Chevron Asphalt Plant Site – ECSI # 1281
Source Control Decision

Project Manager: Mark Pugh, Project Manager, Northwest Region Cleanup Program

Date: July 8, 2010

Peer Reviewers: Mike Romero, Karen Tarnow, NWR Portland Harbor Section

Responsible Party (RP): Chevron Environmental Management Company (former owner/operator)

RP Contact:
Brett Hunter
Chevron Environmental Management Company
6111 Bollinger Canyon Road, 3628
San Ramon, CA 94583-5186

Project Consultant:
Brooke Bonkowski, P.E.
Arcadis
111 SW Columbia St. Ste. 725
Portland, OR 97201
T. 503.220.8201 ext. 1105 | F. 503.220.8209

Property Owner/Operator
Paramount Petroleum Corporation

Operator Contact:
D. Mark Wells, P.E.
Northwest Environmental Manager
Paramount Petroleum Corporation
20555 Richmond Beach Drive N.W.
Seattle, WA 98177
(206) 546-0504 office
(206) 794-9759 cell
mwells@ppcla.com

1. Introduction

This Source Control Decision (SCD) provides the Oregon Department of Environmental Quality's (DEQ's) summary of a Source Control Evaluation (SCE) and source control measures that have been completed for the Chevron Willbridge Asphalt Plant site located at 5501 NW Front Avenue in Portland, Oregon (Figure 1). The SCE was completed in accordance with the Joint Source Control Strategy (JSCS; DEQ and USEPA, 2005).

The site is located approximately 600 feet southwest of a portion of the Willamette River within the area designated by the United States Environmental Protection Agency (EPA) as the Portland

Harbor Superfund Study Area. The SCE was completed to identify site-related contaminants and assess whether the site was a current or potential source of contamination to the Willamette River from uncontrolled environmental releases. Source control measures were developed based on the findings of the SCE and implemented as described below.

DEQ provided oversight during the SCE under terms of a Voluntary Cleanup Letter Agreement dated June 22, 2006. Based on a preliminary evaluation of potentially complete pathways to the river it was apparent that stormwater discharge to the City of Portland stormwater conveyance lines associated with City outfalls #19 and #22 that discharge to the Willamette River was the primary pathway of concern at the site.

A detailed summary of the investigative and source control work completed at the site is contained in a Source Control Evaluation Report (ARCADIS, 2009a). The following tasks have been completed and are discussed in greater detail below:

- Catch basin sediment sampling, analysis, cleanout and offsite disposal
- Camera survey of active and inactive storm drain lines at the site
- Cleanout of accessible on-site storm drain lines
- Cleanout of off-site storm drain lines associated with manholes AAM084, AAP796 and AAP799
- Four rounds of stormwater sampling
- Identification of additional best management practices (BMPs) for stormwater management
- Stormwater Pollution Control Plan (SWPCP) revision

Based on a review of the SCE Report and related documents, DEQ concludes that this site is not a significant ongoing source of contaminants to the Willamette River, and that source control measures implemented at the site will prevent potential future significant impacts. A discussion of site conditions, monitoring results, source control measures, and the basis for DEQ's source control decision are presented below.

This SCD applies only to potential impacts to the Willamette River, and does not constitute a no further action finding from DEQ for all potential exposure pathways and receptors. Residual contamination exists at the site, and the potential for risk to site workers would need to be assessed, and remedies implemented as appropriate, before a no further action determination could be considered by DEQ. DEQ does not consider the residual contamination to be a high priority, and thus will not require additional work to address residual contamination at this time.

2. Site Description and History

2.1 Site description. The site consists of 31.3 acres located at 5501 NW Front Avenue in Portland, Multnomah County, Oregon, in the northwestern portion of the Guilds Lake Industrial District. The site is listed with Multnomah County as Tax Lot 400, Township 1 North, Range 1 East, Section 19 (NW ¼). The area is zoned Heavy Industrial (HI). There are no residential areas within ¼ mile of the site.

The site is bounded to the northwest by the ConocoPhillips Willbridge Terminal, to the northeast by NW Front Avenue, to the southeast by Kittridge Business Park and to the southwest by the Burlington Northern Santa Fe Railroad tracks. Significant environmental contamination is present at the ConocoPhillips Willbridge Terminal site. Information on contamination and remedial actions at the ConocoPhillips Willbridge Terminal site can be found in DEQ's Environmental Cleanup Site Information (ECSI) database site #1549.

2.2 Site features. The site contains 91 aboveground product storage tanks (ASTs; Figure 2). Ten have a capacity of 80,000 barrels (bbls) or greater. Containment for the tanks consists of concrete walls and earthen berms with a total capacity of 1,642,600 bbls. Tanks have a single-bottom metal construction. No underground storage tanks are present at the site. In addition to the tanks, eight truck loading racks and one rail car loading rack are present on site.

The crude oil tank yard, located on the western portion of the site, consists of tanks for crude oil and asphalt products. The Guilds Lake tank yard, located in the southern portion of the site, stores asphalt products and aviation fuel for the Chevron Willbridge Light Products Terminal. Product is transferred from the Guilds Lake tank yard area through dedicated piping. No loading or unloading of product requiring connection or disconnection occurs in the Guilds Lake tank yard.

The site has approximately 238,630 square feet (ft^2) of paved roadways and rooftops. In addition, there are approximately 170,000 ft^2 of surface area on the top of the tanks at the site which drain to the ground surface. The total impervious area at the site is approximately 409,000 ft^2.

2.3 Stormwater Control System. Figure 3 shows the stormwater drainage sub-basins at the site:

- Area 1: Guilds Lake Tank Yard
- Area 2: Equipment Storage and Parking
- Area 3: Refinery and Emulsion Tank Yard
- Area 4: Crude Oil Tank Yard
- Area 5: Parking lot and rail line

Areas 1, 2 and 4 are covered by gravel, allowing much of the stormwater in these areas to infiltrate. Areas 3 and 5 are paved. The remainder of the site to the southeast of Area 2 is the former Federal Housing Authority (FHA) property that contains its own stormwater conveyance system. The FHA property was developed for shipyard worker housing. Most of the associated catch basins in the FHA area have been covered with highly compacted gravel and could not be located. A camera survey showed many lines were collapsed and/or filled with gravelly deposits. As discussed below, dry weather flow was observed downstream of V39, and may be related to broken/collapsed pipe that allows shallow groundwater infiltration.

Stormwater runoff at the site is collected in two stormwater collection vaults (V33, V39; Figure 4) before being discharged to the City of Portland stormwater conveyance. V33 is 4 feet in diameter and 12' deep. V39 is approximately 6 feet x 6 feet and approximately 9 feet deep. Each vault contains a valve to facilitate controlled releases. V39 and V33 are the site's designated

National Pollutant Discharge Elimination System (NPDES) stormwater discharge sampling locations.

Stormwater in Areas 3 and 4 is directed to V33 in the northern site area, where the line connects to the City of Portland (COP) line approximately 150 feet to the northeast along NW Front Avenue at AAP800. This flow discharges to COP Outfall 22 (OF#22). There are no active stormwater line connections downstream of V33.

Area 1 is the only basin in the operational site area that contributes to the V39 stormwater collection system. Minor contributions from Area 2 enter the storm drain line downstream of stormwater valve V39. From V39 the storm drain line extends approximately 1000 feet downstream of V39 before joining a private storm line to the southeast that eventually discharges to the Willamette River at COP OF#19.

Historic plans show a former drain line connected at AAP799 from AAM084 near the northern corner of the site. Manholes AAP796 and AAM084 were shown to contain laterals heading towards the site (Figure 5). Camera surveys of these lines showed that the laterals heading to the site were intentionally blocked with concrete plugs, and thus provide no contribution to COP storm lines. In-line solids observed between AAM084 and AAP796 were removed as a source control measure as discussed below.

In addition to the V33 and V39 systems, there is also a portion of the former FHA stormwater system that is evidently intact and connects to a private lateral to the southeast. It is located along the southeast property boundary parallel to NW Front Avenue and includes manholes AND864, AAP809, AAP907, AAP911, and AAP912. This was identified as stormwater drainage basin Area 5, although there are no associated catch basins evident, and the area was not graded to collect stormwater. A number of laterals were observed between AND864 and AAP809 during the camera survey. Dry weather flow was observed in one lateral. The line underlays an active rail spur that prevented a detailed evaluation and sampling of this segment. Manhole AND864 was observed during the stormwater sampling events. No flow was observed in the line.

Another private lateral originating from the northwest is present and runs along the southwestern property boundary. Near AAP 830 the line crosses into the southernmost part of the site property. Stormwater plans show a catch basin associated with AAP830. As stated in the Stormwater Sampling Plan (ARCADIS BBL. 2007a), this structure is actually a covered metal stormwater vault. The vault is located in an area where stormwater infiltration occurs. It does not function as a catch basin or receive overland runoff from the site, and was not subject to further evaluation or sampling during the SCE.

Discharges from individual catch basins also are regulated by stormwater valves, with the exception of one catch basin located in Area 2, downstream of the valve at Outfall V39. These valves remain in the closed position until stormwater accumulation on site requires opening the valves. Stormwater management protocols facilitate spill response, inspection, regulation and/or additional treatment (e.g., sorbent socks) of stormwater prior to discharge from the site.

Overland flow of stormwater to the Willamette River does not occur at the site. The refinery and tank yards are contained within walls and berms. All refinery storage tanks are located within secondary containment. The majority of the undeveloped area on the southeastern part of the site is covered with pervious gravel and vegetation. However, a small section in the northern portion of Area 2 is paved and drains to the stormwater line downstream of V39 through the catch basin in Area 2.

2.3 API Separator. The American Petroleum Institute (API) separator serves to separate oil and sediments from wastewater generated at the site prior to discharge to the sanitary sewer under permit with the City of Portland. Oil rises to the top of the API separator and is skimmed off for reprocessing. Sediments settle to the bottom and are cleaned out with a sludge pump. The following onsite water drains to (API) separator:

- on-site strip drains
- drains inside buildings and warehouses
- water draws on the crude and light products tanks
- pump cooling water
- boiler blow-down
- truck loading and unloading areas
- pipe trenches
- pump containment pads

2.4 Current and historical site operations. The former Chevron Willbridge Asphalt Plant was constructed in 1947 and has been in continuous operation since that time. During World War II, the undeveloped lot southeast of the refinery, labeled "Undeveloped Property" on Figure 2, was developed by the Federal Housing Authority (FHA) to be used as shipyard worker housing. Portions of FHA stormwater system are connected to a main site storm drain discharge line.

In 2005, Chevron sold the property to Paramount Petroleum Corporation (PPC). Chevron signed a letter agreement with DEQ on June 22, 2006 for completion of a SCE and to implement source control measures if deemed necessary, in accordance with JSCS guidance. PPC is the current owner/operator of the site; Alon USA Energy, Inc. acquired PPC in 2006.

The current processes and operations at the site include asphalt refining, emulsions manufacturing and asphalt blending. The refinery produces asphalt, asphalt emulsions, modified asphalt emulsions for roofing products, vacuum gas oil for gasoline refinery feedstock, kerosene, naphtha and middle distillates. Figure 2 shows the location of various processes and the location of material storage tanks on site.

3. Regulatory History

The United States Environmental Protection Agency (USEPA) conducted a preliminary assessment at the site in 1983. A No Further Remedial Action Planned designation was issued by the USEPA in 1984. In 1994, Chevron signed a letter agreement with the Oregon Department of Environmental Quality (DEQ) and the site was transferred into the DEQ Voluntary Cleanup

Program (VCP). In 1995, Chevron chose to proceed independently with site investigations and terminated the VCP letter agreement.

In 2002, DEQ prepared a strategy recommendation for the site. DEQ recommended conducting an expanded preliminary assessment (XPA) at the site. Chevron signed a DEQ VCP letter agreement and conducted the XPA. The XPA report was published in 2004 (SAIC, 2004).

Stormwater discharges at the site are managed under a NPDES 1200Z permit. Site stormwater has been regulated under permit since 1992. In 2005, PPC acquired the site operations and the permit was transferred to them. PPC has been in compliance with their permit since 2005. PPC is a conditionally exempt generator (CEG) of hazardous waste (EPA ID #ORD009031873). Air discharges are managed under a Title V permit (#26-2025-TV-01).

4. Hazardous Substance Releases, Investigations and Cleanups

4.1 Spills. A total of 6 spills are on record in DEQ Spill Program Files, although at least 3 other significant spills occurred at the site since 1957.

Most spills involved crude oil or asphaltic emulsions of low mobility that hardened upon cooling. On April 15, 1998 a tanker truck carrying 9000 gallons of gasoline crashed through the Chevron fence, rolled over and caught fire resulting in the death of the driver. Much of the fuel reportedly burned. Fire suppression water and residual gasoline were reportedly contained in the API separator system. CET Environmental Services responded to the scene on behalf of the trucking firm. They checked storm drain outfalls in the surrounding area and reported oil and debris were present. It is not clear at which outfall the oil was observed. CET flushed out the storm lines in the surrounding area. Ten gallons of fuel were recovered from the storm drain.

Most recently, on July 1, 2008, approximately 840 gallons of crude oil were spilled in the crude products tank yard while transferring crude oil from tank T-104 to tank T-105. DEQ was notified and participated in the spill response actions conducted by PPC. The spill did not occur near any stormwater catch basins, and no oil entered the on-site stormwater system. Some of the oil collected in wastewater catch basin WWCB-62, which drains to the on-site API oil-water separator. Assessment and cleanup activities satisfied DEQ Spill Program requirements and no additional work was required.

4.2 EPA Preliminary Assessment. EPA conducted a Preliminary Assessment at the site in 1983. Based on their findings EPA issued a No Further Remedial Action Planned determination in 1984.

4.3 Soil Sampling and Well Installation and Sampling-1993. In 1993 Chevron conducted a soil investigation in the active plant area consisting of 19 soil borings (Seacorp, 1993). Ten of these were completed as monitoring wells. Petroleum hydrocarbons were detected at elevated concentrations in subsurface soil. Surface samples (i.e., 3 feet or shallower) were not collected. Most polycyclic aromatic hydrocarbon (PAH) concentrations detected in soil were below EPA Preliminary Remediation Goals (PRGs) for soil, and metals were detected within the range of expected naturally occurring concentrations. Benzene, toluene, ethylbenzene and xylenes (BTEX) were detected infrequently at low levels in soil. BTEX and PAHs were detected in groundwater at a low frequency and generally low to moderate levels. Metals generally were not detected in groundwater samples.

4.4 Soil Sampling Investigation-1994. In 1994 Chevron conducted a soil investigation in the former FHA area. A total of 20 soil borings were advanced, and 3 were completed as monitoring wells. In addition, surface soil samples were collected. Petroleum hydrocarbons reportedly were not detected in soil. This report was not available for DEQ review.

4.5 Groundwater Sampling Results Summary. The site monitoring wells were installed in three phases beginning in 1985, including the 1993 and 1994 investigations discussed above. The groundwater monitoring well network consists of 30 wells generally installed at total depths ranging from 12 to 20 feet (Figure 5). Twenty-six of these wells were sampled periodically from 1993 to 2003.

Given the site history and nature of operations, historical groundwater samples were analyzed for total petroleum hydrocarbon (TPH), PAHs and BTEX. Groundwater samples collected during the 2003 Expanded Preliminary Assessment (XPA; see section 4.7 below) were analyzed for total and dissolved metals in addition to volatile organic compounds (VOCs) and PAHs. Metals results are shown on Tables 2C and 2D in Appendix A, respectively. A summary of BTEX and PAH results is shown on Tables 2F and 2G in Appendix A, respectively.

Note that only wells along the northeastern property boundary, in the hydrogeologic downgradient position from the site, were screened against JSCS Screening Level Values (SLVs) (i.e., wells A-1, A-8, W-1, W-2, W-3, W-4, U-North, U-South). DEQ screened groundwater concentrations from these selected wells to evaluate the potential for off-site migration of contamination towards the Willamette River. Selected wells are highlighted in blue on the data tables in Appendix A.

4.5.1 Metals

Total arsenic, copper, lead and zinc concentrations were detected in almost every selected well at concentrations above JSCS SLVs. Cadmium and chromium also exceeded JSCS SLVs in some selected wells. It should be noted that for non-detect results, many reported detection limits exceed JSCS SLVs. In addition, metals analyses are limited to one sampling event.

Owing to a relatively low screening concentration for arsenic (0.000045 mg/L), every detected arsenic concentration exceeded its JSCS SLV, with 6 of 8 samples exceeding it by a factor of 100 or more. Similarly, cadmium has a relatively low screening concentration and exceeded JSCS criterion by a factor of 100 or more in 4 of 8 samples. One concentration of copper and one concentration of lead exceeded their respective JSCS SLVs by a factor of 100 or more.

Dissolved concentrations exceeded JSCS SLVs at a significantly lower frequency. This is expected because suspended particulates (i.e., particulates > 0.45 microns) in monitoring well samples that contribute to total metal concentrations are filtered out of dissolved samples.

Dissolved arsenic exceeded its JSCS SLV in 4 of 8 selected wells, while only one detection each of cadmium, copper and zinc exceeded JSCS SLVs. Three of the four dissolved arsenic concentrations exceed its JSCS SLV by a factor of 100 or more.

4.5.2 PAHs

PAH concentrations in groundwater that exceeded JSCS are limited to selected wells W-2, W-3 and W-4, located in the northwest site area. With the exception of acenaphthene and pyrene in W-4, there were no exceedences of JSCS SLVs for any PAHs in the three most recent sampling

events conducted in March 2002, September 2002, and October 2003. Concentrations that exceed JSCS SLVs by a factor of 100 or more were limited to one sampling event conducted in 1997. The concentrations detected in this event are anomalously high.

4.5.3 BTEX

BTEX concentrations in groundwater that exceeded JSCS are limited to benzene in selected wells W-2, W-3 and W-4, located in the northwest site area. Exceedences in W-2 are limited to one detection in 1993. Benzene has not been detected in the 13 subsequent W-2 sampling events.

Benzene was detected in W-3 and W-4 at concentrations ranging from non-detect to 22 ug/L, and non-detect to 51 ug/L, respectively, in the three most recent sampling events conducted in March 2002, September 2002, and October 2003.

4.6 Separate-phase hydrocarbon. Separate-phase hydrocarbon (SPH) historically has been detected in the following wells:

- well A-3, in the central area of the crude oil tank yard
- wells A-5 and A-10, in the crude oil tank yard near the southwestern site boundary
- well A-6, near the distillation area and lab
- well A-7, in the vicinity of the refining/distillation area
- well W-14, located adjacent to the oil collector in the Guilds Lake tank yard.

An SPH monitoring and recovery program was implemented in October 2001. From 2001-2005 select monitoring wells were gauged monthly. Only minor volumes of SPH have been recovered since October 2001. Three of the wells (A-3, A-6 and A-7) currently have a regularly measurable thickness of SPH. Based on the viscous nature of the SPH and its limited extent on site based on groundwater monitoring results as discussed above, the potential for off-site migration of existing SPH appears low.

4.7 Expanded Preliminary Assessment (SAIC, 2004) An Expanded Preliminary Assessment (XPA) was conducted in 2003 under DEQ oversight. A total of 10 borings were advanced and total of 28 soil samples were collected and analyzed for total petroleum hydrocarbons, PAHs, volatile organic compounds (VOCs), pesticides, and metals. Most of the detected concentrations were below risk-based concentrations (RBCs) for human health, and DEQ did not require additional investigation to assess human health.

Another round of monitoring well sampling was conducted during the XPA, and represents the most recent site-wide groundwater sampling event. Benzene, naphthalene, PAHs and VOCs were detected in groundwater, primarily within the central portion of the site. Groundwater results from XPA sampling are discussed in Section 5.

5. Potential Sources and Contaminants of Interest

5.1 Potential contaminant sources. Potential contaminant sources include leaks or spills from ASTs or transfer piping containing crude oil, asphalt, vacuum gas oils, fuel oil and other petroleum products, and resulting impacts to stormwater, soil and groundwater. Caustic soda

and hydrochloric acid are stored in aboveground tanks in the refinery and emulsions tank yard area, as shown on Figure 2. These materials are used in the manufacturing of emulsified asphalt.

Historically, ferric chloride was used in manufacturing at the site. It is no longer used, but the tank and its containment remain in place for potential use in the future.

Currently, no polychlorinated biphenyl (PCB) transformers are present on site. Historically, PCB transformers were present on site; however, they were all removed prior to 1996. The specific location and details of the removal of historical PCB transformers are unknown.

Chevron registered with EPA as a hazardous waste generator in 1981 and was a large quantity generator (LQG) during their tenure at the site. Paramount Petroleum, the current operator, reported as a LQG in 2006 based on the volume of tank bottom sludge. Paramount Petroleum is now a CEG of hazardous waste, with reported waste streams in 2008 consisting of solvent on rags, aerosol cans, limited tank bottom sludge, 5 pounds waste mercury, and 15 pounds of mercury waste generated during cleanup of spill residue. Records from 2000 indicate 9 kilograms of mercury waste were generated from ongoing processes and disposed off-site. Mercury use at the site is associated with the laboratory, located near stormwater catch basin (SWCB) 37. Catch basin sampling discussed below showed a highly elevated mercury concentration in SWCB-37.

Historical hazardous waste streams include chromium waste (D007) from tank bottom sludge, and sand blast grit and paint chips containing cadmium (D006) and lead (D008). D018 (benzene) listed waste represents a major portion of hazardous waste historically generated at the site (100,000 kilograms annual) and either tank bottom and/or API separator sludge.

Residual SPH in 5 shallow monitoring wells is a potential source of dissolved phase contamination in groundwater, but impacts appear highly localized around these wells. Low to moderately impacted soil and residual asphaltic particulates from historical spills are potential contaminant sources to the stormwater system via accumulation in catch basins and potential migration into the stormwater conveyance system. This was the primary contaminant source and pathway evaluated for the SCE as described below.

5.3 Contaminants of interest. The following contaminants of interest (COIs) were identified for the SCE:

- Metals (antimony arsenic, cadmium, chromium, cyanide, copper, lead, mercury, nickel, selenium, silver, zinc)
- PCBs
- Organochlorine pesticides
- VOCs
- Semi-volatile organic compounds (SVOCs), including phthalate esters
- PAHs

5.4 Contaminated media. There is known soil and groundwater contamination at the site. Soil and groundwater contamination was investigated most recently by Chevron in 2003. Most of the residual contaminants detected in soil and groundwater were below levels of concern for human health. Catch basin sediment sampled during the SCE showed a number of contaminants, including PAHs and metals, above JSCS SLVs. A program of catch basin cleanout has been

established on an annual basis. Relatively low levels of COIs were detected in site stormwater samples, although some exceeded JSCS SLVs as discussed below.

6. Potentially Complete Contaminant Migration Pathways to the Willamette River

6.1 Stormwater. Stormwater is a complete pathway. The site contributes to City of Portland storm lines that discharge at outfalls #19 and #22. Given the distance and physical separation from the river by NW Front Avenue, the overland flow pathway is not complete. Potential contaminant sources to stormwater include erodible soils, contaminated groundwater infiltration, catch basin and/or residual in-line sediments, and releases related to ongoing operations.

6.2 Groundwater discharge to the Willamette River. Conclusions regarding this pathway are based on the screening presented in Section 4.5 above.

Site-related PAHs in groundwater do not appear to present a threat to the Willamette River based on their low frequency and magnitude detected in groundwater, especially in the three latest sampling events. In addition, PAHs have low mobility in groundwater because of low solubility and tendency to adsorb to soil and not move as a dissolved fraction with advective groundwater flow.

A number of total metals were detected at relatively high concentrations and frequency in groundwater. Similar to PAHs, metals that are COIs have low mobility in groundwater because of low solubility and tendency to adsorb to soil and not move as a dissolved fraction with advective groundwater flow.

Dissolved metals concentrations in groundwater, which represent the fraction that may be available for transport in groundwater through advective flow, show somewhat lower concentrations and a markedly lower frequency of detection. With the exception of arsenic, exceedences of SLVs for dissolved metals in groundwater are limited to a single well. Given the distance to the river (~1000 feet) DEQ does not believe that arsenic concentrations originating in site groundwater pose a significant threat via discharge to the Willamette River or that a remedial action is warranted. Major groundwater impacts occurred prior to 1985, when initial monitoring wells were installed, and could date back to the 1940s. No significant releases to groundwater have occurred since 1985, therefore the groundwater plume appears stable and not likely to expand beyond its current extent or beyond site boundaries.

It is not uncommon to see elevated levels of arsenic in groundwater from the Willamette Basin due to naturally occurring concentrations and groundwater redox conditions. Petroleum releases at the site also may result in elevated dissolved arsenic concentrations in groundwater, because microbial degradation of organic material such as petroleum consumes oxygen, further promoting reductive conditions usually favorable for arsenic desorption from the soil matrix into groundwater . Because petroleum contamination in groundwater is localized and within site boundaries, elevated arsenic concentrations related to petroleum releases at the site also would expected to be localized.

Historically, low to moderate levels of benzene have been detected in only about 6 of 26 monitoring wells that have been sampled on a regular basis. Therefore benzene (and other BTEX compounds) detections are not indicative of a site-wide and/or ongoing source to shallow groundwater. DEQ concludes that moderate levels detected infrequently at the downgradient edge of the site will likely attenuate to significantly lower levels through dilution, dispersion, abiotic reactions and biodegradation prior to reaching the Willamette River. Furthermore, there is significant petroleum contamination as a result of releases from other sites in the area, including the ConocoPhillips Willbridge Bulk fuel terminal located across NW Front Avenue in the downgradient direction (see ECSI #1549). Remedies have been implemented at the ConocoPhillips Willbridge site, including free-product removal, construction of engineered cutoff walls around a storm sewer line associated with OF#22 that acts as a migration pathway, and installation of a sheet-pile barrier wall along the waterfront to control light non-aqueous phase liquid and dissolved-phase contaminant migration in groundwater to the river. Therefore, DEQ does not believe that the low to moderate benzene concentrations in site groundwater pose a significant threat via discharge to the Willamette River given the distance to the river (~1000 feet) or that a remedial action is warranted. As discussed above, major groundwater impacts occurred prior to 1985 and the groundwater plume appears stable and not likely to expand beyond its current extent or beyond site boundaries.

6.3 Groundwater infiltration into storm lines. Groundwater infiltration into site storm drain lines, with subsequent discharge to the Willamette River, was identified as a potential concern for three separate areas at the site discussed below.

6.3.1 Outfall V33 and NW Front Avenue Utility Corridor.

Dry weather flow was not observed during the initial camera surveys in February 2007 during a period of high water table.

Groundwater infiltration in this area was evaluated by comparing historical groundwater concentrations in nearby wells W1, W2, W3 and W4. Groundwater depths in these wells ranged from 12 to 20.1 feet below ground surface (bgs), with an average of 15 feet bgs. The storm sewer lines in this area are 12 feet deep and therefore could be susceptible to groundwater infiltration during high water table conditions. . The relatively deep water table depths in this area compared to the southeastern side of the site are likely due to this area being largely paved, which limits stormwater infiltration and recharge to shallow groundwater.
A number of metals, including total arsenic, copper, lead and zinc, exceed their respective SLVs in unfiltered groundwater from W1, W2, W3 and W4. Dissolved metal concentrations show a lower frequency of detection, with SLV exccedences limited to arsenic in W2, W3, W4, Cadmium in W3, and copper and zinc in W2. Dissolved arsenic concentrations were relatively high compared to its SLV (>100x), however there are no anthropogenic sources of arsenic at the site, and as discussed above in section 6.2, it appears that arsenic is a result of naturally occurring concentrations in soil and groundwater redox conditions. Petroleum releases at the site also may result in elevated dissolved arsenic concentrations in groundwater, but because petroleum contamination in groundwater is localized and within site boundaries, elevated arsenic concentrations related to petroleum releases at the site also would expected to be localized.

BTEX detections in the latest groundwater sampling event are limited to W4, with a benzene concentration of 51.8 ug/L. Benzene has been detected in this well in less than half of the historical sampling events. The localized, sporadic detections of benzene area not indicative of an ongoing source warranting remedial action and do not appear to pose a significant threat for infiltration into City storm drain lines on NW Front Avenue.

PAH detections above SLVs in W1, W2, W3 and W4 are limited to acenaphthene in W4. This isolated detection does not appear to present a significant threat for infiltration into City storm drain lines on NW Front Avenue.

6.3.2 Former FHA Line in Northeast Site Area

Due to access limitations and lack of observation points, the storm drain line segment from AAP911 to AAP912 was identified as an area for potential groundwater infiltration. Because a video survey could not be conducted in this area to directly observe whether groundwater infiltration was occurring, the evaluation was conducted by comparing groundwater contaminant concentrations detected during the most recent sampling event in nearby monitoring wells (e.g., A-8, U-North, U-South). PAHs, BTEX and metals were not detected above JSCS SLVs in these wells (Table 1). It should be noted that PAH detection limits exceeded JSCS SLVs. Furthermore, historical groundwater levels in wells A-8 range between about 12 and 14 feet bgs, and in U-South and U-North range between about 14 and 17 feet bgs. These levels are below the depth of the storm drain line (~5 feet bgs). Based on this screening, lack of contaminant sources to groundwater in this area, and depth to groundwater, it is not likely that infiltration of contaminated groundwater into site storm drain lines, or nearby City of Portland storm drain lines, is significant in this area.

6.3.3 V39 Area

As illustrated on Figure 6, groundwater infiltration into the storm drain line was observed in a number of camera surveys conducted in summer 2007 near and downstream of V39, generally away from tanks or other potential contaminant sources. Groundwater levels in this area are generally shallower compared to other site areas as there is a permeable surface that allows stormwater infiltration into subsurface deposits. The incompetent nature of many of the historic FHA lines likely facilitates infiltration of meteoric water, and also shallow groundwater when the water table rises significantly during periods of prolonged precipitation.

The section of pipe where infiltration was observed that is closest to a potential contaminant source is represented by Run 20, located near tank T-106. Groundwater sample results from the nearby monitoring wells (e.g., A-10, W-12, W-14) are included in Appendix A. It should be noted that these wells are from 250 to 300 feet from the Run 20 leak. PAHs, BTEX and metals generally were not detected above JSCS SLVs in wells A-10 and W-12. Exceedences are limited to arsenic (A-10, W-12) and copper (W-12). Some contaminants were detected at relatively high concentrations in W-14, including arsenic, lead and phenanthrene, which were detected in W-14 at >100X their respective JSCS SLV.

Other PAHs generally were not detected, although the laboratory detection limits exceed SLVs in all cases.

Infiltration was also observed downstream of V39 and appears related to the older FHA lines that were incorporated into the existing system. This area was used as residential housing and there are no known contaminant sources in this area, consistent with non-detect to low levels of contaminants detected in groundwater discussed in section 6.3.2.

7. Stormwater Source Control Measures

7.1 Catch basin sediment sampling and removal. Catch basin sampling was conducted in August 2007. Representative samples were collected from five stormwater drainage areas at the site (Figure 7). Samples were formed by compositing subsamples from each catch basin in the respective area.

Only one catch basin from Areas 1 and 2 contained appreciable sediment. Therefore follow-up sampling on an individual catch basin basis was not conducted for these areas.

Area 3 was divided in 3A (outside of the refinery and emulsion tank yard) and 3B (within the refinery and emulsion yard) because catch basins in Area 3A had been routinely cleaned, while 3B had not. Sample 3A was comprised of 19 subsamples; Area 3B was comprised of 6 subsamples. Area 4 was comprised of 4 subsamples. There was insufficient sediment volume for sample collection from Area 5.

Based on the composite sample results, selected archived samples from a number of individual catch basins were further analyzed to assess areal contaminant distribution and identify potential source areas. Catch basin sampling data are summarized on Table 1.

7.1.1 Composite Sediment Samples

The following contaminants of interest (COIs) commonly exceeded bioaccumulation screening level values (SLVs) in composite samples:

- metals (arsenic, cadmium, lead)
- bis(2-ethylhexyl)phthalate
- total PCBs
- total DDT

The PCB Aroclors 1254 and 1260 were the only PCB compounds detected. Detected concentrations were below their individual toxicity SLVs in each sample. Total PCBs exceeded the bioaccumulation SLV (0.00039 mg/kg) in each sample, but were below the toxicity SLV of 0.676 mg/kg. DDT was the only organochlorine compound to exceed its SLV in the composite samples. Similar to PCBs, total DDT concentrations in each composite sample exceeded its bioaccumulation SLV (0.0003 mg/kg), but were below the toxicity SLV of 0.0629 mg/kg.

Exceedences of SLVs for toxicity were most common for the metals, but limited to copper, lead and mercury. Concentration of other analytes that exceed toxicity SLVs include a number of PAH compounds in composite sample 3B, and bis(2-ethylhexyl)phthalate concentrations in 4 of 5 composite samples.

Following sample collection, the catch basins were cleaned and a total of 0.4 cubic yards of solids were disposed off-site in a permitted landfill.

7.1.2 Individual Catch Basin Samples

Follow-up sampling for metals (arsenic, copper, lead, mercury, zinc) and phthalates (bis[2-ethylhexyl]phthalate) was conducted for selected catch basins. Individual catch basin results for metals showed that two catch basins (SWCB-32, SWCB-37) in Area 3B had substantially higher mercury concentrations than other samples. SWCB-37 and SWCB-32 are both located in the general proximity of the laboratory. SWCB-37 is the closest at approximately 50 feet east of the laboratory. Lead was notably higher in these catch basins as well, and also SWCB-53, SWCB-54, SWCB-56 in the southeast end of the refinery area (Area 3B), and SWCB-22 in Area 4.

In general, bis(2-ethylhexyl)phthalate was found at elevated concentrations above SLVs in catch basins across Areas 3A, 3B and 4. Concentrations in SWCB-31, SWCB-32, SWCB-37, SWCB-39, SWCB-44, SWCB-45, and SWCB-50 in Area 3A, and SWCB-51 and SWCB-52 in Area 3B exceeded toxicity SLVs by over a factor of 10. As for mercury and lead, SWCB-37 had the highest bis(2-ethylhexyl)phthalate concentration. The source of the bis(2-ethylhexyl)phthalate is not known.

7.2 Camera Survey and In-line Sediment Removal. The camera survey was used to determine the configuration of the stormwater conveyance system downstream of V-33 and V-39, verify that the historical stormwater connection to the site at AAM084 was plugged, and to determine if there were other site-related stormwater lines connected to the COP line on NW Front Avenue. The camera survey and line cleanouts were conducted in three events. Pipes were generally cleaned prior to surveying. A total of 25 camera runs covering approximately 2500 feet of storm pipe were documented on video. The scope of the camera survey is shown on Figure 4.

Signs of obvious petroleum impact were limited to a sheen noted in an isolated area near manhole AAP-821, located just downstream from V39. It appeared associated with an asphaltic material. Approximately 3 gallons of this material were removed. A total of 0.75 cubic yards of sediment were removed from all accessible lines downstream of outfalls V33 and V39.

Based on recommendations in the SCE report, Chevron conducted additional off-site storm drain line investigation and cleanout (ARCADIS, 2009b). A camera survey was conducted from AAP796 towards the site to verify that this segment is inactive, and to assess and clean-out accumulated site-related sediment. A concrete barrier was observed approximately 16 feet south of AAP796, and appears to be the sidewall of a sanitary sewer manhole. Sediment was removed from the lines and filled approximately ¼ of a 55-gallon drum. One composite sample was

collected and analyzed for disposal characterization (Table 2). In general, COI concentrations were detected at similar concentrations in the composite sample representing removed material as in on-site catch basin composite samples. All detected concentrations were below 10 times the corresponding toxicity SLV. Aroclor 1248 was detected in the off-site composite sample at a relatively low concentration (0.0075 mg/kg), but not in on-site catch basin samples.

7.3 Ongoing Measures to Reduce Stormwater Contamination. PPC implements a stormwater management program permitted through DEQ's Water Quality Program. A Stormwater Pollution Control Plan (SWPCP) has been developed for the site, and was recently revised based on Chevron's recommendations to improve stormwater source control measures at the site (Paramount Petroleum, 2009).

The SWPCP describes the BMPs currently implemented and maintained at the site. The BMPs include structural and engineered controls, and operational controls. The site BMPs are listed below:

- Stormwater valves. Stormwater valves in catch basins and Outfalls V33 and V39 are used to regulate discharge of materials or polluted stormwater from the site. These valves are kept shut until storm events require that the valves be opened to discharge stormwater from the site. Prior to discharge, stormwater is visually inspected to prevent sheen and oils from discharging with the stormwater.

- Stormwater discharge regulation. Prior to opening the valve at Outfall V33 or the valve at Outfall V39 to drain on-site stormwater, the vault around the valve is visually checked for sheen. If sheen is observed, sorbent pads are used to remove the sheen from the water before the valve is opened. In addition, sorbent booms are permanently installed in the valve vaults. Monthly inspections of the two vaults are conducted to inspect for oily sheen and suspended solids, to check that the inlet and outlet valves are functioning properly, and to assess the condition of the booms to determine if replacements are needed.

- Containment. All on-site drain valves are kept in the closed position to prevent unwanted material from flowing into the stormwater system. Refinery tanks and chemicals stored on site are kept in secondary containment. The main tank yards (Guilds Lake and crude oil) are walled and bermed. Each tank yard is capable of containing the entire volume of its largest tank in case of a failure. The eight tank truck loading racks are either bermed or have areas around them to contain spills.

- On-site API separator. All on-site strip drains, drains inside buildings and warehouses, water draws on the light product and crude tanks, pump cooling water, boiler blow-down, truck loading and unloading areas, pipe trenches, and pump containment pads drain to the API separator, followed by on-site treatment and discharge to the sanitary sewer.

- Runoff protection. Boiler houses, pump houses, laboratories, emulsion manufacturing, warehouses and the maintenance shop are covered with roof structures. Other chemicals at the refinery (i.e., emulsifying chemicals) are stored inside a warehouse and protected from stormwater contact. Empty drums are placed in the drum storage area, which is surrounded by strip drains leading to the API separator.

- Erosion control. Catch basins, in areas with unpaved surfaces with greater potential for erosion, are equipped with Dandy Bags®, or filters, which retain dust and other materials on the surface of the filter while stormwater passes through. Drain webs are installed on catch basins in paved high-truck-traffic areas.
- Housekeeping. Monthly visual checks of Dandy Bags and drain webs are conducted as part of regular maintenance activities at the site. Dandy Bags are inspected annually and cleaned or replaced as needed. Drain webs are inspected semiannually. Sorbent booms are changed periodically. Materials and waste stored on site are kept in warehouses or sheltered areas to prevent them from coming into contact with stormwater.
- On-site management plans. Plans have been developed and are maintained on site for emergency preparedness and response, spill control and countermeasures, regional spill response, and management of hazardous waste.
- Training. All operations and maintenance employees are Hazardous Waste Operations and Emergency Response standard (HAZWOPER) First Responder Operations (Level 2), or higher, trained and recertified as defined by the Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120 each year. Operations and maintenance personnel are trained on aspects of the SWPCP annually as a part of the site environmental compliance training. Additionally, annual training is provided for both spill response measures and housekeeping procedures. Truck drivers undergo training before they are allowed to self-load at the site loading racks to help reduce spills and truck boil-over during loading.

Recent revisions/amendments to the SWPCP based on recommendations made by Chevron, and approved by DEQ, include:

- Increase catch basin and drain web inspection frequency in high-traffic, paved areas of the site to quarterly from semiannually.
- Increase catch basin and Dandy Bag inspection frequency in unpaved, low-traffic areas of the site to semiannually from annually
- Perform an annual storm line cleanout in the line extending from Outfall V39 to manhole AAP917 for 2 years, in conjunction with the annual catch basin cleanout performed during the third quarter before the wet season begins. Record the volume of sediment cleaned out of the lines. If the volume of sediment removed from the lines is less than 0.3 cubic yard (one 55-gallon drum) each year, after 2 years reduce the line cleanout frequency to once every 5 years. Maintain records of the storm line cleanout and sediment accumulation with the stormwater BMP records.
- Perform site-wide street sweeping annually on impervious surfaces with routine traffic flow at the site. Street sweeping will be performed in conjunction with the annual catch basin cleanout performed in the third quarter, before the wet season begins. Maintain records of the street sweeping with the stormwater BMP records.

- Require the site Environmental Compliance Specialist to attend an off-site stormwater management class prepared by a stormwater specialist. Any new personnel taking over this position will attend the same training. Operations personnel who make the decision to open on-site stormwater valves when stormwater has collected will complete annual stormwater awareness online or classroom training held at the site as a part of their annual training requirements.

8. Stormwater Monitoring Summary. Four sampling events were conducted under the JSCS source control evaluation. Samples were collected from the stormwater valve at Outfall V33 and at manhole AAP825 downstream of the stormwater valve at Outfall V39 during each event (8 total samples; Figure 7). The V39 sample was collected from AAP825 in order to capture potential contaminant contributions between V39 and AAP825. Sampling was completed in accordance with the Stormwater Sampling Plan (ARCADIS BBL 2007a) and met JSCS storm event criteria. Sampling results were presented in a series of technical memoranda (ARCADIS BBL, 2007b; ARCADIS BBL 2008a; ARCADIS BBL 2008b).

Stormwater samples were analyzed for metals (aluminum, arsenic, cadmium, copper, lead, mercury and zinc [total and dissolved]), PAHs, PCBs, organochlorine pesticides, and phthalates.

Table 3 summarizes the frequency and magnitude that COIs were detected above SLVs in stormwater and catch basin composite samples. The listed magnitude of exceedence (MOE) represents the ratio of the detected concentration to the SLV (i.e., concentration/SLV). Table 4 below shows maximum concentrations of COIs for stormwater from Outfalls V33 and V39 compared to SLVs.

8.1 Metals. Total copper, lead and zinc concentrations were detected commonly in stormwater samples above SLVs. All detected metal concentrations were within an order of magnitude of their respective SLVs (MOE </=10). Mercury, which was detected at relatively high levels in catch basin sediment, was not detected in any of the stormwater samples and thus is not included on Table 3.

8.2 Organochlorine Pesticides. Several DDT-related compounds in addition to heptachlor, aldrin, and dieldrin were detected above SLVs in 2 or fewer stormwater samples representing each outfall. The two detections of total DDT compounds had MOEs of 8 and 14, respectively. For other organochlorine pesticide detections the MOE ranged from 18 to 48.

8.3 Polychlorinated Biphenyls (PCBs). PCBs were not detected in any of the 8 samples. However, due to matrix interference the detection limits were elevated with respect to typical achievable detection limits, and are above SLVs.

8.4 PAHs. The following PAHs had the highest MOEs:

- benzo(b)fluoranthene (11.7 times the SLV, January 14, 2008 V33 stormwater sample)
- chrysene (11.7 times the SLV, January 14, 2008 V33 stormwater sample)
- phenanthrene (18 times the SLV, January 14, 2008 V33 stormwater sample)

- phenanthrene (15 times the SLV, March 28, 2008 V33 stormwater sample)

The remaining PAH exceedences ranged between 1.1 and 9.3 times the SLV. Detected PAHs are consistent with those detected above SLVs in catch basin sediment, with the exception that indeno(1,2,3-cd)pyrene was not detected in stormwater samples.

8.5 Phthalate Esters. Bis(2-ethylhexyl)phthalate was the only phthalate ester detected in stormwater. It was detected in 2 of 8 samples at concentrations less than 5 times its SLV.

9. Summary and Conclusions. Chevron completed a SCE in accordance with JSCS guidance and DEQ-approved work plans. Potential contaminant pathways of concern included stormwater discharge into the Willamette River via the City of Portland sewer system, groundwater migration and discharge to the Willamette River, and site groundwater infiltration into on-site and off-site storm drain lines and the Willamette River. Accessible portions of the storm drain system were video surveyed to verify that there were no unauthorized/uncontrolled and/or unknown contributions to the site stormwater control system or from the site to the City of Portland stormwater conveyances. In-line sediment in storm lines below stormwater outfalls V33 and V39 were cleaned to the extent practical using currently available methods. DEQ concludes that legacy contamination at the site has been characterized and controlled to the extent feasible based on the following:

- Existing and potential facility-related contaminant sources have been identified and characterized. Historical site investigations have adequately characterized known contaminant releases. Extensive camera surveys and line cleanouts were completed, and catch basin sediment and stormwater with potentially complete pathways to the Willamette River were analyzed during the SCE for a comprehensive suite of analytes.
- Stormwater (and groundwater infiltrating into the storm system) is the only complete pathway to the Willamette River at the site. Stormwater discharges are controlled and regulated to the extent practical. Stormwater discharges from the site are regulated by valves at V33 and V39 in addition to valves within individual catch basins. Stormwater runoff in the areas at highest risk of releases, such as truck loading and unloading areas, pipe trenches, pump containment pads, and drains inside buildings and warehouses, are directed to the API and sanitary sewer. In the tank farm areas stormwater largely infiltrates and minimal runoff enters catch basins.
- Groundwater infiltration into storm lines occurs primarily in the former FHA area and only was observed at one location (run 20) within the operational area of the site. Groundwater monitoring indicates that relatively low PAH, VOC and dissolved metals concentrations are detected infrequently in this area and in wells at the downgradient side of the site. DEQ concludes that groundwater contamination is not a significant concern for infiltration into storm drains lines or migration and discharge to the Willamette River. Low concentrations would further attenuate prior to reaching the City of Portland storm line on NW Front Avenue, so infiltration of significantly impacted site-related groundwater appears unlikely.
- Groundwater monitoring results are not indicative of a significant ongoing source of contaminants infiltrating via groundwater to the stormwater system, the groundwater

plume appears stable and contained with site boundaries, and natural attenuation will continue to reduce groundwater concentrations. Therefore DEQ concludes that source control measures related to residual groundwater contamination are not warranted.

- PPC employs comprehensive site-wide stormwater BMPs. Supplemental BMPs were identified in the SCE to control impacts to the stormwater collection system and have been implemented. These supplemental BMPs include periodic sweeping and a periodic catch basin cleanout program, and storm drain line inspections and cleanouts as needed. The supplemental BMPs have been incorporated and memorialized in a revised SWPCP.

  There is no clear pattern of SLV exceedences, although levels in catch basin sediment and stormwater from the primary operational areas of the site (i.e., the V33 drainage basin) are somewhat higher than other site areas, as would be expected. The relatively high levels detected in some V33 catch basin samples may reflect that they had not been cleaned for an extended period of time. The sedimentation rate in general appears very low. The total amount of sediment removed from all catch basins was less than 0.5 cubic yards, and included catch basins that had not been cleaned for years.

  PAHs, in addition to copper, lead and zinc, were commonly detected in stormwater samples above SLVs. These COIs are likely site-related. The copper, lead, and zinc concentrations are within an order-of-magnitude of their respective SLVs and less than their respective NPDES industrial stormwater benchmark values of 100, 400, and 600 ug/l. PAH concentrations are less than 20 times their respective SLVs.

  Bis(2-ethylhexyl)phthalate and pesticide concentrations in stormwater also were detected above SLVs, but at a relative low frequency. The source of the phthalates and DDT is unknown and may be an area-wide signature in the drainage basin in general..

  DEQ does not believe these levels are indicative of ongoing or uncontrolled sources of legacy contamination on the site warranting additional investigation or source control measures. The source control measures described in this report are expected to minimize the potential of contaminants leaving the site and entering the Willamette River to the extent feasible or practical.

In summary, DEQ concludes that legacy contamination at the site has been identified and controlled to minimize the potential for contaminants to be released to stormwater. For this reason, DEQ's Cleanup Program is not requiring additional site characterization or stormwater source control measures at this time. This decision is contingent upon the site operator, PPC, maintaining BMPs identified in the SWPCP. This decision may need to be reconsidered if new information becomes available that indicates additional source control is warranted.

Water quality-based programs and regulations, including but not limited to NPDES permits and the City's authorities to regulate discharges into their stormwater system, are designed to ensure that future stormwater discharges from the site will be managed as necessary to prevent adverse environmental impacts in the Willamette River. DEQ is reviewing the overall adequacy of these efforts with regard to Portland Harbor remedial objectives and will be proposing changes if necessary. This could include development of a Portland Harbor-specific industrial stormwater permit.

References:

ARCADIS BBL. 2007a. Stormwater Sampling Plan, Former Chevron Willbridge Asphalt Plant No. 209293. August 3.

ARCADIS BBL. 2007b. Stormwater Sampling Technical Memorandum No. 1, Former Chevron Willbridge Asphalt Plant No. 2098293. November 28.

ARCADIS BBL. 2008a. Stormwater Sampling Technical Memorandum No. 2, Former Chevron Willbridge Asphalt Plant No. 209293. April 18.

ARCADIS BBL. 2008b. Stormwater Sampling Technical Memorandum No. 3, Former Chevron Willbridge Asphalt Plant No. 209293. May 21.

ARCADIS. 2009a. *Source Control Evaluation Report*, May 2009.

ARCADIS. 2009b. *Former Chevron Willbridge Asphalt Plant Line Cleanout*, November 2009.

Oregon Department of Environmental Quality and United States Environmental Protection Agency, 2005, *Portland Harbor Joint Source Control Strategy*. December 2005. http://www.deq.state.or.us/lq/cu/nwr/PortlandHarbor/docs/JSCSFinal0512.pdf

Paramount Petroleum Corporation, 2009, *Stormwater Pollution Control Plan, WB2-ENV-5000, Permit File 16055, 1200-Z Permit*. May 18, 2009.

Science Applications International Corporation. 2004. *Expanded Preliminary Assessment Report*. February 12.

Seacorp, 1993, *Environmental Site Investigation Report, Chevron Willbridge Asphalt Refinery*. November 4, 1993.

Seacorp, 1994, *Environmental Site Investigation Report, Guilds Lake-Willbridge Surplus Property*. March 15, 1994.

Washington State Department of Ecology. 1994. *Natural Background Soil Metals Concentrations in Washington State, Publication 94-115*. Toxics Cleanup Program. October.

Figures:

Figure 1: Site Location Map
Figure 2: Site Layout Map
Figure 3: Stormwater Drainage Basin Map
Figure 4: Stormwater System Map
Figure 5: Monitoring Wells