E-01	2.72E-01	3.33E-01	5.70E-02	3.99E-01	9.66E-02	3.82E-01	1.60E-01	4.66E-03	1.40E-02	4.61E-01	2.50E-01	1.12E-01	1.01E-02	2.03E-02	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-04_8-11_PW	PWS-04	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	2.81E-01	2.00E-01	2.72E-01	3.33E-01	5.70E-02	1.49E-01	1.60E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	1.43E-01	9.46E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-05_8-11_PW	PWS-05	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	8.52E-01	2.54E-01	4.90E-01	3.33E-01	5.70E-02	1.82E-01	2.09E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	9.25E-02	5.46E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-06_8-11_PW	PWS-06	SB	non-NAPL	N	1.12E+00	5.89E-01	7.74E-01	3.24E-03	4.38E-03	1.20E-01	9.00E-01	1.99E-01	2.71E-01	3.26E-01	5.39E-02	1.49E-01	1.60E-02	2.56E-01	3.47E-03	4.27E-03	1.16E-02	1.10E-01	5.96E-02	1.09E-01	9.61E-03	3.56E-03	4.86E-03	7.71E-03	6.07E-04	4.05E-03	3.71E-02	3.63E-02	4.02E-02	4.06E-02	4.02E-02	2.39E-02	2.39E-02	3.03E-02
PWS-07_8-11_PW	PWS-07	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.21E-01	9.92E-01	3.64E-01	3.02E-01	3.33E-01	5.70E-02	3.40E-01	5.87E-02	3.62E-01	1.98E-01	4.66E-03	1.40E-02	2.23E-01	1.36E-01	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-08_8-11_PW	PWS-08	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	2.31E-01	4.48E-03	1.20E-01	7.17E-01	2.15E-01	3.07E-01	3.33E-01	5.70E-02	2.25E-01	1.67E-02	3.46E-01	2.03E-01	4.66E-03	1.40E-02	1.90E-01	1.17E-01	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-09_8-11_PW	PWS-09	SB	non-NAPL	N	1.12E+00	5.89E-01	7.74E-01	3.24E-03	4.37E-03	1.20E-01	1.85E-01	1.99E-01	2.70E-01	3.26E-01	5.38E-02	1.49E-01	1.60E-02	2.56E-01	3.46E-03	4.26E-03	1.15E-02	5.64E-02	4.83E-02	1.09E-01	9.59E-03	3.55E-03	4.84E-03	7.65E-03	6.00E-04	3.99E-03	3.68E-02	3.61E-02	4.00E-02	4.04E-02	4.00E-02	2.37E-02	2.37E-02	3.01E-02
PWS-12_8-11 DUP_PW	PWS-12	SB	non-NAPL	FD	1.12E+00	5.89E-01	7.73E-01	3.23E-03	4.33E-03	1.20E-01	1.74E-01	1.99E-01	2.70E-01	3.24E-01	5.25E-02	1.48E-01	1.59E-02	2.55E-01	3.41E-03	4.10E-03	1.07E-02	5.61E-02	4.81E-02	1.08E-01	9.38E-03	3.46E-03	4.58E-03	7.04E-03	5.21E-04	3.35E-03	3.45E-02	3.36E-02	3.79E-02	3.84E-02	3.79E-02	2.11E-02	2.11E-02	2.74E-02
PWS-12_8-11_PW	PWS-12	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	9.72E-02	2.00E-01	2.72E-01	3.33E-01	5.70E-02	1.49E-01	1.60E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	5.73E-02	4.88E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-13_1-4_PW	PWS-13	SB	non-NAPL	N	1.12E+00	5.89E-01	7.74E-01	3.23E-03	4.35E-03	1.20E-01	1.50E-01	1.99E-01	2.70E-01	3.25E-01	5.32E-02	1.48E-01	1.59E-02	2.55E-01	3.44E-03	4.19E-03	1.11E-02	5.63E-02	4.82E-02	1.08E-01	9.49E-03	3.51E-03	4.72E-03	7.36E-03	5.62E-04	3.68E-03	3.57E-02	3.49E-02	3.90E-02	3.95E-02	3.90E-02	2.25E-02	2.25E-02	2.88E-02
PWS-13_8-11_PW	PWS-13	SB	non-NAPL	N	1.12E+00	5.89E-01	7.74E-01	3.24E-03	4.38E-03	1.20E-01	1.50E-01	1.99E-01	2.71E-01	3.26E-01	5.39E-02	1.49E-01	1.60E-02	2.56E-01	3.47E-03	4.26E-03	1.15E-02	5.64E-02	4.83E-02	1.09E-01	9.60E-03	3.55E-03	4.85E-03	7.68E-03	6.03E-04	4.02E-03	3.69E-02	3.62E-02	4.01E-02	4.05E-02	4.01E-02	2.38E-02	2.38E-02	3.02E-02
PWS-15_8-11_PW	PWS-15	SB	non-NAPL	N	1.09E+00	5.51E-01	6.35E-01	1.94E-03	1.43E-03	1.18E-01	1.34E-01	1.69E-01	1.74E-01	1.23E-01	9.43E-03	1.06E-01	1.16E-02	1.19E-01	8.88E-04	5.13E-04	7.36E-04	2.50E-02	2.57E-02	3.68E-02	1.74E-03	6.01E-04	4.07E-04	4.26E-04	1.97E-05	1.05E-04	2.57E-03	2.41E-03	3.41E-03	3.56E-03	3.41E-03	9.42E-04	9.42E-04	1.51E-03
PWS-16_8-11_PW	PWS-16	SB	non-NAPL	N	1.11E+00	5.82E-01	7.44E-01	2.88E-03	3.17E-03	1.20E-01	2.56E-01	1.93E-01	2.45E-01	2.50E-01	2.87E-02	1.38E-01	1.49E-02	2.11E-01	2.25E-03	1.81E-03	3.10E-03	4.58E-02	4.15E-02	7.99E-02	5.22E-03	1.86E-03	1.60E-03	1.85E-03	9.31E-05	5.09E-04	1.06E-02	1.00E-02	1.34E-02	1.39E-02	1.34E-02	4.33E-03	4.33E-03	6.68E-03
PWS-16B_8-11_PW	PWS-16	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	2.33E-01	2.00E-01	2.72E-01	3.33E-01	5.70E-02	1.49E-01	1.60E-02	2.60E-01	5.60E-02	4.66E-03	1.40E-02	5.73E-02	4.88E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-25_8-11_PW	PWS-25	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	6.46E-01	2.00E-01	2.72E-01	3.33E-01	5.70E-02	1.77E-01	1.60E-02	2.95E-01	3.05E-01	4.66E-03	1.40E-02	2.06E-01	1.61E-01	1.12E-01	1.01E-02	8.68E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	4.38E-02	4.33E-02	4.59E-02	4.62E-02	4.59E-02	3.34E-02	3.34E-02	3.89E-02
PWS-26_8-11_PW	PWS-26	SB	non-NAPL	N	1.12E+00	5.89E-01	7.73E-01	3.23E-03	4.33E-03	1.20E-01	2.29E-01	1.99E-01	2.70E-01	3.24E-01	5.27E-02	1.48E-01	1.59E-02	2.55E-01	3.42E-03	4.12E-03	1.08E-02	1.46E-01	9.86E-02	1.08E-01	9.40E-03	5.52E-03	4.61E-03	7.11E-03	5.30E-04	3.42E-03	3.48E-02	3.39E-02	3.82E-02	3.87E-02	3.82E-02	2.14E-02	2.14E-02	2.77E-02
PWS-17_4-7 POREWATER	PWS-17	MC	non-NAPL	N	1.12E+00	1.12E+00	7.63E-01	3.49E-01	3.86E-03	2.30E-01	2.69E+00	4.53E-01	3.11E-01	2.95E-01	4.11E-02	2.70E-01	2.91E-02	2.38E-01	2.91E-03	2.88E-03	5.88E-03	5.21E-02	4.57E-02	9.65E-02	7.41E-03	2.69E-03	2.83E-03	3.63E-03	2.05E-04	1.17E-03	1.49E-02	1.42E-02	1.78E-02	1.82E-02	1.78E-02	6.94E-03	6.94E-03	1.02E-02
PWS-27_8-11 POREWATER	PWS-27	MC	non-NAPL	N	1.11E+00	5.69E-01	6.98E-01	2.43E-03	2.16E-03	1.19E-01	1.42E-01	1.83E-01	2.12E-01	1.79E-01	1.61E-02	1.24E-01	6.98E-02	1.63E-01	1.42E-03	9.18E-04	1.39E-03	3.47E-02	3.36E-02	5.51E-02	2.95E-03	1.59E-03	7.52E-04	8.10E-04	3.84E-05	2.06E-04	3.64E-03	3.42E-03	4.76E-03	4.96E-03	4.76E-03	1.37E-03	1.37E-03	2.18E-03
PWS-30_8-11_ POREWATER	PWS-30	MC	non-NAPL	N	1.12E+00	5.88E-01	7.70E-01	3.19E-03	4.16E-03	1.20E-01	1.49E-01	1.98E-01	2.67E-01	3.14E-01	4.82E-02	1.47E-01	1.58E-02	2.49E-01	3.23E-03	3.61E-03	8.46E-03	5.47E-02	4.73E-02	1.04E-01	8.63E-03	3.17E-03	3.81E-03	5.40E-03	3.48E-04	2.09E-03	2.09E-02	2.02E-02	2.39E-02	2.43E-02	2.39E-02	1.12E-02	1.12E-02	1.55E-02
LSI-01_8-11 POREWATER	LSI-01	SB	non-NAPL	N	1.11E+00	5.81E-01	7.42E-01	2.86E-03	3.11E-03	1.20E-01	1.76E-01	1.92E-01	2.44E-01	2.46E-01	2.78E-02	1.38E-01	1.49E-02	2.09E-01	2.20E-03	1.74E-03	2.95E-03	4.52E-02	4.11E-02	7.84E-02	5.06E-03	1.80E-03	1.53E-03	1.75E-03	8.79E-05	4.80E-04	1.01E-02	9.57E-03	1.28E-02	1.33E-02	1.28E-02	4.10E-03	4.10E-03	6.34E-03
LSI-02_8-11 POREWATER	LSI-02	SB	non-NAPL	N	1.11E+00	5.81E-01	7.42E-01	2.86E-03	3.11E-03	1.20E-01	7.42E-01	2.50E-01	2.44E-01	2.46E-01	2.78E-02	1.56E-01	1.49E-02	2.09E-01	2.20E-03	1.74E-03	2.95E-03	1.28E-01	9.51E-02	7.84E-02	5.06E-03	4.02E-03	1.53E-03	1.75E-03	8.79E-05	4.80E-04	1.01E-02	9.57E-03	1.28E-02	1.33E-02	1.28E-02	4.10E-03	4.10E-03	6.34E-03
LSI-20_8-11 POREWATER	LSI-20	SB	non-NAPL	N	1.11E+00	5.81E-01	7.42E-01	2.86E-03	3.11E-03	1.20E-01	1.45E+00	1.92E-01	3.38E-01	2.46E-01	2.78E-02	1.38E-01	1.49E-02	2.09E-01	2.20E-03	1.74E-03	2.95E-03	1.03E-01	9.43E-02	7.84E-02	5.06E-03	3.78E-03	1.53E-03	1.75E-03	8.79E-05	4.80E-04	1.01E-02	9.57E-03	1.28E-02	1.33E-02	1.28E-02	4.10E-03	4.10E-03	6.34E-03
LSI-24-8-11 POREWATER	LSI-24	SB	non-NAPL	N	1.11E+00	5.81E-01	7.42E-01	2.86E-03	3.11E-03	1.79E-01	1.62E+00	1.92E-01	2.44E-01	2.46E-01	2.78E-02	1.47E-01	2.03E-02	2.09E-01	2.20E-03	1.74E-03	2.95E-03	9.10E-02	7.90E-02	7.84E-02	5.06E-03	3.85E-03	1.53E-03	1.75E-03	8.79E-05	4.80E-04	1.01E-02	9.57E-03	1.28E-02	1.33E-02	1.28E-02	4.10E-03	4.10E-03	6.34E-03
PWS-1_8-10 POREWATER	PWS-01	SB	non-NAPL	N	1.12E+00	5.90E-01	1.35E+00	3.27E-03	4.48E-03	3.50E-01	4.88E+00	1.16E+00	3.58E-01	3.33E-01	5.70E-02	3.19E-01	1.60E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	8.96E-02	5.06E-02	1.12E-01	1.01E-02	3.77E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	3.31E-02	3.27E-02	3.46E-02	3.48E-02	3.46E-02	2.52E-02	2.52E-02	2.93E-02
PWS-3_8-11 POREWATER	PWS-03	SB	non-NAPL	N	1.12E+00	5.88E-01	7.71E-01	3.20E-03	4.22E-03	1.20E-01	6.37E-01	5.16E-01	2.86E-01	3.17E-01	4.97E-02	1.97E-01	4.22E-02	2.51E-01	3.30E-03	3.78E-03	9.18E-03	3.12E-01	1.91E-01	1.05E-01	1.01E-02	1.69E-02	4.07E-03	5.91E-03	3.97E-04	2.43E-03	2.26E-02	2.19E-02	2.55E-02	2.59E-02	2.55E-02	1.26E-02	1.26E-02	1.71E-02
PWS-4_8-11 POREWATER	PWS-04	SB	non-NAPL	N	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	5.39E-01	2.30E-01	2.72E-01	3.33E-01	5.70E-02	1.49E-01	1.60E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	1.18E-01	7.07E-02	1.12E-01	1.01E-02	7.21E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	3.31E-02	3.27E-02	3.46E-02	3.48E-02	3.46E-02	2.52E-02	2.52E-02	2.93E-02
PWS-5_8-11 POREWATER	PWS-05	SB	non-NAPL	N	1.12E+00	5.85E-01	7.56E-01	3.01E-03	3.56E-03	1.20E-01	6.70E-01	2.25E-01	2.55E-01	2.75E-01	3.52E-02	2.18E-01	1.53E-02	2.27E-01	2.61E-03	2.34E-03	4.35E-03	9.70E-02	5.52E-02	8.92E-02	6.36E-03	2.29E-03	2.18E-03	2.63E-03	1.40E-04	7.76E-04	1.11E-02	1.06E-02	1.37E-02	1.41E-02	1.37E-02	4.82E-03	4.82E-03	7.27E-03
PWS-6_8-11 POREWATER	PWS-06	SB	non-NAPL	N	1.11E+00	5.77E-01	8.16E-01	9.06E-01	2.68E-03	1.29E-01	1.62E+00	3.12E-01	2.35E-01	2.16E-01	2.19E-02	1.76E-01	1.43E-02	1.89E-01	1.83E-03	1.31E-03	2.09E-03	8.81E-02	5.60E-02	6.78E-02	4.01E-03	1.41E-03	1.11E-03	1.23E-03	5.96E-05	3.22E-04	5.44E-03	5.12E-03	7.01E-03	7.28E-03	7.01E-03	2.12E-03	2.12E-03	3.32E-03
PWS-7_8-10 DUP POREWATER	PWS-07	SB	non-NAPL	FD	1.12E+00	5.86E-01	2.77E+00	2.26E+00	3.85E-03	4.79E-01	4.52E+00	2.76E+00	1.14E+00	2.94E-01	4.09E-02	3.15E+00	8.34E-01	8.55E-01	2.95E-01	2.86E-03	5.82E-03	1.04E+00	5.91E-01	1.91E-01	5.06E-02	3.63E-02	2.80E-03	3.59E-03	2.03E-04	1.15E-03	1.47E-02	1.41E-02	1.76E-02	1.81E-02	1.76E-02	6.85E-03	6.85E-03	1.00E-02
PWS-7_8-10 POREWATER	PWS-07	SB	non-NAPL	N	1.12E+00	5.87E-01	7.64E-01	7.71E-01	3.89E-03	1.30E-01	1.20E+00	5.32E-01	5.73E-01	2.97E-01	4.18E-02	4.83E-01	8.27E-02	3.26E-01	2.36E-01	2.95E-03	6.09E-03	2.16E-01	1.31E-01	9.73E-02	7.52E-03	1.14E-02	2.91E-03	3.77E-03	2.15E-04	1.23E-03	1.54E-02	1.47E-02	1.83E-02	1.87E-02	1.83E-02	7.24E-03	7.24E-03	1.06E-02
PWS-8_8-11 POREWATER	PWS-08	SB	non-NAPL	N	1.12E+00	5.88E-01	7.70E-01	3.19E-03	4.19E-03	1.20E-01	6.96E-01	4.96E-01	2.93E-01	3.15E-01	4.88E-02	4.42E-01	4.47E-02	2.50E-01	3.26E-03	3.67E-03	8.72E-03	1.77E-01	1.09E-01	1.04E-01	1.39E-02	7.47E-03	3.91E-03	5.58E-03	3.66E-04	2.21E-03	2.15E-02	2.09E-02	2.45E-02	2.49E-02	2.45E-02	1.17E-02	1.17E-02	1.61E-02
PWS-9_8-11 POREWATER	PWS-09	SB	non-NAPL	N	1.12E+00	5.86E-01	7.61E-01	3.07E-03	3.76E-03	1.20E-01	4.45E-01	2.65E-01	2.68E-01	2.88E-01	3.90E-02	1.44E-01	1.55E-02	2.34E-01	2.81E-03	2.68E-03	5.29E-03	6.37E-02	4.51E-02	9.41E-02	7.04E-03	6.62E-03	2.58E-03	3.24E-03	1.79E-04	1.01E-03	1.34E-02	1.28E-02	1.62E-02	1.67E-02	1.62E-02	6.09E-03	6.09E-03	9.02E-03
PWS-12_8-11 POREWATER	PWS-12	SB	non-NAPL	N	1.11E+00	5.72E-01	7.08E-01	2.52E-03	2.33E-03	1.19E-01	1.43E-01	1.85E-01	2.18E-01	1.92E-01	1.79E-02	1.27E-01	1.38E-02	1.72E-01	1.55E-03	1.04E-03	1.59E-03	3.67E-02	3.51E-02	5.93E-02	5.39E-03	4.13E-03	8.57E-04	9.30E-04	4.44E-05	2.39E-04	4.16E-03	3.91E-03	5.42E-03	5.64E-03	5.42E-03	1.58E-03	1.58E-03	2.51E-03
PWS-13_8-11 POREWATER	PWS-13	SB	non-NAPL	N	1.09E+00	5.52E-01	1.12E+01	1.50E+01	1.21E+00	2.36E-01	1.25E+00	5.01E-01	1.26E+00	7.38E-01	9.65E-03	1.21E+00	5.80E-02	1.38E+00	5.18E-01	4.22E-02	7.56E-04	1.16E-01	1.14E-01	5.75E-02	3.16E-03	3.59E-03	4.17E-04	4.38E-04	2.03E-05	1.08E-04	1.99E-03	1.87E-03	2.64E-03	2.76E-03	2.64E-03	7.31E-04	7.31E-04	1.17E-03
PWS-15_8-11 POREWATER	PWS-15	SB	non-NAPL	N	1.12E+00	5.87E-01	7.65E-01	3.13E-03	3.96E-03	1.20E-01	4.56E-01	1.97E-01	2.63E-01	3.01E-01	4.33E-02	1.65E-01	1.57E-02	2.42E-01	3.01E-03	3.09E-03	6.56E-03	5.97E-02	4.62E-02	9.89E-02	7.78E-03	2.83E-03	3.10E-03	4.08E-03	2.38E-04	1.37E-03	1.65E-02	1.58E-02	1.94E-02	1.99E-02	1.94E-02	7.97E-03	7.97E-03	1.15E-02
PWS-16_8-11 POREWATER	PWS-16	SB	non-NAPL	N	1.09E+00	5.45E-01	9.27E-01	1.82E-03	1.29E-03	1.17E-01	1.08E+00	6.43E-01	2.14E-01	1.12E-01	8.29E-03	3.36E-01	2.37E-02	1.09E-01	7.90E-04	4.48E-04	6.37E-04	6.26E-02	4.13E-02	3.31E-02	1.53E-03	6.36E-04	3.53E-04	3.69E-04	1.70E-05	9.07E-05	1.68E-03	1.57E-03	2.24E-03	2.34E-03	2.24E-03	6.14E-04	6.14E-04	9.86E-04
PWS-25_4-8 POREWATER	PWS-25	SB	non-NAPL	N	1.12E+00	5.88E-01	7.70E-01	3.18E-03	4.15E-03	1.20E-01	1.89E-01	1.98E-01	2.67E-01	3.13E-01	4.78E-02	1.67E-01	1.58E-02	2.48E-01	3.21E-03	3.56E-03	8.27E-03	3.14E-01	2.08E-01	1.03E-01	1.92E-02	1.21E-02	3.75E-03	5.27E-03	3.36E-04	2.01E-03	2.05E-02	1.98E-02	2.35E-02	2.39E-02	2.35E-02	1.09E-02	1.09E-02	1.51E-02
PWS-26_8-11 POREWATER	PWS-26	SB	non-NAPL	N	1.12E+00	5.86E-01	7.82E-01	3.09E-03	3.79E-03	1.20E-01	5.44E-01	1.97E-01	2.60E-01	2.91E-01	3.98E-02	2.02E-01	1.55E-02	2.36E-01	2.85E-03	2.76E-03	5.50E-03	1.22E-01	7.61E-02	9.50E-02	7.17E-03	2.80E-03	2.67E-03	3.38E-03	1.88E-04	1.06E-03	1.39E-02	1.32E-02	1.68E-02	1.72E-02	1.68E-02	6.38E-03	6.38E-03	9.41E-03
PWS-26_8-11_DUP POREWATER	PWS-26	SB	non-NAPL	FD	1.12E+00	5.90E-01	7.76E-01	3.27E-03	4.48E-03	1.20E-01	5.59E-01	2.20E-01	2.72E-01	3.33E-01	5.70E-02	1.89E-01	1.62E-02	2.60E-01	3.59E-03	4.66E-03	1.40E-02	1.36E-01	8.28E-02	1.12E-01	1.01E-02	5.98E-03	5.57E-03	9.60E-03	9.26E-04	7.14E-03	3.31E-02	3.27E-02	3.46E-02	3.48E-02	3.46E-02	2.52E-02	2.52E-02	2.93E-02
PWS-28_8-11 POREWATER	PWS-28	SB	non-NAPL	N	1.12E+00	5.88E-01	7.71E-01	3.20E-03	4.20E-03	1.20E-01	1.49E-01	1.98E-01	2.67E-01	3.15E-01	4.90E-02	1.47E-01	1.58E-02	2.50E-01	3.27E-03	3.69E-03	8.82E-03	5.50E-02	4.74E-02	1.05E-01	8.77E-03	3.22E-03	3.94E-03	5.65E-03	3.72E-04	2.26E-03	2.18E-02	2.11E-02	2.47E-02	2.51E-02	2.47E-02	1.19E-02	1.19E-02	1.63E-02
Shallow Porewater Site 1	PWS-1	SB	non-NAPL	N	3.17E-03	4.93E-03	2.08E-02	8.20E-02	1.59E-01	1.13E-04	1.27E-02	6.27E-03	4.30E-03	6.60E-03	3.20E-03	1.08E-03	4.43E-04	1.05E-03	1.94E-03	1.61E-03	2.46E-04	5.09E-04	5.22E-04	1.99E-04	1.09E-05	1.11E-05	5.84E-06	1.97E-07	6.73E-08	2.64E-08	1.99E-06	1.41E-07	2.87E-07	4.35E-07	4.27E-08	3.86E-08	1.55E-07	7.50E-08
Deep Porewater Site 1	PWS-1	SB	non-NAPL	N	5.37E-02	1.98E+00	7.58E+00	9.82E+00	5.14E+00	2.20E-02	3.39E+00	5.27E-01	2.33E-01	1.40E-01	3.21E-02	2.71E-01	7.72E-03	4.29E-02	2.57E-02	1.21E-02	1.05E-03	7.11E-03	6.26E-03	1.98E-03	8.89E-05	7.34E-05	2.68E-05	1.21E-06	6.34E-08	2.49E-08	7.35E-06	4.21E-06	8.21E-06	7.23E-06	8.74E-06	3.62E-08	1.46E-07	7.03E-08
Shallow Porewater Site 2	PWS-2	MC	non-NAPL	N	9.83E-02	1.65E+00	2.34E+01	3.89E+01	2.95E+01	1.13E-04	8.05E-02	5.91E-02	1.83E-01	4.17E-01	1.41E-01	2.50E-02	3.37E-03	5.49E-02	8.77E-02	4.97E-02	1.09E-02	2.68E-04	1.01E-03	8.80E-04	1.46E-05	2.04E-05	3.75E-05	2.27E-06	5.62E-08	2.20E-08	1.35E-06	1.16E-07	2.44E-06	3.58E-07	3.04E-07

ATTACHMENT G-C: IWTU Calculation for Pore Water Data (direct measurement)

Table 4: IWTU and ΣIWTU Calculations[1]

NAPL or non-NAPL Area	Sampling Period	Exposure Area[2]	Location	Sample ID	Sample Type[3]	Naphthalene	C-1 Naphthalenes	C-2 Naphthalenes	C-3 Naphthalenes	C-4 Naphthalenes	Acenaphthylene	Acenaphthene	Fluorene	C-1 Fluorenes	C-2 Fluorenes	C-3 Fluorenes	Phenanthrene	Anthracene	C-1 Phenanthrenes/Anthracenes	C-2 Phenanthrenes/Anthracenes	C-3 Phenanthrenes/Anthracenes	C-4 Phenanthrenes/Anthracenes	Fluoranthene	Pyrene	C-1 Fluoranthenes/Pyrenes	Benzo(a)anthracene	Chrysene	C-1 Benz(a)anth/Chrysenes	C-2 Benz(a)anth/Chrysenes	C-3 Benz(a)anth/Chrysenes	C-4 Benz(a)anth/Chrysenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	ΣIWTU Full DLs	ΣIWTU 1/2 DLs
Final Chronic Value (µg/L)						193.6	81.69	30.24	11.1000	4.048	306.9	55.85	39.3	13.99	5.305	1.916	19.13	20.73	7.436	3.199	1.256	0.5594	7.109	10.11	4.887	2.227	2.042	0.8557	0.4827	0.1675	0.07062	0.6774	0.6415	0.9008	0.9573	0.9008	0.275	0.2825	0.4391	--	--
Non-NAPL Areas	July 2012	MC	PWS-27	PWS-27_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.08
		SB	PWS-01	PWS-01_8-9_PW	N	0.0058	0.0183	0.0539	0.0432	0.0011	0.0029	0.1667	0.0522	0.0333	0.0639	0.0315	0.0078	0.0022	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.84**	0.85
		SB	PWS-03	PWS-03_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0005	0.0164	0.0181	0.0196	0.0639	0.0315	0.0210	0.0047	0.0520	0.0516	0.0041	0.0309	0.0658	0.0249	0.0233	0.0048	0.0105	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.72**	0.74
		SB	PWS-04	PWS-04_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0050	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0204	0.0094	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**	0.54
		SB	PWS-05	PWS-05_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0153	0.0065	0.0352	0.0639	0.0315	0.0096	0.0010	0.0354	0.0012	0.0041	0.0309	0.0132	0.0055	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.56**	0.57
		SB	PWS-06	PWS-06_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0162	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0159	0.0060	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**	0.45
		SB	PWS-07	PWS-07_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0178	0.0093	0.0217	0.0639	0.0315	0.0179	0.0028	0.0494	0.0641	0.0041	0.0309	0.0318	0.0136	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.67**	0.69
		SB	PWS-08	PWS-08_8-11_PW	N	0.0058	0.0072	0.0257	0.0210	0.0011	0.0004	0.0129	0.0055	0.0221	0.0639	0.0315	0.0118	0.0008	0.0471	0.0656	0.0041	0.0309	0.0271	0.0117	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.67**	0.69
		SB	PWS-09	PWS-09_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0033	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.42
		SB	PWS-12	PWS-12_8-11 DUP_PW	FD	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0031	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.39
		SB	PWS-12	PWS-12_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0017	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.51
		SB	PWS-13	PWS-13_1-4_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.40
		SB	PWS-13	PWS-13_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.42
		SB	PWS-15	PWS-15_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.08
		SB	PWS-16	PWS-16_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0047	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.17
		SB	PWS-16	PWS-16B_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0042	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0181	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**	0.53
		SB	PWS-25	PWS-25_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0116	0.0051	0.0196	0.0639	0.0315	0.0093	0.0008	0.0402	0.0985	0.0041	0.0309	0.0294	0.0161	0.0233	0.0048	0.0045	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.67**	0.68
		SB	PWS-26	PWS-26_8-11_PW	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0041	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0212	0.0100	0.0233	0.0048	0.0031	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.55**	0.42
	October 2012	MC	PWS-17	PWS-17_4-7 POREWATER	N	0.0058	0.0138	0.0257	0.0333	0.0011	0.0007	0.0487	0.0117	0.0234	0.0639	0.0315	0.0146	0.0015	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.43**	0.34
		MC	PWS-27	PWS-27_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0040	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0030	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.33**	0.10
		MC	PWS-30	PWS-30_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.32**	0.28
		SB	LSI-01	LSI-01_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0032	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.53**	0.16
		SB	LSI-02	LSI-02_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0136	0.0066	0.0196	0.0639	0.0315	0.0089	0.0008	0.0354	0.0012	0.0041	0.0309	0.0232	0.0113	0.0233	0.0048	0.0044	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.56**	0.21
		SB	LSI-20	LSI-20_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0267	0.0051	0.0272	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0187	0.0112	0.0233	0.0048	0.0041	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.58**	0.22
		SB	LSI-24	LSI-24-8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0006	0.0297	0.0051	0.0196	0.0639	0.0315	0.0084	0.0011	0.0354	0.0012	0.0041	0.0309	0.0165	0.0094	0.0233	0.0048	0.0042	0.0075	0.0259	0.0109	0.3611	0.0782	0.0826	0.0588	0.0554	0.0588	0.1927	0.1876	0.1207	**1.57**	0.21
		SB	PWS-01	PWS-1_8-10 POREWATER	N	0.0058	0.0072	0.0446	0.0003	0.0011	0.0011	0.0876	0.0295	0.0257	0.0639	0.0315	0.0167	0.0008	0.0354	0.0012	0.0041	0.0309	0.0128	0.0051	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.47**	0.62
		SB	PWS-03	PWS-3_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0115	0.0132	0.0209	0.0639	0.0315	0.0105	0.0021	0.0354	0.0012	0.0041	0.0309	0.0461	0.0196	0.0233	0.0055	0.0101	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.41**	0.40
		SB	PWS-04	PWS-4_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0097	0.0059	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0169	0.0071	0.0233	0.0048	0.0037	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.34**	0.47
		SB	PWS-05	PWS-5_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0122	0.0059	0.0196	0.0639	0.0315	0.0120	0.0008	0.0354	0.0012	0.0041	0.0309	0.0160	0.0061	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.35**	0.22
		SB	PWS-06	PWS-6_8-11 POREWATER	N	0.0058	0.0072	0.0289	0.1000	0.0011	0.0004	0.0301	0.0084	0.0199	0.0639	0.0315	0.0105	0.0008	0.0354	0.0012	0.0041	0.0309	0.0177	0.0072	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.47**	0.28
		SB	PWS-07	PWS-7_8-10 DUP POREWATER	FD	0.0058	0.0072	0.0933	0.2162	0.0011	0.0016	0.0818	0.0712	0.0858	0.0639	0.0315	0.1709	0.0416	0.1272	0.1178	0.0041	0.0309	0.1632	0.0631	0.0462	0.0330	0.0266	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**2.52**	**1.36**
		SB	PWS-07	PWS-7_8-10 POREWATER	N	0.0058	0.0072	0.0257	0.0734	0.0011	0.0004	0.0217	0.0137	0.0429	0.0639	0.0315	0.0261	0.0041	0.0481	0.0932	0.0041	0.0309	0.0336	0.0139	0.0233	0.0048	0.0082	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.61**	0.52
		SB	PWS-08	PWS-8_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0125	0.0127	0.0214	0.0639	0.0315	0.0235	0.0022	0.0354	0.0012	0.0041	0.0309	0.0263	0.0112	0.0233	0.0076	0.0046	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.39**	0.37
		SB	PWS-09	PWS-9_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0081	0.0069	0.0203	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0102	0.0049	0.0233	0.0048	0.0051	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.34**	0.23
		SB	PWS-12	PWS-12_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0079	0.0071	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.33**	0.11
		SB	PWS-13	PWS-13_8-11 POREWATER	N	0.0058	0.0072	0.4530	**2.2613**	0.9387	0.0008	0.0249	0.0150	0.1408	0.3751	0.0315	0.0889	0.0038	0.4048	0.6627	0.3264	0.0309	0.0374	0.0214	0.0358	0.0085	0.0114	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**6.92**	**2.80**
		SB	PWS-15	PWS-15_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0082	0.0051	0.0196	0.0639	0.0315	0.0089	0.0008	0.0354	0.0012	0.0041	0.0309	0.0092	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.33**	0.25
		SB	PWS-16	PWS-16_8-11 POREWATER	N	0.0058	0.0072	0.0387	0.0003	0.0011	0.0004	0.0220	0.0198	0.0255	0.0639	0.0315	0.0261	0.0016	0.0354	0.0012	0.0041	0.0309	0.0224	0.0084	0.0233	0.0048	0.0024	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.41**	0.16
		SB	PWS-25	PWS-25_4-8 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0034	0.0051	0.0196	0.0639	0.0315	0.0089	0.0008	0.0354	0.0012	0.0041	0.0309	0.0470	0.0215	0.0233	0.0108	0.0075	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.39**	0.35
		SB	PWS-26	PWS-26_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0098	0.0051	0.0196	0.0639	0.0315	0.0110	0.0008	0.0354	0.0012	0.0041	0.0309	0.0193	0.0082	0.0233	0.0048	0.0021	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.35**	0.24
		SB	PWS-26	PWS-26_8-11_DUP POREWATER	FD	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0100	0.0056	0.0196	0.0639	0.0315	0.0099	0.0008	0.0354	0.0012	0.0041	0.0309	0.0194	0.0083	0.0233	0.0048	0.0031	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.35**	0.48
		SB	PWS-28	PWS-28_8-11 POREWATER	N	0.0058	0.0072	0.0257	0.0003	0.0011	0.0004	0.0027	0.0051	0.0196	0.0639	0.0315	0.0078	0.0008	0.0354	0.0012	0.0041	0.0309	0.0082	0.0049	0.0233	0.0048	0.0020	0.0075	0.0259	0.0109	0.3611	0.0590	0.0624	0.0444	0.0418	0.0444	0.1455	0.1416	0.0911	**1.32**	0.29
	Sept 2017	SB	PWS-1	Shallow Porewater Site 1	N	0.0000	0.0001	0.0007	0.0085	0.0578	0.0000	0.0002	0.0002	0.0003	0.0017	0.0036	0.0001	0.0000	0.0002	0.0010	0.0038	0.0026	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.08	
		MC	PWS-2	Shallow Porewater Site 2	N	0.0005	0.0206	0.8102	**4.0270**	**10.7460**	0.0000	0.0015	0.0016	0.0147	0.1084	0.1597	0.0014	0.0002	0.0093	0.0463	0.1162	0.1139	0.0000	0.0001	0.0003	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**16.2**	
		SB	PWS-3	Shallow Porewater Site 3	N	0.0000	0.0000	0.0002	0.0010	0.0181	0.0000	0.0000	0.0000	0.0000	0.0002	0.0006	0.0000	0.0000	0.0001	0.0006	0.0006	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.02	
		SB	PWS-4	Shallow Porewater Site 4	N	0.0000	0.0001	0.0007	0.0040	0.0371	0.0000	0.0001	0.0001	0.0000	0.0006	0.0030	0.0001	0.0000	0.0003	0.0009	0.0027	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.05	
		SB	PWS-5	Shallow Porewater Site 5	N	0.0002	0.0003	0.0033	0.0337	0.1336	0.0000	0.0002	0.0001	0.0002	0.0021	0.0049	0.0001	0.0000	0.0002	0.0014	0.0050	0.0046	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.19	
		SB	PWS-6	Shallow Porewater Site 6	N	0.0000	0.0001	0.0006	0.0038	0.0230	0.0000	0.0001	0.0001	0.0001	0.0005	0.0020	0.0000	0.0000	0.0001	0.0006	0.0025	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.04	
		SB	PWS-7	Shallow Porewater Site 7	N	0.0000	0.0001	0.0006	0.0045	0.0257	0.0000	0.0001	0.0001	0.0001	0.0007	0.0037	0.0000	0.0000	0.0001	0.0006	0.0006	0.0025	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.04	
		SB	PWS-8	Shallow Porewater Site 8	N	0.0001	0.0002	0.0012	0.0095	0.0590	0.0000	0.0002	0.0001	0.0003	0.0018	0.0064	0.0001	0.0000	0.0002	0.0015	0.0052	0.0043	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.09	
		SB	PWS-9	Shallow Porewater Site 9	N	0.0000	0.0001	0.0006	0.0046	0.0292	0.0000	0.0002	0.0001	0.0001	0.0006	0.0033	0.0000	0.0000	0.0001	0.0008	0.0034	0.0025	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.05	
		SB	PWS-10	Shallow Porewater Site 10	N	0.0000	0.0001	0.0009	0.0123	0.1010	0.0000	0.0003	0.0002	0.0004	0.0020	0.0035	0.0001	0.0000	0.0002	0.0012	0.0036	0.0025	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.13	
		SB	PWS-11	Shallow Porewater Site 11	N	0.0000	0.0001	0.0006	0.0077	0.0578	0.0000	0.0003	0.0002	0.0002	0.0014	0.0033	0.0001	0.0001	0.0002	0.0014	0.0045	0.0025	0.0002	0.0001	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.08	
		SB	PWS-12	Shallow Porewater Site 12	N	0.0026	0.0045	0.0148	0.0537	0.1964	0.0000	0.0011	0.0024	0.0026	0.0061	0.0090	0.0042	0.0002	0.0020	0.0047	0.0090	0.0078	0.0017

ATTACHMENT D

Pro-UCL Version 5.0 Output Sheets

APPENDIX G-D-1

Pro-UCL Version 5.0 Output Sheets

Scappoose Bay Porewater Data, 90% Upper Confidence Limits

(Only results for PAHs with 5 or more detections are presented)

Acenaphthene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	34
Number of Detects	30	Number of Non-Detects	4
Number of Distinct Detects	30	Number of Distinct Non-Detects	4
Minimum Detect	0.174	Minimum Non-Detect	0.134
Maximum Detect	9.299	Maximum Non-Detect	0.15
Variance Detects	3.526	Percent Non-Detects	11.76%
Mean Detects	1.241	SD Detects	1.878
Median Detects	0.683	CV Detects	1.514
Skewness Detects	3.323	Kurtosis Detects	12.08
Mean of Logged Detects	-0.363	SD of Logged Detects	0.998

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.549	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.927	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.32	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.162	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.111	Standard Error of Mean	0.309
SD	1.771	90% KM (BCA) UCL	1.526
90% KM (t) UCL	1.514	90% KM (Percentile Bootstrap) UCL	1.527
90% KM (z) UCL	1.506	90% KM Bootstrap t UCL	1.848
90% KM Chebyshev UCL	2.037	95% KM Chebyshev UCL	2.457
97.5% KM Chebyshev UCL	3.039	99% KM Chebyshev UCL	4.184

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.606	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.776	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.184	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.165	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.998	k star (bias corrected MLE)	0.921
Theta hat (MLE)	1.243	Theta star (bias corrected MLE)	1.347
nu hat (MLE)	59.9	nu star (bias corrected)	55.25
MLE Mean (bias corrected)	1.241	MLE Sd (bias corrected)	1.293

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.393	nu hat (KM)	26.75
Approximate Chi Square Value (26.75, α)	17.91	Adjusted Chi Square Value (26.75, β)	17.63
90% Gamma Approximate KM-UCL (use when n>=50)	1.659	90% Gamma Adjusted KM-UCL (use when n<50)	1.685

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.096
Maximum	9.299	Median	0.642

SD	1.806	CV	1.648
k hat (MLE)	0.642	k star (bias corrected MLE)	0.605
Theta hat (MLE)	1.708	Theta star (bias corrected MLE)	1.812
nu hat (MLE)	43.64	nu star (bias corrected)	41.13
MLE Mean (bias corrected)	1.096	MLE Sd (bias corrected)	1.409
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (41.13, α)	30.01	Adjusted Chi Square Value (41.13, β)	29.64
90% Gamma Approximate UCL (use when n>=50)	1.502	90% Gamma Adjusted UCL (use when n<50)	1.52

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.933	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.927	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0986	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.162	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.104	Mean in Log Scale	-0.625
SD in Original Scale	1.801	SD in Log Scale	1.187
90% t UCL (assumes normality of ROS data)	1.508	90% Percentile Bootstrap UCL	1.51
90% BCA Bootstrap UCL	1.663	90% Bootstrap t UCL	1.904
90% H-UCL (Log ROS)	1.634		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.556	90% H-UCL (KM -Log)	1.429
KM SD (logged)	1.063	90% Critical H Value (KM-Log)	1.88
KM Standard Error of Mean (logged)	0.185		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.103	Mean in Log Scale	-0.63
SD in Original Scale	1.801	SD in Log Scale	1.194
90% t UCL (Assumes normality)	1.507	90% H-Stat UCL	1.648

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Acenaphthylene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	25
Number of Detects	8	Number of Non-Detects	26
Number of Distinct Detects	8	Number of Distinct Non-Detects	17
Minimum Detect	0.121	Minimum Non-Detect	0.117
Maximum Detect	0.902	Maximum Non-Detect	0.12
Variance Detects	0.0714	Percent Non-Detects	76.47%
Mean Detects	0.317	SD Detects	0.267
Median Detects	0.207	CV Detects	0.843
Skewness Detects	1.81	Kurtosis Detects	3.282
Mean of Logged Detects	-1.397	SD of Logged Detects	0.717

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.776	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.245	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.164	Standard Error of Mean	0.0271
SD	0.148	90% KM (BCA) UCL	0.197
90% KM (t) UCL	0.2	90% KM (Percentile Bootstrap) UCL	0.201
90% KM (z) UCL	0.199	90% KM Bootstrap t UCL	0.238
90% KM Chebyshev UCL	0.246	95% KM Chebyshev UCL	0.283
97.5% KM Chebyshev UCL	0.334	99% KM Chebyshev UCL	0.434

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.476	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.201	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.165	k star (bias corrected MLE)	1.436
Theta hat (MLE)	0.146	Theta star (bias corrected MLE)	0.221
nu hat (MLE)	34.63	nu star (bias corrected)	22.98
MLE Mean (bias corrected)	0.317	MLE Sd (bias corrected)	0.265

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.235	nu hat (KM)	83.97
Approximate Chi Square Value (83.97, α)	67.85	Adjusted Chi Square Value (83.97, β)	67.28
90% Gamma Approximate KM-UCL (use when n>=50)	0.203	90% Gamma Adjusted KM-UCL (use when n<50)	0.205

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0823
Maximum	0.902	Median	0.01

SD	0.181	CV	2.196
k hat (MLE)	0.474	k star (bias corrected MLE)	0.452
Theta hat (MLE)	0.174	Theta star (bias corrected MLE)	0.182
nu hat (MLE)	32.21	nu star (bias corrected)	30.7
MLE Mean (bias corrected)	0.0822	MLE Sd (bias corrected)	0.122
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (30.70, α)	21.19	Adjusted Chi Square Value (30.70, β)	20.88
90% Gamma Approximate UCL (use when n>=50)	0.119	90% Gamma Adjusted UCL (use when n<50)	0.121

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.173	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0868	Mean in Log Scale	-3.642
SD in Original Scale	0.179	SD in Log Scale	1.431
90% t UCL (assumes normality of ROS data)	0.127	90% Percentile Bootstrap UCL	0.127
90% BCA Bootstrap UCL	0.144	90% Bootstrap t UCL	0.163
90% H-UCL (Log ROS)	0.127		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.967	90% H-UCL (KM -Log)	0.174
KM SD (logged)	0.453	90% Critical H Value (KM-Log)	1.443
KM Standard Error of Mean (logged)	0.0831		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.12	Mean in Log Scale	-2.483
SD in Original Scale	0.166	SD in Log Scale	0.694
90% t UCL (Assumes normality)	0.157	90% H-Stat UCL	0.129

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Anthracene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	27
Number of Detects	12	Number of Non-Detects	22
Number of Distinct Detects	12	Number of Distinct Non-Detects	15
Minimum Detect	0.0162	Minimum Non-Detect	0.0116
Maximum Detect	0.834	Maximum Non-Detect	0.016
Variance Detects	0.0531	Percent Non-Detects	64.71%
Mean Detects	0.106	SD Detects	0.23
Median Detects	0.0433	CV Detects	2.165
Skewness Detects	3.401	Kurtosis Detects	11.68
Mean of Logged Detects	-3.109	SD of Logged Detects	1.083

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.413	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.859	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.434	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.256	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0451	Standard Error of Mean	0.0248
SD	0.139	90% KM (BCA) UCL	0.0915
90% KM (t) UCL	0.0776	90% KM (Percentile Bootstrap) UCL	0.0725
90% KM (z) UCL	0.0769	90% KM Bootstrap t UCL	0.267
90% KM Chebyshev UCL	0.12	95% KM Chebyshev UCL	0.153
97.5% KM Chebyshev UCL	0.2	99% KM Chebyshev UCL	0.292

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.794	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.77	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.347	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.256	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.697	k star (bias corrected MLE)	0.578
Theta hat (MLE)	0.153	Theta star (bias corrected MLE)	0.184
nu hat (MLE)	16.72	nu star (bias corrected)	13.87
MLE Mean (bias corrected)	0.106	MLE Sd (bias corrected)	0.14

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.106	nu hat (KM)	7.192
Approximate Chi Square Value (7.19, α)	2.959	Adjusted Chi Square Value (7.19, β)	2.855
90% Gamma Approximate KM-UCL (use when n>=50)	0.11	90% Gamma Adjusted KM-UCL (use when n<50)	0.114

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.044	
Maximum	0.834	Median	0.01	

SD	0.141	CV	3.203
k hat (MLE)	0.641	k star (bias corrected MLE)	0.604
Theta hat (MLE)	0.0686	Theta star (bias corrected MLE)	0.0728
nu hat (MLE)	43.62	nu star (bias corrected)	41.1
MLE Mean (bias corrected)	0.044	MLE Sd (bias corrected)	0.0566
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (41.10, α)	30	Adjusted Chi Square Value (41.10, β)	29.63
90% Gamma Approximate UCL (use when n>=50)	0.0603	90% Gamma Adjusted UCL (use when n<50)	0.0611

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.799	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.859	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.256	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0388	Mean in Log Scale	-5.256
SD in Original Scale	0.142	SD in Log Scale	1.808
90% t UCL (assumes normality of ROS data)	0.0707	90% Percentile Bootstrap UCL	0.0693
90% BCA Bootstrap UCL	0.0948	90% Bootstrap t UCL	0.229
90% H-UCL (Log ROS)	0.0612		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-3.978	90% H-UCL (KM -Log)	0.0364
KM SD (logged)	0.89	90% Critical H Value (KM-Log)	1.735
KM Standard Error of Mean (logged)	0.159		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0425	Mean in Log Scale	-4.25
SD in Original Scale	0.141	SD in Log Scale	1.061
90% t UCL (Assumes normality)	0.0742	90% H-Stat UCL	0.0354

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Benzo(a)Anthracene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	20
Number of Detects	5	Number of Non-Detects	29
Number of Distinct Detects	5	Number of Distinct Non-Detects	15
Minimum Detect	0.00316	Minimum Non-Detect	0.00153
Maximum Detect	0.0192	Maximum Non-Detect	0.0506
Variance Detects	4.1761E-5	Percent Non-Detects	85.29%
Mean Detects	0.0104	SD Detects	0.00646
Median Detects	0.0101	CV Detects	0.624
Skewness Detects	0.373	Kurtosis Detects	-1.148
Mean of Logged Detects	-4.76	SD of Logged Detects	0.728

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.966	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.179	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0035	Standard Error of Mean	8.7482E-4
SD	0.00381	90% KM (BCA) UCL	0.00492
90% KM (t) UCL	0.00464	90% KM (Percentile Bootstrap) UCL	0.00477
90% KM (z) UCL	0.00462	90% KM Bootstrap t UCL	0.0041
90% KM Chebyshev UCL	0.00612	95% KM Chebyshev UCL	0.00731
97.5% KM Chebyshev UCL	0.00896	99% KM Chebyshev UCL	0.0122

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.212	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.683	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.36	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.789	k star (bias corrected MLE)	1.249
Theta hat (MLE)	0.00371	Theta star (bias corrected MLE)	0.00829
nu hat (MLE)	27.89	nu star (bias corrected)	12.49
MLE Mean (bias corrected)	0.0104	MLE Sd (bias corrected)	0.00927

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.841	nu hat (KM)	57.18
Approximate Chi Square Value (57.18, α)	43.98	Adjusted Chi Square Value (57.18, β)	43.52
90% Gamma Approximate KM-UCL (use when n>=50)	0.00455	90% Gamma Adjusted KM-UCL (use when n<50)	0.00459

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.00316	Mean	0.0104	
Maximum	0.0192	Median	0.01	

SD	0.00225	CV	0.224
k hat (MLE)	18.02	k star (bias corrected MLE)	16.45
Theta hat (MLE)	5.5778E-4	Theta star (bias corrected MLE)	6.1103E-4
nu hat (MLE)	1225	nu star (bias corrected)	1119
MLE Mean (bias corrected)	0.0101	MLE Sd (bias corrected)	0.00248
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (N/A, α)	1058	Adjusted Chi Square Value (N/A, β)	1056
90% Gamma Approximate UCL (use when n>=50)	0.0106	90% Gamma Adjusted UCL (use when n<50)	0.0106

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.192	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00287	Mean in Log Scale	-6.367
SD in Original Scale	0.00401	SD in Log Scale	0.934
90% t UCL (assumes normality of ROS data)	0.00377	90% Percentile Bootstrap UCL	0.00374
90% BCA Bootstrap UCL	0.00401	90% Bootstrap t UCL	0.0043
90% H-UCL (Log ROS)	0.00354		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-5.969	90% H-UCL (KM -Log)	0.00392
KM SD (logged)	0.688	90% Critical H Value (KM-Log)	1.584
KM Standard Error of Mean (logged)	0.231		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.00554	Mean in Log Scale	-5.44
SD in Original Scale	0.00491	SD in Log Scale	0.688
90% t UCL (Assumes normality)	0.00664	90% H-Stat UCL	0.00665

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-1 Fluorenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	26
Number of Detects	13	Number of Non-Detects	21
Number of Distinct Detects	13	Number of Distinct Non-Detects	13
Minimum Detect	0.214	Minimum Non-Detect	0.174
Maximum Detect	1.261	Maximum Non-Detect	0.272
Variance Detects	0.116	Percent Non-Detects	61.76%
Mean Detects	0.458	SD Detects	0.34
Median Detects	0.307	CV Detects	0.742
Skewness Detects	1.966	Kurtosis Detects	2.717
Mean of Logged Detects	-0.954	SD of Logged Detects	0.555

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.658	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.309	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.246	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.302	Standard Error of Mean	0.0434
SD	0.238	90% KM (BCA) UCL	0.364
90% KM (t) UCL	0.358	90% KM (Percentile Bootstrap) UCL	0.357
90% KM (z) UCL	0.357	90% KM Bootstrap t UCL	0.418
90% KM Chebyshev UCL	0.432	95% KM Chebyshev UCL	0.491
97.5% KM Chebyshev UCL	0.572	99% KM Chebyshev UCL	0.733

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.403	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.739	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.279	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.238	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.043	k star (bias corrected MLE)	2.392
Theta hat (MLE)	0.151	Theta star (bias corrected MLE)	0.192
nu hat (MLE)	79.11	nu star (bias corrected)	62.19
MLE Mean (bias corrected)	0.458	MLE Sd (bias corrected)	0.296

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.61	nu hat (KM)	109.5
Approximate Chi Square Value (109.45, α)	90.97	Adjusted Chi Square Value (109.45, β)	90.31
90% Gamma Approximate KM-UCL (use when n>=50)	0.363	90% Gamma Adjusted KM-UCL (use when n<50)	0.365

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.19
Maximum	1.261	Median	0.0103

SD	0.298	CV	1.573
k hat (MLE)	0.475	k star (bias corrected MLE)	0.452
Theta hat (MLE)	0.399	Theta star (bias corrected MLE)	0.419
nu hat (MLE)	32.27	nu star (bias corrected)	30.76
MLE Mean (bias corrected)	0.19	MLE Sd (bias corrected)	0.282
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (30.76, α)	21.23	Adjusted Chi Square Value (30.76, β)	20.92
90% Gamma Approximate UCL (use when n>=50)	0.275	90% Gamma Adjusted UCL (use when n<50)	0.279

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.812	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.245	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.246	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.256	Mean in Log Scale	-1.647
SD in Original Scale	0.263	SD in Log Scale	0.692
90% t UCL (assumes normality of ROS data)	0.315	90% Percentile Bootstrap UCL	0.314
90% BCA Bootstrap UCL	0.329	90% Bootstrap t UCL	0.361
90% H-UCL (Log ROS)	0.297		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.35	90% H-UCL (KM -Log)	0.325
KM SD (logged)	0.466	90% Critical H Value (KM-Log)	1.45
KM Standard Error of Mean (logged)	0.0947		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.255	Mean in Log Scale	-1.634
SD in Original Scale	0.262	SD in Log Scale	0.644
90% t UCL (Assumes normality)	0.313	90% H-Stat UCL	0.286

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-1 Phenanthrenes/Anthracenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	24
Number of Detects	6	Number of Non-Detects	28
Number of Distinct Detects	6	Number of Distinct Non-Detects	18
Minimum Detect	0.295	Minimum Non-Detect	0.109
Maximum Detect	1.384	Maximum Non-Detect	0.26
Variance Detects	0.188	Percent Non-Detects	82.35%
Mean Detects	0.604	SD Detects	0.434
Median Detects	0.372	CV Detects	0.718
Skewness Detects	1.536	Kurtosis Detects	1.517
Mean of Logged Detects	-0.682	SD of Logged Detects	0.619

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.758	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.362	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.197	Standard Error of Mean	0.0472
SD	0.252	90% KM (BCA) UCL	0.301
90% KM (t) UCL	0.258	90% KM (Percentile Bootstrap) UCL	0.269
90% KM (z) UCL	0.257	90% KM Bootstrap t UCL	0.268
90% KM Chebyshev UCL	0.338	95% KM Chebyshev UCL	0.403
97.5% KM Chebyshev UCL	0.492	99% KM Chebyshev UCL	0.667

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.712	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.701	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.369	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.335	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.968	k star (bias corrected MLE)	1.595
Theta hat (MLE)	0.204	Theta star (bias corrected MLE)	0.379
nu hat (MLE)	35.61	nu star (bias corrected)	19.14
MLE Mean (bias corrected)	0.604	MLE Sd (bias corrected)	0.478

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.612	nu hat (KM)	41.59
Approximate Chi Square Value (41.59, α)	30.41	Adjusted Chi Square Value (41.59, β)	30.04
90% Gamma Approximate KM-UCL (use when n>=50)	0.269	90% Gamma Adjusted KM-UCL (use when n<50)	0.272

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.115
Maximum	1.384	Median	0.01

SD	0.285	CV	2.484
k hat (MLE)	0.38	k star (bias corrected MLE)	0.366
Theta hat (MLE)	0.303	Theta star (bias corrected MLE)	0.314
nu hat (MLE)	25.81	nu star (bias corrected)	24.86
MLE Mean (bias corrected)	0.115	MLE Sd (bias corrected)	0.19
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (24.86, α)	16.36	Adjusted Chi Square Value (24.86, β)	16.09
90% Gamma Approximate UCL (use when n>=50)	0.175	90% Gamma Adjusted UCL (use when n<50)	0.177

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.82	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.341	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.135	Mean in Log Scale	-3.05
SD in Original Scale	0.278	SD in Log Scale	1.292
90% t UCL (assumes normality of ROS data)	0.198	90% Percentile Bootstrap UCL	0.198
90% BCA Bootstrap UCL	0.22	90% Bootstrap t UCL	0.257
90% H-UCL (Log ROS)	0.175		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.943	90% H-UCL (KM -Log)	0.207
KM SD (logged)	0.63	90% Critical H Value (KM-Log)	1.545
KM Standard Error of Mean (logged)	0.118		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.201	Mean in Log Scale	-1.919
SD in Original Scale	0.254	SD in Log Scale	0.66
90% t UCL (Assumes normality)	0.258	90% H-Stat UCL	0.219

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-2 Naphthalenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	22
Number of Detects	6	Number of Non-Detects	28
Number of Distinct Detects	6	Number of Distinct Non-Detects	16
Minimum Detect	0.816	Minimum Non-Detect	0.635
Maximum Detect	11.24	Maximum Non-Detect	0.776
Variance Detects	16.31	Percent Non-Detects	82.35%
Mean Detects	3.12	SD Detects	4.039
Median Detects	1.486	CV Detects	1.294
Skewness Detects	2.294	Kurtosis Detects	5.362
Mean of Logged Detects	0.657	SD of Logged Detects	0.967

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.643	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.368	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.074	Standard Error of Mean	0.341
SD	1.816	90% KM (BCA) UCL	1.69
90% KM (t) UCL	1.52	90% KM (Percentile Bootstrap) UCL	1.502
90% KM (z) UCL	1.511	90% KM Bootstrap t UCL	2.726
90% KM Chebyshev UCL	2.097	95% KM Chebyshev UCL	2.561
97.5% KM Chebyshev UCL	3.204	99% KM Chebyshev UCL	4.468

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.678	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.29	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.34	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.178	k star (bias corrected MLE)	0.7
Theta hat (MLE)	2.649	Theta star (bias corrected MLE)	4.456
nu hat (MLE)	14.14	nu star (bias corrected)	8.402
MLE Mean (bias corrected)	3.12	MLE Sd (bias corrected)	3.729

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.35	nu hat (KM)	23.78
Approximate Chi Square Value (23.78, α)	15.48	Adjusted Chi Square Value (23.78, β)	15.22
90% Gamma Approximate KM-UCL (use when n>=50)	1.649	90% Gamma Adjusted KM-UCL (use when n<50)	1.678

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01		Mean	0.559
Maximum	11.24		Median	0.01

SD	1.98	CV	3.543
k hat (MLE)	0.232	k star (bias corrected MLE)	0.231
Theta hat (MLE)	2.406	Theta star (bias corrected MLE)	2.416
nu hat (MLE)	15.79	nu star (bias corrected)	15.73
MLE Mean (bias corrected)	0.559	MLE Sd (bias corrected)	1.162
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (15.73, α)	9.107	Adjusted Chi Square Value (15.73, β)	8.911
90% Gamma Approximate UCL (use when n>=50)	0.965	90% Gamma Adjusted UCL (use when n<50)	0.987

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.865	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.362	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.581	Mean in Log Scale	-3.116
SD in Original Scale	1.974	SD in Log Scale	2.114
90% t UCL (assumes normality of ROS data)	1.024	90% Percentile Bootstrap UCL	0.996
90% BCA Bootstrap UCL	1.318	90% Bootstrap t UCL	2.2
90% H-UCL (Log ROS)	1.238		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.258	90% H-UCL (KM -Log)	1.049
KM SD (logged)	0.563	90% Critical H Value (KM-Log)	1.504
KM Standard Error of Mean (logged)	0.106		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.864	Mean in Log Scale	-0.682
SD in Original Scale	1.896	SD in Log Scale	0.734
90% t UCL (Assumes normality)	1.289	90% H-Stat UCL	0.814

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-2 Phenanthrenes/Anthracenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	25
Number of Detects	7	Number of Non-Detects	27
Number of Distinct Detects	7	Number of Distinct Non-Detects	18
Minimum Detect	0.056	Minimum Non-Detect	7.9047E-4
Maximum Detect	0.518	Maximum Non-Detect	0.00359
Variance Detects	0.0213	Percent Non-Detects	79.41%
Mean Detects	0.248	SD Detects	0.146
Median Detects	0.203	CV Detects	0.589
Skewness Detects	0.911	Kurtosis Detects	1.604
Mean of Logged Detects	-1.571	SD of Logged Detects	0.695

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.936	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.335	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0517	Standard Error of Mean	0.0217
SD	0.117	90% KM (BCA) UCL	0.0769
90% KM (t) UCL	0.08	90% KM (Percentile Bootstrap) UCL	0.0782
90% KM (z) UCL	0.0795	90% KM Bootstrap t UCL	0.0804
90% KM Chebyshev UCL	0.117	95% KM Chebyshev UCL	0.146
97.5% KM Chebyshev UCL	0.187	99% KM Chebyshev UCL	0.268

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.262	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.162	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.314	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.998	k star (bias corrected MLE)	1.809
Theta hat (MLE)	0.0827	Theta star (bias corrected MLE)	0.137
nu hat (MLE)	41.98	nu star (bias corrected)	25.32
MLE Mean (bias corrected)	0.248	MLE Sd (bias corrected)	0.184

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.194	nu hat (KM)	13.21
Approximate Chi Square Value (13.21, α)	7.199	Adjusted Chi Square Value (13.21, β)	7.027
90% Gamma Approximate KM-UCL (use when n>=50)	0.0948	90% Gamma Adjusted KM-UCL (use when n<50)	0.0971

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.059
Maximum	0.518	Median	0.01

SD	0.116	CV	1.963
k hat (MLE)	0.545	k star (bias corrected MLE)	0.517
Theta hat (MLE)	0.108	Theta star (bias corrected MLE)	0.114
nu hat (MLE)	37.07	nu star (bias corrected)	35.14
MLE Mean (bias corrected)	0.059	MLE Sd (bias corrected)	0.082
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (35.14, α)	24.91	Adjusted Chi Square Value (35.14, β)	24.57
90% Gamma Approximate UCL (use when n>=50)	0.0832	90% Gamma Adjusted UCL (use when n<50)	0.0843

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.209	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.335	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0636	Mean in Log Scale	-3.749
SD in Original Scale	0.114	SD in Log Scale	1.285
90% t UCL (assumes normality of ROS data)	0.0892	90% Percentile Bootstrap UCL	0.0885
90% BCA Bootstrap UCL	0.0965	90% Bootstrap t UCL	0.101
90% H-UCL (Log ROS)	0.0857		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-5.996	90% H-UCL (KM -Log)	0.115
KM SD (logged)	2.272	90% Critical H Value (KM-Log)	3.157
KM Standard Error of Mean (logged)	0.421		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0521	Mean in Log Scale	-5.584
SD in Original Scale	0.119	SD in Log Scale	2.126
90% t UCL (Assumes normality)	0.0788	90% H-Stat UCL	0.109

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

C-3 Naphthalenes

General Statistics

Total Number of Observations	34	Number of Distinct Observations	22
Number of Detects	5	Number of Non-Detects	29
Number of Distinct Detects	5	Number of Distinct Non-Detects	17
Minimum Detect	0.231	Minimum Non-Detect	0.00182
Maximum Detect	14.98	Maximum Non-Detect	0.00327
Variance Detects	39.85	Percent Non-Detects	85.29%
Mean Detects	3.77	SD Detects	6.313
Median Detects	0.906	CV Detects	1.675
Skewness Detects	2.153	Kurtosis Detects	4.681
Mean of Logged Detects	0.243	SD of Logged Detects	1.613

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.656	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.394	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.396	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.556	Standard Error of Mean	0.488
SD	2.544	90% KM (BCA) UCL	1.042
90% KM (t) UCL	1.194	90% KM (Percentile Bootstrap) UCL	1.109
90% KM (z) UCL	1.181	90% KM Bootstrap t UCL	3.235
90% KM Chebyshev UCL	2.019	95% KM Chebyshev UCL	2.682
97.5% KM Chebyshev UCL	3.602	99% KM Chebyshev UCL	5.409

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.456	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.26	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.37	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.574	k star (bias corrected MLE)	0.363
Theta hat (MLE)	6.569	Theta star (bias corrected MLE)	10.39
nu hat (MLE)	5.739	nu star (bias corrected)	3.629
MLE Mean (bias corrected)	3.77	MLE Sd (bias corrected)	6.258

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0478	nu hat (KM)	3.249
Approximate Chi Square Value (3.25, α)	0.704	Adjusted Chi Square Value (3.25, β)	0.662
90% Gamma Approximate KM-UCL (use when n>=50)	2.566	90% Gamma Adjusted KM-UCL (use when n<50)	2.728

Gamma (KM) may not be used when k hat (KM) is < 0.1

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.563

Maximum	14.98	Median	0.01
SD	2.58	CV	4.584
k hat (MLE)	0.219	k star (bias corrected MLE)	0.219
Theta hat (MLE)	2.574	Theta star (bias corrected MLE)	2.57
nu hat (MLE)	14.87	nu star (bias corrected)	14.89
MLE Mean (bias corrected)	0.563	MLE Sd (bias corrected)	1.203
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (14.89, α)	8.466	Adjusted Chi Square Value (14.89, β)	8.278
90% Gamma Approximate UCL (use when n>=50)	0.99	90% Gamma Adjusted UCL (use when n<50)	1.013

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.184	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.556	Mean in Log Scale	-7.158
SD in Original Scale	2.582	SD in Log Scale	3.779
90% t UCL (assumes normality of ROS data)	1.135	90% Percentile Bootstrap UCL	1.082
90% BCA Bootstrap UCL	1.566	90% Bootstrap t UCL	6.085
90% H-UCL (Log ROS)	25.83		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-5.346	90% H-UCL (KM -Log)	0.322
KM SD (logged)	2.386	90% Critical H Value (KM-Log)	3.29
KM Standard Error of Mean (logged)	0.457		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.556	Mean in Log Scale	-5.506
SD in Original Scale	2.582	SD in Log Scale	2.491
90% t UCL (Assumes normality)	1.135	90% H-Stat UCL	0.397

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Chrysene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	27
Number of Detects	14	Number of Non-Detects	20
Number of Distinct Detects	14	Number of Distinct Non-Detects	13
Minimum Detect	6.3558E-4	Minimum Non-Detect	6.0132E-4
Maximum Detect	0.0203	Maximum Non-Detect	0.0363
Variance Detects	2.9208E-5	Percent Non-Detects	58.82%
Mean Detects	0.00763	SD Detects	0.0054
Median Detects	0.0063	CV Detects	0.708
Skewness Detects	1.322	Kurtosis Detects	1.385
Mean of Logged Detects	-5.135	SD of Logged Detects	0.836

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.00367	Standard Error of Mean	8.7834E-4
SD	0.00483	90% KM (BCA) UCL	0.00501
90% KM (t) UCL	0.00481	90% KM (Percentile Bootstrap) UCL	0.00492
90% KM (z) UCL	0.00479	90% KM Bootstrap t UCL	0.00511
90% KM Chebyshev UCL	0.0063	95% KM Chebyshev UCL	0.00749
97.5% KM Chebyshev UCL	0.00915	99% KM Chebyshev UCL	0.0124

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.364	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.163	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.232	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.08	k star (bias corrected MLE)	1.682
Theta hat (MLE)	0.00367	Theta star (bias corrected MLE)	0.00454
nu hat (MLE)	58.25	nu star (bias corrected)	47.1
MLE Mean (bias corrected)	0.00763	MLE Sd (bias corrected)	0.00588

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.576	nu hat (KM)	39.19
Approximate Chi Square Value (39.19, α)	28.36	Adjusted Chi Square Value (39.19, β)	28
90% Gamma Approximate KM-UCL (use when n>=50)	0.00507	90% Gamma Adjusted KM-UCL (use when n<50)	0.00513

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	6.3558E-4	Mean	0.00908
Maximum	0.0203	Median	0.01

SD	0.00359	CV	0.398
k hat (MLE)	4.493	k star (bias corrected MLE)	4.116
Theta hat (MLE)	0.00201	Theta star (bias corrected MLE)	0.00219
nu hat (MLE)	305.5	nu star (bias corrected)	279.9
MLE Mean (bias corrected)	0.00903	MLE Sd (bias corrected)	0.00445
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (279.89, α)	250	Adjusted Chi Square Value (279.89, β)	248.9
90% Gamma Approximate UCL (use when n>=50)	0.0101	90% Gamma Adjusted UCL (use when n<50)	0.0101

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.895	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.874	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.205	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.237	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00367	Mean in Log Scale	-6.316
SD in Original Scale	0.00479	SD in Log Scale	1.204
90% t UCL (assumes normality of ROS data)	0.00475	90% Percentile Bootstrap UCL	0.00483
90% BCA Bootstrap UCL	0.00496	90% Bootstrap t UCL	0.0051
90% H-UCL (Log ROS)	0.00569		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-6.391	90% H-UCL (KM -Log)	0.00551
KM SD (logged)	1.229	90% Critical H Value (KM-Log)	2.034
KM Standard Error of Mean (logged)	0.231		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.00454	Mean in Log Scale	-5.896
SD in Original Scale	0.00515	SD in Log Scale	1.004
90% t UCL (Assumes normality)	0.00569	90% H-Stat UCL	0.00627

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Fluoranthene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	32
Number of Detects	24	Number of Non-Detects	10
Number of Distinct Detects	24	Number of Distinct Non-Detects	8
Minimum Detect	0.0597	Minimum Non-Detect	0.025
Maximum Detect	1.039	Maximum Non-Detect	0.0573
Variance Detects	0.0417	Percent Non-Detects	29.41%
Mean Detects	0.19	SD Detects	0.204
Median Detects	0.123	CV Detects	1.073
Skewness Detects	3.461	Kurtosis Detects	13.65
Mean of Logged Detects	-1.938	SD of Logged Detects	0.671

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.575	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.27	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.181	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.142	Standard Error of Mean	0.0323
SD	0.184	90% KM (BCA) UCL	0.187
90% KM (t) UCL	0.184	90% KM (Percentile Bootstrap) UCL	0.187
90% KM (z) UCL	0.183	90% KM Bootstrap t UCL	0.221
90% KM Chebyshev UCL	0.238	95% KM Chebyshev UCL	0.282
97.5% KM Chebyshev UCL	0.343	99% KM Chebyshev UCL	0.463

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.399	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.756	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.21	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.18	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.943	k star (bias corrected MLE)	1.728
Theta hat (MLE)	0.0979	Theta star (bias corrected MLE)	0.11
nu hat (MLE)	93.28	nu star (bias corrected)	82.96
MLE Mean (bias corrected)	0.19	MLE Sd (bias corrected)	0.145

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.592	nu hat (KM)	40.27
Approximate Chi Square Value (40.27, α)	29.28	Adjusted Chi Square Value (40.27, β)	28.92
90% Gamma Approximate KM-UCL (use when n>=50)	0.195	90% Gamma Adjusted KM-UCL (use when n<50)	0.197

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.137
Maximum	1.039	Median	0.0948

SD	0.19	CV	1.383
k hat (MLE)	0.805	k star (bias corrected MLE)	0.754
Theta hat (MLE)	0.171	Theta star (bias corrected MLE)	0.182
nu hat (MLE)	54.74	nu star (bias corrected)	51.24
MLE Mean (bias corrected)	0.137	MLE Sd (bias corrected)	0.158
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (51.24, α)	38.77	Adjusted Chi Square Value (51.24, β)	38.35
90% Gamma Approximate UCL (use when n>=50)	0.181	90% Gamma Adjusted UCL (use when n<50)	0.183

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.907	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.159	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.181	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.144	Mean in Log Scale	-2.391
SD in Original Scale	0.186	SD in Log Scale	0.911
90% t UCL (assumes normality of ROS data)	0.185	90% Percentile Bootstrap UCL	0.183
90% BCA Bootstrap UCL	0.202	90% Bootstrap t UCL	0.222
90% H-UCL (Log ROS)	0.183		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.453	90% H-UCL (KM -Log)	0.187
KM SD (logged)	0.97	90% Critical H Value (KM-Log)	1.801
KM Standard Error of Mean (logged)	0.17		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.142	Mean in Log Scale	-2.466
SD in Original Scale	0.187	SD in Log Scale	1.012
90% t UCL (Assumes normality)	0.184	90% H-Stat UCL	0.196

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Fluorene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	29
Number of Detects	17	Number of Non-Detects	17
Number of Distinct Detects	17	Number of Distinct Non-Detects	12
Minimum Detect	0.215	Minimum Non-Detect	0.169
Maximum Detect	2.756	Maximum Non-Detect	0.2
Variance Detects	0.506	Percent Non-Detects	50%
Mean Detects	0.656	SD Detects	0.712
Median Detects	0.364	CV Detects	1.084
Skewness Detects	2.254	Kurtosis Detects	4.677
Mean of Logged Detects	-0.779	SD of Logged Detects	0.789

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.656	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.892	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.294	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.215	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.413	Standard Error of Mean	0.0964
SD	0.546	90% KM (BCA) UCL	0.55
90% KM (t) UCL	0.539	90% KM (Percentile Bootstrap) UCL	0.547
90% KM (z) UCL	0.536	90% KM Bootstrap t UCL	0.623
90% KM Chebyshev UCL	0.702	95% KM Chebyshev UCL	0.833
97.5% KM Chebyshev UCL	1.015	99% KM Chebyshev UCL	1.372

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.315	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.755	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.21	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.213	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.542	k star (bias corrected MLE)	1.309
Theta hat (MLE)	0.426	Theta star (bias corrected MLE)	0.501
nu hat (MLE)	52.43	nu star (bias corrected)	44.51
MLE Mean (bias corrected)	0.656	MLE Sd (bias corrected)	0.574

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.572	nu hat (KM)	38.91
Approximate Chi Square Value (38.91, α)	28.12	Adjusted Chi Square Value (38.91, β)	27.76
90% Gamma Approximate KM-UCL (use when n>=50)	0.571	90% Gamma Adjusted KM-UCL (use when n<50)	0.578

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01		Mean	0.333
Maximum	2.756		Median	0.112

SD	0.594	CV	1.784
k hat (MLE)	0.411	k star (bias corrected MLE)	0.395
Theta hat (MLE)	0.81	Theta star (bias corrected MLE)	0.844
nu hat (MLE)	27.96	nu star (bias corrected)	26.83
MLE Mean (bias corrected)	0.333	MLE Sd (bias corrected)	0.53
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (26.83, α)	17.97	Adjusted Chi Square Value (26.83, β)	17.69
90% Gamma Approximate UCL (use when n>=50)	0.497	90% Gamma Adjusted UCL (use when n<50)	0.505

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.858	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.892	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.168	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.215	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.357	Mean in Log Scale	-1.84
SD in Original Scale	0.581	SD in Log Scale	1.234
90% t UCL (assumes normality of ROS data)	0.488	90% Percentile Bootstrap UCL	0.482
90% BCA Bootstrap UCL	0.53	90% Bootstrap t UCL	0.584
90% H-UCL (Log ROS)	0.527		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-1.278	90% H-UCL (KM -Log)	0.449
KM SD (logged)	0.736	90% Critical H Value (KM-Log)	1.618
KM Standard Error of Mean (logged)	0.13		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.377	Mean in Log Scale	-1.554
SD in Original Scale	0.571	SD in Log Scale	0.96
90% t UCL (Assumes normality)	0.505	90% H-Stat UCL	0.452

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Phenanthrene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	29
Number of Detects	18	Number of Non-Detects	16
Number of Distinct Detects	18	Number of Distinct Non-Detects	11
Minimum Detect	0.147	Minimum Non-Detect	0.106
Maximum Detect	3.154	Maximum Non-Detect	0.149
Variance Detects	0.513	Percent Non-Detects	47.06%
Mean Detects	0.456	SD Detects	0.716
Median Detects	0.21	CV Detects	1.57
Skewness Detects	3.571	Kurtosis Detects	13.38
Mean of Logged Detects	-1.25	SD of Logged Detects	0.792

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.453	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.397	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.209	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.293	Standard Error of Mean	0.0945
SD	0.535	90% KM (BCA) UCL	0.412
90% KM (t) UCL	0.417	90% KM (Percentile Bootstrap) UCL	0.42
90% KM (z) UCL	0.414	90% KM Bootstrap t UCL	0.829
90% KM Chebyshev UCL	0.576	95% KM Chebyshev UCL	0.705
97.5% KM Chebyshev UCL	0.883	99% KM Chebyshev UCL	1.233

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.523	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.762	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.282	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.208	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.216	k star (bias corrected MLE)	1.05
Theta hat (MLE)	0.375	Theta star (bias corrected MLE)	0.434
nu hat (MLE)	43.78	nu star (bias corrected)	37.82
MLE Mean (bias corrected)	0.456	MLE Sd (bias corrected)	0.445

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.299	nu hat (KM)	20.36
Approximate Chi Square Value (20.36, α)	12.73	Adjusted Chi Square Value (20.36, β)	12.5
90% Gamma Approximate KM-UCL (use when n>=50)	0.469	90% Gamma Adjusted KM-UCL (use when n<50)	0.477

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01		Mean	0.246
Maximum	3.154		Median	0.151

SD	0.562	CV	2.281
k hat (MLE)	0.452	k star (bias corrected MLE)	0.432
Theta hat (MLE)	0.544	Theta star (bias corrected MLE)	0.57
nu hat (MLE)	30.75	nu star (bias corrected)	29.37
MLE Mean (bias corrected)	0.246	MLE Sd (bias corrected)	0.375
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (29.37, α)	20.08	Adjusted Chi Square Value (29.37, β)	19.77
90% Gamma Approximate UCL (use when n>=50)	0.36	90% Gamma Adjusted UCL (use when n<50)	0.366

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.75	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.231	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.209	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.262	Mean in Log Scale	-2.15
SD in Original Scale	0.555	SD in Log Scale	1.147
90% t UCL (assumes normality of ROS data)	0.387	90% Percentile Bootstrap UCL	0.386
90% BCA Bootstrap UCL	0.461	90% Bootstrap t UCL	0.712
90% H-UCL (Log ROS)	0.333		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.275	Mean in Log Scale	-1.907
SD in Original Scale	0.55	SD in Log Scale	0.91
90% t UCL (Assumes normality)	0.398	90% H-Stat UCL	0.297

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Pyrene

General Statistics

Total Number of Observations	34	Number of Distinct Observations	32
Number of Detects	22	Number of Non-Detects	12
Number of Distinct Detects	22	Number of Distinct Non-Detects	10
Minimum Detect	0.0413	Minimum Non-Detect	0.0257
Maximum Detect	0.591	Maximum Non-Detect	0.0488
Variance Detects	0.0137	Percent Non-Detects	35.29%
Mean Detects	0.128	SD Detects	0.117
Median Detects	0.0949	CV Detects	0.916
Skewness Detects	3.238	Kurtosis Detects	12.28
Mean of Logged Detects	-2.284	SD of Logged Detects	0.621

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.624	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.264	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.189	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.0927	Standard Error of Mean	0.0182
SD	0.103	90% KM (BCA) UCL	0.118
90% KM (t) UCL	0.116	90% KM (Percentile Bootstrap) UCL	0.117
90% KM (z) UCL	0.116	90% KM Bootstrap t UCL	0.135
90% KM Chebyshev UCL	0.147	95% KM Chebyshev UCL	0.172
97.5% KM Chebyshev UCL	0.206	99% KM Chebyshev UCL	0.274

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.937	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.193	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.187	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.372	k star (bias corrected MLE)	2.079
Theta hat (MLE)	0.0538	Theta star (bias corrected MLE)	0.0614
nu hat (MLE)	104.4	nu star (bias corrected)	91.47
MLE Mean (bias corrected)	0.128	MLE Sd (bias corrected)	0.0885

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.804	nu hat (KM)	54.66
Approximate Chi Square Value (54.66, α)	41.76	Adjusted Chi Square Value (54.66, β)	41.32
90% Gamma Approximate KM-UCL (use when n>=50)	0.121	90% Gamma Adjusted KM-UCL (use when n<50)	0.123

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01		Mean	0.0861
Maximum	0.591		Median	0.0578

SD	0.109	CV	1.269
k hat (MLE)	0.898	k star (bias corrected MLE)	0.838
Theta hat (MLE)	0.0959	Theta star (bias corrected MLE)	0.103
nu hat (MLE)	61.07	nu star (bias corrected)	57.01
MLE Mean (bias corrected)	0.0861	MLE Sd (bias corrected)	0.0941
		Adjusted Level of Significance (β)	0.0914
Approximate Chi Square Value (57.01, α)	43.83	Adjusted Chi Square Value (57.01, β)	43.37
90% Gamma Approximate UCL (use when n>=50)	0.112	90% Gamma Adjusted UCL (use when n<50)	0.113

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.911	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.14	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.189	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0912	Mean in Log Scale	-2.795
SD in Original Scale	0.106	SD in Log Scale	0.866
90% t UCL (assumes normality of ROS data)	0.115	90% Percentile Bootstrap UCL	0.113
90% BCA Bootstrap UCL	0.123	90% Bootstrap t UCL	0.133
90% H-UCL (Log ROS)	0.115		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.738	90% H-UCL (KM -Log)	0.111
KM SD (logged)	0.793	90% Critical H Value (KM-Log)	1.66
KM Standard Error of Mean (logged)	0.143		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.0903	Mean in Log Scale	-2.832
SD in Original Scale	0.106	SD in Log Scale	0.908
90% t UCL (Assumes normality)	0.114	90% H-Stat UCL	0.117

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

APPENDIX G-D-2

Pro-UCL Version 5.0 Output Sheets

Milton Creek Sediment Data

90% Upper Confidence Limits for Bioaccumulation Screen

(Only results for fluoranthene and pyrene presented)

Fluoranthene

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.02	Minimum Non-Detect	0.00853
Maximum Detect	1.2	Maximum Non-Detect	0.0273
Variance Detects	0.138	Percent Non-Detects	18.18%
Mean Detects	0.249	SD Detects	0.371
Median Detects	0.129	CV Detects	1.489
Skewness Detects	2.587	Kurtosis Detects	7.037
Mean of Logged Detects	-2.124	SD of Logged Detects	1.278

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.631	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.345	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.206	Standard Error of Mean	0.105
SD	0.33	90% KM (BCA) UCL	0.33
90% KM (t) UCL	0.351	90% KM (Percentile Bootstrap) UCL	0.329
90% KM (z) UCL	0.341	90% KM Bootstrap t UCL	0.715
90% KM Chebyshev UCL	0.523	95% KM Chebyshev UCL	0.666
97.5% KM Chebyshev UCL	0.865	99% KM Chebyshev UCL	1.255

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.427	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.225	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.289	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.807	k star (bias corrected MLE)	0.612
Theta hat (MLE)	0.309	Theta star (bias corrected MLE)	0.407
nu hat (MLE)	14.53	nu star (bias corrected)	11.02
MLE Mean (bias corrected)	0.249	MLE Sd (bias corrected)	0.319

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.392	nu hat (KM)	8.626
Approximate Chi Square Value (8.63, α)	3.913	Adjusted Chi Square Value (8.63, β)	3.525
90% Gamma Approximate KM-UCL (use when n>=50)	0.455	90% Gamma Adjusted KM-UCL (use when n<50)	0.505

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.206
Maximum	1.2	Median	0.0825
SD	0.346	CV	1.681
k hat (MLE)	0.619	k star (bias corrected MLE)	0.511
Theta hat (MLE)	0.333	Theta star (bias corrected MLE)	0.403
nu hat (MLE)	13.61	nu star (bias corrected)	11.23
MLE Mean (bias corrected)	0.206	MLE Sd (bias corrected)	0.288
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (11.23, α)	5.747	Adjusted Chi Square Value (11.23, β)	5.262
90% Gamma Approximate UCL (use when n>=50)	0.402	90% Gamma Adjusted UCL (use when n<50)	0.439

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.963	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.143	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.206	Mean in Log Scale	-2.595
SD in Original Scale	0.346	SD in Log Scale	1.571
90% t UCL (assumes normality of ROS data)	0.349	90% Percentile Bootstrap UCL	0.334
90% BCA Bootstrap UCL	0.422	90% Bootstrap t UCL	0.623
90% H-UCL (Log ROS)	1.09		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.547	90% H-UCL (KM -Log)	0.729
KM SD (logged)	1.425	90% Critical H Value (KM-Log)	2.696
KM Standard Error of Mean (logged)	0.458		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.206	Mean in Log Scale	-2.624
SD in Original Scale	0.346	SD in Log Scale	1.617
90% t UCL (Assumes normality)	0.349	90% H-Stat UCL	1.229

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Pyrene

General Statistics

Total Number of Observations	11	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	2
Number of Distinct Detects	9	Number of Distinct Non-Detects	2
Minimum Detect	0.017	Minimum Non-Detect	0.00853
Maximum Detect	1.2	Maximum Non-Detect	0.0273
Variance Detects	0.138	Percent Non-Detects	18.18%
Mean Detects	0.241	SD Detects	0.371
Median Detects	0.135	CV Detects	1.542
Skewness Detects	2.662	Kurtosis Detects	7.44
Mean of Logged Detects	-2.216	SD of Logged Detects	1.349

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.615	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.336	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.199	Standard Error of Mean	0.105
SD	0.329	90% KM (BCA) UCL	0.316
90% KM (t) UCL	0.343	90% KM (Percentile Bootstrap) UCL	0.324
90% KM (z) UCL	0.334	90% KM Bootstrap t UCL	0.693
90% KM Chebyshev UCL	0.515	95% KM Chebyshev UCL	0.658
97.5% KM Chebyshev UCL	0.856	99% KM Chebyshev UCL	1.246

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.417	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.207	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.289	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.754	k star (bias corrected MLE)	0.577
Theta hat (MLE)	0.319	Theta star (bias corrected MLE)	0.417
nu hat (MLE)	13.58	nu star (bias corrected)	10.39
MLE Mean (bias corrected)	0.241	MLE Sd (bias corrected)	0.317

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.367	nu hat (KM)	8.066
Approximate Chi Square Value (8.07, α)	3.535	Adjusted Chi Square Value (8.07, β)	3.169
90% Gamma Approximate KM-UCL (use when n>=50)	0.454	90% Gamma Adjusted KM-UCL (use when n<50)	0.507

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.199
Maximum	1.2	Median	0.085

SD	0.345	CV	1.735
k hat (MLE)	0.597	k star (bias corrected MLE)	0.495
Theta hat (MLE)	0.333	Theta star (bias corrected MLE)	0.402
nu hat (MLE)	13.14	nu star (bias corrected)	10.89
MLE Mean (bias corrected)	0.199	MLE Sd (bias corrected)	0.283
		Adjusted Level of Significance (β)	0.0738
Approximate Chi Square Value (10.89, α)	5.496	Adjusted Chi Square Value (10.89, β)	5.024
90% Gamma Approximate UCL (use when n>=50)	0.394	90% Gamma Adjusted UCL (use when n<50)	0.431

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.295	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.199	Mean in Log Scale	-2.713
SD in Original Scale	0.345	SD in Log Scale	1.657
90% t UCL (assumes normality of ROS data)	0.341	90% Percentile Bootstrap UCL	0.329
90% BCA Bootstrap UCL	0.397	90% Bootstrap t UCL	0.697
90% H-UCL (Log ROS)	1.288		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.637	90% H-UCL (KM -Log)	0.745
KM SD (logged)	1.463	90% Critical H Value (KM-Log)	2.751
KM Standard Error of Mean (logged)	0.469		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.199	Mean in Log Scale	-2.7
SD in Original Scale	0.345	SD in Log Scale	1.638
90% t UCL (Assumes normality)	0.341	90% H-Stat UCL	1.221

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

APPENDIX G-D-3

Pro-UCL Version 5.0 Output Sheets

Scappoose Bay Sediment Data

90% Upper Confidence Limits for Bioaccumulation Screen

(Only results for fluoranthene and pyrene presented)

Fluoranthene

General Statistics

Total Number of Observations	112	Number of Distinct Observations	95
Number of Detects	111	Number of Non-Detects	1
Number of Distinct Detects	94	Number of Distinct Non-Detects	1
Minimum Detect	0.0089	Minimum Non-Detect	0.0129
Maximum Detect	20	Maximum Non-Detect	0.0129
Variance Detects	15	Percent Non-Detects	0.893%
Mean Detects	2.053	SD Detects	3.873
Median Detects	0.465	CV Detects	1.886
Skewness Detects	3.181	Kurtosis Detects	10.2
Mean of Logged Detects	-0.554	SD of Logged Detects	1.72

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.543	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0841	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.035	Standard Error of Mean	0.365
SD	3.843	90% KM (BCA) UCL	2.545
90% KM (t) UCL	2.505	90% KM (Percentile Bootstrap) UCL	2.518
90% KM (z) UCL	2.503	90% KM Bootstrap t UCL	2.62
90% KM Chebyshev UCL	3.129	95% KM Chebyshev UCL	3.625
97.5% KM Chebyshev UCL	4.313	99% KM Chebyshev UCL	5.665

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.737	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.819	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.141	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.0916	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.499	k star (bias corrected MLE)	0.492
Theta hat (MLE)	4.114	Theta star (bias corrected MLE)	4.177
nu hat (MLE)	110.8	nu star (bias corrected)	109.1
MLE Mean (bias corrected)	2.053	MLE Sd (bias corrected)	2.929

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.28	nu hat (KM)	62.8
Approximate Chi Square Value (62.80, α)	48.94	Adjusted Chi Square Value (62.80, β)	48.81
90% Gamma Approximate KM-UCL (use when n>=50)	2.612	90% Gamma Adjusted KM-UCL (use when n<50)	2.619

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0089	Mean	2.035
Maximum	20	Median	0.449

SD	3.861	CV	1.897
k hat (MLE)	0.49	k star (bias corrected MLE)	0.483
Theta hat (MLE)	4.153	Theta star (bias corrected MLE)	4.215
nu hat (MLE)	109.8	nu star (bias corrected)	108.1
MLE Mean (bias corrected)	2.035	MLE Sd (bias corrected)	2.929
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (108.15, α)	89.78	Adjusted Chi Square Value (108.15, β)	89.6
90% Gamma Approximate UCL (use when n>=50)	2.451	90% Gamma Adjusted UCL (use when n<50)	2.456

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0609	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0841	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.035	Mean in Log Scale	-0.592
SD in Original Scale	3.861	SD in Log Scale	1.76
90% t UCL (assumes normality of ROS data)	2.505	90% Percentile Bootstrap UCL	2.532
90% BCA Bootstrap UCL	2.562	90% Bootstrap t UCL	2.647
90% H-UCL (Log ROS)	3.822		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.591	90% H-UCL (KM -Log)	3.741
KM SD (logged)	1.749	90% Critical H Value (KM-Log)	2.292
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.035	Mean in Log Scale	-0.594
SD in Original Scale	3.861	SD in Log Scale	1.764
90% t UCL (Assumes normality)	2.505	90% H-Stat UCL	3.851

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Pyrene

General Statistics

Total Number of Observations	112	Number of Distinct Observations	104
Number of Detects	110	Number of Non-Detects	2
Number of Distinct Detects	102	Number of Distinct Non-Detects	2
Minimum Detect	0.015	Minimum Non-Detect	0.0129
Maximum Detect	15	Maximum Non-Detect	0.383
Variance Detects	7.223	Percent Non-Detects	1.786%
Mean Detects	1.463	SD Detects	2.687
Median Detects	0.4	CV Detects	1.837
Skewness Detects	3.346	Kurtosis Detects	12.08
Mean of Logged Detects	-0.775	SD of Logged Detects	1.609

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.552	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.295	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0845	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.438	Standard Error of Mean	0.252
SD	2.658	90% KM (BCA) UCL	1.764
90% KM (t) UCL	1.763	90% KM (Percentile Bootstrap) UCL	1.764
90% KM (z) UCL	1.761	90% KM Bootstrap t UCL	1.879
90% KM Chebyshev UCL	2.195	95% KM Chebyshev UCL	2.538
97.5% KM Chebyshev UCL	3.014	99% KM Chebyshev UCL	3.948

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.609	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.815	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.13	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.0916	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.543	k star (bias corrected MLE)	0.534
Theta hat (MLE)	2.695	Theta star (bias corrected MLE)	2.739
nu hat (MLE)	119.4	nu star (bias corrected)	117.5
MLE Mean (bias corrected)	1.463	MLE Sd (bias corrected)	2.002

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.293	nu hat (KM)	65.6
Approximate Chi Square Value (65.60, α)	51.41	Adjusted Chi Square Value (65.60, β)	51.28
90% Gamma Approximate KM-UCL (use when n>=50)	1.835	90% Gamma Adjusted KM-UCL (use when n<50)	1.84

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.437
Maximum	15	Median	0.375

SD	2.67	CV	1.859
k hat (MLE)	0.523	k star (bias corrected MLE)	0.515
Theta hat (MLE)	2.747	Theta star (bias corrected MLE)	2.79
nu hat (MLE)	117.1	nu star (bias corrected)	115.3
MLE Mean (bias corrected)	1.437	MLE Sd (bias corrected)	2.002
		Adjusted Level of Significance (β)	0.0976
Approximate Chi Square Value (115.34, α)	96.35	Adjusted Chi Square Value (115.34, β)	96.17
90% Gamma Approximate UCL (use when n>=50)	1.72	90% Gamma Adjusted UCL (use when n<50)	1.723

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0495	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0845	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.438	Mean in Log Scale	-0.826
SD in Original Scale	2.67	SD in Log Scale	1.653
90% t UCL (assumes normality of ROS data)	1.763	90% Percentile Bootstrap UCL	1.771
90% BCA Bootstrap UCL	1.81	90% Bootstrap t UCL	1.829
90% H-UCL (Log ROS)	2.427		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.819	90% H-UCL (KM -Log)	2.335
KM SD (logged)	1.63	90% Critical H Value (KM-Log)	2.188
KM Standard Error of Mean (logged)	0.155		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.438	Mean in Log Scale	-0.821
SD in Original Scale	2.669	SD in Log Scale	1.647
90% t UCL (Assumes normality)	1.763	90% H-Stat UCL	2.409

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

Recommendation Provided only for 95% Confidence Coefficient

Cascadia
Associates, LLC

Cascadia
Associates, LLC