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ANNUAL PERFORMANCE REPORT 1 JANUARY 2018 – 31 DECEMBER 2018;

FIVE YEAR REMEDY PERFORMANCE EVALUATION

EAST MULTNOMAH COUNTY, TROUTDALE SANDSTONE AQUIFER REMEDY ECSI 1479

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Annual Performance Report
1 January 2018 – 31 December 2018

Five Year Remedy Performance Evaluation

East Multnomah County Troutdale Sandstone Aquifer Remedy

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1.0 INTRODUCTION

This report is submitted on behalf of Cascade Corporation (Cascade) and The Boeing Company (Boeing) and summarizes performance and monitoring data for the East Multnomah County, Troutdale Sandstone Aquifer (TSA) remedy project. Data presented in this report were collected during the period of 1 January 2018 through 31 December 2018 as part of the joint remedy being implemented under the Oregon Department of Environmental Quality's (DEQ's) Consent Order No. WMCSR-NWR-96-08 (DEQ, 1997) and conditions in the Record of Decision (ROD) (DEQ, 1996) to remediate a dissolved volatile organic compound (VOC) comingled plumes in the direct vicinity of the Boeing and Cascade properties.

Groundwater investigations of the TSA started in 1993 along with initial groundwater extraction using pump and treat methods. Results of the early investigations indicated groundwater VOC concentrations above the maximum contaminant level (MCLs) for trichloroethene (TCE), tetrachloroethene (PCE), cis-1,2-dichloroethene (cDCE), 1,1-dichloroethane (DCA), and vinyl chloride (VC). However, TCE was determined to be the predominant contaminant and continues to be utilized to evaluate the progress of the remedy. The primary source of contamination to the TSA was contaminated groundwater from the overlying Troutdale Gravel Aquifer (TGA). This report also includes the fourth, five-year remedy performance evaluation, or the 20-year performance evaluation, for the TSA remedy.

1.1 Purpose of Report

The reporting period for the TSA remedy Annual Performance Report presents data through the calendar year 2018. This Annual Performance Report provides an evaluation of the TSA remedy performance, including:

- A summary of the remediation system operation, maintenance, and performance monitoring data;
- Operation of an additional remedial action, a soil vapor extraction (SVE) system;
- An assessment of aquifer restoration progress; and
- Recommendations and future planned activities.

The project area and site are shown in Figure 1-1. The Lower TSA restoration zones (Remedy Zones A, B, C, and D), the TSA remedy network of extraction wells and monitoring wells, and the former and current TSA remedy extraction system layouts are shown in Figure 1-2.

Currently Sand and Gravel Aquifer (SGA) groundwater elevation data are collected monthly from one SGA well, BOP-44(usg), as part of the Portland Water Bureau (PWB) contingency plan (Landau Associates 2015). The location of this SGA well is included in Figure 1-2.

2.0 SIGNIFICANT ISSUES, EVENTS, AND ACTIONS

This section summarizes significant issues, events, and actions taken during the reporting period. The TSA remedy criteria for well and system decommissioning, monitoring well modifications, and general criteria for proposing changes in sampling frequency are summarized in Table 2-1. The current groundwater monitoring schedule, along with recommended modifications (see Section 7.0), is summarized in Table 2-2. A summary of significant documents exchanged with DEQ during the period are presented in Table 2-3.

2.1 Monitoring Program and Schedule Modifications

Monitoring schedule modifications implemented during the reporting period were presented in the *2017 Annual Performance Report: 1 January 2017 through 31 December 2017, Troutdale Sandstone Aquifer Remedy* (Geosyntec Consultants, Inc. [Geosyntec], Landau Associates, and SSPA, 2018). DEQ approved these changes on 2 August 2018 (DEQ, 2018d). Monitoring program changes are described below:

- Pilot shutdown (temporary shutdown to evaluate aquifer response) of extraction well EW-1 to increase flushing rates in the mound area. DEQ approved the pilot shutdown in August 2018 (DEQ, 2018d), and EW-1 was subsequently shut off on 31 August 2018. Monitoring at Lower TSA wells BOP-13(dg), BOP-31(dg), and D-17(dg) was increased to quarterly to monitor potential changes with pilot shutdown of extraction well EW-1.

- Discontinue water level monitoring at privately owned well PMX-167 and PWB wells PWB-2(lts), PWB-1(uts), and PWB-1(lts).

- Decrease water quality monitoring frequency from annual to biennial at Upper TSA monitoring wells BOP-21(ds), BOP-22R(ds), BOP-42(ds), and BOP-62(ds) and Lower TSA monitoring wells BOP-20(dg), BOP-23(dg), BOP-42(dg), and BOP-60(dg).

- Decrease water quality monitoring from semiannual to annual at non-pumping Lower TSA extraction well EW-8, and from quarterly to semiannually at Lower TSA wells EW-16 (non-pumping) and CMW-26(dg).

- Eliminate upper and lower screen sampling at former extraction wells CMW-24dg/EW-5, EW-8, EW-11, EW-12, and EW-15. Future samples will be collected from the upper section of the screens.

- The Oregon Water Resources Department (OWRD) provided approval of decommissioning methods for nine wells on 23 January 2018, following receipt of approval from DEQ (DEQ, 2018a and 2018c). DEQ approved the decommissioning

work plan (Geosyntec, 2018a) on 22 May 2018 and 30 July 2018 (DEQ, 2018a and 2018c). Wells D-18(ds), D-18(dg), D-16(ds), RPW-1(ds), along with non-operated soil vapor extraction wells VW-17D-75.0 and VW-17D-42.5 were decommissioned by backfilling in-place, while BOP-70(ds) was decommissioned by overdrilling between July and October 2018. Well BOP-71(ds) was also approved for decommissioning; however, the decommissioning was postponed pending City of Gresham right of way acquisition and permit approval to remove this well. The locations of the wells are shown in Figure 3-1.

- Decommission upgradient monitoring wells DEQ-1(dg), DEQ-5(ds), DEQ-5(dg), and CMW-3. These wells are currently scheduled to be decommissioned in the summer of 2019.

- Decommission SGA well BOP-44(usg), and TSA wells BOP-44(dg), BOP-44(ds), and EMC-2(dg), which are all located in Remedy Zone A. Although DEQ approved decommissioning of these wells, the schedule for decommissioning is delayed pending DEQ approval for partial closure of Remedy Zone A.

2.2 Municipal Well Field Operations

The PWB operated the Columbia South Shore Well Field municipal production wells (shown in Figure 1-1) twice during 2018. The first event was for seven days from 14 March 2018 to 21 March 2018 to conduct the annual maintenance run and pumped 160 million gallons of groundwater from the well field (PWB, 2019a). The second event was conducted during the summer months to augment drinking water from the Bull Run Reservoir. During the summer months, the Columbia South Shore Well Field operated for a total of 120 days between 20 June 2018 and 17 October 2018 and pumped 4.68 billion gallons (BGal) of groundwater (PWB, 2019b). Below is the estimated pumped volume per aquifer during the summer shutdown:

- Sand and Gravel Aquifer: 2.1 BGal or approximately 46% of total production.
- Blue Lake Aquifer: 2.0 BGal or approximately 44% of total production.
- Troutdale Sandstone Aquifer: 0.5 BGal or approximately 10% of total production.

TSA remedy contingency monitoring was implemented pursuant to the PWB Contingency Monitoring Plan (Landau Associates, 2015). Water levels and groundwater quality samples were collected on 20 July 2018, 20 August 2018, 20 September 2018. Post-PWB pumping contingency sampling was conducted to coincide with the TSA remedy routine sampling event in November 2018.

In addition to the PWB pumping event from the well field located north of the remedy area, the Rockwood Water People's Utility District (Rockwood PUD) periodically operated three SGA wells located near 181st Avenue and NE Halsey Street (southwest of the remedy area). During the

summer seasonal months (between 1 June and 30 September 2018), approximately 0.34 BGal of groundwater were pumped from the Rockwood PUD system (RWPUD, 2019).

3.0 EXTRACTION AND TREATMENT SYSTEMS

This section summarizes the operation and performance of the groundwater extraction remedy. The groundwater Central Treatment System (CTS) is the only groundwater extraction and treatment system remaining in operation for the TSA remedy. The CTS operates to remove VOC mass from the saturated zone and maintain ongoing hydraulic plume control for the TSA groundwater contamination. The location of the groundwater CTS and the currently operating four Lower TSA extraction wells are shown in Figure 1-2. Monitoring well construction details and location coordinates for monitoring and extraction wells are summarized in Table 3-1.

3.1 CTS Operational Summary

The CTS treats groundwater capture through the operation of four Lower TSA extraction wells (EW-1, EW-2, EW-14, and EW-23). The CTS and the extraction wells operated during the 12-month reporting period except as discussed below. EW-1 ceased pumping in August 2018 (per DEQ's approval), when it was placed in to pilot shutdown mode. Planned shutdowns for system maintenance occurred as follows:

- 29 January to 12 February: EW-1 pump shut down; pump and motor replaced.
- 20 February to 05 March: EW-1 Pump offline for repairs.
- 31 August to present EW-1 shutoff for pilot shutdown.
- 24 September: EW-2 pump taken offline for 1 day of sonic cleaning.

Unplanned temporary well shutdowns occurred during the reporting period, as follows:

- 2 January: EW-23 offline as a result of power loss.
- 6 May: All wells down due to area power outages.
- 6 August: EW-1 shutdown for flow meter replacement.
- 5 November: EW-2 flow meter was plugged with silica sand and stopped running, but system was still pumping.
- 11 November: CTS and all wells went offline for approximately half of a day (14 hours) due to power surge.
- 3 December: EW-2 Flow meter was plugged with silica sand and stopped running, but system was still pumping.
- 11 December: EW-2 shutdown for flow meter replacement.

Upper TSA extraction well EW-3 and Lower TSA extraction wells EW-5, EW-8, EW-11, EW-12, EW-13, EW-15, and EW-16 remain in use as monitoring wells.

3.2 Groundwater Extraction Rates

Historically extraction wells have been shutdown once TCE concentrations are consistently below the MCL. The shutdown extraction wells are typically utilized as groundwater monitoring locations or decommissioned based on DEQ approval. Current operating extraction wells include EW-2 and EW-14 (EW-1 operated between January and August 2018), located in the mound area near the CTS, and EW-23 located on the Boeing property in the western treatment area. Extraction well construction data are presented in Table 3-1.

Daily flow data from each well are recorded by the automated programmable logistics controller (PLC) system. Data from the PLC is downloaded weekly, and manual inspections and system field checks are also conducted weekly. Routine system inspections include manual collection of total flow meter readings, filter pressure monitoring, system inspection and maintenance, and collection of temperature and pH data. Target flow rates for the extraction wells have been established to maintain hydraulic capture of the dissolved VOC plume. The 2018 target extraction rates were: EW-1 at 25 gallons per minute (gpm), EW-2 at 25 gpm, EW-14 at 20 gpm, and EW-23 at 30 gpm.

Prior to the pilot shutdown of EW-1, flow rates at EW-1 were cyclic; however, routine maintenance activities were able to keep the flow rate near the target rate of 25 gpm. Flows at EW-2, EW-14, and EW-23 averaged 24, 19, and 31 gpm, respectively, and were either on target or very close to target flow rates. System and individual extraction well shutdowns (Section 3.1) resulted in lower flows at EW-2 in August and September, EW-14 in August to December, and EW-23 in July and September. For the months when the system was fully operational, flow at EW-2 ranged from 17 to 31 gpm, at EW-14 from 15 to 22 gpm, and at EW-23 from 30 to 33 gpm. Flow rates were sufficient to maintain hydraulic capture.

Flow rate and water level data for extraction wells are provided in Appendix A. Average monthly extraction well flow rates over the most recent five-year period are shown in Figures A-1 through A-4 of Appendix A. Significant repair and cleaning events for the operating TSA extraction wells are also noted in Figures A-1 through A-4 of Appendix A. The combined average monthly flow for all wells is shown in Figure A-5. Average flow data for the 12-month reporting period for individual wells and the total combined system are summarized in Appendix A, Table A-1.

3.3 Treatment System Effluent Compliance

CTS performance data consist of weekly flow, pH, and temperature measurements. In addition, influent and effluent samples are collected from the CTS quarterly. Permits to discharge treated groundwater effluent from the CTS are presented in Attachment C to the TSA Remedy Consent Order (DEQ 1997). Performance data were in compliance with permit limits.

CTS data for the reporting period are as follows:

- The total average flow during the twelve-month period, January through December 2018, was 91 gpm (Appendix A, Table A-1);
- Effluent pH ranged from 7.7 to 7.9 standard units (SU) and remained within the effluent limits of 6 to 9 SU;
- Effluent temperature ranged from 60 to 61 degrees Fahrenheit (F); and
- VOCs were not detected at the respective laboratory reporting limits in quarterly effluent samples.

Flow, pH, temperature, and influent and effluent VOC data for the reporting period, including compliance (or discharge) limits, are presented in Appendix A (Table A-2).

3.4 Well Decommissioning

Groundwater monitoring wells D-18(dg) and D-18(ds) and SVE wells VW-17d-42.5 and VW-17d-75.5 were decommissioned in October 2018. Decommissioning of D-16(ds), BOP-70(ds), RPW-1(ds), VW-17d-42.5, and VW-17d-75.5 was recommended in the 2016 TSA Annual Report (Geosyntec, Landau Associates, and SSPA, 2017), which was approved by DEQ (2017; 2018a, 2018c). Decommissioning was recommended for these wells because 1) concentrations of VOCs met the TSA criteria for well decommissioning; 2) well locations were no longer needed for PWB contingency monitoring or were redundant with other locations; or 3) SVE at the vapor wells was completed and the wells were no longer deemed necessary.

Four wells D-16(ds), D-18(ds, dg), and RPW-1(ds), and two SVE wells VW-17d-42.5 and VW-17d-75.5, were decommissioned by backfilling in place, in accordance with the DEQ-approved work plan (Geosyntec, 2018a; DEQ, 2018a and 2018c). One well, BOP-70(ds), was decommissioned by overdrilling. Well decommissioning activities were conducted by Cascade Drilling LLP, Oregon State licensed drillers, and the decommissioning activities were observed by Geosyntec staff geologists. Original boring logs and decommissioning logs are provided in Appendix B.

Investigation derived waste (IDW) generated during decommissioning activities included the following:

- Decommissioning water and water removed from the wells was stored in 55-gallon drums and transported to the Cascade property for transfer into the groundwater treatment system.
- No soil cuttings were generated from wells that were backfilled.

- Water, soil cuttings, and well materials removed from overdrilling BOP-70(ds) were placed into three 20-yard lined roll off boxes that were moved to the Cascade property upon completion of decommissioning activities. A No Longer Contains determination was obtained from DEQ (2018f), and the material was sampled and tested at the request of the landfill. Ultimately the IDW was transported and disposed at the Waste Management Landfill in Hillsboro, Oregon on 22 January 2019. Copies of the DEQ No Longer Contains Letter and disposal receipts are provided in Appendix B.

- A large concrete drilling pad and concrete-filled-well vaults were discovered during decommissioning activities at RPW-1(ds) in July 2018. The concrete was likely placed during well installation activities in the late 1980s (RPW-1(ds) and former well RPW-1(dg) that was previously decommissioned). The concrete drilling pad was broken up with a track-hoe, removed from the RPW-1(ds) property, and the pieces and well monuments/vaults were staged at the Cascade property for off-site disposal (Spring 2019).

- Above ground well monuments from D-18(dg) and D-18(ds) were contained in large concrete-filled vaults. These, and the above ground monument from D-16(dg) were removed from the properties, staged at the Cascade property, and disposed of as non-hazardous solid waste (along with the concrete from RPW-1(ds)) in Spring 2019.

3.5 Soil Vapor Extraction

The SVE system is an additional corrective measure that has been implemented in the TSA mound area where VOC concentrations have been slow to respond to treatment by the groundwater extraction system. Initially in 2014, the SVE system consisted of three wells (VW-17D-42.5, VW-17D-75, and VW-17D-95.5). The system was modified in 2016 by discontinuing vapor extraction at the two shallow wells (VW-17D-42.5 and VW-17D-75) and by adding four new vapor extraction wells (VMW-A through VMW-D). In 2016, the SVE system consisted of: VW-17d-95.5, VMW-A, VMW-B, VMW-C, and VMW-D (Figure 3-2). The SVE system was again expanded in Spring 2019 (installation of three wells VMW-E, -F, and –G) angled towards groundwater monitoring well CMW-18(ds). DEQ approved further expansion to the west and one of these wells (VMW-H) also was installed in Spring 2019. Installation of the remaining five SVE wells to the west is being considered for 2019. In addition, shutdown and rebound testing for some SVE wells was also implemented in Spring 2019. The SVE system operated almost continuously throughout 2018, as discussed in the following sections.

3.5.1 SVE System Operation

The SVE system consists of a 15-horsepower TurboTron regenerative blower and a knock-out tank situated in a shed within the chain-link fence that surrounds the CTS. The system is connected to VW-17d-95.5 by aboveground polyvinyl chloride (PVC) piping and to the other SVE wells via below ground PVC piping. A PVC exhaust stack directly discharges to the atmosphere at a height

of approximately 8 feet (ft). The SVE system maintained an average flow rate of around 448 standard cubic feet per minute (scfm) in 2018 Appendix C (Table C-1; Figure C-2).

3.5.2 SVE System Monitoring

Routine SVE system monitoring consists of the following parameters for the five SVE wells (VMW-A, VMW-B, VMW-C, VMW-D, and VW-17d-95.5) operated in 2018, as well as the system outlet, as follows:

- Weekly Monitoring: collect field measurements of temperature, pressure, flow rates, and vapor data from the system and individual SVE wells;
- Monthly Sampling: collect VOC vapor samples from system effluent; and
- Quarterly Sampling: collect VOC samples (vapor and groundwater) from the individual SVE wells.

VOC results from photoionization detector (PID) measurements and laboratory testing are summarized in Tables C-1 and C-2 and the analytical results are shown in Figure C-1. Analytical laboratory reports and data validation memoranda are provided in Appendix F.

3.5.3 SVE System Mass Removal

The SVE system removed approximately 11 pounds (lbs) of VOCs in 2018 and a total of approximately 60 lbs of VOCs mass from the unsaturated zone of the TSA mound area since the startup of the SVE Pilot Study in 2014. SVE system operational and mass removal data are provided in Appendix C. Flow rates, vapor concentrations (field and laboratory), and estimated mass extracted are summarized in Appendix C, Tables C-1 and C-2, and in Figures C-1 through C-3.

The 2018 analytical results indicate the highest TCE vapor concentrations were observed at well VMW-C (located west of CTS, ranging from 628 to 2,370 micrograms per cubic meter [µg/m^3]). Groundwater samples collected from the SVE wells indicate VMW-C also had the highest TCE concentrations, ranging from 20.3 to 31.0 micrograms per liter (µg/L). Vapor analytical results are shown in Tables C-1 and C-2, and groundwater analytical results from the wells are presented in Table E-1.

In addition to the quarterly samples collected at the SVE wells, groundwater samples were also collected quarterly at nearby well CMW-17(ds), which is located adjacent to the vapor wells and screened near the top of the Upper TSA. CMW-17(ds) is screened from elevation 14 to 24 ft mean sea level (msl), at depths of 97.89 to 107.89 ft below ground surface (bgs). The elevation of the CMW-17(ds) screen correlates to a depth just below where the deepest vapor monitoring well (VW-17d-95.5 is screened from elevation 44.5 to 24.5 ft MSL). VOC concentrations at CMW-17(ds) significantly decreased in 2018 from 15.1 to 7.13 µg/L, indicating a probable correlation between the vapor mass removed and declining groundwater VOC concentrations. In

addition, the data suggests that VOC mass removed from the vadose zone may no longer be available to recontaminate groundwater as levels increase with reduced remedy pumping. Groundwater elevations and TCE concentrations at CMW-17(ds) are shown in Appendix E, Figure E-1.

4.0 REMEDY PERFORMANCE SUMMARY

This section summarizes remedy performance data obtained during this reporting period, including groundwater elevation data and groundwater quality data. Groundwater elevation data are summarized in Appendix D, and groundwater quality data are summarized in Appendix E. Laboratory reports, along with data validation memoranda, are presented in Appendix F.

4.1 Groundwater Elevations

Groundwater elevations were measured monthly, quarterly, semi-annually, and annually based on the Performance Monitoring Schedule (Table 2-2). Depth to groundwater is measured using a portable electric tape meter in the monitoring wells, and with pressure transducers located in 11 wells (four Upper TSA wells, six Lower TSA wells, and one SGA well). Pressure transducers are utilized in wells selected as part of the PWB contingency monitoring plan. Water level data are downloaded monthly from the pressure transducers.

During the 2018 operation of municipal well fields (PWB and Rockwood PUD), drawdown in remedy well groundwater wells of approximately 18 ft in the Upper TSA and 14.8 ft in the Lower TSA were observed along the western portion of the area, wells BOP-22R(ds) and BOP-60(dg), respectively.

Groundwater depths and groundwater elevations are summarized in Table D-1 of Appendix D. Groundwater elevation hydrographs for the wells with pressure transducers along with precipitation data are included in Appendix D in Figures D-1 through D-3. Precipitation during the 12-month reporting period was approximately 27.30 inches, which is approximately 8.73 inches below the normal 36.0 inches of annual precipitation at the Portland airport (National Oceanic and Atmospheric Administration [NOAA], 2019).

4.2 Groundwater Flow and Hydraulic Capture

The objectives of the TSA dissolved VOC plume remedy are to 1) maintain hydraulic capture; 2) prevent further vertical and horizontal spread of VOC contaminants; and 3) allow existing uses of groundwater resources in the eastern Multnomah County (DEQ, 1996). Groundwater elevations near the TSA mound area, located within Remedy Zone C, indicate that inward horizontal gradients towards the operating extraction wells continue due to ongoing remedy pumping. Groundwater contours for the semiannual water level measurement event (February 2018) and the annual event (August 2018) are provided in Figures 4-1a,b and 4-2a,b. Groundwater flow in the Upper TSA is generally towards the north-northwest; however, in August 2018, the groundwater flow along the western portion of the remedy area was temporarily towards the southwest. The temporary change in the groundwater flow pattern is due to the combined operation of the municipals well fields (PWB and Rockwood PUD). Lower TSA inward hydraulic gradients toward the extraction wells are indicative of hydraulic capture and demonstrate the effectiveness of Lower

TSA extraction wells EW-1, EW-2, EW-14, and EW-23 in achieving and maintaining capture. Groundwater flow directions in the Lower TSA in the mound area do not vary significantly from wet to dry season and are strongly influenced by the operating extraction wells. These extraction wells capture groundwater within areas of the site with persistent TCE concentrations above the cleanup level.

4.3 Groundwater Quality

Groundwater quality is evaluated against the MCL for the site COPCs. TCE is the predominant COPC by mass and is used to evaluate remedy progress. TCE has an MCL of 5 µg/L.

Groundwater samples are collected for analytical testing on a quarterly, semi-annually, annually, and biennial frequency based on the DEQ approved Performance Monitoring Schedule (Table 2-2). Biennial analytical monitoring is conducted during odd number calendar years (e.g., 2015 and 2017). Ten wells were reduced from annual to biennial as part of the 2016 Annual Report recommendations, but sampling was instigated prior to receipt of DEQ's approval of the modification so these annual data are included herein. The Performance Monitoring Schedule is reviewed annually to optimize the monitoring program to maintain compliance with the ROD.

Analytical results for groundwater samples collected during the reporting period are summarized in Appendix E, Table E-1. Plots of time versus TCE concentrations for select monitoring wells in or near the mound area and the four operating extraction wells are presented in Appendix E, Figures E-1 through E-8. TCE concentration contours for the semiannual event (February 2018) and the annual event (August 2018) are shown in Figures 5-1a,b and 5-2a,b for the Upper and Lower TSA wells, respectively.

4.3.1 Upper TSA

TCE concentrations in the TSA mound area (located in Remedy Zone C) persist. TCE concentrations during the monitoring period (January through December 2018) ranged from 7.13 to 15.1 µg/L in well CMW-17(ds) (Figure E-1), 14.0 to 17.1 µg/L at CMW-10(ds) (Figure E-5), and 58.7 to 98.6 µg/L at CMW-18(ds) (Figure E-6). TCE concentrations in wells west (BOP-13(ds) and BOP-31(ds)) and south of the mound area (CMW-20(ds)) are below detection limits (Figures E-2, E-3, and E-4, respectively). Groundwater is captured by nearby Lower TSA extraction wells EW-1 (operated between January and August 2018), EW-2, and EW-14 within the vicinity of these three monitoring wells.

In the Upper TSA near the western remedy area and southern extent of the TSA mound area, TCE concentrations were below the MCL, with the exception of well BOP-61(ds) with reported TCE concentrations just above the MCL at 5.3 and 7.0 µg/L, as shown in Figures 5-1a and 5-2a.

4.3.2 Lower TSA

TCE concentrations for the Lower TSA wells sampled in 2018 are shown in Figures 5-1b and 5-2b. In the western portion of the remedy, Remedy Zone B, TCE concentrations were below the MCL with the exception of the August results for well BOP-61(dg) at 5.2 µg/L. TCE concentrations at operating extraction well EW-23 were 1.93 and 2.0 µg/L during the semiannual events, respectively (Appendix E, Figure E-8).

In the central portion of the remedy, Remedy Zone C, TCE concentrations were below the MCL at non-pumping extractions wells EW-5 and EW-12, and operating extraction well EW-1. TCE concentrations were above the MCL at non-pumping extraction well EW-8 (5.31 µg/L from the upper diffusion bag and 5.29 µg/L in the lower diffusion bag during the February event); however, concentrations decreased to below the MCL during the August sampling event. Extraction wells EW-2 (12.1 to 19 µg/L) and EW-14 (6.88 to 9.64 µg/L), see Appendix E, Figure E-8. The highest TCE concentration in the Remedy Zone C area continued to occur in the mound area well D-17(ds) with concentrations ranging from 37.8 to 54.1 µg/L (Appendix E, Figure E-7). Monitoring well D-17(ds) is screened at the top of the Lower TSA across the water table. At well D-17(dg), screened in the lower portion of the Lower TSA, TCE concentrations ranged from 1.27 to 1.48 µg/L in 2018.

In eastern portion of the remediation area, Remedy Zone D, TCE concentrations remained below the MCL with the exception of well CMW-26(dg), where TCE was below the MCL during the February and May events (3.7 and 3.24 µg/L, respectively) but above the MCL during the August event (6.46 µg/L). No sample was collected in November due to approved modifications in the sampling frequency from quarterly to semiannual. The TCE concentration at CMW-26(dg) in February 2019 was 6.51 µg/L

4.4 Remedy Zone A

Based on DEQ's approval of recommendations in the 2017 Annual Report (DEQ, 2018d), groundwater quality sampling was not conducted in 2018 at Remedy Zone A monitoring wells. The City of Portland PWB reported isolated low-level (below the MCL) TCE detection at well PWB-1(lts), which is screened in the Lower TSA, and posed questions to DEQ on TSA hydraulic capture. To evaluate the isolated low-level TCE detections at PWB-1(lts), four samples were collected during the PWB pumping events (July through November 2018). The results of the four samples indicate TCE concentrations ranged from 1.59 to 2.04 µg/L, which are below the MCL. Two samples were also collected from well PWB-1(uts), which is screened in the Upper TSA, and TCE concentration were less than the reporting limit.

TCE results for these two wells are summarized in the table below.

Location	Sample Date	TCE (µg/L)
PWB-1(lts)	7/2/2018	1.9
PWB-1(lts)	8/24/2018	2.04
PWB-1(lts)	9/20/2018	1.59
PWB-1(lts)	11/1/2018	1.82
PWB-1(uts)	9/20/2018	< 0.50
PWB-1(uts)	11/2/2018	< 0.50

The low-level TCE concentrations detected in PWB-1(lts) are below the MCL. TCE is not detected in TSA remedy wells located between well PWB-1(lts) and TSA wells where TCE concentrations remain (i.e., the mound area in Remedy Zone C). The TCE results from PWB-1(lts) appear to indicate an isolated single well with low-level well TCE concentrations. TSA Remedy groundwater extraction ceased in the mid-2000s in Zone A, and the Far North and North Treatment systems were decommissioned in 2007 and 2008. As such, it is likely that the detected TCE concentrations at well PWB-1(lts) are post-remedy remnants, possibly related to localized conditions, such as limited groundwater flux near the groundwater divide between the Blue Lake Aquifer and the TSA and/or localized subsurface conditions that limit TCE attenuation and degradation.

4.5 VOC Mass Removal in Saturated TSA

VOC mass removal estimates are based on groundwater VOC concentrations and the average quarterly groundwater flow for the operating extraction. In 2018, approximately 1.3 lbs of VOC mass were removed through the groundwater extraction system, a decrease from the 2.5 lbs removed in 2017. Since startup of the system in 1996, an estimated total of 494 lbs of VOC mass have been removed from the TSA and SGA. TCE annual mass removal estimates for the TSA remedy are summarized in Appendix E (Table E-2 and Figure E-9), and TCE mass removal estimates for each extraction well are summarized in Appendix E (Table E-3 and Figure E-10).

5.0 FIVE-YEAR EVALUATION

Previous annual reports on the TSA remedy submitted in 2003, 2008, and 2013 described remedy progress after 5, 10, and 15 years of remedy operation, respectively (Landau Associates, et. al., 2003; 2008; and Geosyntec, Landau Associates, and SSPA, 2013). This section, which describes remedy progress after 20 years of operation, focuses on remedy progress that has been achieved during the past five years.

5.1 Restoration Goals

The TSA remedy was designed to restore groundwater quality in the Upper TSA and the Lower TSA in the central portion of the original plume (Remedy Zone C in Figure 1-2) to MCLs by 2018 and to restore groundwater quality in the remainder of the original plume by 2008. For the most part, restoration has progressed as predicted at the time of remedy design. However, restoration of the central portion of the original plume (TSA mound area) is still ongoing. In addition, some limited areas (near BOP-61(ds) and BOP-61(dg), and CMW-26(dg)) within the remainder of the original plume have not yet been restored, although TCE concentrations fluctuate near the MCL.

5.2 TCE Concentrations Relative to the MCL

TCE concentrations in the TSA in 2018 remain above the MCL in only three regions: 1) north of the Cascade property in an area known as the TSA mound area (located in the central portion of the original plume in Remedy Zone C); 2) on the Boeing property in the vicinity of wells BOP-61(ds) and BOP-61(dg) (Remedy Zone B/C boundary); and 3) in the vicinity of 207th Avenue near CMW-26(dg) (Remedy Zone D), as shown in Figures 5-1a and 5-1b. TCE concentrations were less than 10 µg/L and fluctuate near the MCL in the latter two areas, which have limited areal extents.

TCE concentrations were consistently below the MCL in Remedy Zone A and groundwater sampling discontinued in 2018 based on the approval of DEQ. A Partial Closure or Partial No Further Action (NFA) submittal for Remedy Zone A is being prepared.

In the TSA mound area (Remedy Zone C), TCE concentrations exceed the MCL in an area of approximately 28 acres. This area extends for about 1,200 ft in an east-west direction (from west of wells D-17(ds) to east of well CMW-18(ds)) just to the south of the truncation of upper confining layer. In this area, the maximum TCE concentration at water-table monitoring well CMW-18(ds) was 98.6 µg/L, and the maximum TCE concentration at well D-17(ds) was 54.1 µg/L. TCE concentration trends through time are discussed in Section 5.3, below.

The TCE plumes (defined as the estimated area where groundwater concentrations exceed the TCE MCL) in the Upper and Lower TSA have shrunk substantially in area since the onset of remedy pumping in 1998. The combined areal extents of the TCE plumes in the Upper and Lower TSA

have decreased from approximately 400 acres in 1994 to about 28 acres in December 2018 (Figure 5-3). This represents an over 90%reduction in the size of the plumes. During the past five years, the footprint of the TSA plume stayed approximately similar to the extent in 2013 at approximately 28 acres in 2018. Cleanup goals have been achieved in much of the former plume area beneath the Boeing facility (Remedy Zone B) and the eastern portion (Remedy Zone D).

Active pumping at extraction well EW-16 ceased on 31 October 2017 and at EW-1 on 31 August 2018. TCE rebound monitoring is currently being conducted in the area of EW-1; however, historically TCE rebound has been minimal in extraction wells in pilot shutdown mode. TCE rebound at EW-16 has not been observed, as concentrations declined from 4.92 µg/L in August 2017 (prior to shutdown) and ranged from <0.5 to 0.77 ug/L during 2018 monitoring events. However, at monitoring well CMW-26(dg), located close to EW-16, TCE concentrations over the same time period have steadily increased from 3.40 µg/L in August 2017 to 6.46 µg/L in August 2018. EW-16 was previously shutdown from April 2010 to April 2012, and TCE concentrations at CMW-26(dg) also increased and ranged from 5.2 to 9.6 µg/L. The steady increase in TCE concentrations at CMW-26(dg) observed in 2017-2018 is likely due to the absence of groundwater flushing in this region of the TSA Remedy Zone D; however, these TCE concentrations are well within the historic range for CMW-26(dg) and follow a similar pattern of steady increase, but at a lower magnitude.

5.3 Concentration Time Trends

In addition to the areal decrease in the plume size, the TCE concentration magnitude has also decreased overtime, as shown in Figure 5-3. The maximum TCE concentration within the plume in 1994 was observed at former well BOP-60(ds) at 340 µg/L, while the maximum TCE concentration in 2008 was observed at well BOP-62(ds) at 210 µg/L. The maximum TCE concentrations in both 2013 and 2018 were observed at well CMW 18(ds) at 210 to 98.6 µg/L. The decrease of TCE maximum concentrations from 1994 to 2018 represent a 71% decrease in concentrations.

A comparison of the average TCE concentrations through time in the aquifer remedy zones indicates that groundwater meets the Remedial Action Objective goals in Remedy Zone A and the SGA (100% compliant) and in Remedy Zones B and D (greater than 90% compliant) but remains above compliance goals in Remedy Zone C. Partial Closure documentation for Remedy Zone A is currently underway, as approved by DEQ.

Overall, TCE concentrations through time show a decreasing trend over the course of the remedy (Appendix E, Figures E-1 through E-8). Over the last five years, TCE concentrations have generally decreased except at two wells: D-17(ds) and CMW-18(ds) (Figures E-7 and E-8). TCE concentrations at well D-17(ds) fluctuated between 18.9 and 54.1 µg/L (February 2017 and November 2018); however, the last eight consecutive sampling events have shown a steady

increase from 18.9 to 54.1 µg/L. TCE concentrations at CMW-18(ds) have fluctuated between 41 and 98.6 µg/L since 2013.

In August 2018, five wells within Remedy Zone C exhibited TCE concentrations above 10 µg/L: EW-2, D-17(ds), CMW-10(ds), CMW-17(ds), and CMW-18(ds). During the previous 2013 five-year review, TCE concentration trends in the TSA mound area wells indicated ROD remedy goals would not be met by 2018. Since monitoring in 2013 indicated ROD remedy goals were unlikely to be met by 2018, other treatment options were evaluated, including the SVE systems that eventually have been implemented.

The SVE system was implemented to remove VOC mass bound in the pore-water of the unsaturated zone to minimize recontamination of the groundwater upon resaturation. Resaturation occurs as extraction wells are shut off and groundwater levels rise to pre-pumping levels. Rising groundwater levels intersect former areas of the aquifer where TCE impacted groundwater formerly was present and became stranded in pore-water or sorbed to aquifer materials.

For example, groundwater elevations at D-17(ds) increased 3.5 ft (elevation 4.9 to 8.4 ft msl) between 2009 and 2018 and 8.5 ft (elevation 4.8 to 13.3 ft msl) at D-17(dg) during the same approximate timeframe. The increase in elevation indicates resaturation upon decreased remedy pumping. Prior to the startup of remedy pumping, groundwater elevations in the area of D-17(ds) and D-17(dg) were approximately 20 ft MSL (Landau Associates and EMCON, 1994), indicating there is approximately 10 ft of resaturation that could still occur when all remedy pumping ceases.

TCE concentrations in the extraction wells have varied from sampling event to sampling event, in part as the result of varying pumping rates and seasonal effects. TCE concentrations at the monitoring wells have also varied from measurement period to measurement period. Recent TCE increases at mound area wells D-17(ds) and CMW-18(ds) could be related to resaturation (rising groundwater elevations). In early 2019, three angled SVE wells were installed near CMW-18(ds) and data from the newly installed wells will be utilized to develop a better understanding of the increased TCE concentrations.

5.4 Mass Removal

The total TCE mass removed from the TSA by the groundwater extraction system during the past five years was approximately 13.5 lbs. Five extraction wells operated during portions of the last five years (currently only three extraction wells), compared to up to 10 wells during the prior five-year report. However, most of the mass removed during both of the last five-year review intervals has been from the three extraction wells located in the TSA mound area: EW-1, EW-2, and EW-14. Over the last five years, mass removal from these three wells was approximately 2.9 lbs at EW-1, 5.8 lbs at EW-2, and 3.2 lbs at EW-14. The TCE mass removed from the two remaining extraction wells during the past five years was 0.1 lbs at EW-16 and 1.5 lbs EW-23. For comparison, the total amount of TCE removed from extraction wells over the last 10 years is

approximately 48 lbs, with approximately 39 lbs being removed from the TSA mound area extraction wells. Cumulative TCE removal is shown in Appendix E, Table E-2 and Figure E-9, and TCE removal per well is shown in Appendix E, Table E-3 and Figure E-10.

Over the past five years, a total of 60 lbs of mass has been removed by the SVE system and a total of 13.5 lbs from the groundwater by the CTS.

5.5 Restoration Progress

Restoration has been achieved for the SGA and Remedy Zone A and monitoring was ceased in these two areas in 2018 based on DEQ's approval of recommendations in the 2017 Annual Report (DEQ, 2018d). Partial Closure or Partial NFA documentation for the two areas is pending.

Significant progress has been made towards attainment of water-quality restoration in the TSA. The footprint of groundwater in the TSA containing TCE concentrations greater than the MCL has decreased from approximately 400 acres in 1994 to 28 acres in 2018 (Figure 5-3). The TCE concentration magnitude has also decreased from 340 µg/L in 1994 to 98.6 µg/L in 2018, a decrease of 71%. In addition, approximately 555 lbs of TCE mass has been removed (495 lbs from the TSA saturated zone and 60 lbs from the unsaturated zone). However, TCE mass remains in the Remedy Zone C area (TSA mound area) and continued operation of the existing extraction systems should continue to reduce the amount of TCE in this area.

Performance data indicates that the existing pump and treat system continues to be effective in containing the groundwater dissolved VOC plume and for reducing VOC concentrations to below the MCL; however, progress toward restoration in the mound area (Remedy Zone C) is slow. It is anticipated that operation of the pump and treat system within Remedy Zone C will continue beyond 2019 until restoration is complete.

Options currently being implemented to enhance restoration in the mound area where VOC concentrations persist:

1) Pilot shutdown of EW-1 to provide more available water in the aquifer for increased pumping of EW-2 and EW-14, to improve flushing rates in the central and eastern edges of the mound area and lower groundwater elevations. Recent (Spring 2019) optimization and upgrades to the PLC should enable increased pumping at EW-2 and EW-14.

2) Expansion of the SVE system to provide additional mass removal in the vadose zone near wells CMW-18(ds) and D-17(ds) and to minimize the potential for future groundwater recontamination from vadose zone mass in the mound area. The SVE system will operate in conjunction with the groundwater extraction system.

6.0 PERFORMANCE SUMMARY

Significant remedy performance findings are summarized below.

- Data suggest ROD remedy objectives for hydraulic capture continued to be achieved in 2018. Groundwater flow directions in the Upper and Lower TSA indicate ongoing inward and downward flow towards the operating extraction wells, and towards the north-northwest for Upper TSA wells located outside of the influence of the remedy pumping (Figures 4-1a,b and 4-2a,b) except during periods of municipal well pumping. In August 2018, the general groundwater flow pattern in the Upper TSA towards the west of the mound area was influenced by municipal well pumping and flow was generally to the west.

- Extraction at EW-1 ceased on 31 August 2018 when the well was placed into pilot shutdown mode. The 12-month average flow rate from the operating extraction wells was 91 gpm, slightly less than rate during the previous reporting period (114 gpm). Average flow rates at extraction wells EW-2, EW-14, and EW-23 were 24, 19, and 31 gpm, respectively, which are near the design target flow rates.

- In the Upper TSA, TCE concentrations remained above the MCL in the TSA mound area (located in Remedy Zone C) at wells CMW-10(ds) (14 to 17.1 µg/L) and CMW-18(ds) (58.7 to 98.6 µg/L) in 2018. TCE concentrations in wells located outside of the mound area are below the MCL, except at well BOP-61(ds) (7.0 and 5.3 µg/L). TCE concentrations for the Upper TSA wells are shown in Figures 5-1a and 5-2a.

- In the Lower TSA, the highest TCE concentrations remain in the mound area (located in Remedy Zone C) near wells D-17(dg) (7.13 to 15.1 µg/L) and D-17(ds) (37.8 to 54.1 µg/L); see Figures 5-1b and 5-2b. Outside of the mound area, TCE concentrations were below the MCL in 2018 with the exception of well BOP-61(dg) (5.2 µg/L in August 2018) in Remedy Zone B and well CMW-26(ds) (6.46 µg/L) in Remedy Zone D.

- TCE concentrations for Lower TSA extraction wells remained generally stable and consistent with previous years. The highest TCE concentrations measured in the extraction wells during this reporting period were as follows: EW-1 (non-detect to 3.93 µg/L), EW-2 (12.1 to 19.0 µg/L), EW-14 (6.88 to 9.64 µg/L), and EW-23 (0.77 to 2.0 µg/L).

- The SVE system has removed approximately 60 lbs of VOC mass from the unsaturated zone near the mound area (located in Remedy Zone C) since startup in 2014. The system was expanded with four additional SVE wells in Spring of 2019, and additional wells in the western portion of the mound area are being considered for 2019. Rebound testing at four SVE wells is also ongoing. The SVE system and rebound testing are anticipated to continue to operate throughout 2019. Groundwater concentrations at adjacent monitoring well CMW-17(ds) steadily declined during 2017 and 2018 to concentrations close to the MCL, likely demonstrating the effectiveness of the SVE system for groundwater treatment.

7.0 RECOMMENDATIONS AND FUTURE PLANNED ACTIVITIES

Water-quality restoration was achieved in the SGA and in the Upper and Lower TSA north of Sandy Boulevard (Remedy Zone A), and DEQ has approved proceeding with a Partial Closure for these Remedy Zones (DEQ, 2018e). Water quality restoration has also been achieved in the majority of the western portion of the remedy (Remedy Zone B), and the vast majority of the eastern portion of the remedy (Remedy Zone D). Residual TCE is detected above or near the MCL in three areas: Upper TSA near the Zone B/C boundary, in the eastern portion of the remedy area (the mound area) in the Upper and Lower TSA (Remedy Zone C), and occasionally in an isolated monitoring well (CMW-26ds) located in the eastern portion of the remedy area (Remedy Zone D). TCE concentrations in Remedy Zone B and D are near the MCL and isolated in areal extent.

We request DEQ concurrence for the following proposed changes, to optimize the monitoring programs and the remedy performance to support potential accelerated closure.

7.1 Recommended Changes for Treatment Systems

We recommend no changes to operation of either the CTS or the SVE systems. The CTS continues to operate and maintain hydraulic control of the dissolved VOC plume. We recommend the continued operation of wells EW-2, EW-14, and EW-23. We further recommend the continued pilot shutdown of EW-1 to allow for additional flushing in the TSA mound area through pumping at EW-2 and EW-14.

The SVE system has shown to be effective at removing VOC mass from the unsaturated zone and we recommend the continued operation and expansion of the system toward wells CMW-18(ds). In addition, we recommend proceeding with the DEQ-approved work plan to further expand the SVE expansion westward towards D-17(ds).

7.2 Recommend Changes to Monitoring Program and Schedule Modifications

The following monitoring program and schedule modifications are recommended for approval consideration by DEQ:

- Decommission Upper TSA wells BOP-22R(ds) and BOP-60R(ds). These two wells are located in the northwestern portion of Remedy Zone B and have other remedy wells located between their locations and wells with TCE concentrations remaining above the MCL, per criteria outlined in Table 2-1.
    - Well BOP-22R(ds) was installed in October 2008, while BOP-60R(ds) was installed in March 2010. Both replacement wells were installed to verify the potential downward migration of TCE through the original well annulus. The original wells were decommissioned upon installation of the replacement wells.

- TCE concentrations at BOP-22R(ds) have been below the reporting limit since sampling began in 2008, with the exception of one result collected directly after well development (30 µg/L in November 2008). TCE concentrations at BOP-60R(ds) have consistently been below the MCL (maximum detect at 2.5 µg/L in February 2011), and consistently below the reporting limit since May 2012.

- Well BOP-22R(ds) is currently utilized to monitor as part of the PWB pumping contingency plan; therefore, we recommend PWB monitoring be conducted at well BOP-62(ds), which is located closer to the dissolved VOC plume along the western portion of the remedy area.

- Decommissioning of Lower TSA wells CMW-8(dg) and CMW-10(dg). These two wells are located on Union Pacific Railroad Property between the Cascade facility and I-84. CMW-8(dg) and CMW-10(dg) were installed in 1990 to monitor groundwater directly north of the Cascade facility. Water quality restoration has been achieved in the Lower TSA in the vicinity of these two wells, which are located upgradient relative to the mound area wells and groundwater extraction wells.

  - TCE concentrations at CMW-8(dg) historically were as high as 80 µg/L in May 1997 and have been below the MCL since August 2005. TCE concentrations have been below detection limits at CMW-8(dg) since August 2007 through August 2017.

  - At CMW-10(dg), TCE concentrations were historically up to 61 µg/L in August 1996, and below the MCL since August of 1998. TCE concentrations have been below detection limits since August 2013 through August 2018.

7.3 Partial Closure by Select Areas of the Remedy

We recommend that remedy areas that have met cleanup criteria in accordance with the ROD be approved by DEQ for partial closure as a precursor to eventual site closure activities. The partial closure (or partial NFA) will help unencumber land development on parcels owned by other individuals or corporations (other than Cascade or Boeing) by removing controls established for the remedy area in the DEQ approved *Institutional Control Plan* (Landau Associates, Prowell Environmental, 1999). Remedy activities and monitoring will continue in areas that exhibit VOC concentrations above the MCL or areas that provide spatial coverage of the dissolved VOC plume.

Monitoring wells located in TSA Remedy Zone A met closure requirements, and in 2018, DEQ authorized the preparation of partial closure (partial NFA) for the SGA and TSA Remedy Zone A (DEQ, 2018e).

Restoration has been achieved in the remedy area located east of NE 205th Avenue (Remedy Zone D) and therefore, we are recommending a partial closure (partial NFA) for this area of the remedy. Currently, wells CMW-26(dg), EW-16 (converted to monitoring status in 2017), and EW-11 (converted to monitoring status in 2009) are utilized to monitor groundwater quality in Remedy Zone D. TCE concentrations at EW-11 and EW-16 have been below the MCL since September 2009 and February 2013, respectively. TCE concentrations at CMW-26(dg) have been below the MCL since August 2013, with one exception in August 2018 (1 of 22 monitoring events or 5%). Remedy objectives stated in the ROD have been achieved for the Upper TSA and the Lower TSA in Remedy Zone D. We recommend semiannual sampling at CMW-26(dg) during 2019, and if TCE concentrations at CMW-26(dg) remain stable or decline, we recommend partial closure of this area of the remedy.

8.0 REFERENCES

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TABLES

Table 2-1
Remedy Well Network Criteria
TSA Remedy - East Multnomah County

This table summarizes TSA remedy criteria for extraction well pilot shutdown, well and system decommissioning, monitoring well network modifications, and changes in sampling frequency. These criteria were presented in Section 5 of the eighth TSA annual performance report[1] and are summarized below for ongoing reference.

1. PILOT SHUTDOWN CRITERIA

The following criteria are for TSA extraction well(s) currently in pilot shutdown mode:

- *If TCE concentrations in these pilot shutdown wells increase to levels equal to or above the MCL for two consecutive quarters, extraction at individual wells shall resume.*
- *If TCE remains below the MCL cleanup level for 2 years, DEQ will evaluate potential decommissioning of these wells.*

2. MONITORING WELL NETWORK MODIFICATION

Wells may be removed from the monitoring program if a well meets one or more of the following criteria:

- *TCE concentrations have been consistently below detection limits for 2 or more years.*
- *The well is located outside the limits of the plume and is no longer needed to monitor hydraulic plume control or restoration progress.*
- *The location of a well duplicates another well better suited to evaluate hydraulic control and restoration progress.*

3. SAMPLING FREQUENCY MODIFICATIONS

The following criteria serve to standardize current and future monitoring adjustments as restoration progresses over the coming years:

Criteria for Increasing Sampling Frequency:

- *The sampling frequency will be increased at a well if TCE concentrations increase to detected levels for two consecutive sampling events where they have been below detection limits for 2 or more years.*
- *The sampling frequency will be increased at a well if TCE concentrations increase above the MCL for two consecutive sampling events where they have been below the MCL for 2 or more years.*

Criteria for Reducing Sampling Frequency:

- *If TCE has been consistently below detection limits for the prior 2 years, the sampling frequency may be reduced.*
- *If TCE has been stable to declining for the prior 2 years, the sampling frequency may be reduced.*

4. CRITERIA FOR WELL DECOMMISSIONINGS

Extraction and monitoring well decommissionings will be proposed to DEQ if the following criteria are met:

- *Extraction well decommissioning may be proposed to DEQ if TCE concentrations remain consistently below the MCL in that well for 2 years following pilot shutdown; two consecutive TCE detections at or above the MCL may prompt resumed operation.*
- *Monitoring well decommissioning will be proposed to DEQ if TCE concentrations remain below the MCL for 2 consecutive years.*

[1]Landau Associates, Prowell Environmental, Pegasus Geoscience, 2006. Troutdale Sandstone Aquifer Remedial Action Annual Performance Evaluation, 04/01/05 through 03/31/06. 30 June 2006.

Table 2-2
Performance Monitoring Schedule - 1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

Well	Aquifer	Water Level Measurements	Water Quality Sampling	Responsibility
Groundwater Systems				
CTS Influent	—	—	Quarterly	Cascade
CTS Effluent	—	—	Quarterly	Cascade
TSA Extraction Wells				
EW-1 (pilot shutdown)	Lower TSA	Monthly	Quarterly	Cascade
EW-2 (on)	Lower TSA	Monthly	Quarterly	Cascade
EW-14 (on)	Lower TSA	Monthly	Quarterly	Cascade
EW-23 (on)	Lower TSA	Monthly	Semiannually	Cascade
TSA Monitoring Wells				
BOP-13(ds)	Upper TSA	Quarterly	Quarterly	Boeing
BOP-13(dg)	Lower TSA	Quarterly	Quarterly	Boeing
BOP-20(ds)	Upper TSA	Semiannually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-20(dg)	Lower TSA	Annually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-21(ds)	Upper TSA	Annually PWB Monitoring	Biennial PWB Monitoring	Boeing
BOP-22R(ds)	Upper TSA	PWB Monitoring to Decommission	—	Boeing
BOP-23(dg)	Lower TSA	Annually PWB Monitoring	Biennial PWB Monitoring	Boeing
BOP-31(ds)	Upper TSA	Quarterly	Quarterly	Boeing
BOP-31(dg)	Lower TSA	Quarterly	Quarterly	Boeing
BOP-42(ds)	Upper TSA	Annually	Biennial	Boeing
BOP-42(dg)	Lower TSA	Annually	Biennial	Boeing
BOP-44(ds)	Upper TSA	Decommission	Decommission	Cascade
BOP-44(dg)	Lower TSA	Decommission	Decommission	Cascade
BOP-60R(ds)	Upper TSA	Annually to Decommission	Biennial to Decommission	Boeing
BOP-60(dg)	Lower TSA	Annually	Biennial	Boeing
BOP-61(ds)	Upper TSA	Semiannually	Semiannually	Boeing
BOP-61(dg)	Lower TSA	Semiannually	Semiannually	Boeing
BOP-62(ds)	Upper TSA	Annually	Biennial	Boeing
BOP-65(ds)	Upper TSA	Semiannually	Annually	Boeing
BOP-66(ds)	Upper TSA	Semiannually	Semiannually	Boeing
D-17(ds)	Lower TSA	Quarterly	Quarterly	Cascade
D-17(dg)	Lower TSA	Quarterly	Quarterly	Cascade
DEQ-1(dg)	Lower TSA	Decommission	—	Cascade
DEQ-5(ds)	Upper TSA	Decommission	—	Cascade
DEQ-5(dg)	Lower TSA	Decommission	—	Cascade
EMC-2(dg)	Lower TSA	Decommission	—	Cascade
EW-3 (monitoring only)	Upper TSA	Annually	Biennially	Boeing
EW-8 (monitoring only)	Lower TSA	Semiannually	Annually	Cascade
EW-11 (monitoring only)	Lower TSA	Annually	Biennial	Cascade
EW-12 (monitoring only)	Lower TSA	Semiannually	Quarterly	Cascade
EW-13 (monitoring only)	Lower TSA	Semiannually	Annually	Boeing
EW-15 (monitoring only)	Lower TSA	Annually	Biennial	Cascade
EW-16 (monitoring)	Lower TSA	Semiannually	Semiannually	Cascade
CMW-3	TSA	Decommission	—	Cascade
CMW-8(dg)	Lower TSA	Semiannually to Decommission	Biennial to Decommission	Cascade
CMW-10(ds)	Upper TSA	Quarterly	Quarterly	Cascade
CMW-10(dg)	Lower TSA	Semiannually to Decommission	Annually to Decommission	Cascade
CMW-14R(ds)	Lower TSA	Semiannually	SemiAnnually	Cascade

Table 2-2
Performance Monitoring Schedule - 1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

Well	Aquifer	Water Level Measurements	Water Quality Sampling	Responsibility
CMW-17(ds)	Upper TSA	Quarterly	Quarterly	Cascade
CMW-18(ds)	Upper TSA	Quarterly	Quarterly	Cascade
CMW-19(ds)	Upper TSA	Quarterly	Quarterly	Cascade
CMW-20(ds)	Upper TSA	Semiannually	Annually	Cascade
CMW-22(dg)	Lower TSA	Semiannually	Biennial	Cascade
CMW-24(dg)/EW-5	Lower TSA	Semiannually	Semiannually	Cascade
CMW-25(dg)	Lower TSA	Semiannually	Semiannually	Cascade
CMW-26(dg)	Lower TSA	Semiannually	Semiannually	Cascade
CMW-36(dg)	Lower TSA	PWB Monitoring	PWB Monitoring	Cascade
PWB-1(uts)	Upper TSA	Semiannually	Biennial	Cascade
PWB-1(lts)	Lower TSA	Annually	Biennial	Cascade
SGA Monitoring Wells				
BOP-44(usg)	Upper SGA	PWB Monitoring to Decommission	--	Cascade
Soil Vapor and Groundwater Monitoring Wells				
VMW-17d-95.5 (soil vapor onl	Upper TSA	Quarterly	Quarterly	Cascade
VMW-A	Upper TSA	Quarterly	Quarterly	Cascade
VMW-B	Upper TSA	Quarterly	Quarterly	Cascade
VMW-C	Upper TSA	Quarterly	Quarterly	Cascade
VMW-D	Upper TSA	Quarterly	Quarterly	Cascade
VMW-E	Upper TSA	Quarterly	Quarterly	Cascade
VMW-F	Upper TSA	Quarterly	Quarterly	Cascade
VMW-G	Upper TSA	Quarterly	Quarterly	Cascade
VMW-H	Upper TSA	Quarterly	Quarterly	Cascade

NOTES:

[a]Annual monitoring performed in August; semiannual in February and August; quarterly in February, May, August, and November. Two-year monitoring was performed in August 2017 and will be conducted in August 2019.

Recommendations for modifications to the Monitoring Schedules are indicated in red text, and wells recommended for decommissioning are also in red text and shaded green.

PMX-208dg: monitoring as PMX-208dg was discontinued in 2017 as part of the Eastside Decommissioning Activities.

DEQ approved decommissioning of DEQ-1(dg), DEQ-5(ds), DEQ-5(dg), CMW-3, BOP-44(ds), BOP-44(dg), BOP-44(usg), and EMC-2(dg) via email on 08.02.18. These wells are shaded green and are shown in black font. Decommissioning of wells in Remedy Zone A, BOP-44(ds), BOP-44(dg), BOP-44(usg), and EMC-2(dg), is pending final DEQ approval of Remedy Zone A Closure and revision of the PWB Contingency Monitoring Plan.

Table 2-3
Significant Remedy Documents – 1 January 2018 through 31 December 2018
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
4/2/18	Letter	Geosyntec	Revised Well Decommissioning Work Plan, East Multnomah County Troutdale Sandstone Aquifer Remedy, Fairview, Oregon, ECSI No. 1479	Revised work plan for decommissioning D-16(ds, dg), D-18(ds, dg), BOP-71(ds), BOP-70(ds), RPW-1(ds) and two vapor extraction wells VW-17-42.5, -75. Revision clarified decommissioning approval history.
4/3/18	Report	Geosyntec, Landau Associates, and SSPA	Cascade Boeing TSA 2017 Annual Report, East Multnomah County Troutdale Sandstone Aquifer Remedy, ECSI 1479	TSA Annual Report recommendations included: • Pilot shutdown of extraction well EW-1. • Eliminate upper and lower screen sampling at former extraction wells. • Water level and water quality monitoring frequency changes at several wells. • Decommission upgradient monitoring wells DEQ-1(dg), DEQ-5(ds), DEQ-5(dg), and CMW-3. • Decommission SGA Well BOP-44(usg), and TSA wells BOP-44(dg), BOP-44(ds), and EMC-2(dg). • Partial closure of TSA Remedy Zone A and Sand and Gravel Aquifer (SGA).
5/22/18	Letter	DEQ	Revised Well Decommissioning Work Plan, East Multnomah county Troutdale Sandstone Aquifer, Remedy, Fairview, Oregon. ECSI #1479	DEQ approval of decommissioning of three wells: BOP-70(ds), BOP-71(ds), and RPW-1(ds).

Table 2-3
Significant Remedy Documents – 1 January 2018 through 31 December 2018
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
6/18/18	Memorandum	Geosyntec	East Multnomah County Groundwater TSA Remedy (ECSI 1479), Response to Well Decommissioning Work Plan Comments	Memo provided clarification to DEQ and responded to comments and questions received from GSI Water Solutions (GSI) on behalf of the Portland Water Bureau (PWB) regarding the 2 April 2018 Revised Well Decommissioning Work Plan.
7/2/18	Letter	DEQ	Work Plan for Soil Vapor Extraction System Expansion, East Multnomah County, Troutdale Sandstone Aquifer Remedy, Fairview, Oregon (ECSI #1479)	DEQ approval of the work plan for installation of three soil vapor extraction (SVE) wells (Appendix G of the 2017 Annual Report).
7/25/18	Email	Geosyntec	EMC TSA Remedy: D-16dg groundwater results and decommissioning complete for Well RPW-1ds	Notification of completion of decommissioning of RPW-1ds.
7/30/18	Email	DEQ	RE: EMC TSA Remedy: D-16dg groundwater results and decommissioning complete for Well RPW-1ds	DEQ approval of decommissioning six wells: D-16dg/ds, D-18dg/ds, and VW-17D-42.5/75.

Table 2-3
Significant Remedy Documents – 1 January 2018 through 31 December 2018
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
8/2/18	Email	DEQ	RE: EMC TSA Remedy: Annual Performance Report 2017	DEQ approval of portions of the 2017 TSA Annual Report, including Sections 6.1, 6.2, and 6.3 (recommendations for EW-1 pilot shutdown, monitoring frequency changes, and decommissioning) with the exception of cessation of monitoring at PWB-1(uts) and PWB-1(lts). DEQ is further evaluating Section 6.4, recommendation for partial closure of Remedy Zone A and the SGA.
8/30/18	Letter	Geosyntec	TSA SVE Well Drilling – No-Longer Contains Determination Request, Cascade Troutdale Sandstone Aquifer Remedy (ECSI No. 1479), Fairview, Oregon	Request to DEQ for a "No Longer Contains Determination" to dispose of investigation derived waste (IDW) generated from SVE drilling in 2016 (drill core/core boxes).
9/26/18	Email	Geosyntec	RE: EMC TSA Remedy: D-16dg groundwater results and decommissioning complete for Well RPW-1ds	Email notification to DEQ of pending decommissioning activities for groundwater monitoring wells D-18(ds), D-16(dg), D-16(ds), and two soil vapor extraction wells, VW-17D-75.0 and VW-17D-42.5; verification D-18(dg) was decommissioned previously.
10/8/18	Letter	DEQ	Subject: No Longer Contained-In Determination, East Multnomah County, Troutdale Sandstone Aquifer Remedy, 2201 NE 201st Ave. Fairview, Oregon (ECSI #1479)	DEQ approval of IDW generated from drilling SVE wells in 2016 "No Longer Contains" and does not exhibit hazardous waste characteristics; approval for disposal.

Table 2-3
Significant Remedy Documents – 1 January 2018 through 31 December 2018
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
10/11/18	Email	DEQ	RE: Meeting with PWB today	DEQ support for partial NFA Closures for Remedy Zone A and SGA.
12/11/18	Letter	Geosyntec	BOP70ds Well Decommissioning – No-Longer Contains Determination Request, East Multnomah County Troutdale Sandstone Aquifer Remedy (ECSI No. 1479), Fairview, Oregon	Request to DEQ for a "No Longer Contains Determination" to dispose of IDW generated from decommissioning well BOP-70ds by overdrilling.
12/27/18	Letter	DEQ	No Longer Contained-In Determination for Investigation Derived Waste. East Multnomah County Troutdale Sandstone Aquifer Remedy 2201 NE 201st Ave. Fairview, Oregon. (ECSI #1479)	DEQ approval of IDW generated from decommissioning BOP-70(ds) "No Longer Contains" and does not exhibit hazardous waste characteristics; approval for disposal.

Table 3-1
Well Construction Data - 1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

Well	Aquifer Screened	NAD 1983 State Plane Oregon (ft)		Elevations (ft MSL)				Depth of Boring (ft bgs)
		X Coordinate	Y Coordinate	Ground Surface	Measuring Point	Top of Screen	Bottom of Screen	
Extraction Wells								
EW-1	Lower TSA	7699560.1	689504.6	124.1	124.04	-27.8	-57.8	183
EW-2	Lower TSA	7700692.2	689205.9	126.2	126.01	-6.8	-46.8	179
EW-14	Lower TSA	7699952.7	689329.7	128.4	127.63	-21.9	-51.9	230
EW-23	Lower TSA	7698806.9	690524.7	83.8	83.93	-26.2	-66.2	157
Monitoring Wells & Former Extraction Wells Approved for Monitoring Use								
BOP-13(ds)	Upper TSA	7699461.3	689388.4	126.7	128.94	9.0	-1.0	132
BOP-13(dg)	Lower TSA	7699465.9	689375.4	127.5	128.71	-41.0	-61.0	193
BOP-20(ds)	Upper TSA	7698395.4	691041.6	78.2	77.45	9.0	-11.0	97
BOP-20(dg)	Lower TSA	7698381.4	691042.6	78.1	77.32	-105.0	-125.0	209
BOP-21(ds)	Upper TSA	7697591.5	691105.0	77.1	78.02	-88.0	-108.0	192
BOP-22R(ds)	Upper TSA	7697050.528	691019.5093	84.2	82.91	-158.8	-178.8	310
BOP-23(dg)	Lower TSA	7699526.6	690832.2	75.2	76.96	-26.0	-46.0	125
BOP-31(ds)	Upper TSA	7699322.2	690090.6	97.1	99.04	17.0	7.0	91
BOP-31(dg)	Lower TSA	7699323.6	690105.1	96.5	98.51	-34.0	-54.0	154
BOP-42(ds)	Upper TSA	7698251.0	689588.3	129.3	130.74	-8.0	-28.0	159
BOP-42(dg)	Lower TSA	7698236.8	689588.9	129.5	130.71	-92.0	-112.0	243
BOP-44(ds)	Upper TSA	7698995.4	691938.6	32.5	35.24	-23.0	-43.0	76
BOP-44(dg)	Lower TSA	7699014.1	691938.6	32.6	35.15	-104.0	-124.0	166
BOP-60R(ds)	Upper TSA	7697726.613	690503.5041	83.16	82.8	-71.8	-81.8	165
BOP-60(dg)	Lower TSA	7697704.8	690369.9	93.8	93.59	-165.0	-185.0	280
BOP-61(ds)	Upper TSA	7698640.8	690240.7	96.3	94.64	6.0	-4.0	100
BOP-61(dg)	Lower TSA	7698632.5	690246.1	96.2	94.43	-60.0	-70.0	171
BOP-62(ds)	Upper TSA	7697855.5	689987.2	112.1	112.29	-42.0	-51.9	166
BOP-65(ds)	Upper TSA	7698234.0	690115.0	104.4	104.22	2.0	-8.0	113
BOP-66(ds)	Upper TSA	7698670.7	690111.4	103.3	102.97	13.0	3.0	102
D-17(ds)	Lower TSA	7699886.2	689530.7	121.9	123.28	12.0	2.0	121
D-17(dg)	Lower TSA	7699869.5	689532.2	121.8	124.61	-30.0	-50.0	178
DEQ-1(dg)	Lower TSA	7701973.4	688195.6	151.0	150.58	-53.0	-73.0	235
DEQ-5(ds)	Upper TSA	7698660.3	688786.4	155.9	155.68	19.9	0.0	160
DEQ-5(dg)	Lower TSA	7698650.5	688787.3	155.9	155.95	-58.0	-78.0	240
EMC-2(dg)	Lower TSA	7701014.5	692008.0	44.8	43.51	-75.0	-85.0	140
EW-3	Upper TSA	7697737.4	690313.3	97.1	94.26	-77.9	-102.9	205
EW-8	Lower TSA	7699521.9	690435.9	77.3	77.16	6.8	-33.2	163
EW-11	Lower TSA	7702091.6	689192.5	115.4	114.73	-22.8	-62.8	235
EW-12	Lower TSA	7699532.9	689992.8	94.4	94.14	-16.1	-46.1	197
EW-13	Lower TSA	7698486.3	690082.6	104.5	103.59	-33.5	-73.5	234
EW-15	Lower TSA	7701759.5	689205.3	116.7	116.21	-27.3	-57.3	186
EW-16	Lower TSA	7702424.1	689665.5	84.2	83.71	-40.3	-80.3	198
CMW-3	Upper & Lower TSA	7700342.3	688415.4	148.1	147.69	25.0	-53.0	209
CMW-8(dg)	Lower TSA	7700075.7	689028.3	137.0	136.21	-41.0	-56.0	199
CMW-10(ds)	Upper TSA	7700599.9	688922.1	135.2	134.54	21.0	6.0	135
CMW-10(dg)	Lower TSA	7700589.4	688923.9	135.3	135.05	-53.0	-68.0	210
CMW-14R(ds)	Lower TSA	7700852.9	689866.6	83.9	83.48	29.0	9.0	76
CMW-17(ds)	Upper TSA	7700547.4	689425.5	120.0	121.89	24.0	14.0	110
CMW-18(ds)	Upper TSA	7700889.2	689267.3	118.2	117.66	16.0	6.0	118
CMW-19(ds)	Upper TSA	7700297.2	688642.8	144.3	144.08	10.0	0.0	170
CMW-20(ds)	Upper TSA	7699683.6	688990.1	150.5	152.72	6.0	-4.0	158
CMW-22(dg)	Lower TSA	7701545.4	689850.7	82.1	81.65	-42.0	-52.0	142
CMW-24(dg)/EW-5	Lower TSA	7700192.8	689918.9	80.5	77.74	8.0	-42.1	127
CMW-25(dg)	Lower TSA	7699797.3	690022.8	75.7	75.28	-34.0	-44.0	131
CMW-26(dg)	Lower TSA	7703189.8	689303.5	106.3	108.98	-59.0	-69.0	238
CMW-36(dg)	Lower TSA	7701389.7	690792.4	79.1	78.84	-31.0	-41.0	162
PMX-167 [W. Interlachen]	Upper TSA	7701730.1	693573.0	45.0	44.84	----- Not Available -----		50
PMX-208(dg) [Simpson]	Lower TSA	7701239.6	690330.0	80.2	81.14	-15.0	-35.0	115
PWB-1(lts)	Lower TSA	7700352.3	692604.8	14.0	16.48	-98.0	-118.0	134
PWB-1(uts)	Upper TSA	7700344.1	692612.1	13.9	15.98	-51.0	-71.0	86
PWB-2(lts)	Lower TSA	7701771.0	693589.1	45.1	44.32	-20.0	-40.0	90
BOP-44(usg)	SGA	7698996.3	691888.8	24.6	34.25	-181.0	-191.0	219

Table 3-1
Well Construction Data - 1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

Well	Aquifer Screened	NAD 1983 State Plane Oregon (ft)		Elevations (ft MSL)				
		X Coordinate	Y Coordinate	Ground Surface	Measuring Point	Top of Screen	Bottom of Screen	Depth of Boring (ft bgs)
Soil Vapor and Groundwater Monitoring Wells								
VW-75d-95.5	Upper TSA - Vapor only	7700536.9	689410.4	120.0	-------	*44.5*	*24.5*	130
VMW-A	Upper TSA + Vapor	7700436.7	689423.9	121.0	-------	34.5	14.5	114
VMW-B	Upper TSA + Vapor	7700630.8	689380.7	120.7	-------	36.2	16.2	111
VMW-C	Upper TSA + Vapor	7700339.8	689398.9	122.0	-------	34.5	14.5	110
VMW-D	Upper TSA + Vapor	7700693.2	689302.0	120.6	-------	33.1	13.1	110
VMW-E*	Upper TSA + Vapor	7700720.3	689167.7	130.6	-------	30.7	9.49	171
VMW-F*	Upper TSA + Vapor	7700742.7	689252.3	126.4	-------	32.5	11.28	163
VMW-G*	Upper TSA + Vapor	7700722.3	689335.1	121.9	-------	30.05	8.83	160
VMW-H	Upper TSA + Vapor	7700240.9	689484.6	124.1	-------	37.76	17.76	106

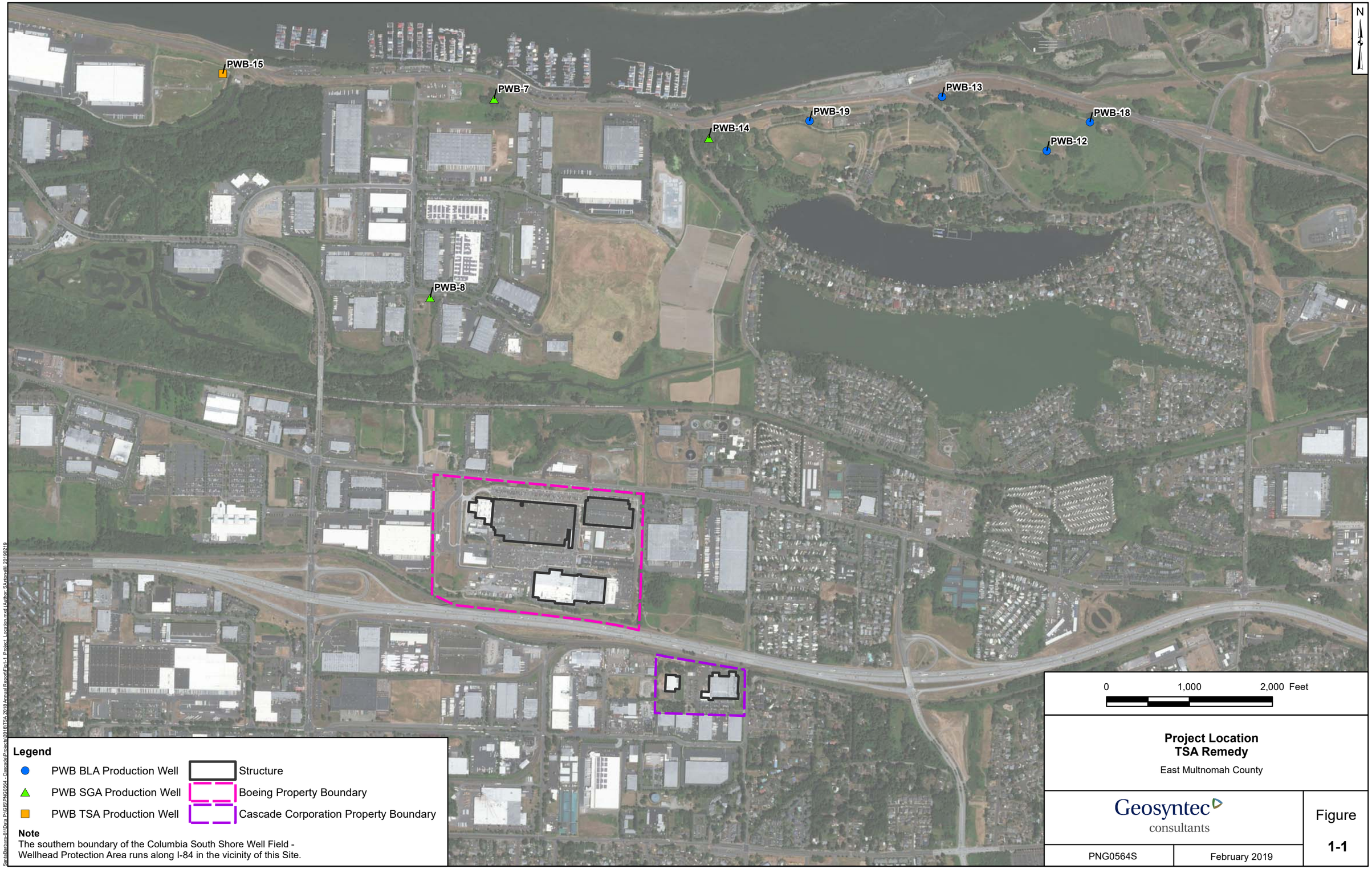
NOTES:

1. Monitoring wells indicated in red text were recommended for sampling frequency modifications (Table 2-2). Wells indicated in red text and green shading are recommended for decommissioning. Wells indicated in black text and green shading were previously approved for decommissioning but have not yet been decommissioned (pending Summer 2019).

2. EW-16 was converted to monitoring in October 2017; approved by DEQ 10.04.17.

ft = feet
MSL = mean sea level
bgs = below ground surface
*Angled well

FIGURES



Project Location
TSA Remedy

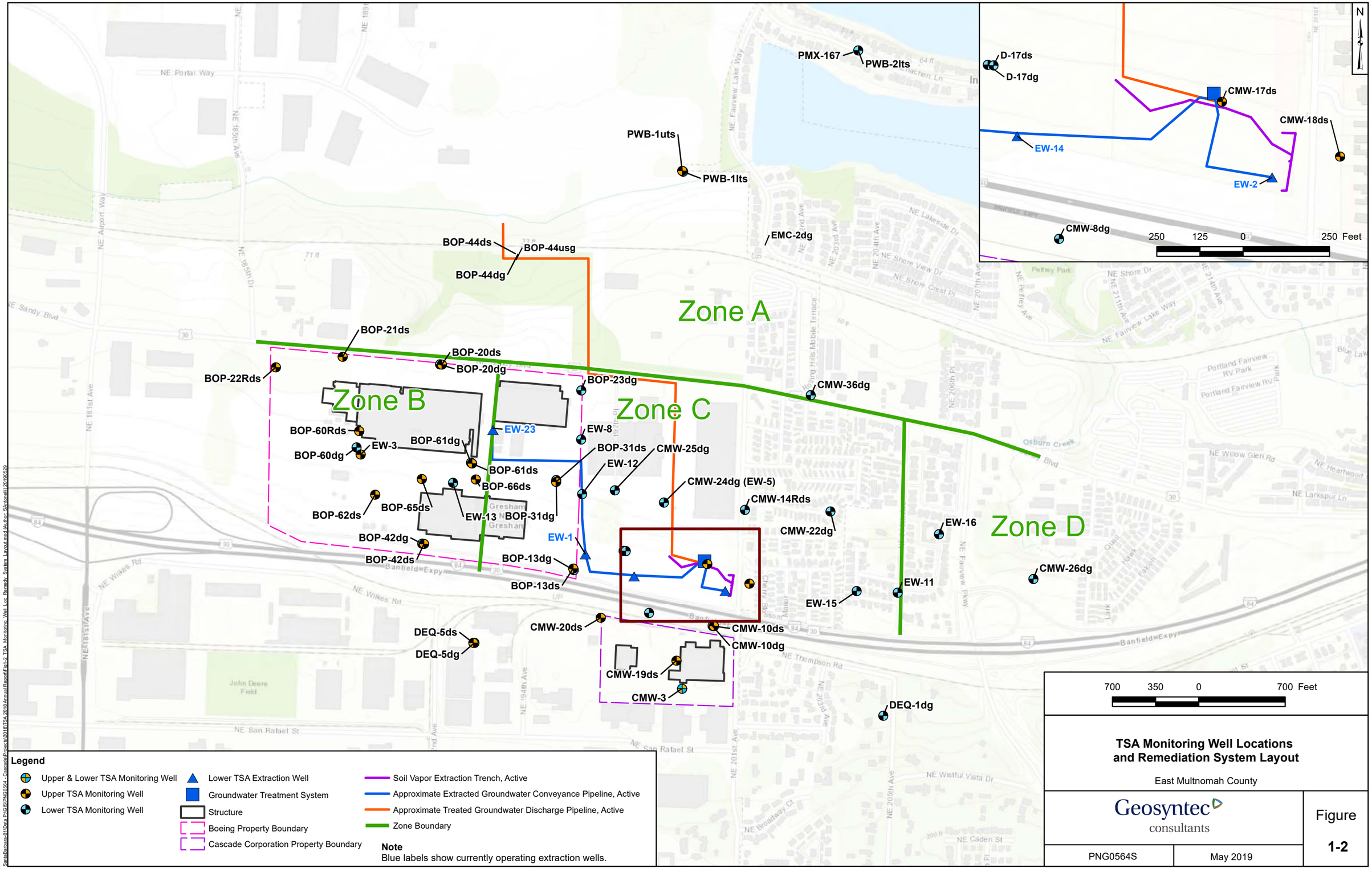
East Multnomah County

Geosyntec consultants

PNG0564S | February 2019

Figure **1-1**

SantaBarbara-01\Data P:\GIS\PNG\0564 - Cascade\eProjects\2018\TSA 2018 Annual Report\Fig1-1 Project Location.mxd (Author: SAnton\ll) 20190219



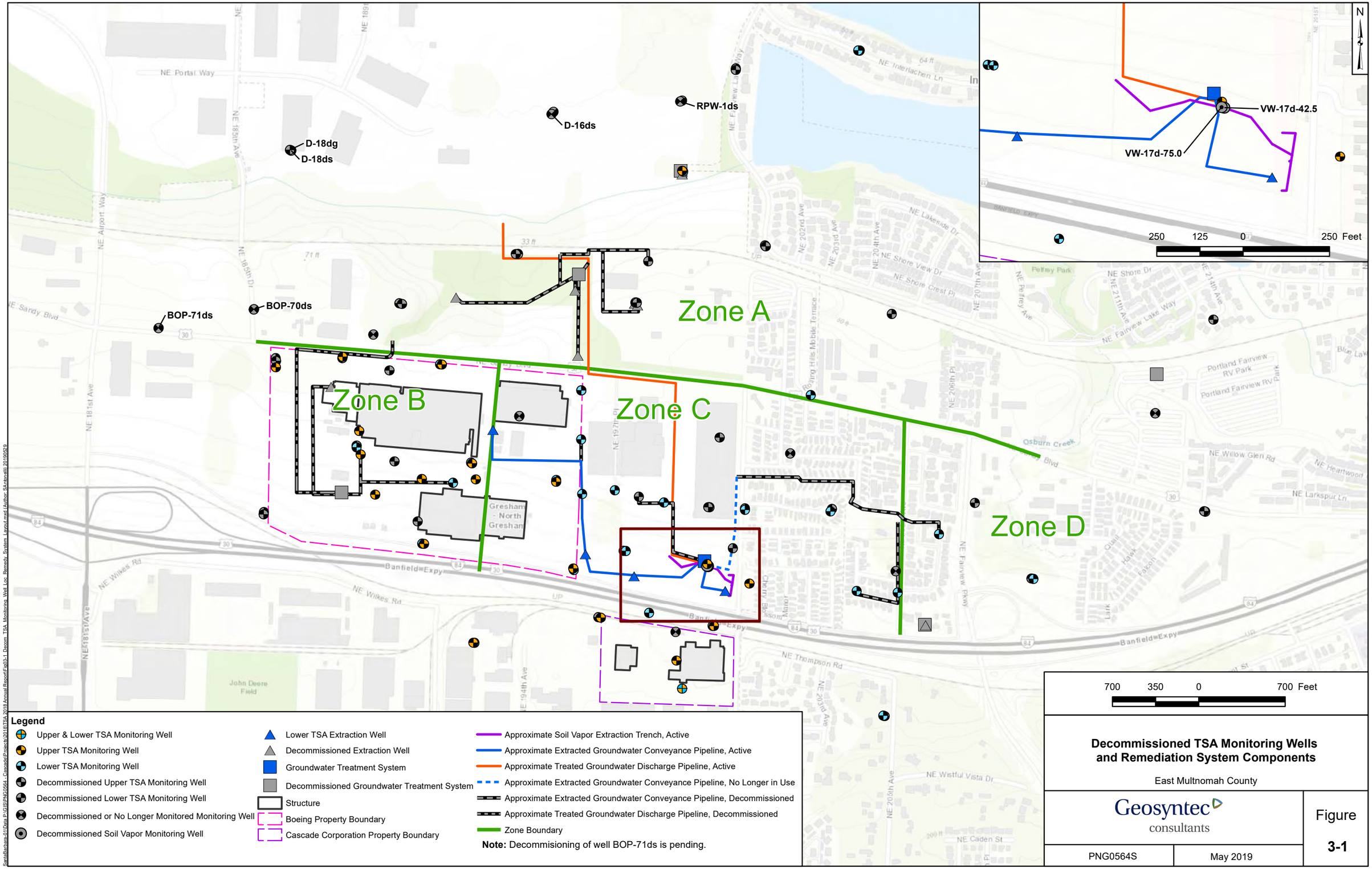
TSA Monitoring Well Locations and Remediation System Layout

East Multnomah County

Geosyntec consultants

PNG0564S | May 2019

Figure 1-2



Legend

- Upper & Lower TSA Monitoring Well
- Upper TSA Monitoring Well
- Lower TSA Monitoring Well
- Decommissioned Upper TSA Monitoring Well
- Decommissioned Lower TSA Monitoring Well
- Decommissioned or No Longer Monitored Monitoring Well
- Decommissioned Soil Vapor Monitoring Well
- Lower TSA Extraction Well
- Decommissioned Extraction Well
- Groundwater Treatment System
- Decommissioned Groundwater Treatment System
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary
- Approximate Soil Vapor Extraction Trench, Active
- Approximate Extracted Groundwater Conveyance Pipeline, Active
- Approximate Treated Groundwater Discharge Pipeline, Active
- Approximate Extracted Groundwater Conveyance Pipeline, No Longer in Use
- Approximate Extracted Groundwater Conveyance Pipeline, Decommissioned
- Approximate Treated Groundwater Discharge Pipeline, Decommissioned
- Zone Boundary

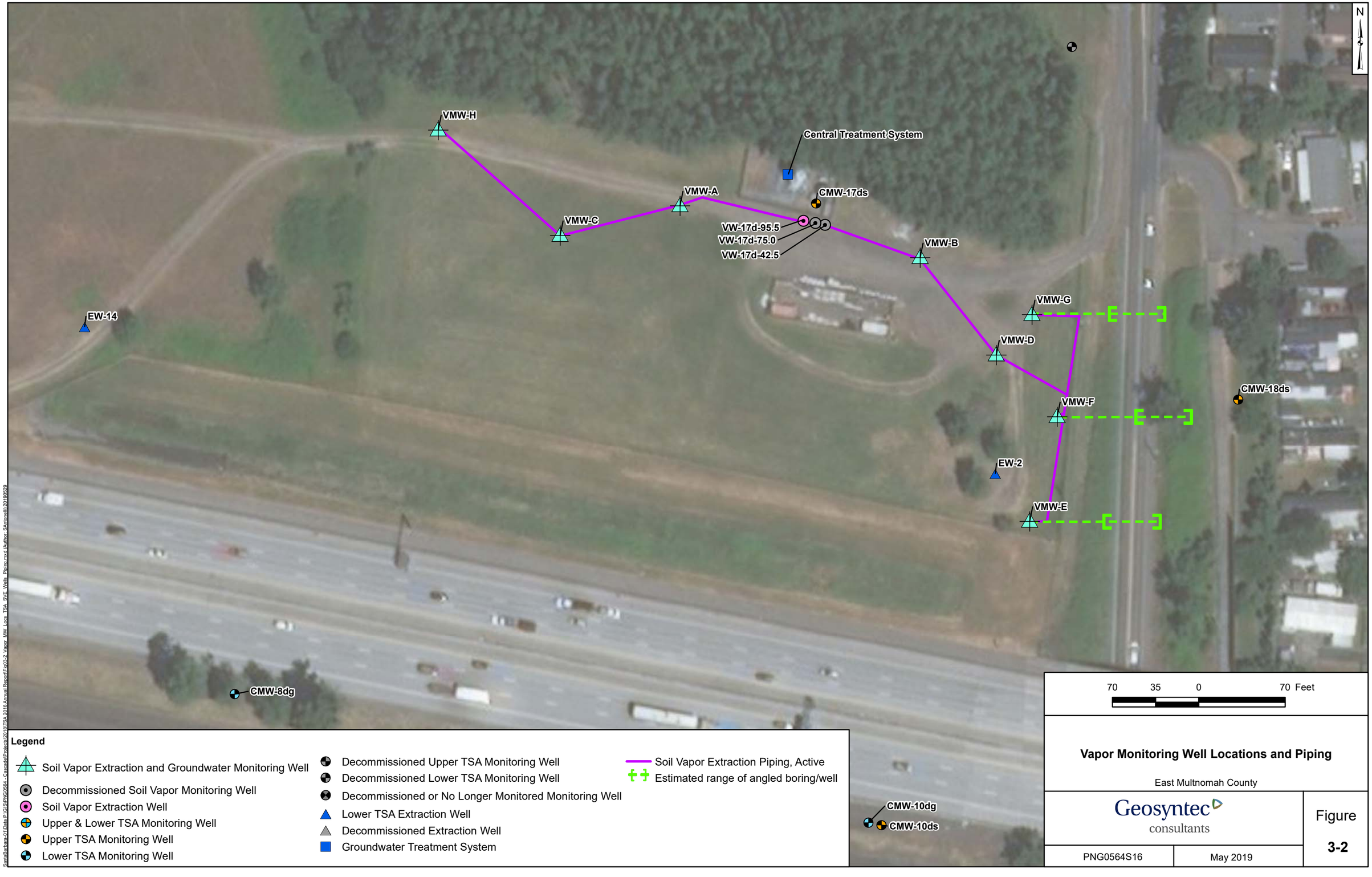
Note: Decommisioning of well BOP-71ds is pending.

Decommissioned TSA Monitoring Wells and Remediation System Components

East Multnomah County

Geosyntec consultants

PNG0564S	May 2019	Figure 3-1



Legend

- Soil Vapor Extraction and Groundwater Monitoring Well
- Decommissioned Soil Vapor Monitoring Well
- Soil Vapor Extraction Well
- Upper & Lower TSA Monitoring Well
- Upper TSA Monitoring Well
- Lower TSA Monitoring Well
- Decommissioned Upper TSA Monitoring Well
- Decommissioned Lower TSA Monitoring Well
- Decommissioned or No Longer Monitored Monitoring Well
- Lower TSA Extraction Well
- Decommissioned Extraction Well
- Groundwater Treatment System
- Soil Vapor Extraction Piping, Active
- Estimated range of angled boring/well

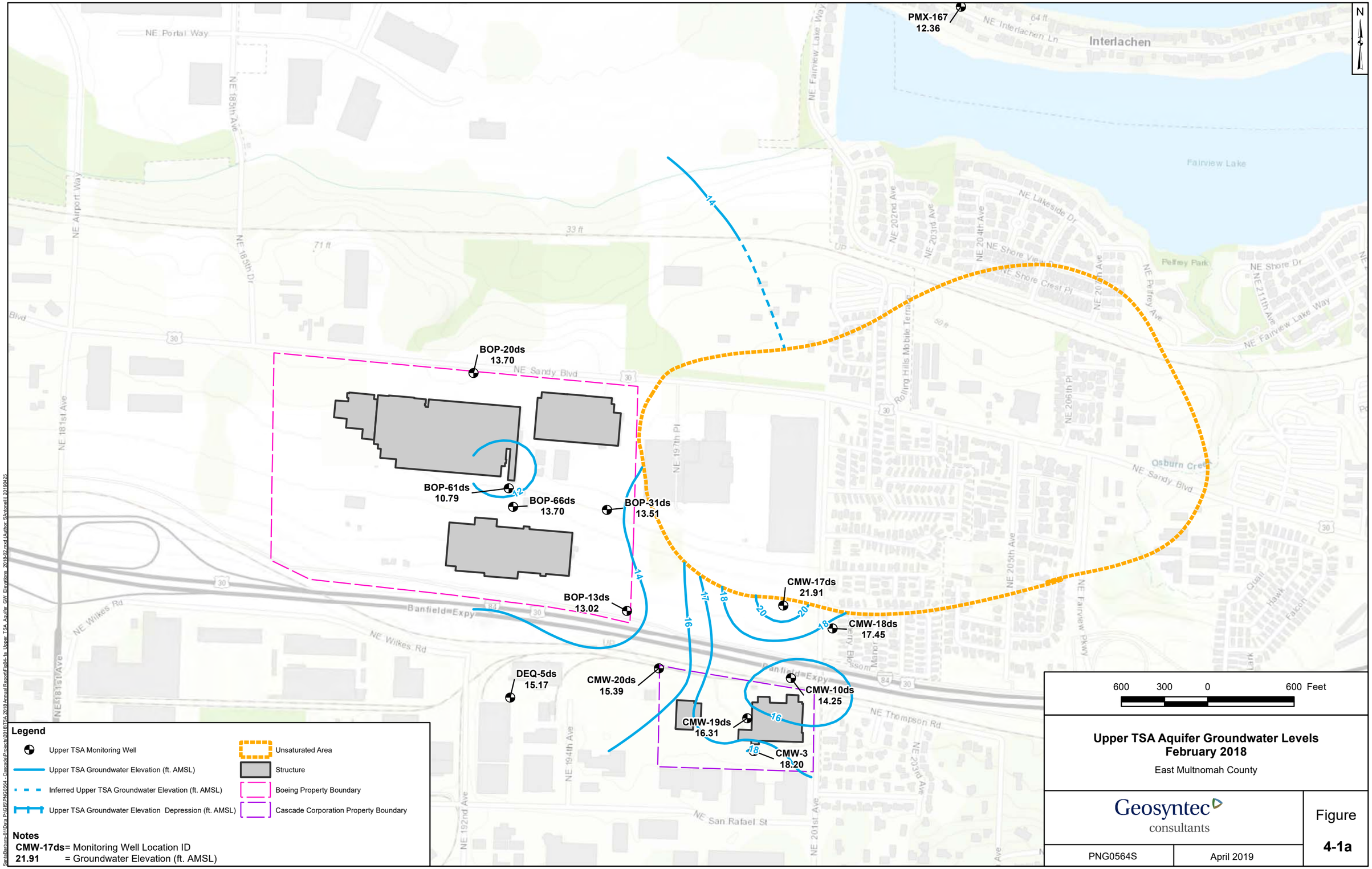
Vapor Monitoring Well Locations and Piping

East Multnomah County

Geosyntec consultants

PNG0564S16 | May 2019

Figure 3-2



Legend

- Upper TSA Monitoring Well
- Upper TSA Groundwater Elevation (ft. AMSL)
- Inferred Upper TSA Groundwater Elevation (ft. AMSL)
- Upper TSA Groundwater Elevation Depression (ft. AMSL)
- Unsaturated Area
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

CMW-17ds= Monitoring Well Location ID
21.91 = Groundwater Elevation (ft. AMSL)

600 300 0 600 Feet

Upper TSA Aquifer Groundwater Levels February 2018

East Multnomah County

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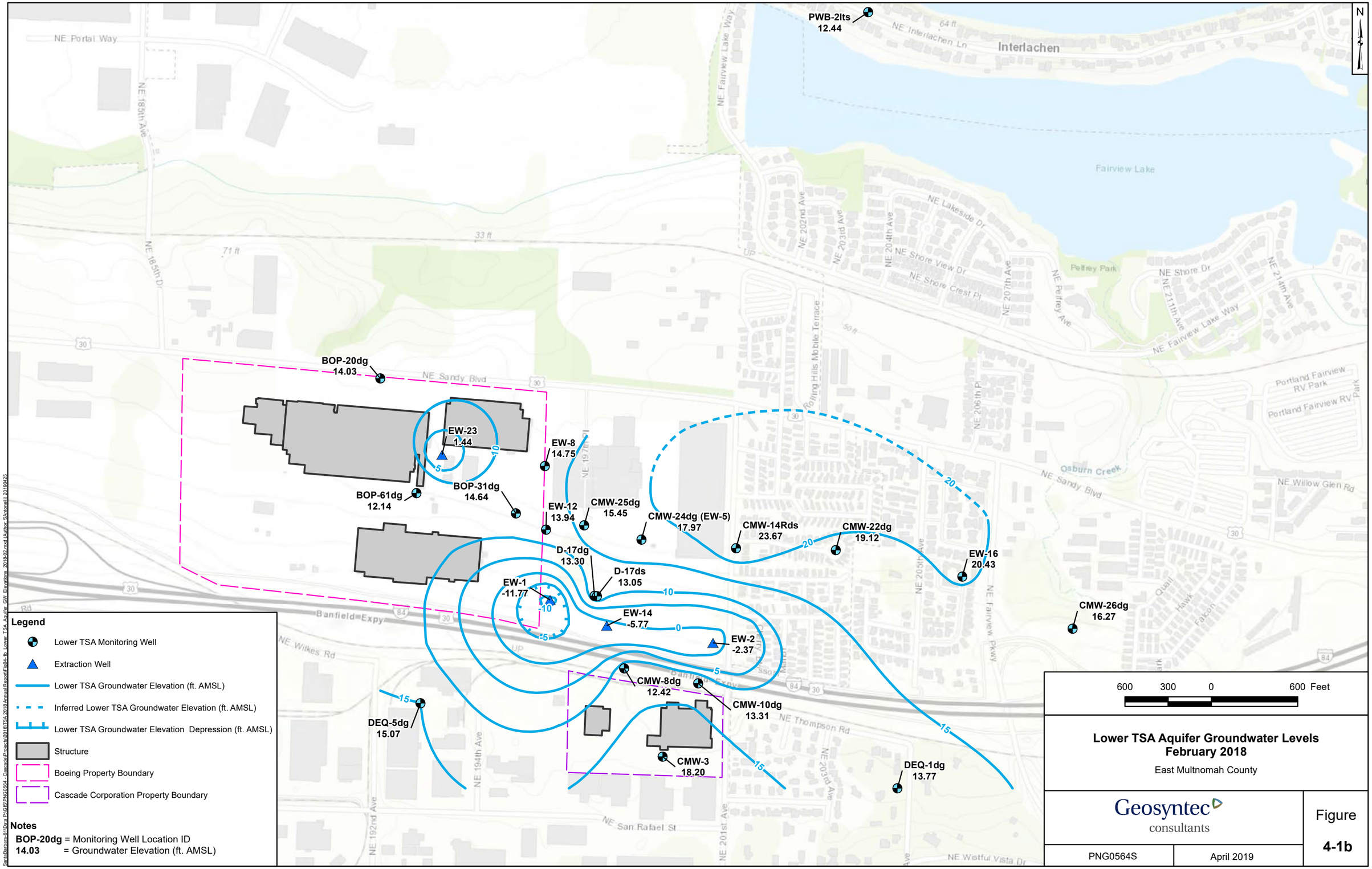
PNG0564S | April 2019

Figure **4-1a**

SantaBarbara-01\Data P:\GIS\PNG\0564 - Cascade\Projects\2018\TSA 2018 Annual Report\Fig04-1a Upper TSA Aquifer GW Elevations 2018-02.mxd (Author: SAntonelli) 20190425



Legend

- Lower TSA Monitoring Well
- Extraction Well
- Lower TSA Groundwater Elevation (ft. AMSL)
- Inferred Lower TSA Groundwater Elevation (ft. AMSL)
- Lower TSA Groundwater Elevation Depression (ft. AMSL)
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

BOP-20dg = Monitoring Well Location ID
14.03 = Groundwater Elevation (ft. AMSL)

Lower TSA Aquifer Groundwater Levels February 2018

East Multnomah County

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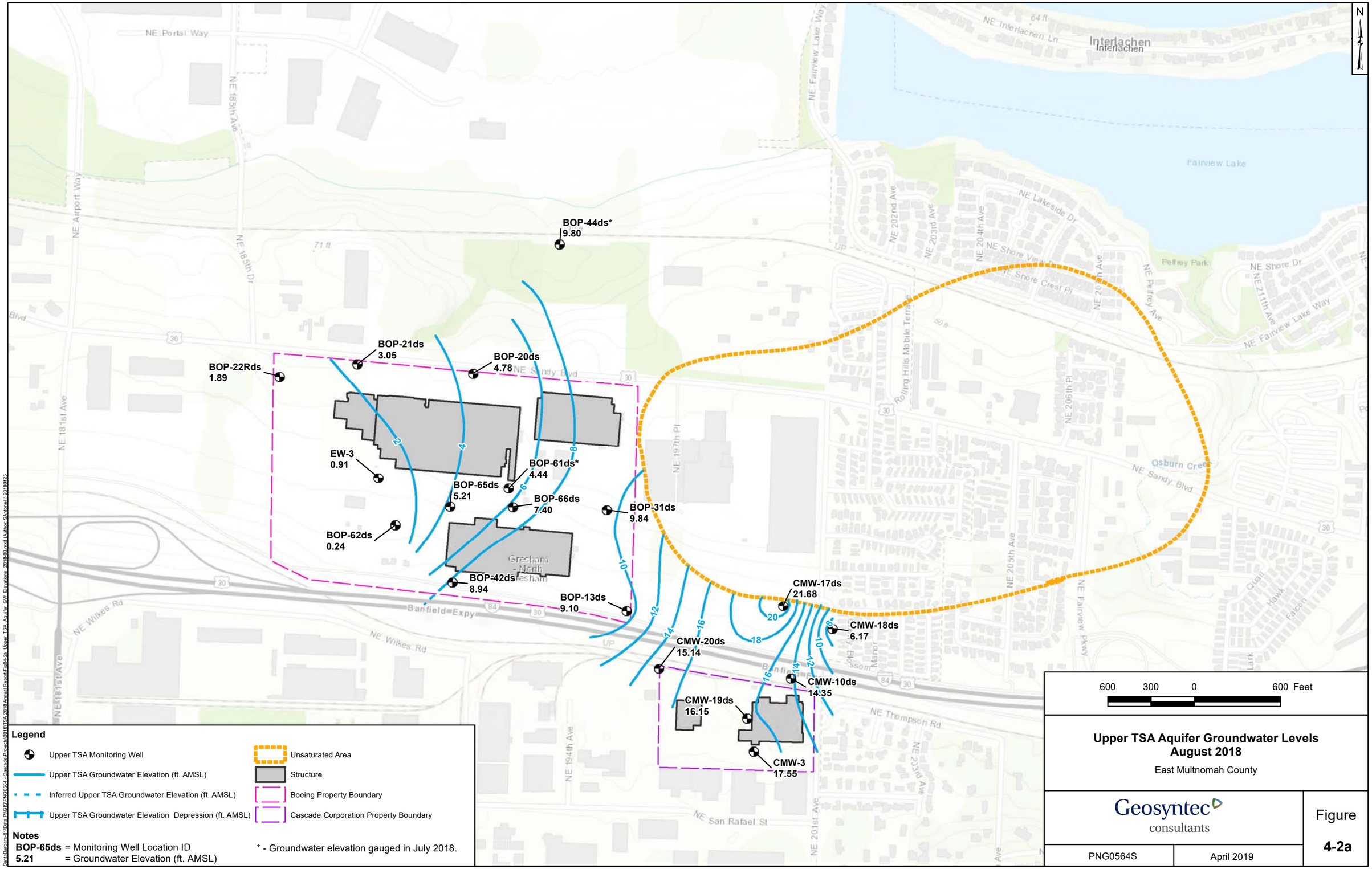
Figure **4-1b**



Legend

- Upper TSA Monitoring Well
- Upper TSA Groundwater Elevation (ft. AMSL)
- Inferred Upper TSA Groundwater Elevation (ft. AMSL)
- Upper TSA Groundwater Elevation Depression (ft. AMSL)
- Unsaturated Area
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

BOP-65ds = Monitoring Well Location ID
5.21 = Groundwater Elevation (ft. AMSL)

* - Groundwater elevation gauged in July 2018.

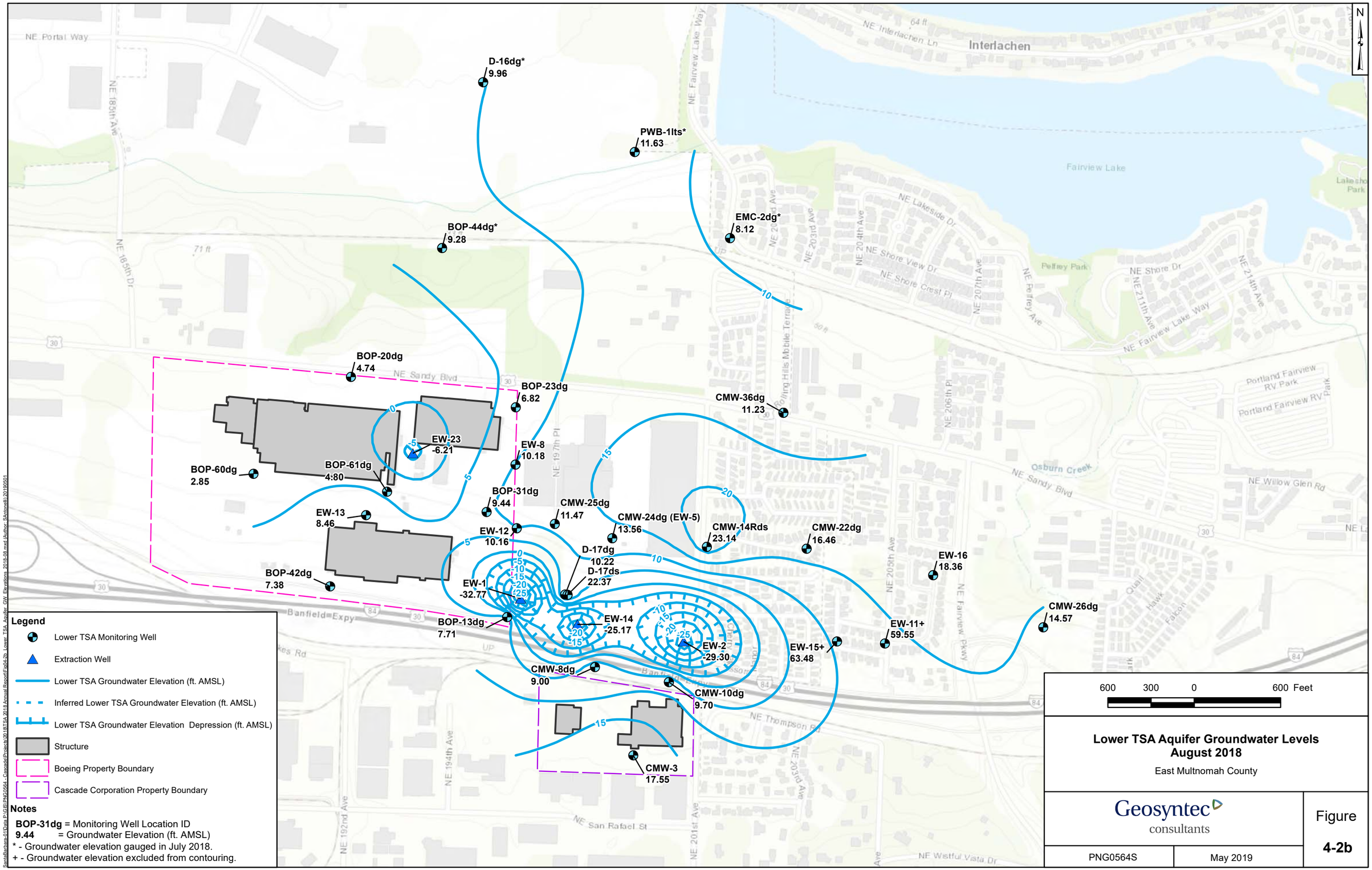
Upper TSA Aquifer Groundwater Levels August 2018

East Multnomah County

Geosyntec consultants

PNG0564S | April 2019

Figure **4-2a**



Legend

- Lower TSA Monitoring Well
- Extraction Well
- Lower TSA Groundwater Elevation (ft. AMSL)
- Inferred Lower TSA Groundwater Elevation (ft. AMSL)
- Lower TSA Groundwater Elevation Depression (ft. AMSL)
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

BOP-31dg = Monitoring Well Location ID
9.44 = Groundwater Elevation (ft. AMSL)
* - Groundwater elevation gauged in July 2018.
+ - Groundwater elevation excluded from contouring.

600 300 0 600 Feet

Lower TSA Aquifer Groundwater Levels
August 2018
East Multnomah County

Geosyntec consultants

PNG0564S | May 2019

Figure **4-2b**

BOP-61ds
7.0

BOP-66ds
2.9

BOP-31ds
< 0.20

BOP-13ds
1.8

CMW-17ds
15.1

CMW-18ds
58.7

CMW-10ds
16.9

CMW-19ds
< 1.00

55

45

35

25

15

5

Legend

- Upper TSA Monitoring Well
- Upper TSA Trichloroethene Contour (µg/L)
- Inferred Upper TSA Trichloroethene Contour (µg/L)
- Unsaturated Area
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

CMW-18ds = Monitoring Well Location ID
58.7 = TCE Concentration (µg/L)

Maximum values are reported for locations with field duplicates and/or multiple depths.
If analyte was not detected, the minimum reporting limit was shown.

N

500 250 0 500 Feet

Upper TSA Aquifer Trichloroethene Concentrations February 2018

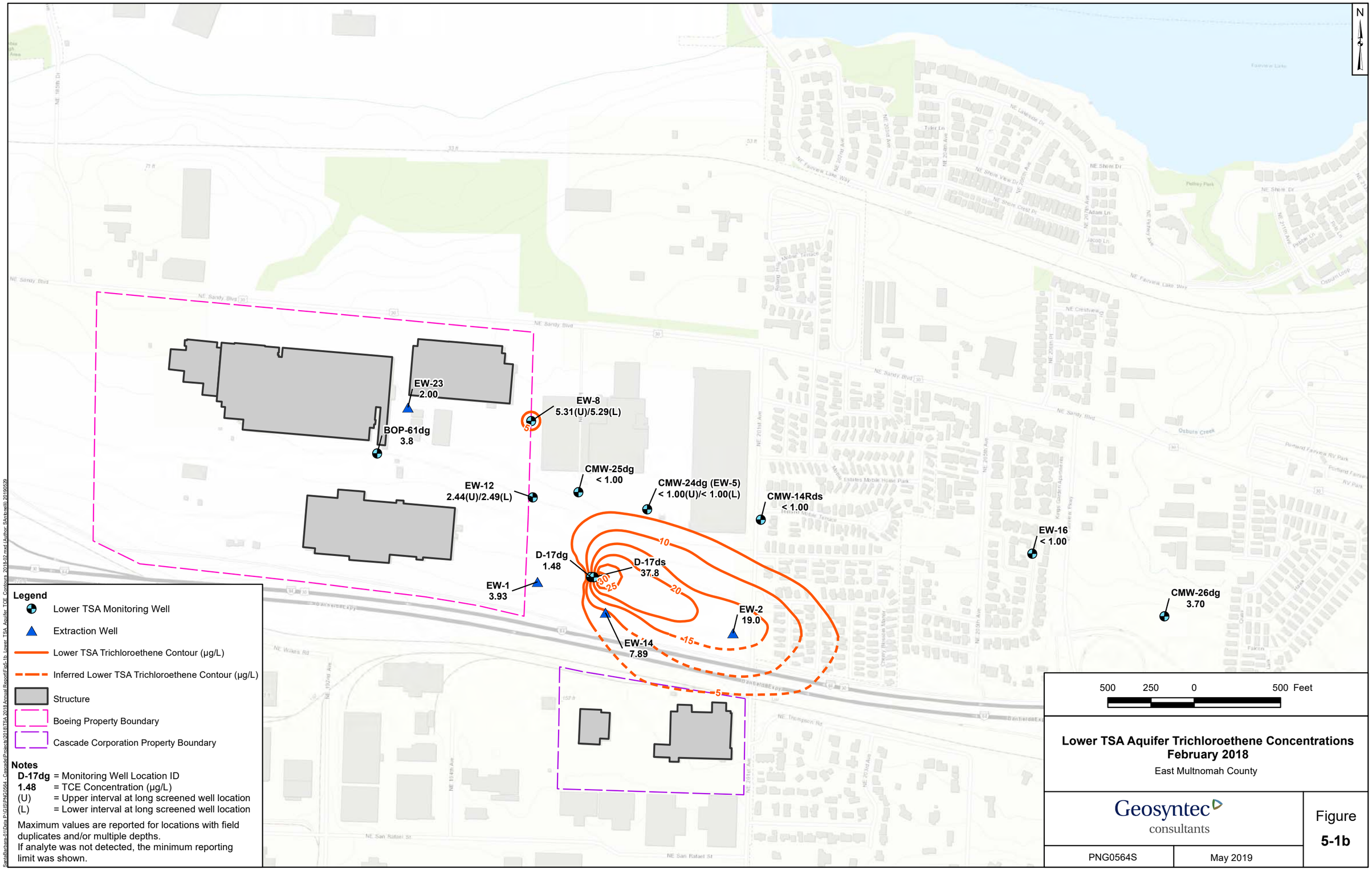
East Multnomah County

Geosyntec consultants

PNG0564S | May 2019

Figure 5-1a

SantaBarbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2018\TSA 2018 Annual Report\Fig5-1a_Upper_TSA_Aquifer_TCE_Contours_2018-02.mxd (Author: SAnbinelli) 20190529



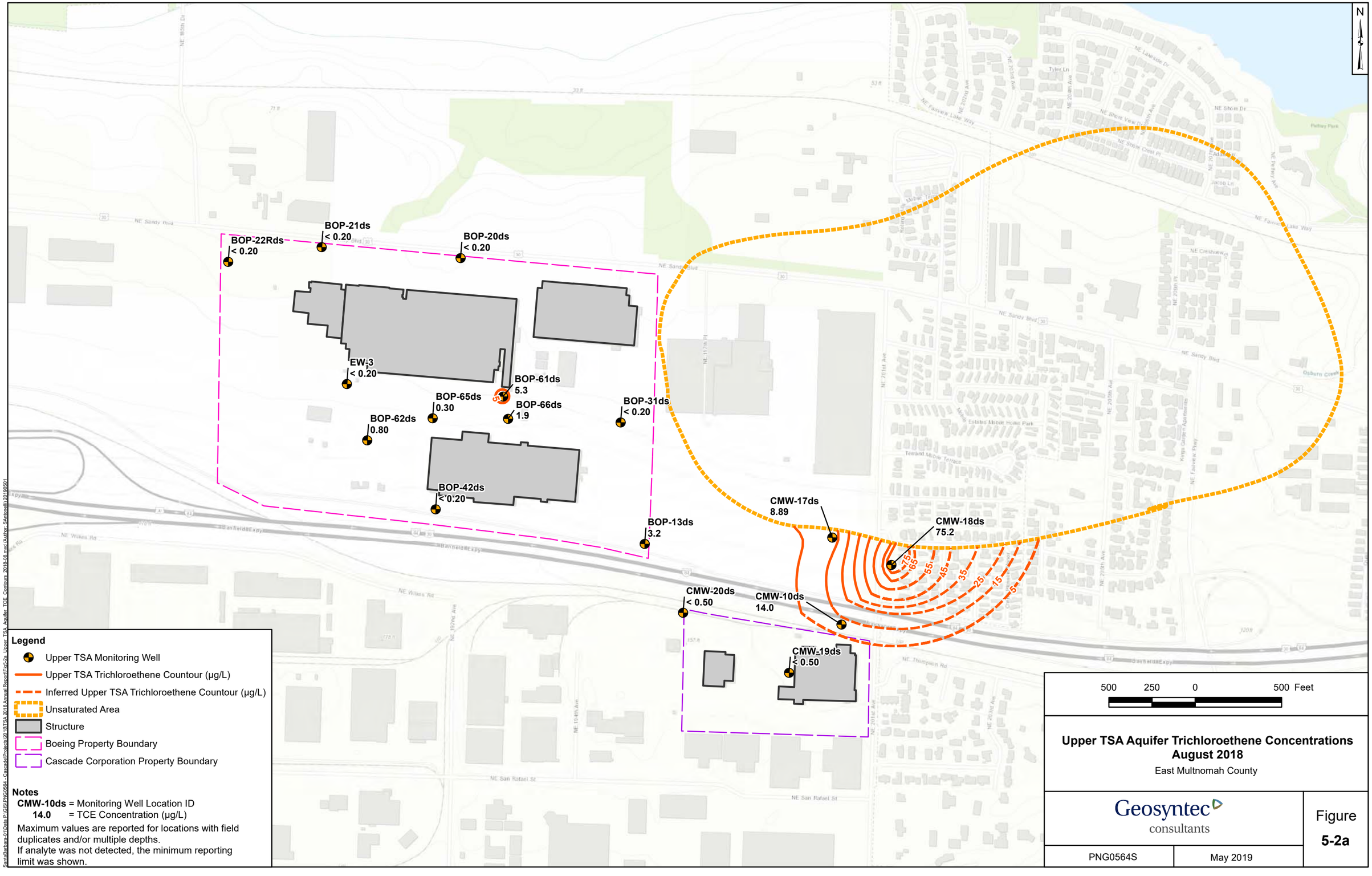
Lower TSA Aquifer Trichloroethene Concentrations February 2018

East Multnomah County

Geosyntec consultants

PNG0564S | May 2019

Figure 5-1b



Upper TSA Aquifer Trichloroethene Concentrations August 2018

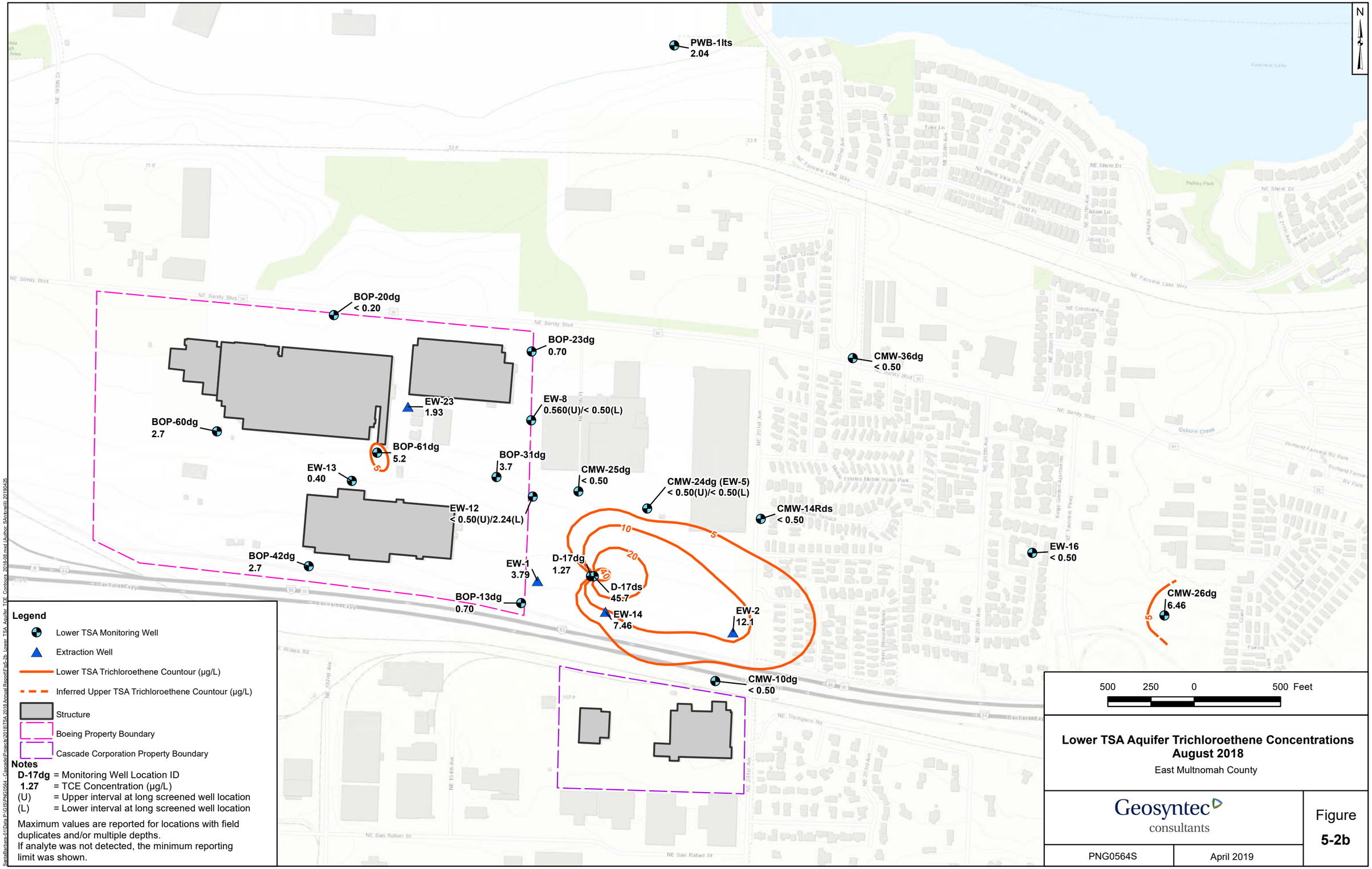
East Multnomah County

Geosyntec consultants

PNG0564S | May 2019

Figure 5-2a

SantaBarbara-01\Data P:\GIS\PNG0564 - CascadeProject\2018TSA 2018 Annual Report\Fig5-2a Upper TSA Aquifer TCE Contours 2018-08.mxd (Author: SAntonelli) 20190501



Legend

- Lower TSA Monitoring Well
- Extraction Well
- Lower TSA Trichloroethene Countour (µg/L)
- Inferred Upper TSA Trichloroethene Countour (µg/L)
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

D-17dg = Monitoring Well Location ID
1.27 = TCE Concentration (µg/L)
(U) = Upper interval at long screened well location
(L) = Lower interval at long screened well location

Maximum values are reported for locations with field duplicates and/or multiple depths.
If analyte was not detected, the minimum reporting limit was shown.

Lower TSA Aquifer Trichloroethene Concentrations August 2018

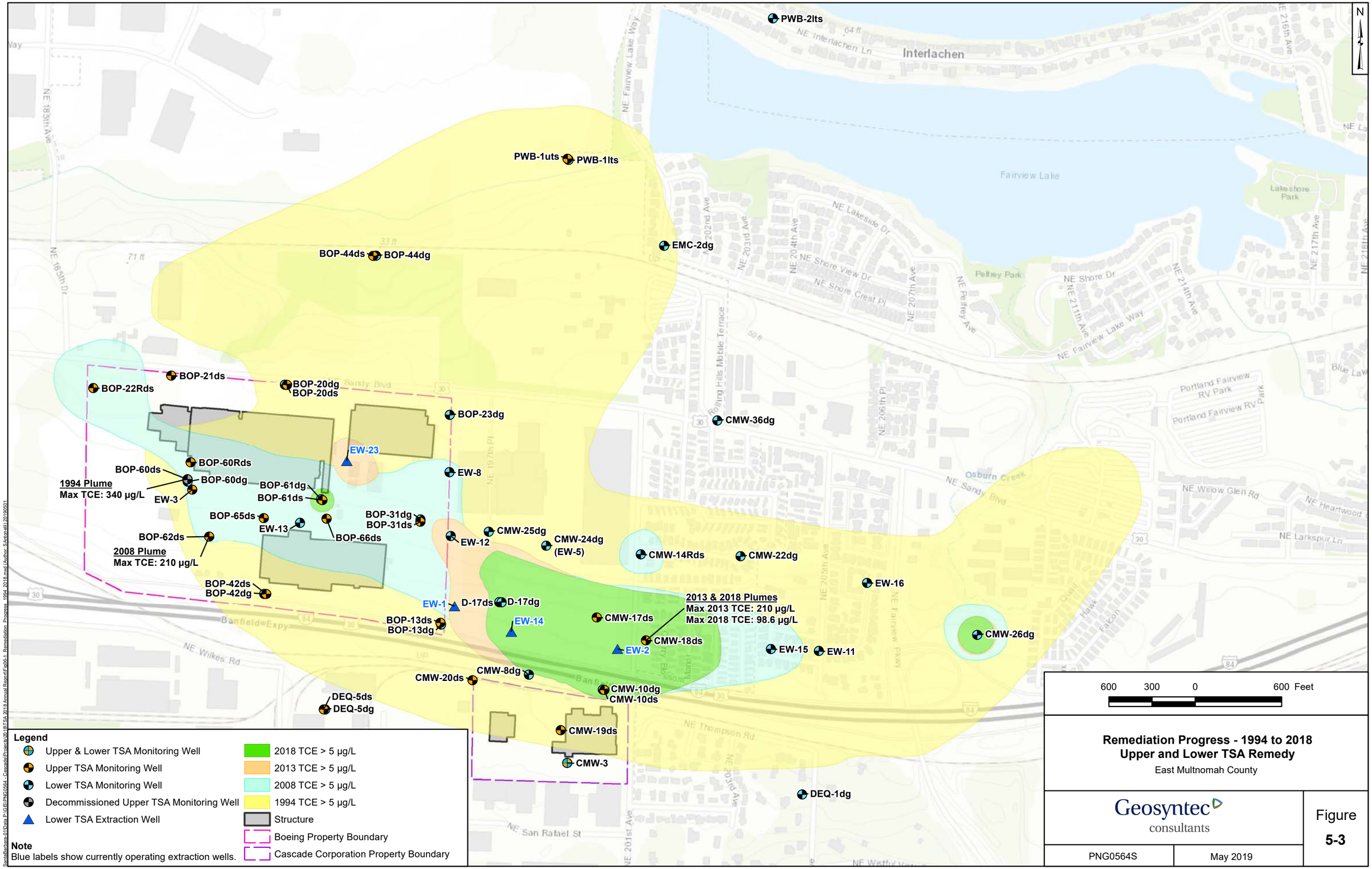
East Multnomah County

Geosyntec consultants

PNG0564S | April 2019

Figure **5-2b**

I:\Data P:\GIS\PNG0564 - Cascade\Projects\2018\TSA 2018 Annual Report\Fig5-2b Lower TSA Aquifer TCE Contours 2018-08.mxd (Author: SAntonelli) 20190425



Remediation Progress - 1994 to 2018
Upper and Lower TSA Remedy

East Multnomah County

Geosyntec consultants

PNG0564S | May 2019

Figure 5-3

APPENDIX A

Extraction Rate Profiles

Table A-1
TSA Extraction Rates 1 January 2018 through 31 December 2018 and
12-Month Averages through 31 December 2018
TSA Remedy - East Multnomah County

Zone	12-Mo. Avg.	01/2018	02/2018	03/2018	04/2018	05/2018	06/2018	07/2018	08/2018	09/2018	10/2018	11/2018	12/2018
Zone B	**31**	**33**	**33**	**33**	**30**	**31**	**31**	**30**	**30**	**30**	**30**	**31**	**31**
EW-23	*31*	*33*	*33*	*33*	*30*	*31*	*31*	*30*	*30*	*30*	*30*	*31*	*31*
Zone C	**60**	**65**	**43**	**69**	**87**	**79**	**77**	**73**	**60**	**40**	**49**	**37**	**37**
EW-1	*26*	*30*	*12*	*25*	*36*	*30*	*30*	*27*	*18*	*0*	*0*	*0*	*0*
EW-2	*24*	*19*	*17*	*23*	*29*	*28*	*27*	*25*	*23*	*21*	*31*	*20*	*20*
EW-14	*19*	*16*	*15*	*21*	*22*	*20*	*21*	*20*	*18*	*18*	*18*	*17*	*17*
Total Avg Flow TSA	**91**	**98**	**76**	**102**	**117**	**110**	**108**	**103**	**90**	**70**	**79**	**67**	**68**

NOTES:

Monthly average flow rates are shown in gallons per minute for each well.

Wells that have not operated during the last 12 months are not shown.

EW-1 pilot shutdown began in September 2018 (pump shut off 31 August 2018)

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

Parameter	Discharge Limitations[a]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
January 2018								
pH	6.0 – 9.0	su	—	7.70	7.78	7.80	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	33	--	—	Daily
February 2018								
Trichloroethene	5.0	µg/L	2/7/2018	< 1.0	< 1.0	< 1.0	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	2/7/2018	< 1.0	< 1.0	< 1.0	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	2/7/2018	< 1.0	< 1.0	< 1.0	0	Quarterly
Tetrachloroethene	5.0	µg/L	2/7/2018	< 1.0	< 1.0	< 1.0	0	Quarterly
Vinyl Chloride	2.0	µg/L	2/7/2018	< 1.0	< 1.0	< 1.0	0	Quarterly
pH	6.0 – 9.0	su	—	7.80	7.80	7.80	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	33	--	—	Daily
March 2018								
pH	6.0 – 9.0	su	—	7.80	7.80	7.80	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	33	--	—	Daily
April 2018								
pH	6.0 – 9.0	su	—	7.70	7.78	7.80	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	36	--	—	Daily
May 2018								
Trichloroethene	5.0	µg/L	5/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	5/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	5/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	5/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	5/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.80	7.83	7.90	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	31	--	—	Daily
June 2018								
pH	6.0 – 9.0	su	—	7.80	7.80	7.80	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	31	--	—	Daily
July 2018								
pH	6.0 – 9.0	su	—	7.80	7.80	7.80	0	Weekly
Temperature	—	ºF	—	60	61	61	—	Weekly
Flow[#]	—	gpm	—	--	30	--	—	Daily
August 2018								
Trichloroethene	5.0	µg/L	8/8/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	8/8/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	8/8/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	8/8/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	8/8/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.80	7.80	7.80	0	Weekly
Temperature	—	ºF	—	60	60	61	—	Weekly
Flow[#]	—	gpm	—	--	30	--	—	Daily

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

Parameter	Discharge Limitations[a]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
September 2018								
pH	6.0 – 9.0	su	—	7.80	7.80	7.80	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	30	--	—	Daily
October 2018								
pH	6.0 – 9.0	su	—	7.80	7.80	7.80	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	31	--	—	Daily
November 2018								
Trichloroethene	5.0	µg/L	11/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	11/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	11/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	11/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	11/1/2018	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.80	7.80	7.80	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	31	--	—	Daily
December 2018								
pH	6.0 – 9.0	su	—	7.80	7.88	7.90	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	31	--	—	Daily

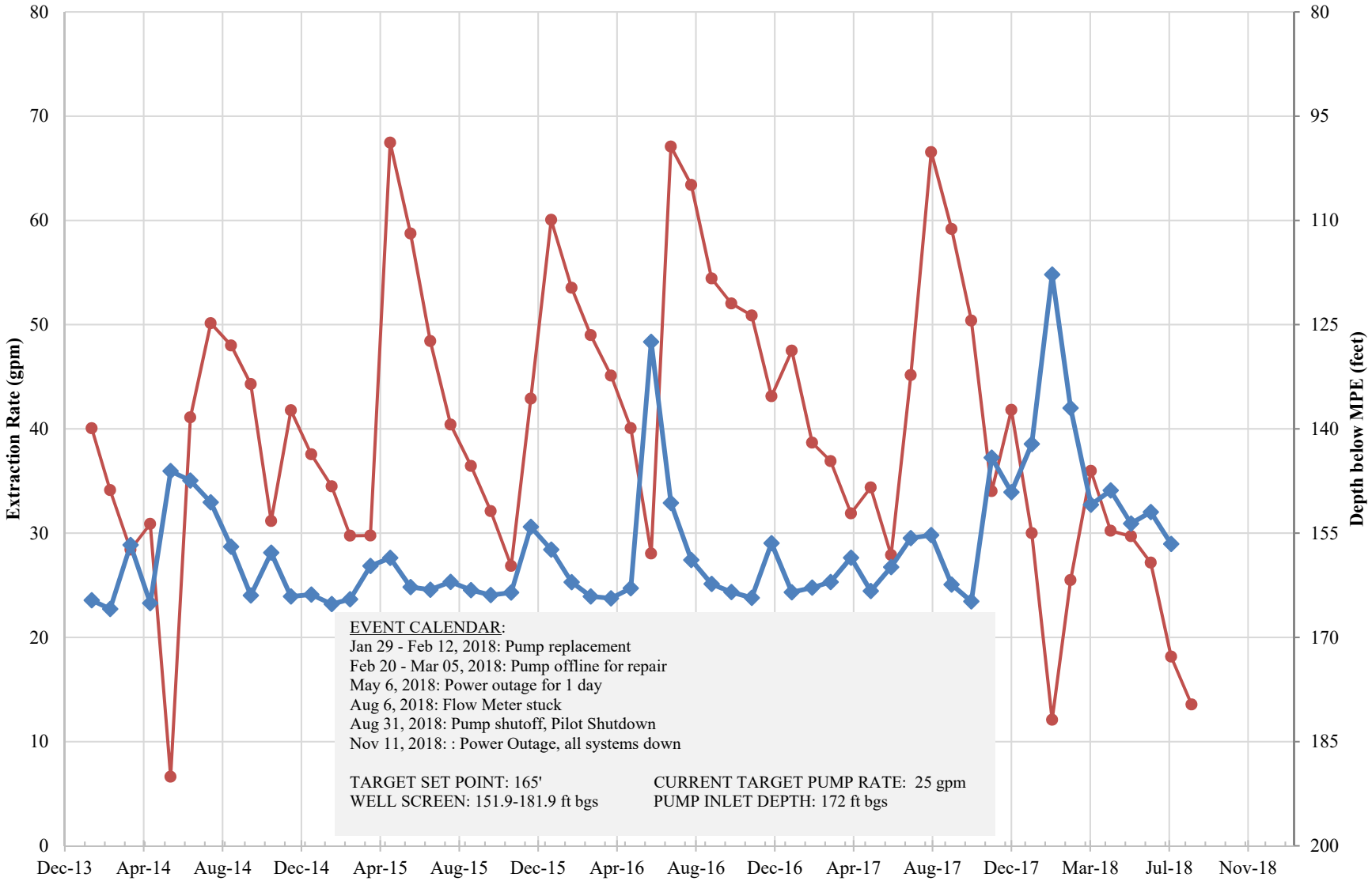
NOTES:

[a]Discharge limitations for the CTS are per Attachment C to DEQ Consent Order No. WMCSR-NWR-96-08 dated 2/14/97.

Analysis for VOCs includes TS-C-Eff.

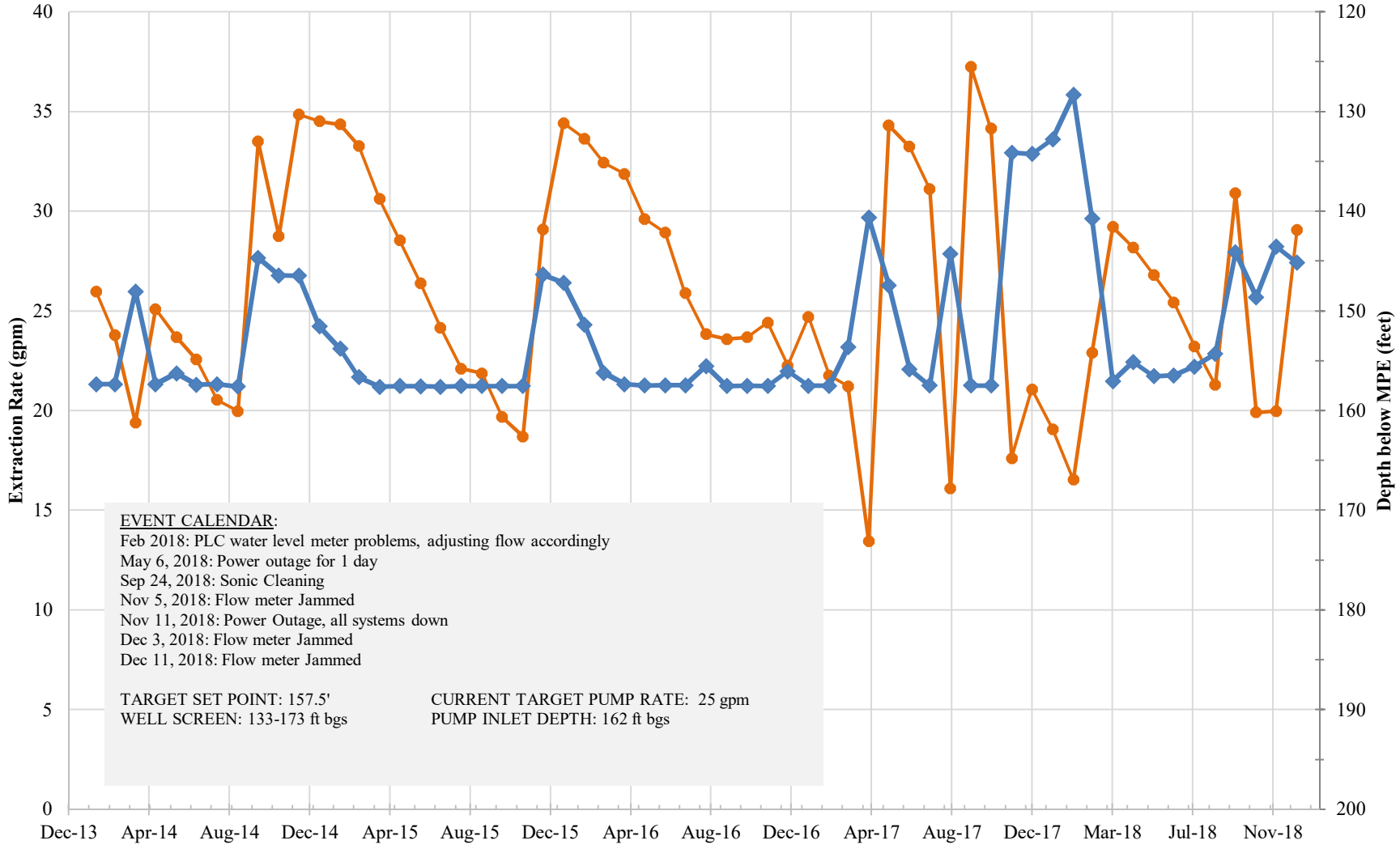
[#]Flow includes EW-1, EW-2, EW-14, and EW-23.

µg/L = micrograms/liter; ºF = degrees Fahrenheit; gpm = gallons per minute; su = standard units.



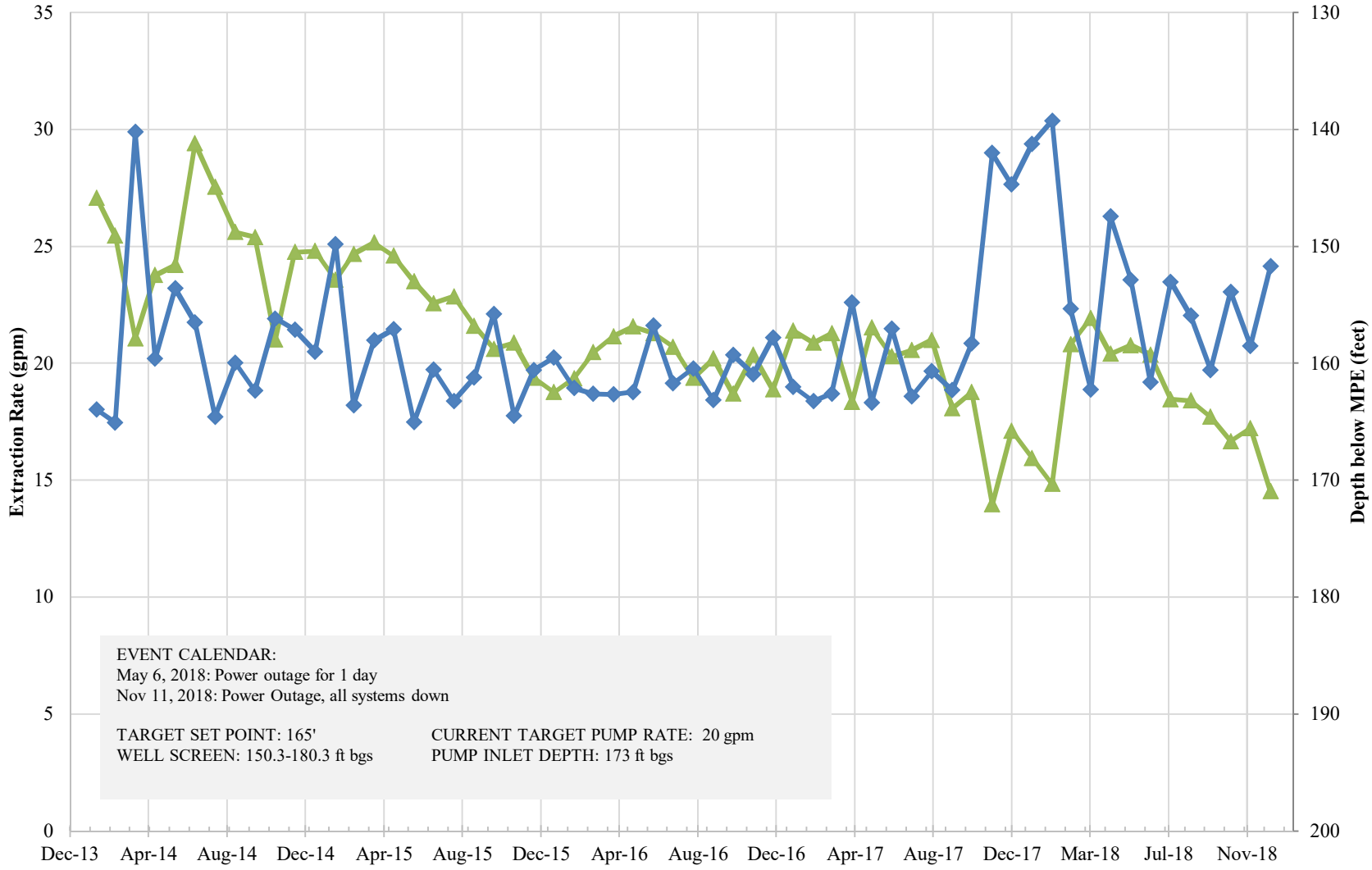
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-1 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-1



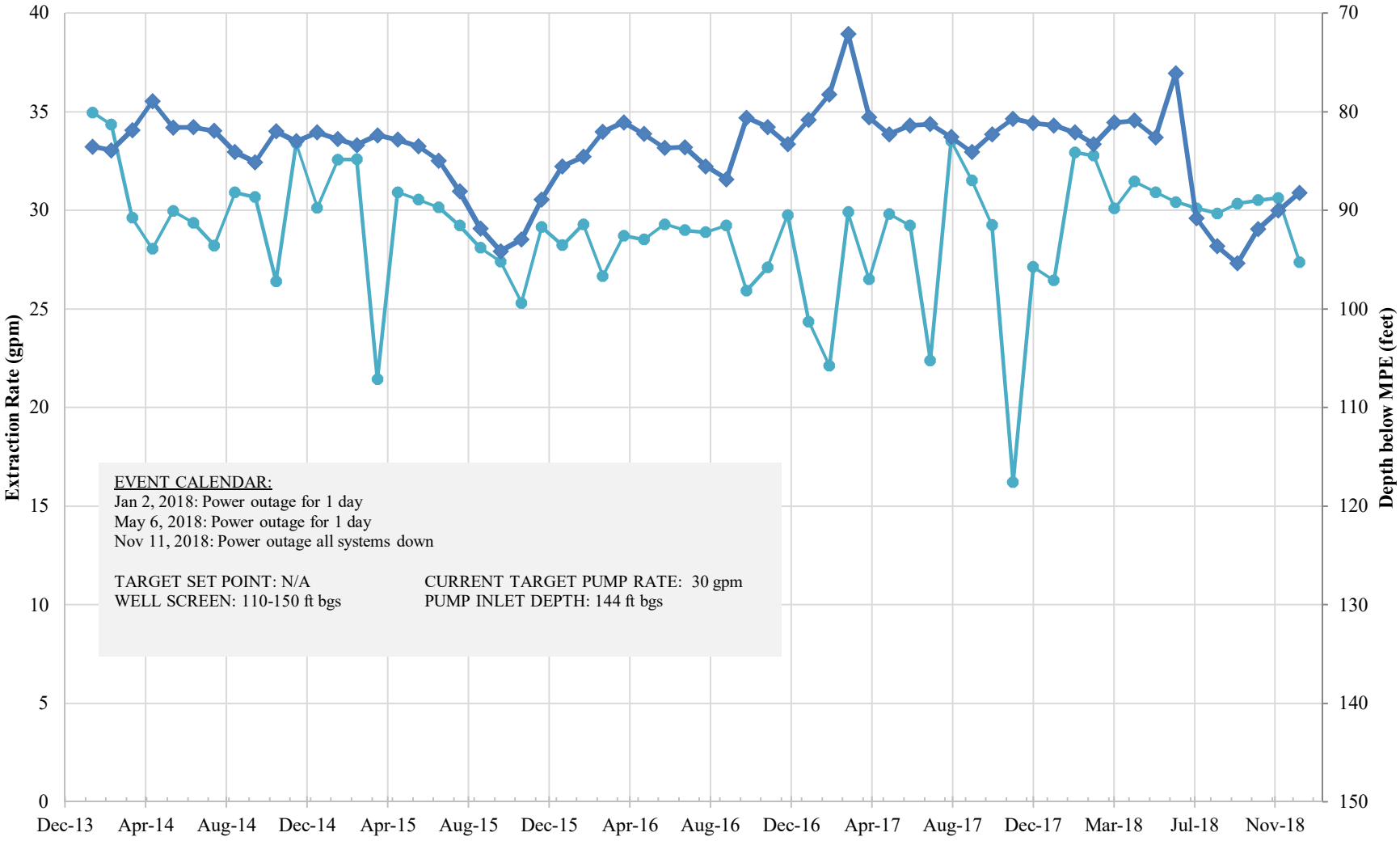
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-2 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-2



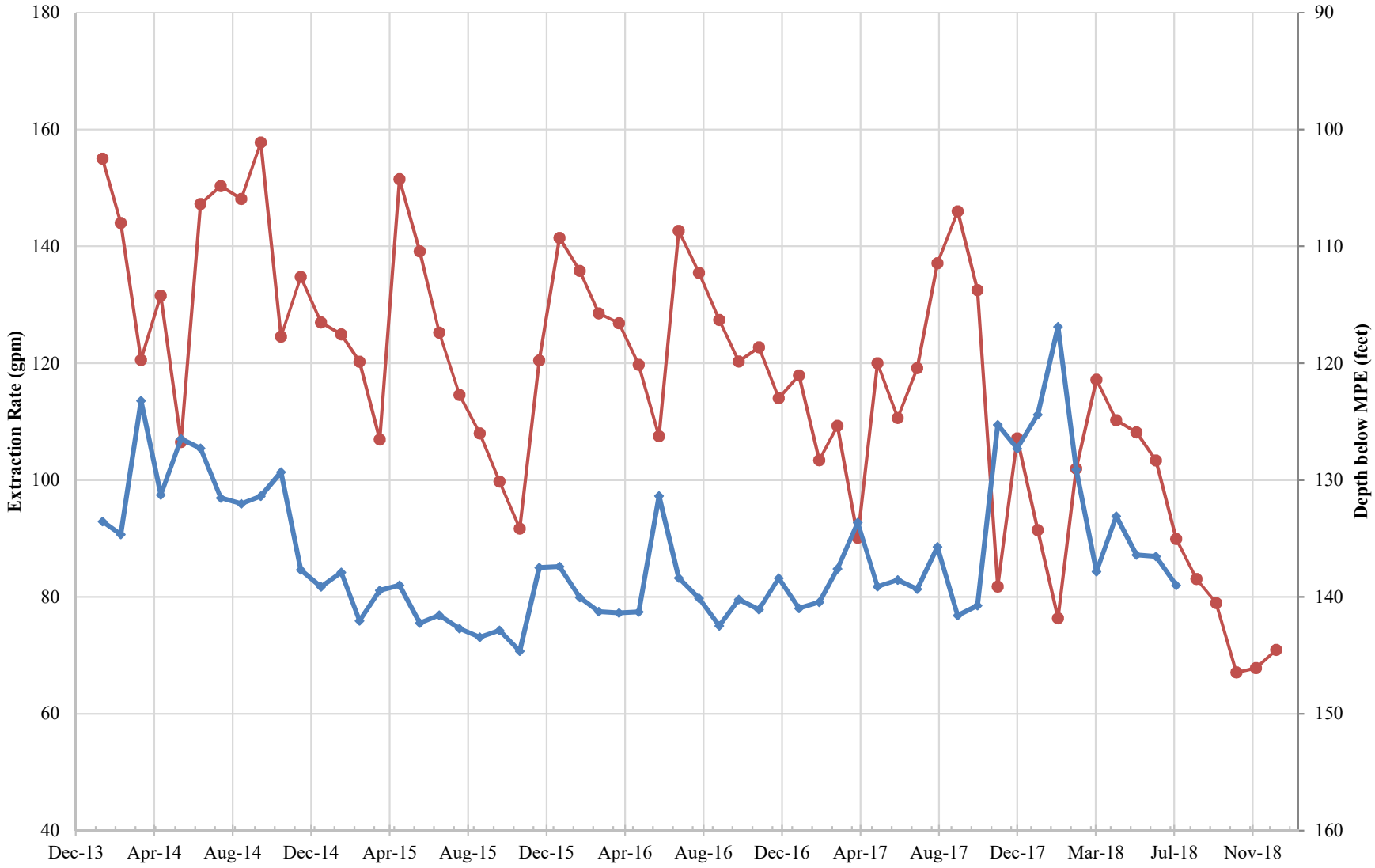
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-14 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-3



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-23 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-4



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Total Extraction Rate for Remedy All Wells TSA Remedy**	Figure A-5

APPENDIX B

Well Decommissioning

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765 & OAR 690-205-0210)

MULT 130705
2/12/2019

WELL I.D. LABEL# L
START CARD # 1039393
ORIGINAL LOG # MULTNOMAH 3952

(1) LAND OWNER

Owner Well I.D. RPW-1DS
First Name _____ Last Name _____
Company MICHAEL CEREGHINO
Address 20818 NE WISTFU VISTA DR
City FAIRVIEW State OR Zip 97024

(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 MILLS KNIFE

(4) PROPOSED USE

☐ Domestic ☒ Irrigation ☐ Community
☐ Industrial/ Commericial ☐ Livestock ☐ Dewatering
☐ Thermal ☐ Injection ☒ Other DECOMMISION WELL (PERF A

(5) BORE HOLE CONSTRUCTION

Special Standard ☒ (Attach copy)
Depth of Completed Well 115.00 ft.

BORE HOLE

Dia	From	To
10	0	115

SEAL

Material	From	To	Amt	sacks/lbs
Cement	0	115	80	S
		Calculated	80	
		Calculated		

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☒ Other TREMIE PIPE
Backfill placed from 0 ft. to 115 ft. Material CEMENT GROUT
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
●	○	10	☐	0	72	.25	●	○	☒	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

Shoe ☐ Inside ☐ Outside ☐ Other Location of shoe(s) _____
Temp casing ☐ Yes Dia _____ From +☐ _____ To _____

(7) PERFORATIONS/SCREENS

Perforations Method Mills Knife
Screens Type V-Wire Material Stainless Steel

Perf/ Screen	Casing/ Screen Liner	Dia	From	To	Scrn/slot width	Slot length	# of slots	Tele/ pipe size
Perf	Casing	10	4	70	.25	2	264	
Screen	Casing	10	72	115	.04			

(8) WELL TESTS: Minimum testing time is 1 hour

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 56 °F Lab analysis ☐ Yes By _____
Water quality concerns? ☐ Yes (describe below) TDS amount 100 ppm

From	To	Description	Amount	Units

(9) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 3.00 E E/W WM
Sec 20 NE 1/4 of the SE 1/4 Tax Lot 100
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD
◯ Street address of well ◉ Nearest address
UNDEVELOPED AGRICULTURAL FIELD WEST OF FAIRVIEW LAKE WAY & SOUTH OF INTERLACHEN LANE, FAIRVIEW, OR

(10) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Pre-Alteration	7/10/2018		☒	1
Completed Well			☐	

Flowing Artesian? ☒ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(11) WELL LOG

Ground Elevation _____

Material	From	To
Remove Casing - Restore Surface	0	4
Perf & Cement Grout - Mills Knife	4	70
Cement Grout	70	115

Date Started 7/10/2018 Completed 7/12/2018

(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 1786 Date 2/12/2019

Signed JOSEPH STALOCH (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 1786 Date 2/12/2019

Signed JOSEPH STALOCH (E-filed)

Contact Info (optional) _____

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

MULT 130705

2/12/2019

Map of Hole

2/12/2019 NE Interlachen Ln - Google Maps

Google Maps NE Interlachen Ln, Fairview, OR

N
W + E
S

https://www.google.com/maps/place/NE+Interlachen+Ln,+Oregon/@45.5516484,-122.4597562,623m/data=!3m1!1e3!4m5!3m4!1s0x5495a2dec242483b:0xafafad77d63d2fa7!8m2!3d45.551899!4d-122.... 1/1

WATER SUPPLY WELL REPORT - continuation page

MULT 130705

2/12/2019

Map of Hole

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem Oregon 97301-1266
(503) 986-0900
www.wrd.state.or.us

Special Standards
Request Form

REQUEST FOR WRITTEN APPROVAL TO USE CONSTRUCTION METHODS NOT INCLUDED IN OREGON ADMINISTRATIVE RULES 690-200 THROUGH 690-240

Before the request can be considered, this form must be completed. Requests shall be submitted to the Well Construction Program Coordinator, Water Resources Department, 725 Summer Street NE, Suite A, Salem OR 97301-1266. Requests may also be considered by the appropriate Regional Manager.

Date of request: 7/05/18 **Oral approval date (if applicable):** 06/28/18

Bonded Well Constructor (**name, license #, and mailing address**): Joe Staloch - #1786

13600 SE Ambler Rd. Clackamas OR, 97015

(1) Location of Well: NE 1/4 SE 1/4 Tax lot 100 Section 20,

Township 1 N, Range 3 E, Multnomah County

Address at well site: Undeveloped agricultural field west of Fairview Lake Way and south

of Interlachen Lane, Fairview, OR

(2) Start Card Number(s)(for work to be done): 1039393

(3) Name and Address of Land Owner: Michael Cereghino

20818 NE Wistful Vista Dr, Fairview, OR 97024

(4) Distance to the nearest septic tank, drainfield, closed sewage line (if water supply well)

N/A

(5) The unusual site conditions which necessitate this request: 10" Steel cased artisian well

poses difficulty to overdrill. See attached construction log for well design.

See attached logs, tables and photos.

(6) The proposed construction methods that the bonded well constructor believes will be adequate for this well: (attach additional pages if needed)

Perforate casing and Grout in Place as per abandonment method used on nearby well RPW-1(DG) in 2010.

See Attached (MULT 104700). Remove monument and repair surface.

WATER SUPPLY WELL REPORT - continuation page

MULT 130705

2/12/2019

Map of Hole

(7) Diagram showing the pertinent features of the proposed well design and construction: (attach additional pages if needed)

Well _____ Orig Start # _____ Depth (ft.)

Concrete Seal _____ to _____

Bentonite Seal _____ to _____

Blank Casing _____ to _____

Well Screen _____ to _____

Filter Pack _____ to _____

Well Diameter _____ to _____

Total Depth _____ to _____

Well Name	Orig Start Card	Depth
RPW-1(ds)	58103	117 ft

PLEASE NOTE:

(1) The Well Construction Standards serve to protect ground water resources. By approving and issuing this special construction standard the Oregon Water Resources Department is not representing that a well constructed in accordance with this condition will maintain structural integrity or that it meets engineering standards. The well constructor/or landowner is responsible for ensuring that a well is constructed in a manner that protects ground water resources as required under Oregon Administrative Rules 690-200 through 690-240.

(2) If it should be determined at some future date that the well, due to its construction, is allowing ground water contamination, waste or loss of artesian pressure, the undersigned shall return to the site and rectify the problem.

(3) If oral approval was granted, a written request must be submitted to the Department either within three (3) working days of the date of oral approval or prior to the completion of the associated well work. Failure to submit a written request as described above may void prior oral approval.

I have read and understand the above information. I further attest that the information provided is accurate to the best of my knowledge.

Bonded Constructor Signature: _____

MULT 130734

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

2/13/2019

WELL I.D. LABEL# L 88979

START CARD # 1035837

(1) LAND OWNER

Owner Well I.D. BOP-70DS

First Name _____ Last Name _____

Company CASCADE CORPORATION

Address 19000 NE SANDY BLVD

City PORTLAND State OR Zip 97230

(2) TYPE OF WORK

☐ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☒ Abandonment

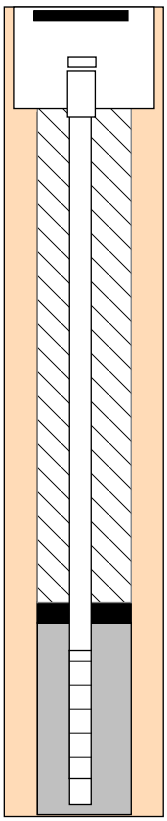
(3) DRILL METHOD

☐ Rotary Air ☒ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☐ Other _____

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 282.00 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 2

BORE HOLE
Diameter 12 From 0 To 282

CASING
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ◯Steel ◯Plastic ☐ ☐

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ◯Steel ◯Plastic ☐ ☐

SEAL
From 0 To 3
Material Concrete
Amount 6 Sacks Grout weight _____

SCREEN
Casing/Liner _____ Material _____
Diameter _____ From _____ To _____
Slot Size _____

FILTER
From _____ To _____ Material _____ Size of pack _____

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 56 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 100 ppm

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 3.00 E E/W WM
Sec 29 NE 1/4 of the SW 1/4 Tax Lot ROW
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD
◯ Street address of well ◉ Nearest address
EAST SIDE OF NE 185TH AVE NORTH OF INTERSECTION OF NE SANDY BLVD, GRESHAM, OR 97230

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+ SWL(ft)
Existing Well / Predeepening	10/23/2018		68.3
Completed Well			

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+ SWL(ft)

(8) WELL LOG

Ground Elevation _____

Material	From	To
Remove monument and restore surface	0	3
Abandon cluster MWs by overdrill method	3	282

Date Started 10/23/2018 Completed 10/29/2018

(unbonded) Monitor 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 monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10618 Date 2/13/2019
Password : (if filing electronically) _____
Signed CHRISTOPHER BAKER (E-filed)

(bonded) Monitor 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 monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10408 Date 2/13/2019
Password : (if filing electronically) _____
Signed PETER LARSEN (E-filed)
Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

MULT 130734

2/13/2019

WELL I.D. LABEL# L 88979

START CARD # 1035837

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Grout	3	282	68	S	9.5

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

Abandon MW cluster (three 2" MWs) with 12" mud rotary overdrill. Remove MW materials from boring prior to drilling. Overdrill to depth and backfill with Bentonite grout (20% solids) @ 9.5 lbs / gallon. Remove monument and restore surface.
Original Start Card: 1000699
Original Well Tag: 88979

MULT 130701

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

2/12/2019

WELL I.D. LABEL# L 13024

START CARD # 1037558

(1) LAND OWNER

Owner Well I.D. D-16(DG)

First Name _____ Last Name _____

Company BT PROPERTY LLC

Address 55 GLENLAKE PKWY NE

City ATLANTA State GA Zip 30328

(2) TYPE OF WORK

☐ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☒ Abandonment

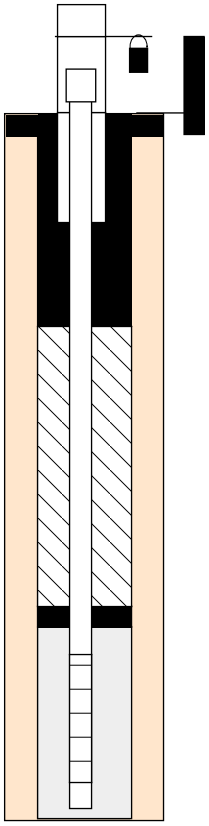
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☒ Other ABANDON IN PLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 241.00 ft. Special Standard ☒



MONUMENT/VAULT Above Ground
From 3 To 3

BORE HOLE
Diameter 2 From 0 To 241

CASING
Dia. 2 From ☒ 2.5 To 221
Gauge Sch 80 Wld Thrd
Material ◯ Steel ◉ Plastic ☐ ☒

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ◯ Steel ◯ Plastic ☐ ☐

SEAL
From 0 To 10
Material Bentonite Chips
Amount 3 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material PVC - Sch 40
Diameter 2 From 221 To 241
Slot Size 0.020

FILTER
From _____ To _____ Material _____ Size of pack _____

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 56 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 100 ppm

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 3.00 E E/W WM
Sec 20 SW 1/4 of the SW 1/4 Tax Lot 01900
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◯ Street address of well ◉ Nearest address

FIELD EAST OF: 19250 NE PORTAL WAY, PORTLAND, OR 97230

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening	10/2/2018		☐	10
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation _____

Material	From	To
Remove monument & upper well	0	3
Decom 2" MW in place as per Final Order	3	241

Date Started 10/2/2018 Completed 10/4/2018

(unbonded) Monitor 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 monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10618 Date 2/11/2019
Password : (if filing electronically) _____
Signed CHRISTOPHER BAKER (E-filed)

(bonded) Monitor 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 monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10408 Date 2/11/2019
Password : (if filing electronically) _____
Signed PETER LARSEN (E-filed)
Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

MULT 130701

2/12/2019

WELL I.D. LABEL# L13024

START CARD # 1037558

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Grout	10	241	2	S	9.8

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

Abandon 2" MW in place as per Final Order. Remove monument and upper portion of well and restore surface.
Original Start: 36679
Well Tag: L13024

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

MULT 130701

2/12/2019

Map of Hole

2/11/2019 19250 NE Portal Way - Google Maps

Google Maps **19250 NE Portal Way** , Portland, OR 97203

Imagery ©2019 Google, Map data ©2019 Google 200 ft

N
W + E
S

MONITORING WELL REPORT - continuation page

MULT 130701

2/12/2019

Map of Hole

Oregon
Kate Brown, Governor

Water Resources Department
North Mall Office Building
725 Summer St NE, Suite A
Salem, OR 97301
Phone (503) 986-0900
Fax (503) 986-0904
www.wrd.state.or.us

January 12, 2018

PETER S. LARSEN MWC# 10408
CASCADE DRILLING LP
13600 SE AMBLER ROAD
CLACKAMAS, OREGON 97015

FINAL ORDER

Dear Mr. Larson:

The Special Standards Request Form you submitted for owner: BT Property LLC, Start Card number 1037558 (D-16dg) is hereby approved; you may decommission this monitoring well as outlined on your Special Standards Request Form. All other monitoring well decommissioning rules shall be adhered to. A copy of your Special Standards Request Form is enclosed.

If you have any questions regarding this letter, I may be contacted at (503) 986-0852, or by e-mail at Joel.W.Jeffery@oregon.gov.

Sincerely,

Joel Jeffery, Coordinator
Well Construction Program
Well Construction and Compliance Section

enclosure

cc: Barry Sanford, Well Inspector: Northwest Region
File

This is a final order in other than contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080 you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

MULT 130700

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

2/12/2019

WELL I.D. LABEL# L

START CARD # 1035839

(1) LAND OWNER

Owner Well I.D. DS-16(DS)

First Name _____ Last Name _____

Company BT PROPERTY LLC

Address 55 GLENLAKE PKWY NE

City ATLANTA State GA Zip 30328

(2) TYPE OF WORK

☐ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☒ Abandonment

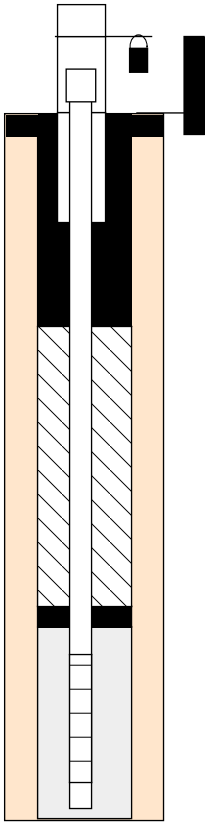
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☒ Other ABANDON IN PLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 152.00 ft. Special Standard ☒



MONUMENT/VAULT Above Ground
From 3 To 3

BORE HOLE
Diameter 2 From 0 To 152

CASING
Dia. 2 From ☒ 2.5 To 130
Gauge Sch 80 Wld Thrd
Material ◯ Steel ◉ Plastic ☐ ☒

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ◯ Steel ◯ Plastic ☐ ☐

SEAL
From 0 To 10.4
Material Bentonite Chips
Amount 3 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material PVC - Sch 80
Diameter 2 From 130 To 150
Slot Size 0.020

FILTER
From _____ To _____ Material _____ Size of pack _____

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 56 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 100 ppm

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 3.00 E E/W WM
Sec 20 SW 1/4 of the SW 1/4 Tax Lot 01900
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◯ Street address of well ◉ Nearest address

FIELD EAST OF: 19250 NE PORTAL WAY, PORTLAND, OR 97230

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening	10/1/2018		☐	10.4
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation _____

Material	From	To
Remove monument & upper well	0	3
Decom 2" MW in place as per Final Order	3	152

Date Started 10/1/2018 Completed 10/4/2018

(unbonded) Monitor 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 monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10618 Date 2/11/2019
Password : (if filing electronically) _____
Signed CHRISTOPHER BAKER (E-filed)

(bonded) Monitor 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 monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10408 Date 2/12/2019
Password : (if filing electronically) _____
Signed PETER LARSEN (E-filed)
Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

MULT 130700

2/12/2019

WELL I.D. LABEL# L

START CARD # 1035839

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Grout	10.4	152	1	S	9.8

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

Abandon 2" MW in place as per Final Order. Remove monument and upper portion of well and restore surface.
Original Start: 25589
Well Tag: (no tag found on monument or const log)

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

MULT 130700

2/12/2019

Map of Hole

2/11/2019 19250 NE Portal Way - Google Maps

Google Maps **19250 NE Portal Way** , Portland, OR 97203

Imagery ©2019 Google, Map data ©2019 Google 200 ft

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W + E
S

MONITORING WELL REPORT - continuation page

MULT 130700

2/12/2019

Map of Hole

Oregon
Kate Brown, Governor

Water Resources Department
North Mall Office Building
725 Summer St NE, Suite A
Salem, OR 97301
Phone (503) 986-0900
Fax (503) 986-0904
www.wrd.state.or.us

January 12, 2018

PETER S. LARSEN MWC# 10408
CASCADE DRILLING LP
13600 SE AMBLER ROAD
CLACKAMAS, OREGON 97015

FINAL ORDER

Dear Mr. Larson:

The Special Standards Request Form you submitted for owner: BT Property LLC, Start Card number 1035839 (D16ds) is hereby approved; you may decommission this monitoring well as outlined in your Special Standards Request Form. ***If you are going to use bentonite grout to abandon the well, then it may only be used to abandon the portion of the well that is below the static water level. Above the static water level another approved sealing material must be used.*** All other monitoring well decommissioning rules shall be adhered to. A copy of your Special Standards Request Form is enclosed.

If you have any questions regarding this letter, I may be contacted at (503) 986-0852, or by e-mail at Joel.W.Jeffery@oregon.gov.

Sincerely,

Joel Jeffery, Coordinator
Well Construction Program
Well Construction and Compliance Section

enclosure

cc: Barry Sanford, Well Inspector: Northwest Region
File

This is a final order in other than contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080 you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

MULT 130702

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

2/12/2019

WELL I.D. LABEL# L

START CARD # 1035841

(1) LAND OWNER

Owner Well I.D. D-18(DS)

First Name _____ Last Name _____

Company WESTERN B NORTHWEST OR LLC

Address 18818 TILLER AVE #227

City IRVINE State CA Zip 92612

(2) TYPE OF WORK

☐ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☒ Abandonment

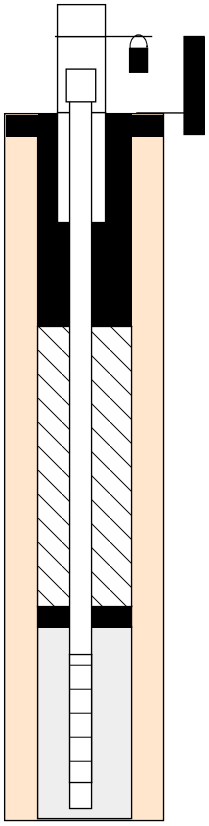
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☒ Other ABANDON IN PLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 177.00 ft. Special Standard ☒



MONUMENT/VAULT Above Ground
From 3 To 3

BORE HOLE
Diameter 2 From 0 To 177

CASING
Dia. 2 From ☒ 2.5 To 167
Gauge Sch 80 Wld Thrd
Material ◯ Steel ◉ Plastic ☐ ☒

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ◯ Steel ◯ Plastic ☐ ☐

SEAL
From 0 To 3
Material Other
Amount 5 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material PVC - Sch 80
Diameter 2 From 167 To 177
Slot Size 0.020

FILTER
From _____ To _____ Material _____ Size of pack _____

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 57 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 100 ppm

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 3.00 E E/W WM
Sec 20 SW 1/4 of the SW 1/4 Tax Lot 00107
Tax Map Number 00107 Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◉ Street address of well ◯ Nearest address

18792 NE PORTAL WAY, PORTLAND, OR 97230

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening	10/10/2018		☐	21.5
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation _____

Material	From	To
Remove monument and restore surface	0	3
Decom 2" MW in place as per Final Order	3	177

Date Started 10/10/2018 Completed 10/11/2018

(unbonded) Monitor 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 monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10618 Date 2/11/2019
Password : (if filing electronically) _____
Signed CHRISTOPHER BAKER (E-filed)

(bonded) Monitor 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 monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10408 Date 2/11/2019
Password : (if filing electronically) _____
Signed PETER LARSEN (E-filed)
Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

MULT 130702

WELL I.D. LABEL# L

START CARD # 1035841

2/12/2019

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Chips	3	21.5	1	S	
Bentonite Grout	21.5	177	1	S	9.8

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

Abandon 2" MW in place as per Final Order. Remove monument and upper portion of well and restore surface.
Original Start: 75415
Well Tag: Unavailable

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

MULT 130702

2/12/2019

Map of Hole

2/11/2019 18792 NE Portal Way - Google Maps

Google Maps 18792 NE Portal Way, Portland, OR 97230

N
W + E
S

https://www.google.com/maps/place/18792+NE+Portal+Way,+Portland,+OR+97230/@45.5506855,-122.4710695,389m/data=!3m1!1e3!4m5!3m4!1s0x5495a2fd5b26301d:0x8a4e6e81380e19ca!8m2!3d... 1/1

MONITORING WELL REPORT - continuation page

MULT 130702

2/12/2019

Map of Hole

Oregon
Kate Brown, Governor

Water Resources Department
North Mall Office Building
725 Summer St NE, Suite A
Salem, OR 97301
Phone (503) 986-0900
Fax (503) 986-0904
www.wrd.state.or.us

January 12, 2018

PETER S. LARSEN MWC# 10408
CASCADE DRILLING LP
13600 SE AMBLER ROAD
CLACKAMAS, OREGON 97015

FINAL ORDER

Dear Mr. Larson:

The Special Standards Request Form you submitted for owner: Western B Northwest Oregon LLC. C/O Marvin F Poer & Co., Start Card number 1035841 (D-18ds) is hereby approved; you may decommission this monitoring well as outlined on your Special Standards Request Form. All other monitoring well decommissioning rules shall be adhered to. A copy of your Special Standards Request Form is enclosed.

If you have any questions regarding this letter, I may be contacted at (503) 986-0852, or by e-mail at Joel.W.Jeffery@oregon.gov.

Sincerely,

Joel Jeffery, Coordinator
Well Construction Program
Well Construction and Compliance Section

enclosure

cc: Barry Sanford, Well Inspector: Northwest Region
File

This is a final order in other than contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080 you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

MULT 130703

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

2/12/2019

WELL I.D. LABEL# L 99270

START CARD # 1035843

(1) LAND OWNER

Owner Well I.D. VW-17D-42.5

First Name _____ Last Name _____

Company CASCADE CORPORATION

Address 2201 NE 201ST AVE

City PORTLAND State OR Zip 97230

(2) TYPE OF WORK

☐ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☒ Abandonment

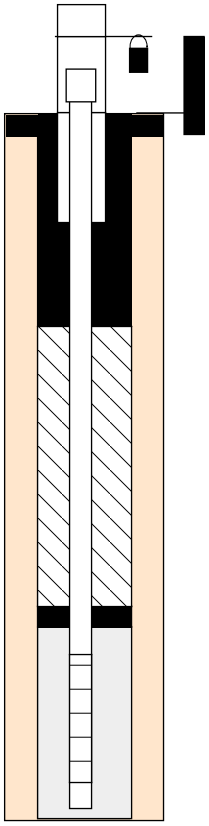
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☒ Other ABANDON IN PLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 42.50 ft. Special Standard ☒



MONUMENT/VAULT Above Ground
From 3 To 3

BORE HOLE
Diameter 2 From 0 To 42.5

CASING
Dia. 2 From ☒ 2.5 To 37.5
Gauge Sch 40 Wld ☐ Thrd ☒
Material ◯ Steel ◉ Plastic

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld ☐ Thrd ☐
Material ◯ Steel ◯ Plastic

SEAL
From 0 To 3
Material Other
Amount 6 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material PVC - Sch 40
Diameter 2 From 37.5 To 42.5
Slot Size 0.020

FILTER
From _____ To _____ Material _____ Size of pack _____

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature _____ °F Lab analysis ☐ Yes By Dry Hole

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount _____

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 3.00 E E/W WM
Sec 29 SE 1/4 of the NE 1/4 Tax Lot 01005
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD
◯ Street address of well ◉ Nearest address
2525 NE 201ST AVE, PORTLAND, OR 97230

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☒

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation _____

Material	From	To
Remove Monument & Upper Well, Restore	0	3
Surface and Decom well in place	3	42.5

Date Started 10/1/2018 Completed 10/2/2018

(unbonded) Monitor 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 monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10618 Date 2/11/2019
Password : (if filing electronically) _____
Signed CHRISTOPHER BAKER (E-filed)

(bonded) Monitor 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 monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10408 Date 2/11/2019
Password : (if filing electronically) _____
Signed PETER LARSEN (E-filed)
Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

MULT 130703

WELL I.D. LABEL# L99270

START CARD # 1035843

2/12/2019

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Chips	3	42.5	1	S	

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Material	From	To

Comments/Remarks

Abandon 2" MW in place as per Final Order. Remove monument and upper portion of well and restore surface.
Original Start: 1015934
Well Tag: L99270

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

MULT 130703

2/12/2019

Map of Hole

Oregon
Kate Brown, Governor

Water Resources Department
North Mall Office Building
725 Summer St NE, Suite A
Salem, OR 97301
Phone (503) 986-0900
Fax (503) 986-0904
www.wrd.state.or.us

January 12, 2018

PETER S. LARSEN MWC# 10408
CASCADE DRILLING LP
13600 SE AMBLER ROAD
CLACKAMAS, OREGON 97015

FINAL ORDER

Dear Mr. Larson:

The Special Standards Request Form you submitted for owner: Cascade Corporation, Start Card number 1035843 (VW-17D-42.5) is hereby approved; you may decommission this monitoring well as outlined in your Special Standards Request Form. All other monitoring well decommissioning rules shall be adhered to. A copy of your Special Standards Request Form is enclosed.

If you have any questions regarding this letter, I may be contacted at (503) 986-0852, or by e-mail at Joel.W.Jeffery@oregon.gov.

Sincerely,

Joel Jeffery, Coordinator
Well Construction Program
Well Construction and Compliance Section

enclosure

cc: Barry Sanford, Well Inspector: Northwest Region
File

This is a final order in other than contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080 you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

MONITORING WELL REPORT - continuation page

MULT 130703

2/12/2019

Map of Hole

Google Maps **2201 NE 201st Ave**, Portland, OR 97230

N
W + E
S

MULT 130704

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

2/12/2019

WELL I.D. LABEL# L 99269

START CARD # 1035844

(1) LAND OWNER

Owner Well I.D. VW-17D-75

First Name _____ Last Name _____

Company CASCADE CORPORATION

Address 2201 NE 201ST AVE

City PORTLAND State OR Zip 97230

(2) TYPE OF WORK

☐ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☒ Abandonment

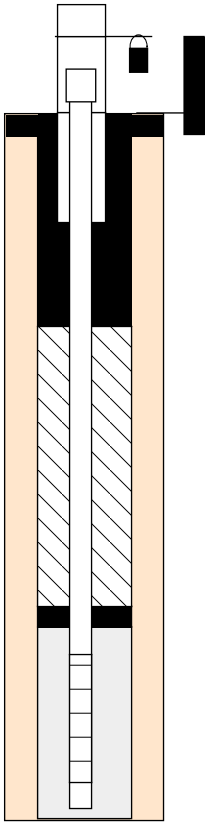
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☒ Other ABANDON IN PLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 75.00 ft. Special Standard ☒



MONUMENT/VAULT Above Ground
From 3 To 3

BORE HOLE
Diameter 2 From 0 To 75

CASING
Dia. 2 From ☒ 2.5 To 55
Gauge Sch 40 Wld Thrd
Material ◯ Steel ◉ Plastic ☐ ☒

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ◯ Steel ◯ Plastic ☐ ☐

SEAL
From 0 To 3
Material Other
Amount 6 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material PVC - Sch 40
Diameter 2 From 55 To 75
Slot Size 0.020

FILTER
From _____ To _____ Material _____ Size of pack _____

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature _____ °F Lab analysis ☐ Yes By Dry Hole

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount _____

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 3.00 E E/W WM
Sec 29 SE 1/4 of the NE 1/4 Tax Lot 01005
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◯ Street address of well ◉ Nearest address

2525 NE 201ST AVE, PORTLAND, OR 97230

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☒

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation _____

Material	From	To
Remove Monument & Upper Well, Restore	0	3
Surface and Decom well in place	3	75

Date Started 10/1/2018 Completed 10/2/2018

(unbonded) Monitor 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 monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10618 Date 2/11/2019
Password : (if filing electronically) _____
Signed CHRISTOPHER BAKER (E-filed)

(bonded) Monitor 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 monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10408 Date 2/11/2019
Password : (if filing electronically) _____
Signed PETER LARSEN (E-filed)
Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

MULT 130704

WELL I.D. LABEL# L99269

START CARD # 1035844

2/12/2019

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Chips	3	35	1	S	
Bentonite Grout	35	75	1	S	

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

Abandon 2" MW in place as per Final Order. Remove monument and upper portion of well and restore surface.
Original Start: 1015933
Well Tag: L99269

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

MULT 130704

2/12/2019

Map of Hole

Google Maps **2201 NE 201st Ave**, Portland, OR 97230

N
W + E
S

MONITORING WELL REPORT - continuation page

MULT 130704

2/12/2019

Map of Hole

Oregon
Kate Brown, Governor

Water Resources Department
North Mall Office Building
725 Summer St NE, Suite A
Salem, OR 97301
Phone (503) 986-0900
Fax (503) 986-0904
www.wrd.state.or.us

January 12, 2018

PETER S. LARSEN MWC# 10408
CASCADE DRILLING LP
13600 SE AMBLER ROAD
CLACKAMAS, OREGON 97015

FINAL ORDER

Dear Mr. Larson:

The Special Standards Request Form you submitted for owner: Cascade Corporation, Start Card number 1035844 (VW-17D-75.0) is hereby approved; you may decommission this monitoring well as outlined on your Special Standards Request Form. All other monitoring well decommissioning rules shall be adhered to. A copy of your Special Standards Request Form is enclosed.

If you have any questions regarding this letter, I may be contacted at (503) 986-0852, or by e-mail at Joel.W.Jeffery@oregon.gov.

Sincerely,

Joel Jeffery, Coordinator
Well Construction Program
Well Construction and Compliance Section

enclosure

cc: Barry Sanford, Well Inspector: Northwest Region
File

This is a final order in other than contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080 you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

Please print or type
(Form designed for use on elite (12-pitch) typewriter.)

NON-HAZARDOUS WASTE MANIFEST	1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Waste Tracking Number
	CESQG	1	888-785-7225	190935/228912

GENERATOR

5. Generator's Name and Mailing Address
Cascade Corporation
2525 NE 201st Ave
Gresham, OR 97030
Generator's Phone:

Generator's Site Address (if different than mailing address)

6. Transporter 1 Company Name: Advanced Chemical Transport, Inc. (OR) — U.S. EPA ID Number: CAR000070540

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address
Waste Management (Hillsboro)
3205 SE Minter Bridge Rd.
Hillsboro, OR 97123
Facility's Phone: 503-640-9427
U.S. EPA ID Number: NON HAZ

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	
1.	NON HAZARDOUS (LIQUID WITH SOLIDS)	001	TT	2500	G	
2.						
3.						
4.						

13. Special Handling Instructions and Additional Information
Project Number 190935 Document # D228912
1) 129446OR CAW-_____

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: PAT YATON C/O Cascade — Signature: Patrick E Yaton — Month: 1 — Day: 22 — Year: 19

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter Signature (for exports only): Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Scott Abbs — Signature: [signature] — Month: 1 — Day: 22 — Year: 19

Transporter 2 Printed/Typed Name — Signature — Month — Day — Year

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator) — U.S. EPA ID Number
Facility's Phone:

17c. Signature of Alternate Facility (or Generator) — Month — Day — Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: Matthew Larson — Signature: Matthew Larson — Month: 1 — Day: 22 — Year: 19

GC Labels • Printed in the USA
1-800-997-6966

DESIGNATED FACILITY TO GENERATOR

Reorder Part# MANIFEST-CONHWC

Please print or type
(Form designed for use on elite (12-pitch) typewriter.)

NON-HAZARDOUS WASTE MANIFEST	1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Waste Tracking Number
	CESQG	1	888-785-7225	190935/228911

GENERATOR

5. Generator's Name and Mailing Address

Cascade Corporation
2525 NE 201st Ave
Gresham, OR 97030
Generator's Phone:

Generator's Site Address (if different than mailing address)

6. Transporter 1 Company Name — U.S. EPA ID Number

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address — U.S. EPA ID Number

Waste Management (Hillsboro)
3205 SE Minter Bridge Rd.
Hillsboro, OR 97123
Facility's Phone: 503-640-9427

NON HAZ

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.
1.	NON HAZARDOUS (SOLID)	1	CM	1000	P
2.					
3.					
4.					

13. Special Handling Instructions and Additional Information

Project Number 190935 Document# D228911

1) 129445OR CAW 20 YD

DB1614

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: c/o Cascade PAT YANDEN — Signature — Month — Year

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:

Transporter Signature (for exports only): Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Ken Campbell — Signature: Ken Campbell — Month: 1 Day: 22 Year: 19

Transporter 2 Printed/Typed Name — Signature — Month — Day — Year

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

17c. Signature of Alternate Facility (or Generator) — Month — Day — Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: Jon Thime — Signature — Month: 1 Day: 24 Year: 19

QC Labels • Printed in the USA
1-800-997-6966

DESIGNATED FACILITY TO GENERATOR

Reorder Part# MANIFEST-CENHWC
913-097-6966

Please print or type
(Form designed for use on elite (12-pitch) typewriter.)

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Waste Tracking Number
CESQG	1	888-785-7225	190935/228913

GENERATOR

5. Generator's Name and Mailing Address

Cascade Corporation
2525 NE 201st Ave
Gresham, OR 97030

Generator's Phone:

Generator's Site Address (if different than mailing address)

6. Transporter 1 Company Name: Advanced Chemical Transport, Inc. (OR) — U.S. EPA ID Number: CAR000070540

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address

Waste Manaqment (Hillsboro)
3205 SE Minter Bridge Rd.
Hillsboro, OR 97123

Facility's Phone: ~~503-640-9127~~

U.S. EPA ID Number: NON HAZ

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	
1.	NON HAZARDOUS (SOLID/LIQUID)	1	CM	6000	P	
2.						
3.						
4.						

13. Special Handling Instructions and Additional Information

Project Number 190935 Document #: D228913

1) ~~129445~~OR CAW
129446 OR

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable ~~international~~ and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: PAT YADON c/o Cascade — Signature: Patrick E Yadon — Month 1 Day 22 Year 19

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:

Transporter Signature (for exports only): Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Ken Campbell — Signature: Ken Campbell — Month 1 Day 22 Year 19

Transporter 2 Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

17c. Signature of Alternate Facility (or Generator) — Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: Matthew Larson — Signature: Matthew Larson — Month 1 Day 28 Year 19

GC Labels • Printed in the USA
1-800-997-6966

DESIGNATED FACILITY TO GENERATOR

Reorder Part# MANIFEST-C6NHWC
913-897-6966

Please print or type
(Form designed for use on elite (12-pitch) typewriter.)

NON-HAZARDOUS WASTE MANIFEST	1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Waste Tracking Number
	CESQG	1	888-785-7225	190935/228729

GENERATOR

5. Generator's Name and Mailing Address

Cascade Corporation
2525 NE 201st Ave
Gresham, OR 97030

Generator's Phone:

Generator's Site Address (if different than mailing address)

6. Transporter 1 Company Name: Advanced Chemical Transport, Inc. (OR) — U.S. EPA ID Number: CAR000070540

7. Transporter 2 Company Name — U.S. EPA ID Number

8. Designated Facility Name and Site Address

Waste Management (Hillsboro)
3205 SE Minter Bridge Rd.
Hillsboro, OR 97123

Facility's Phone: 503-640-9427

U.S. EPA ID Number: NON HAZ

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	
1.	NON HAZARDOUS (SOLID)	1	CM	10 000	P	
2.						
3.						
4.						

13. Special Handling Instructions and Additional Information

Project Number 190935 Document #: D228729

1) 129448OR CAW-1 - CM

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: PATRICK YAPOM — Signature: Patrick Yapom — Month 1 Day 21 Year 19

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:

Transporter Signature (for exports only): Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Ken Campbell — Signature: Ken Campbell — Month 1 Day 21 Year 19

Transporter 2 Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

17. Discrepancy

17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator) — U.S. EPA ID Number

Facility's Phone:

17c. Signature of Alternate Facility (or Generator) — Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: Anthime — Signature: Anthime — Month 1 Day 21 Year 19

DESIGNATED FACILITY TO GENERATOR

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Waste Tracking Number
NON-RCRA GEN	1	(800)424-9300	18101689[illegible]CWM

5. Generator's Name and Mailing Address
CASCADE CORPORATION
2525NE 201ST AVENUE
FAIRVIEW OR 97024-0000

Generator's Site Address (if different than mailing address)

Generator's Phone: (800)227-2233

6. Transporter 1 Company Name: **ADVANCED CHEMICAL TRASPORT, INC.**
U.S. EPA ID Number: CAR000070540

7. Transporter 2 Company Name
U.S. EPA ID Number

8. Designated Facility Name and Site Address
WM/HILLSBORO LANDFILL INC.
3205 SE MINTER BRIDGE ROAD
HILLSBORO OR 97123
U.S. EPA ID Number: NON-RCRA TSD

Facility's Phone: (503)640-9427

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.
	1. **MATERIAL NOT REGULATED BY D.O.T. (DRILLING SOIL)** 128795OR	1	CM	20	Y
	2.				
	3.				
	4.				

13. Special Handling Instructions and Additional Information

1. 128795OR - LF01 - NON-HAZARDOUS SOIL

E/R PROVIDER: CHEMTREC (1-800 424-9300) CONTRACT NUMBER 24117

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: [signature] | Signature: [signature] for [illegible] | Month/Day/Year: 10/16/18

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter Signature (for exports only): Date leaving U.S.:

16. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: Robert Hurd | Signature: [signature] | Month/Day/Year: 10/16/18
Transporter 2 Printed/Typed Name: | Signature: | Month Day Year

17. Discrepancy
17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection
Manifest Reference Number:

17b. Alternate Facility (or Generator) | U.S. EPA ID Number: N/O 10/16
Facility's Phone:

17c. Signature of Alternate Facility (or Generator) | Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a
Printed/Typed Name: Jen Prime | Signature: Jen Prime | Month/Day/Year: 10/16/18

WASTE MANAGEMENT

Hillsboro Landfill, Inc
3205 SE Minter Bridge
Hillsboro, OR, 97123
Ph: (503)-640-9427

Original
Ticket# 1503101

Customer Name CASCADE DRILLING LP CASCADE D
Ticket Date 10/16/2018
Payment Type Credit Account
Manual Ticket#
Hauling Ticket#
Route
State Waste Code
Manifest 181016999CWM
Destination
PO 838737
Profile 128795OR (LF01 - Non-Hazardous Waste Solid)
Generator OR-CASCADE CORP CASCADE CORPORATION 2201 NE 201ST AVE FAIRVIEW OR 97204

Carrier ACT
Vehicle# T-113
Container
Driver KEITH
Check#
Billing # 0003446
Gen EPA ID N/A
Grid

Volume

	Time	Scale	Operator	Inbound		
In	10/16/2018 12:15:59	Outbound	mlarson2		Gross	41540 lb
Out	10/16/2018 13:06:29	Outbound	BLAKE1		Tare	28680 lb
					Net	12860 lb
					Tons	6.43

Comments

Consumer Comments? We want to know. Please call.

	Product	LD%	Qty	UOM	Rate	Tax	Amount	Origin
1	ENVCLEANUP SPWPCS-	100	6.43	Tons				MULT-IN
2	LINER FEE-LINER FE	100	1	Each				MULT-IN
3	RENTAL DAY/BOX EA-	100	1	Each				MULT-IN
4	13% FEA-13% FEA FE	100		%				MULT-IN

Driver's Signature

403WM

APPENDIX C

SVE Data

Table C-1
Soil Vapor Extraction 1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County Oregon

Well ID	Date	Time (hrs)	Temperature (degrees F)	Flow Rate (scfm)	PID Measurement (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet Well						
SVE System Outlet	01/02/18	15:40	100	441.3	0.6	3.51
SVE System Outlet	01/09/18	12:00	128	434.6	0.6	3.51
SVE System Outlet	01/15/18	13:20	118	415.1	0.6	3.51
SVE System Outlet	01/23/18	12:50	100.2	431.6	0.6	3.51
SVE System Outlet	01/30/18	14:50	90	438.6	0.7	4.09
SVE System Outlet	02/06/18	13:20	100	433.1	0.6	3.51
SVE System Outlet	02/13/18	14:15	100	460.8	0.6	3.51
SVE System Outlet	02/20/18	16:10	90	439.4	0.6	3.51
SVE System Outlet	02/27/18	14:45	90	442.6	0.6	3.51
SVE System Outlet	03/06/18	12:00	100	436.1	0.6	3.51
SVE System Outlet	03/13/18	8:40	100	440.3	0.6	3.51
SVE System Outlet	03/20/18	9:15	95	408.1	0.6	3.51
SVE System Outlet	03/27/18	12:50	90	435.5	0.6	3.51
SVE System Outlet	04/03/18	12:00	95	445.6	0.6	3.51
SVE System Outlet	04/10/18	13:50	95	442.4	0.6	3.51
SVE System Outlet	04/16/18	11:50	95	436.8	0.6	3.51
SVE System Outlet	04/24/18	13:00	115	428.9	0.7	4.09
SVE System Outlet	05/01/18	8:00	100	430.6	0.6	3.51
SVE System Outlet	05/09/18	12:50	120	436.3	0.5	2.92
SVE System Outlet	05/15/18	7:30	95	428.6	0.4	2.34
SVE System Outlet	05/22/18	14:00	120	429.8	0.5	2.92
SVE System Outlet	05/28/18	15:20	110	431.6	0.5	2.92
SVE System Outlet	06/04/18	15:00	110	444.6	0.6	3.51
SVE System Outlet	06/12/18	13:00	120	458.1	0.6	3.51
SVE System Outlet	06/19/18	14:00	125	434.2	0.6	3.51
SVE System Outlet	06/26/18	9:40	110	436.8	0.7	4.09
SVE System Outlet	07/02/18	18:00	125	441.2	0.7	4.09
SVE System Outlet	07/10/18	9:30	100	454.1	0.7	4.09
SVE System Outlet	07/16/18	14:00	135	458.9	0.7	4.09
SVE System Outlet	07/22/18	11:00	115	432.6	0.7	4.09
SVE System Outlet	07/30/18	13:40	125	460.3	0.7	4.09
SVE System Outlet	08/07/18	7:00	110	440.1	0.6	3.51
SVE System Outlet	08/14/18	7:00	130	464.7	0.6	3.51
SVE System Outlet	08/20/18	9:00	100	460.6	0.7	4.09
SVE System Outlet	08/28/18	13:55	130	471.6	0.6	3.51
SVE System Outlet	09/03/18	10:00	100	451.6	0.6	3.51
SVE System Outlet	09/10/18	10:00	100	451.6	0.5	2.92
SVE System Outlet	09/17/18	14:00	110	461.6	0.7	4.09
SVE System Outlet	09/25/18	8:00	52	450.6	0.6	3.51
SVE System Outlet	10/02/18	9:48	100	454.6	0.6	3.51

Table C-1
Soil Vapor Extraction 1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County Oregon

Well ID	Date	Time (hrs)	Temperature (degrees F)	Flow Rate (scfm)	PID Measurement (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet Well						
SVE System Outlet	10/09/18	10:30	110	460.1	0.6	3.51
SVE System Outlet	10/16/18	8:45	110	458.9	0.6	3.51
SVE System Outlet	10/22/18	10:30	100	469.6	0.6	3.51
SVE System Outlet	10/30/18	13:00	100	461.6	0.5	2.92
SVE System Outlet	11/06/18	12:55	100	484.6	0.5	2.92
SVE System Outlet	11/13/18	8:40	90	454.6	0.5	2.92
SVE System Outlet	11/20/18	12:25	95	456.4	0.5	2.92
SVE System Outlet	11/27/18	11:00	95	461.4	0.5	2.92
SVE System Outlet	12/04/18	13:18	95	441.1	0.6	3.51
SVE System Outlet	12/12/18	13:00	90	458.2	0.4	2.34
SVE System Outlet	12/18/18	15:00	100	477.3		
SVE System Outlet	12/24/18	13:20	90	456.9		
SVE System Outlet	12/30/18	15:42	95	438.6		

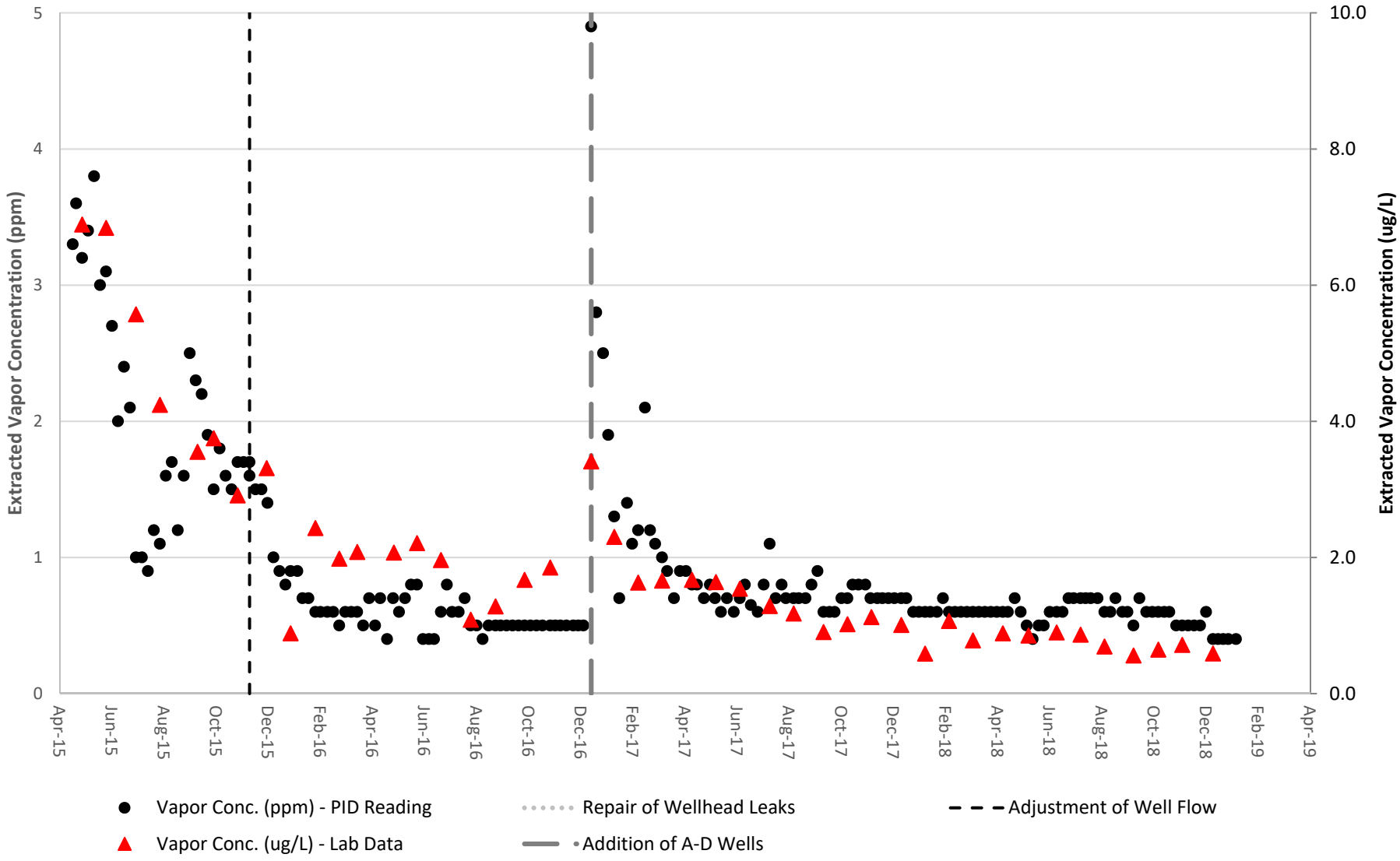
Notes:

ID = identification
hrs = hours
F = Fahrenheit
scfm = standard cubic feet per minute
ppm = parts per million
µg/L = micrograms per Liter
VOC = volatile organic compounds
Bold text indicates sampling dates for data shown on Table C-2
Calculated VOC concentrations are based on PID readings

Table C-2
Soil Vapor Extraction - Laboratory VOC Results
TSA Remedy - East Multnomah County Oregon

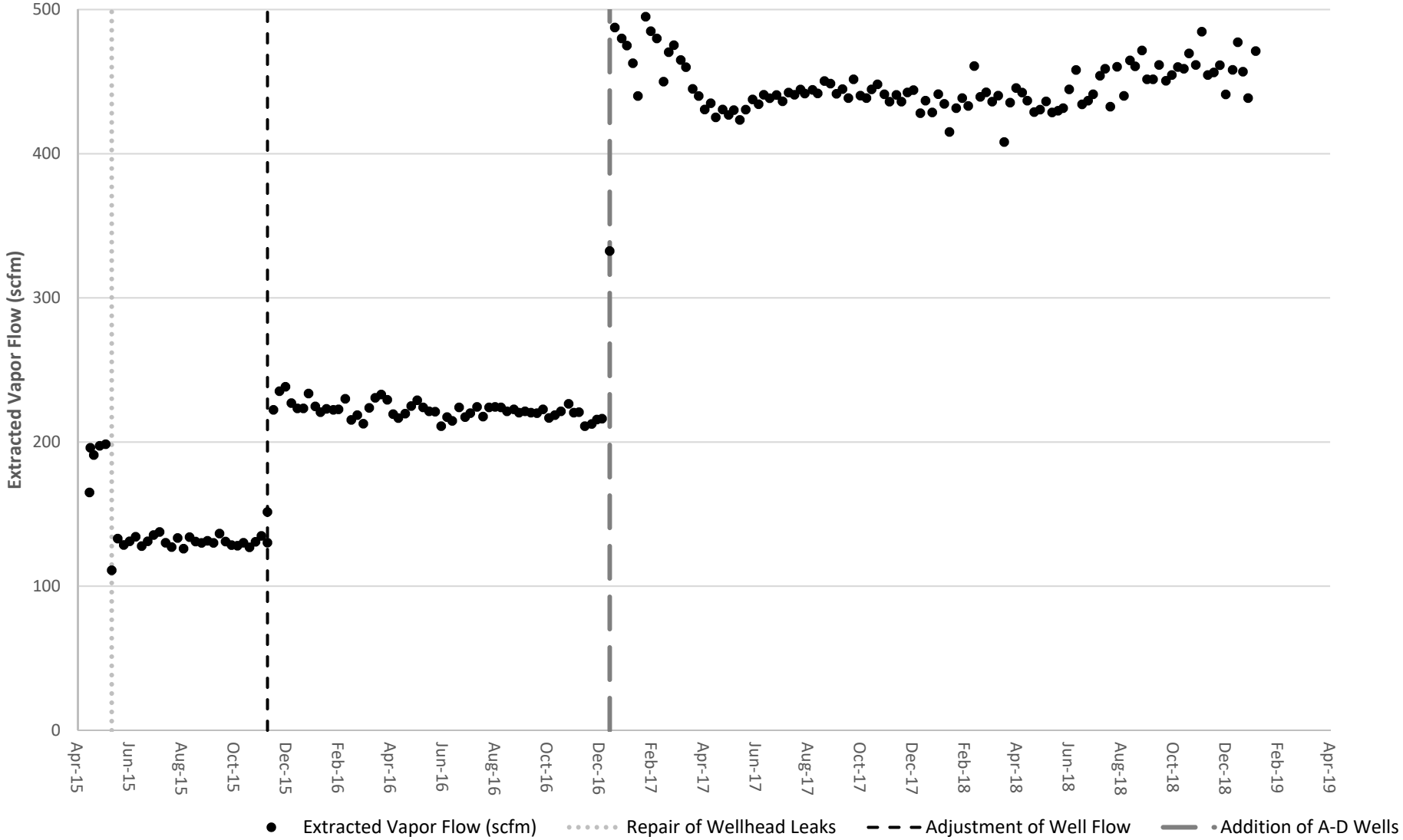
Well ID	Date	cis-1,2-dichloroethene ($\mu g/m^3$)	Trichloro-ethene ($\mu g/m3$)	Tetrachloro-ethene ($\mu g/m3$)	Total VOCs ($\mu g/m3$)	Flow Rate (scfm)
System Outlet	01/09/18	38	490	58	586	434.6
	02/06/18	54	940	71	1065	433.1
	03/06/18	49	680	52	781	436.1
	04/10/18	52	770	62	884	442.4
	05/09/18	55	740	57	852	436.3
	06/12/18	51	790	57	898	458.1
	07/10/18	64	750	51	865	454.1
	08/07/18	43	610	38	691	440.1
	09/10/18	44	480	35	559	451.6
	10/09/18	41	570	33	644	460.1
	11/06/18	61	610	43	714	484.6
	12/12/18	39	510	40	589	458.2
Well VW17D-95.5	02/06/18	50	360	23	433	98.3
	05/09/18	45	360	18	423	99.1
	08/07/18	<2.1	5.6	<2.1	5.6	99.3
	11/06/18	<2.1	<2.1	<2.1	0	98.9
Well VMW-A	02/06/18	<1.9	<1.9	<1.9	0	123.1
	05/09/18	<2.1	<2.1	<2.1	0	123.1
	08/07/18	<2.2	<2.2	<2.2	0	122.9
	11/06/18	<2.2	<2.2	<2.2	0	123.1
Well VMW-B	02/06/18	<1.9	<1.9	<1.9	0	122.8
	05/09/18	<2.2	<2.2	<2.2	0	121.6
	08/07/18	<2.2	<2.2	<2.2	0	123
	11/06/18	<2.1	<2.1	<2.1	0	122.6
Well VMW-C	02/06/18	110	2,100	160	2,370	124.6
	05/09/18	96	2,000	110	2,206	122.4
	08/07/18	35	560	33	628	122.8
	11/06/18	120	1,200	91	1,411	122.4
Well VMW-D	02/06/18	<2.0	2.1	2.2	4.3	124.1
	05/09/18	<2.1	<2.1	<2.1	0	122.5
	08/07/18	<2.3	<2.3	<2.3	0	122.9
	11/06/18	<2.0	<2.0	<2.0	0	122.3

Notes:
ID = identification
scfm = standard cubic feet per minute
$\mu g/m^3$ = micrograms per cubic meter
VOC = volatile organic compounds
Total VOCs are the calculated sum of the three VOCs shown



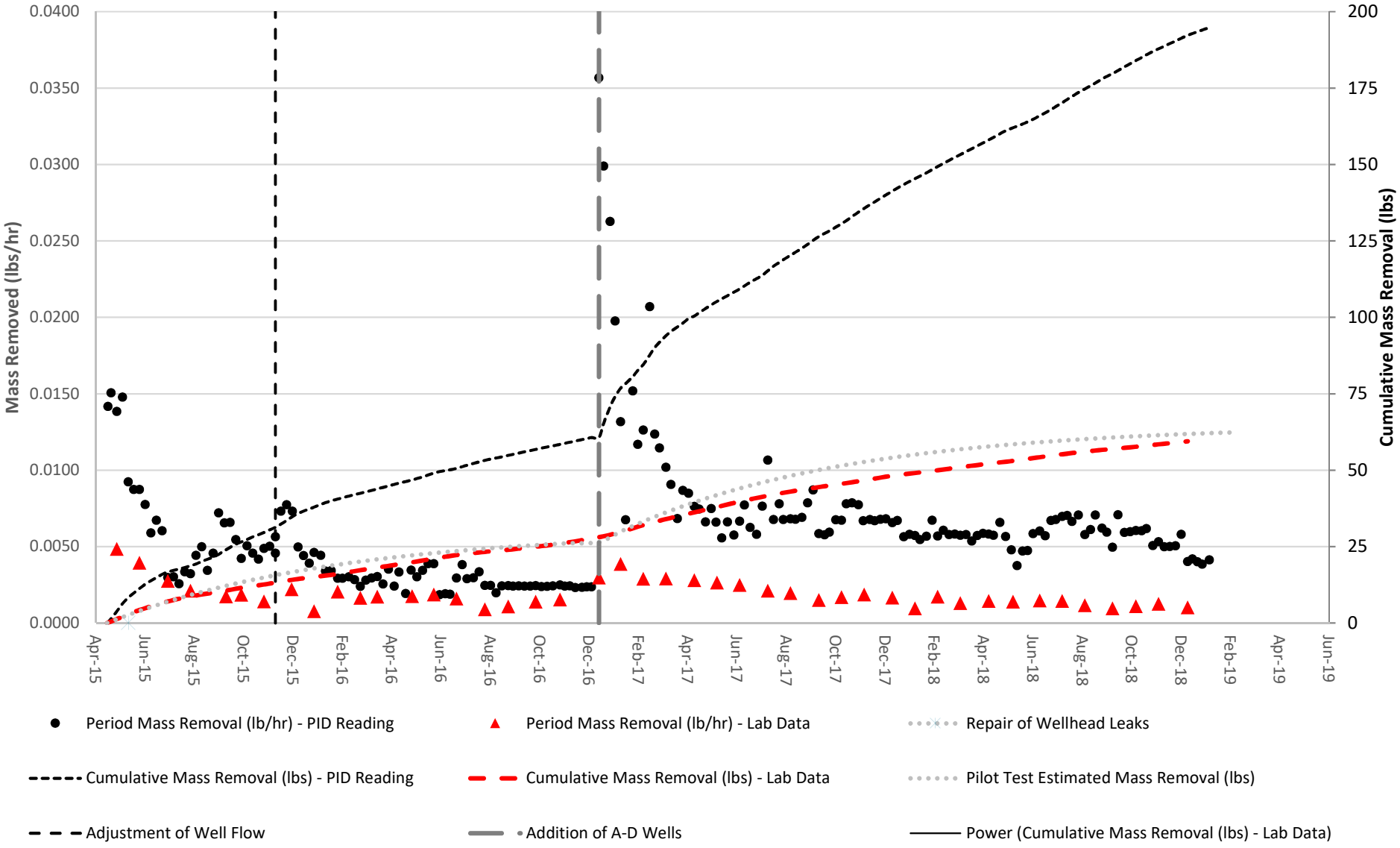
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**SVE Effluent cVOC Vapor Concentration** **TSA Remedy**	Figure C-1



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**SVE Extracted Vapor Flow (Weekly Average)** **TSA Remedy**	Figure C-2



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**SVE System Mass Removal** **TSA Remedy**	Figure C-3

APPENDIX D

Groundwater Elevation Data

Table D-1
Groundwater Elevations - 1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Extraction Wells						
Lower	EW-1	2/7/2018	12:35	124.04	135.81	-11.77
Lower	EW-1	5/1/2018	9:05	124.04	155.9	-31.86
Lower	EW-1	8/7/2018	12:20	124.04	156.81	-32.77
Lower	EW-1	11/1/2018	7:54	124.04	117.19	6.85
Lower	EW-14	2/7/2018	12:55	127.63	133.4	-5.77
Lower	EW-14	5/1/2018	9:25	127.63	154.98	-27.35
Lower	EW-14	8/7/2018	12:30	127.63	152.8	-25.17
Lower	EW-14	11/1/2018	7:30	127.63	165.72	-38.09
Lower	EW-16	2/7/2018	11:25	83.71	63.28	20.43
Lower	EW-16	5/1/2018	12:55	83.71	62.68	21.03
Lower	EW-16	8/7/2018	10:05	83.71	65.35	18.36
Lower	EW-16	11/1/2018	7:10	83.71	67.37	16.34
Lower	EW-2	2/7/2018	12:45	126.01	128.38	-2.37
Lower	EW-2	5/1/218	9:15	126.01	157.79	-31.78
Lower	EW-2	8/7/2018	12:25	126.01	155.31	-29.3
Lower	EW-2	11/1/2018	7:40	126.01	151.61	-25.6
Lower	EW-23	2/7/2018	13:05	83.93	82.49	1.44
Lower	EW-23	8/7/2018	12:35	83.93	90.14	-6.21
Lower	EW-23	11/1/2018	17:30	83.93	95.96	-12.03
Monitoring Wells						
Upper	BOP-13ds	2/5/2018	11:39	128.94	115.92	13.02
Upper	BOP-13ds	5/4/2018	15:12	128.94	117.27	11.67
Upper	BOP-20ds	8/6/2018	11:32	77.45	72.67	4.78
Upper	BOP-21ds	8/6/2018	12:40	78.02	74.97	3.05
Upper	BOP-22Rds	8/6/2018	9:20	82.91	81.02	1.89
Upper	BOP-31ds	2/5/2018	12:27	99.04	85	14.04
Upper	BOP-31ds	5/4/2018	14:20	99.04	85.03	14.01
Upper	BOP-31ds	8/6/2018	15:25	99.04	89.2	9.84
Upper	BOP-42ds	8/6/2018	12:31	130.74	121.8	8.94
Upper	BOP-44ds	7/20/2018	--	35.24	25.44	9.8
Upper	BOP-61ds	2/5/2018	14:15	94.64	83.64	11
Upper	BOP-61ds	8/6/2018	17:58	94.64	90.2	4.44
Upper	BOP-62ds	8/6/2018	17:40	112.29	112.05	0.24
Upper	BOP-65ds	8/6/2018	16:25	104.22	99.01	5.21
Upper	BOP-66ds	2/5/2018	13:04	102.97	89.27	13.7
Upper	BOP-66ds	8/6/2018	15:45	102.97	95.57	7.4
Upper	CMW-10ds	2/7/2018	9:20	134.54	120.2	14.34
Upper	CMW-10ds	5/1/2018	13:25	134.54	120.24	14.3
Upper	CMW-10ds	8/7/2018	8:50	134.54	120.19	14.35
Upper	CMW-10ds	11/1/2018	9:00	134.54	122.6	11.94
Upper	CMW-17ds	2/7/2018	12:20	121.89	99.98	21.91
Upper	CMW-17ds	5/1/2018	9:45	121.89	100.12	21.77
Upper	CMW-17ds	8/7/2018	12:15	121.89	100.21	21.68
Upper	CMW-17ds	11/1/2018	8:15	121.89	101.69	20.2
Upper	CMW-18ds	2/7/2018	10:45	117.66	100.21	17.45
Upper	CMW-18ds	5/1/2018	12:20	117.66	100.58	17.08
Upper	CMW-18ds	8/7/2018	9:10	117.66	100.49	17.17

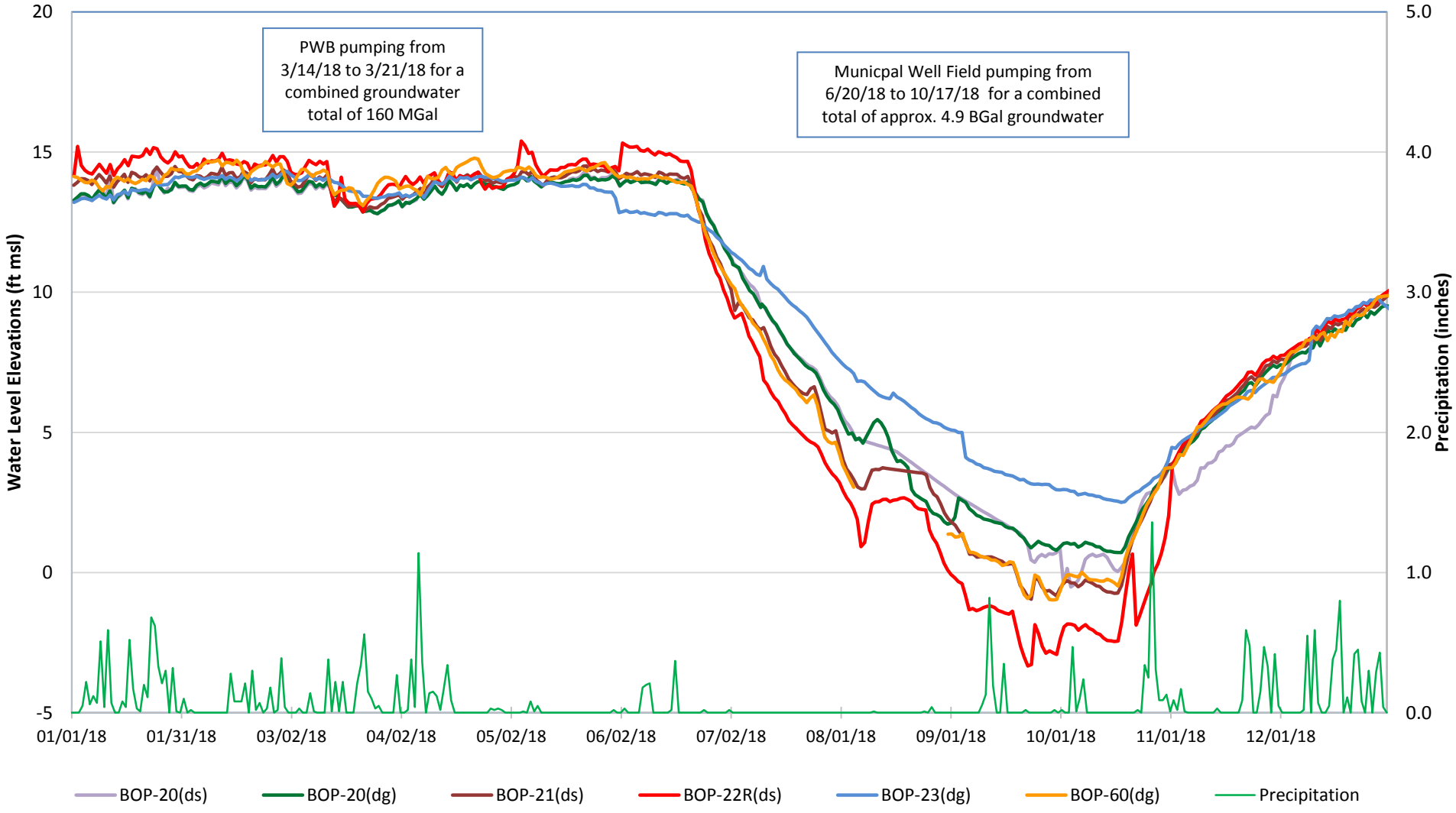
Table D-1
Groundwater Elevations - 1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Upper	CMW-18ds	11/1/2018	8:24	117.66	102.41	15.25
Upper	CMW-19ds	2/7/2018	8:50	144.08	127.77	16.31
Upper	CMW-19ds	5/1/2018	14:20	144.08	127.23	16.85
Upper	CMW-19ds	8/7/2018	8:35	144.08	127.93	16.15
Upper	CMW-19ds	11/1/2018	8:40	144.08	130.24	13.84
Upper	CMW-20ds	2/7/2018	10:10	152.72	137.33	15.39
Upper	CMW-20ds	8/7/2018	7:30	152.72	137.58	15.14
Upper	DEQ-5ds	2/7/2018	10:25	155.68	140.51	15.17
Upper	EW-3	8/7/2018	9:50	94.26	93.35	0.91
Upper	PMX-167	2/7/2018	11:12	44.84	32.48	12.36
Upper	PWB-1uts	9/20/2018	13:51	15.98	9.22	6.76
Upper	PWB-1uts	11/2/2018	8:50	15.98	8.84	7.14
Upper and Lower	CMW-3	2/7/2018	8:30	147.69	129.49	18.2
Upper and Lower	CMW-3	8/7/2018	--	147.69	130.14	17.55
Lower	BOP-13dg	8/6/2018	12:48	128.71	121	7.71
Lower	BOP-20dg	2/5/2018	15:23	77.32	63.42	13.9
Lower	BOP-23dg	8/6/2018	13:24	76.96	70.14	6.82
Lower	BOP-31dg	2/5/2018	13:51	98.51	84.4	14.11
Lower	BOP-31dg	8/6/2018	10:50	98.51	89.07	9.44
Lower	BOP-42dg	8/6/2018	12:21	130.71	123.33	7.38
Lower	BOP-44dg	7/20/2018	--	35.15	25.87	9.28
Lower	BOP-60dg	8/6/2018	8:17	93.59	90.74	2.85
Lower	BOP-61dg	2/5/2018	14:41	94.43	82.5	11.93
Lower	BOP-61dg	8/6/2018	11:24	94.43	89.63	4.8
Lower	CMW-10dg	2/7/2018	9:30	135.05	121.74	13.31
Lower	CMW-10dg	8/7/2018	8:45	135.05	125.35	9.7
Lower	CMW-14Rds	2/7/2018	11:00	83.48	59.81	23.67
Lower	CMW-14Rds	8/7/2018	9:30	83.48	60.34	23.14
Lower	CMW-22dg	2/7/2018	11:10	81.65	62.53	19.12
Lower	CMW-22dg	8/7/2018	--	81.65	65.19	16.46
Lower	CMW-24dg (EW-5)	2/8/2018	9:45	77.74	59.77	17.97
Lower	CMW-24dg (EW-5)	8/7/2018	10:40	77.74	64.18	13.56
Lower	CMW-25dg	2/7/2018	15:05	75.28	59.83	15.45
Lower	CMW-25dg	8/7/2018	9:45	75.28	63.81	11.47
Lower	CMW-26dg	2/7/2018	11:55	108.98	92.71	16.27
Lower	CMW-26dg	5/1/2018	14:00	108.98	92.35	16.63
Lower	CMW-26dg	8/7/2018	11:05	108.98	94.41	14.57
Lower	CMW-8dg	2/7/2018	9:45	136.21	123.79	12.42
Lower	CMW-8dg	8/7/2018	--	136.21	127.21	9
Lower	D-17dg	2/7/2018	13:35	124.61	111.31	13.3
Lower	D-17dg	8/7/2018	11:30	124.61	114.39	10.22
Lower	D-17ds	2/7/2018	13:50	123.28	110.23	13.05
Lower	D-17ds	5/1/2018	12:00	123.28	110.98	12.3
Lower	D-17ds	8/7/2018	11:35	123.28	111.91	11.37
Lower	D-17ds	11/1/2018	9:45	123.28	114.88	8.4
Lower	DEQ-1dg	2/7/2018	10:55	150.58	136.81	13.77
Lower	DEQ-5dg	2/7/2018	10:20	155.95	140.88	15.07
Lower	EW-11	8/7/2018	--	114.73	55.18	59.55

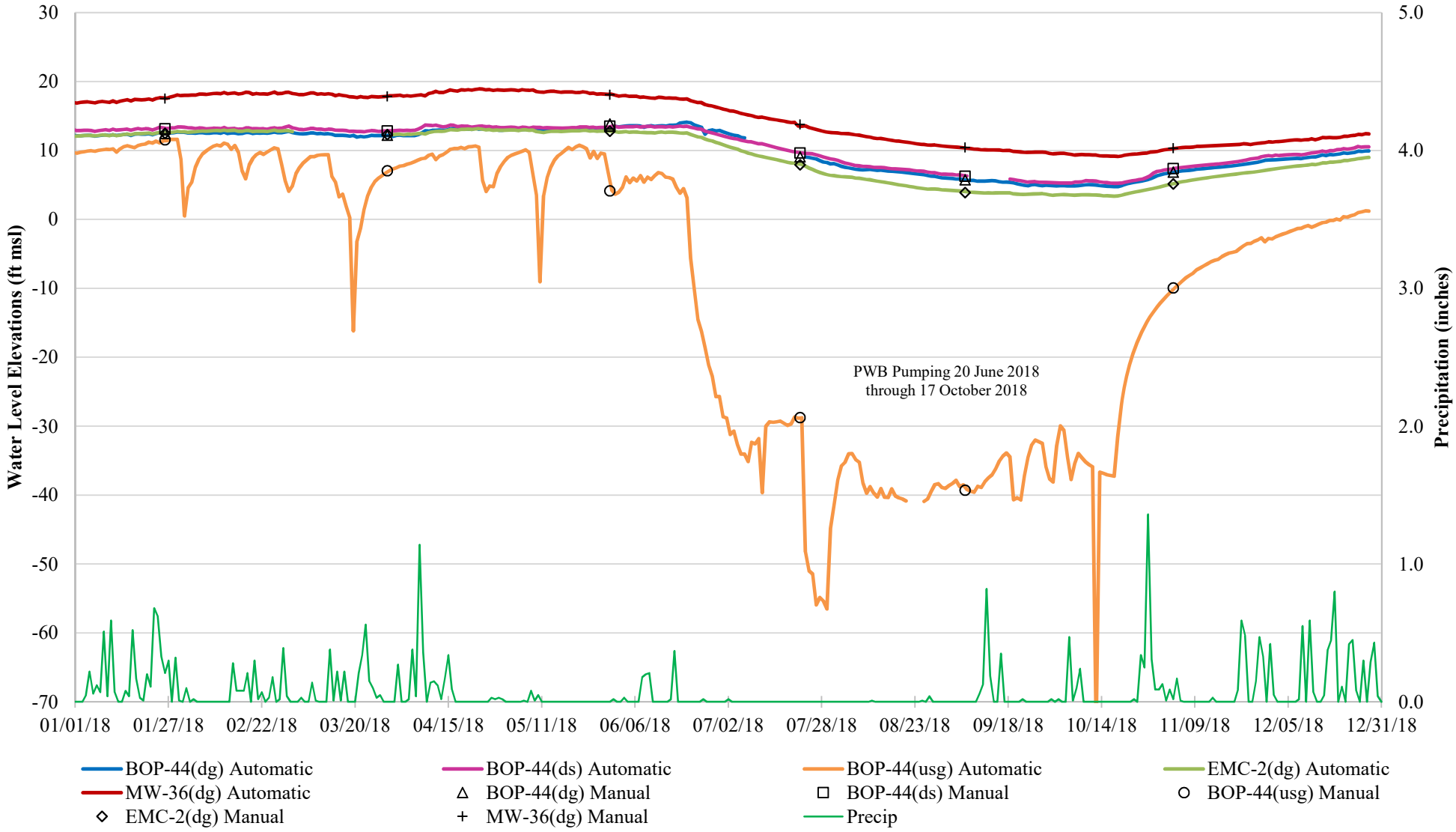
Table D-1
Groundwater Elevations - 1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Lower	EW-12	2/7/2018	14:35	94.14	80.2	13.94
Lower	EW-12	5/1/2018	11:30	94.14	80.31	13.83
Lower	EW-12	8/7/2018	11:25	94.14	83.98	10.16
Lower	EW-13	8/7/2018	10:20	103.59	95.13	8.46
Lower	EW-15	8/7/2018	--	116.21	52.73	63.48
Lower	EW-8	2/8/2018	10:30	77.16	62.41	14.75
Lower	EW-8	8/7/2018	12:00	77.16	66.98	10.18
Lower	PWB-2lts	2/7/2018	11:16	44.32	31.88	12.44
Vapor Monitoring Wells						
Upper	VMW-A	2/8/2018	10:55	123.34	100.89	22.45
Upper	VMW-A	5/1/2018	10:15	123.34	100.92	22.42
Upper	VMW-A	8/7/2018	7:45	123.34	100.83	22.51
Upper	VMW-A	11/1/2018	13:45	123.34	101.94	21.4
Upper	VMW-B	2/8/2018	10:15	123.25	97.8	25.45
Upper	VMW-B	5/1/2018	10:50	123.25	98.37	24.88
Upper	VMW-B	8/7/2018	7:55	123.25	98.43	24.82
Upper	VMW-B	11/1/2018	15:15	123.25	98.55	24.7
Upper	VMW-C	2/8/2018	11:15	124.17	100	24.17
Upper	VMW-C	5/1/2018	10:35	124.17	99.51	24.66
Upper	VMW-C	8/7/2018	8:05	124.17	99.58	24.59
Upper	VMW-C	11/1/2018	14:35	124.17	100.54	23.63
Upper	VMW-D	2/8/2018	10:35	122.67	98.84	23.83
Upper	VMW-D	5/1/2018	11:10	122.67	99.05	23.62
Upper	VMW-D	8/7/2018	8:15	122.67	99.1	23.57
Upper	VMW-D	11/1/218	16:00	122.67	98.61	24.06

Notes:
ft MSL = feet above mean sea level
TOC = top of casing
-- = data were not available

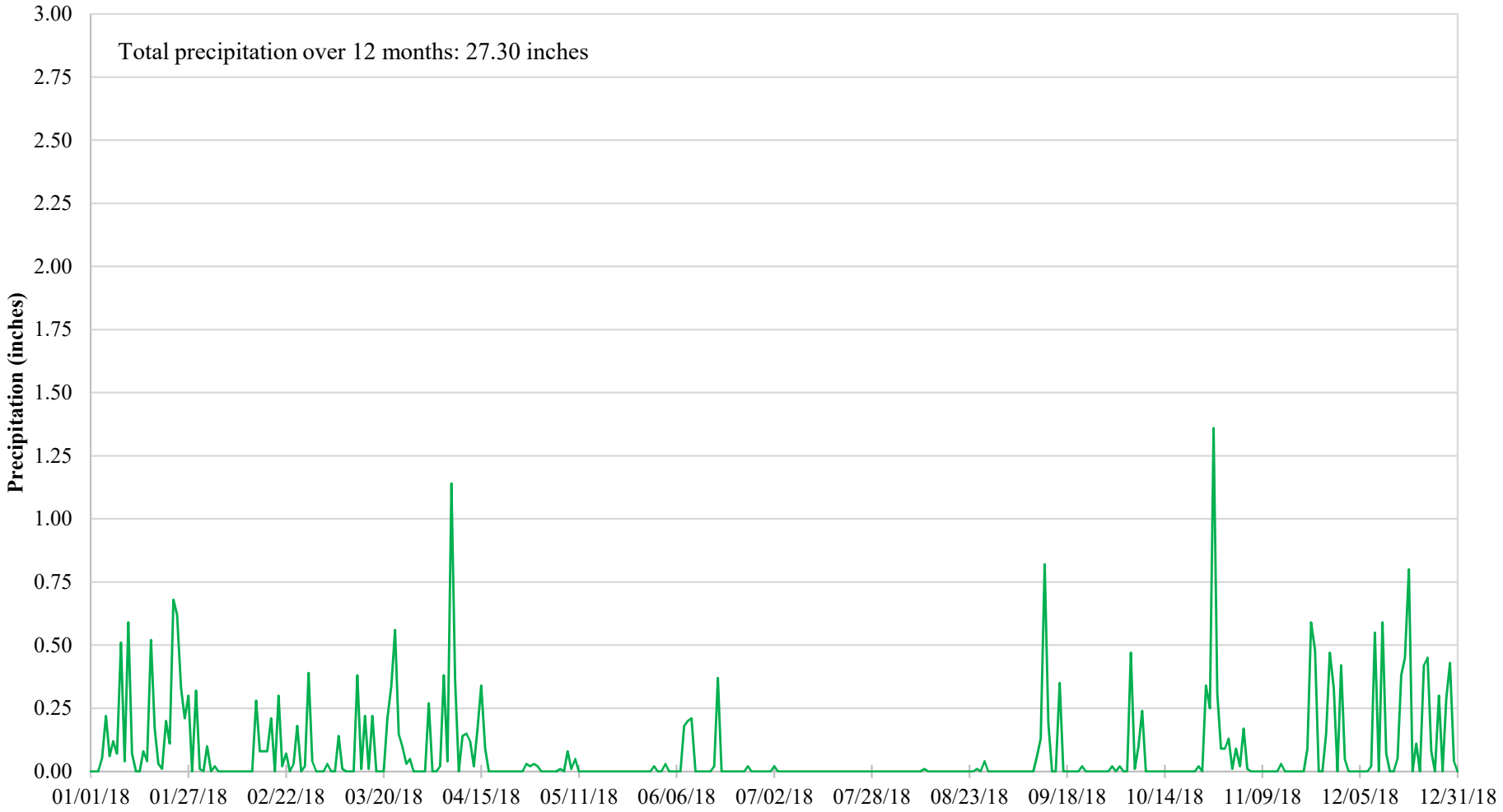


East Multnomah County Cleanup	**Hydrograph for TSA Wells January 2018 - December 2018**	Figure D-1



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Hydrograph for TSA Wells** **1 January 2018 to 31 December 2018**	Figure D-2



Note: Data from NOAA National Weather Service Preliminary Local Climatological Data (WS Form: F-6); Portland International Airport

Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Precipitation** **1 January 2018 - 31 December 2018**	Figure D-3

APPENDIX E

Groundwater Quality Data

Table E-1
Groundwater Analytical Results - (µg/L)
1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride
System Influent/Effluent								
Lower	TS-C-Inf	TS-C-INF-020818	2/7/2018	**6.51**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	TS-C-Inf	TS-C-INF-050118	5/1/2018	**5.95**	< 0.500	0.739	< 0.500	<0.500
Lower	TS-C-Inf	TS-C-INF-080818	8/8/2018	**5.56**	< 0.500	0.579	< 0.500	< 0.500
Lower	TS-C-Inf	TS-C-INF-110118	11/1/2018	**7.35**	0.508	0.843	< 0.500	< 0.500
Lower	TS-C-Eff	TS-C-EFF-020718	2/7/2018	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
Lower	TS-C-Eff	TS-C-EFF-020718-DUP	2/7/2018	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
Lower	TS-C-Eff	TS-C-EFF-050118	5/1/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	TS-C-Eff	TS-C-EFF-050118-DUP	5/1/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	TS-C-Eff	TS-C-EFF-080818	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	TS-C-Eff	TS-C-EFF-080818-DUP	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	TS-C-Eff	TS-C-EFF-110118	11/1/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	TS-C-Eff	TS-C-EFF-110118 DUP	11/1/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Extraction Wells								
Lower	EW-1	EW1-020718	2/7/2018	**3.93**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	EW-1	EW1-050118	5/1/2018	**3.32**	< 0.500	**0.744**	< 0.500	< 1.00
Lower	EW-1	EW1-080818	8/8/2018	**3.79**	< 0.500	**0.752**	<0.5.00	<0.5.00
Lower	EW-1	EW1-110118	11/1/2018	<0.500	<0.500	<0.500	<0.500	<0.500
Lower	EW-2	EW2-020718	2/7/2018	**19**	**1.09**	**1.69**	< 1.00	< 1.00
Lower	EW-2	EW2-050118	5/1/2018	**12.1**	**0.897**	**1.3**	< 0.500	< 0.500
Lower	EW-2	EW2-080818	8/8/2018	**12.1**	**0.832**	**1.32**	< 0.500	< 0.500
Lower	EW-2	EW2-110118	11/1/2018	**12.9**	**0.993**	**1.32**	< 0.500	< 0.500
Lower	EW-14	EW14-020718	2/7/2018	**7.89**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	EW-14	EW14-050118	5/1/2018	**6.88**	**0.526**	**0.828**	< 1.00	< 1.00
Lower	EW-14	EW14-080818	8/8/2018	**7.46**	< 0.500	**0.897**	< 0.500	< 0.500
Lower	EW-14	EW14-110118	11/1/2018	**9.64**	**0.537**	**1.14**	< 1.00	< 1.00
Lower	EW-16	EW16-020718	2/7/2018	<1.00	< 1.00	< 1.00	< 1.00	< 1.00
Lower	EW-16	EW16-050118	5/1/2018	<0.500	<0.500	<0.500	<0.500	<0.500
Lower	EW-16	EW16-080818	8/8/2018	<0.500	<0.500	<0.500	<0.500	<0.500
Lower	EW-16	EW16-110118	11/1/2018	**0.77**	<0.500	<0.500	<0.500	<0.500
Lower	EW-23	EW23-020718	2/7/2018	**2**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	EW-23	EW23-080818	8/8/2018	**1.93**	<0.500	<0.500	<0.500	<0.500

Table E-1
Groundwater Analytical Results - (µg/L)
1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride
Monitoring Wells								
Lower	BOP-13dg	BOP-13DG-0818	8/6/2018	**0.7**	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-20dg	BOP-20DG-0818	8/6/2018	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-20dg	BOP-20DG-0818	8/6/2018	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-23dg	BOP-23DG-0818	8/6/2018	**0.7**	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-31dg	BOP-31DG-0818	8/6/2018	**3.7**	**0.40**	**0.4**	< 0.20	< 0.20
Lower	BOP-42dg	BOP-42DG-0818	8/6/2018	**2.7**	< 0.20	**1.6**	< 0.20	< 0.20
Lower	BOP-60dg	BOP-60DG-0818	8/6/2018	**2.7**	< 0.20	**0.3**	< 0.20	< 0.20
Lower	BOP-61dg	BOP-61DG-0218	2/5/2018	**3.8**	< 0.20	**1.2**	< 0.20	< 0.20
Lower	BOP-61dg	BOP-61DG-0818	8/6/2018	**5.2**	< 0.20	**0.50**	< 0.20	< 0.20
Lower	CMW-10dg	CMW10DG-080818	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	CMW-14Rds	CMW14RDS-020718	2/7/2018	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
Lower	CMW-14Rds	CMW14RDS-080818	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	CMW-24dg (EW-5)	CMW24DG-020818-L	2/8/2018	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
Lower	CMW-24dg (EW-5)	CMW24DG-020818-U	2/8/2018	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
Lower	CMW-24dg (EW-5)	CMW24DG-080818-L	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	CMW-24dg (EW-5)	CMW24DG-080818-U	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	CMW-25dg	CMW25DG-020718	2/7/2018	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
Lower	CMW-25dg	CMW25DG-080818	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	CMW-26dg	CMW26DG-020718	2/7/2018	**3.7**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	CMW-26dg	CMW26DG-050118	5/1/2018	**3.24**	< 0.500	< 0.500	< 0.500	< 0.500
Lower	CMW-26dg	CMW26DG-080818	8/8/2018	**6.46**	< 0.500	< 0.500	< 0.500	< 0.500
Lower	CMW-36dg	MW-36DG-072018	7/20/2018	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
Lower	CMW-36dg	MW-36DG-82018	8/20/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	CMW-36dg	MW-36DG-110118	11/1/2018	**0.629**	< 0.500	< 0.500	< 0.500	< 0.500
Lower	D-17dg	D17DG-020718	2/7/2018	**1.48**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	D-17dg	D17DG-080818	8/8/2018	1.27	< 0.500	< 0.500	< 0.500	< 0.500
Lower	D-17dg	D17DG-080818	1/2/2019*	1.23	< 0.500	< 0.500	< 0.500	< 0.500
Lower	D-17ds	D17DS-020718	2/7/2018	**37.8**	**1.02**	**7.64**	< 1.00	< 1.00
Lower	D-17ds	D17DS-050118	5/1/2018	**42.1**	1.25	**10.1**	< 0.500	< 0.500
Lower	D-17ds	D17DS-080818	8/8/2018	**45.7**	**1.41**	**11.7**	< 0.500	< 0.500
Lower	D-17ds	D17DS-110118	11/1/2018	**54.1**	**1.52**	**12**	< 0.500	< 0.500
Lower	EW-8	EW8-020818-L	2/8/2018	**5.29**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	EW-8	EW8-020818-U	2/8/2018	**5.31**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	EW-8	EW8-080818-L	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	EW-8	EW8-080818-U	8/8/2018	**0.56**	< 0.500	< 0.500	< 0.500	< 0.500
Lower	EW-12	EW12-020718-L	2/7/2018	**2.49**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	EW-12	EW12-020718-U	2/7/2018	**2.44**	< 1.00	< 1.00	< 1.00	< 1.00
Lower	EW-12	EW12-050118-L	5/1/2018	**2.29**	< 0.500	< 0.500	< 0.500	< 0.500

Table E-1
Groundwater Analytical Results - (µg/L)
1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride
Lower	EW-12	EW12-050118-U	5/1/2018	**1.43**	< 0.500	< 0.500	< 0.500	< 0.500
Lower	EW-12	EW12-080818-L	8/8/2018	**2.24**	< 0.500	< 0.500	< 0.500	< 0.500
Lower	EW-12	EW12-080818-U	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Lower	EW-13	EW-13-0818	8/7/2018	**0.4**	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-13ds	BOP-13DS-0218	2/5/2018	**1.7**	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-13ds	BOP-Z-0218	2/5/2018	**1.8**	< 0.20	**0.2**	< 0.20	< 0.20
Upper	BOP-13ds	BOP-13DS-0518	5/4/2018	**2.2**	< 0.20	**0.30**	< 0.20	< 0.20
Upper	BOP-13ds	BOP-13DS-0818	8/7/2018	**3.2**	< 0.20	**0.5**	< 0.20	< 0.20
Upper	BOP-20ds	BOP-20DS-0818	8/6/2018	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-21ds	BOP-21DS-0818	8/6/2018	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-21ds	BOP-Y-0818	8/60/2018	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-22Rds	BOP-22RDS-0818	8/6/2018	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-31ds	BOP-31DS-0818	8/6/2018	**3.7**	**0.4**	**0.4**	< 0.20	< 0.20
Upper	BOP-42ds	BOP-42DS-0818	8/6/2018	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-61ds	BOP-61DS-0218	2/5/2018	**7**	**0.3**	**0.9**	< 0.20	< 0.20
Upper	BOP-61ds	BOP-61DS-0818	8/6/2018	**5.3**	**0.2**	**0.6**	< 0.20	< 0.20
Upper	BOP-62ds	BOP-62DS-0818	8/6/2018	**0.8**	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-65ds	BOP-65DS-0818	8/6/2018	**0.3**	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-66ds	BOP-66DS-0218	2/5/2018	**2.9**	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-66ds	BOP-66DS-0818	8/6/2018	**1.9**	< 0.20	< 0.20	< 0.20	< 0.20
Upper	CMW-10ds	CMW10DS-020718	2/7/2018	**16.9**	< 1.00	< 1.00	< 1.00	< 1.00
Upper	CMW-10ds	CMW10DS-050118	5/1/2018	**14.9**	0.713	< 0.500	< 0.500	< 0.500
Upper	CMW-10ds	CMW10DS-080818	8/8/2018	**14**	0.678	< 0.500	< 0.500	< 0.500
Upper	CMW-10ds	CMW10DS-110118	11/1/2018	**17.1**	**0.765**	< 0.500	< 0.500	< 0.500
Upper	CMW-17ds	CMW17DS-020718	2/7/2018	**14.9**	< 1.00	**2.17**	< 1.00	< 1.00
Upper	CMW-17ds	CMW17DS-020718-DUP	2/7/2018	**15.1**	< 1.00	**2.15**	< 1.00	< 1.00
Upper	CMW-17ds	CMW17DS-050118	5/1/2018	**15.1**	**0.791**	**2.36**	< 0.500	< 0.500
Upper	CMW-17ds	CMW17DS-080818	8/8/2018	**8.64**	**0.549**	**1.26**	< 0.500	< 0.500
Upper	CMW-17ds	CMW17DS-080818-DUP	8/8/2018	**8.89**	**0.556**	**1.32**	< 0.500	< 0.500
Upper	CMW-17ds	CMW17DS-110118	11/1/2018	**7.13**	< 0.500	**1.18**	< 0.500	< 0.500
Upper	CMW-18ds	CMW18DS-020718	2/7/2018	**58.7**	**1.36**	**7.39**	< 1.00	< 1.00
Upper	CMW-18ds	CMW18DS-050118	5/1/2018	**62.7**	**1.88**	**9.62**	< 0.500	< 0.500
Upper	CMW-18ds	CMW18DS-080818	8/8/2018	**75.2**	**3.71**	**9.9**	< 0.500	< 0.500
Upper	CMW-18ds	CMW18DS-080818-DUP	8/8/2018	**72.8**	**3.23**	**10.6**	< 0.500	< 0.500
Upper	CMW-18ds	CMW18DS-110118	11/1/2018	**98.6**	**3.98**	**14.9**	< 0.500	< 0.500
Upper	CMW-18ds	CMW18DS-110118-DUP	11/1/2018	**92.6**	**3.31**	**14.8**	< 0.500	< 0.500

Table E-1
Groundwater Analytical Results - (µg/L)
1 January 2018 through 31 December 2018
TSA Remedy - East Multnomah County

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride
Upper	CMW-19ds	CMW19DS-020718	2/7/2018	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
Upper	CMW-19ds	CMW19DS-050118	5/1/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Upper	CMW-19ds	CMW19DS-080818	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Upper	CMW-19ds	CMW19DS-110118	11/1/2018	**0.84**	< 0.500	< 0.500	< 0.500	< 0.500
Upper	CMW-20ds	CMW20DS-080818	8/8/2018	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500
Upper	EW-3	EW-3-0818	8/7/2018	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vapor Monitoring Wells								
Upper	VMW-A	VMWA-020818	2/8/2018	**15**	< 1.00	**1.45**	< 1.00	< 1.00
Upper	VMW-A	VMWA-050118	5/1/2018	**11.5**	0.637	**1.46**	< 0.500	< 0.500
Upper	VMW-A	VMWA-080818	8/8/2018	**8.03**	< 0.500	**0.988**	< 0.500	< 0.500
Upper	VMW-A	VMWA-110118	11/1/2018	**8.14**	< 0.500	**1.15**	< 0.500	< 0.500
Upper	VMW-B	VMWB-020818	2/8/2018	**26**	**1.24**	**3.47**	< 1.00	< 1.00
Upper	VMW-B	VMWB-050118	5/1/2018	**11.5**	**0.682**	**1.91**	< 0.500	< 0.500
Upper	VMW-B	VMWB-080818	8/8/2018	**20.2**	1.6	**3.04**	< 0.500	< 0.500
Upper	VMW-B	VMWB-110118	11/1/2018	**27.5**	1.34	**3.97**	< 0.500	< 0.500
Upper	VMW-C	VMWC-020818	2/8/2018	**31**	**1.11**	**2.37**	< 1.00	< 1.00
Upper	VMW-C	VMWC-050118	5/1/2018	**26.3**	**0.633**	**1.88**	< 0.500	< 0.500
Upper	VMW-C	VMWC-080818	8/8/2018	**20.3**	**0.799**	**1.34**	< 0.500	< 0.500
Upper	VMW-C	VMWC-110118	11/1/2018	**29.5**	**0.762**	**2.7**	< 0.500	< 0.500
Upper	VMW-D	VMWD-020818	2/8/2018	**18.8**	< 1.00	**2.25**	< 1.00	< 1.00
Upper	VMW-D	VMWD-050118	5/1/2018	**17.2**	**0.668**	**2.47**	< 0.500	< 0.500
Upper	VMW-D	VMWD-080818	8/8/2018	**15.4**	**0.769**	**2.01**	< 0.500	< 0.500
Upper	VMW-D	VMWD-110118	11/1/2018	**17.8**	**0.655**	**2.75**	< 0.500	< 0.500

Notes:

Results are presented in micrograms per liter (µg/L)

BOP = wells installed by and /or on Boeing Corporation Property

CMW = monitoring wells installed by and/or on Cascade Corporation property.

< = compound not detected above the reporting limit shown.

Bold value indicates detection above method detection limit.

Sample ID with "DUP" indicates duplicate sample.

Sample ID with "U" indicates sample collected from the upper portion of the screened interval.

Sample ID with "L" indicates sample collected from the lower portion of the screened interval.

Samples analyzed using EPA Method 8260 and results shown above have been validated with applicable qualifiers shown.

Laboratory and validation reports for above listed samples are presented on a disc in Appendix F.

N/A = not applicable

*D-17(dg) was inadvertantly not sampled in November 2018.

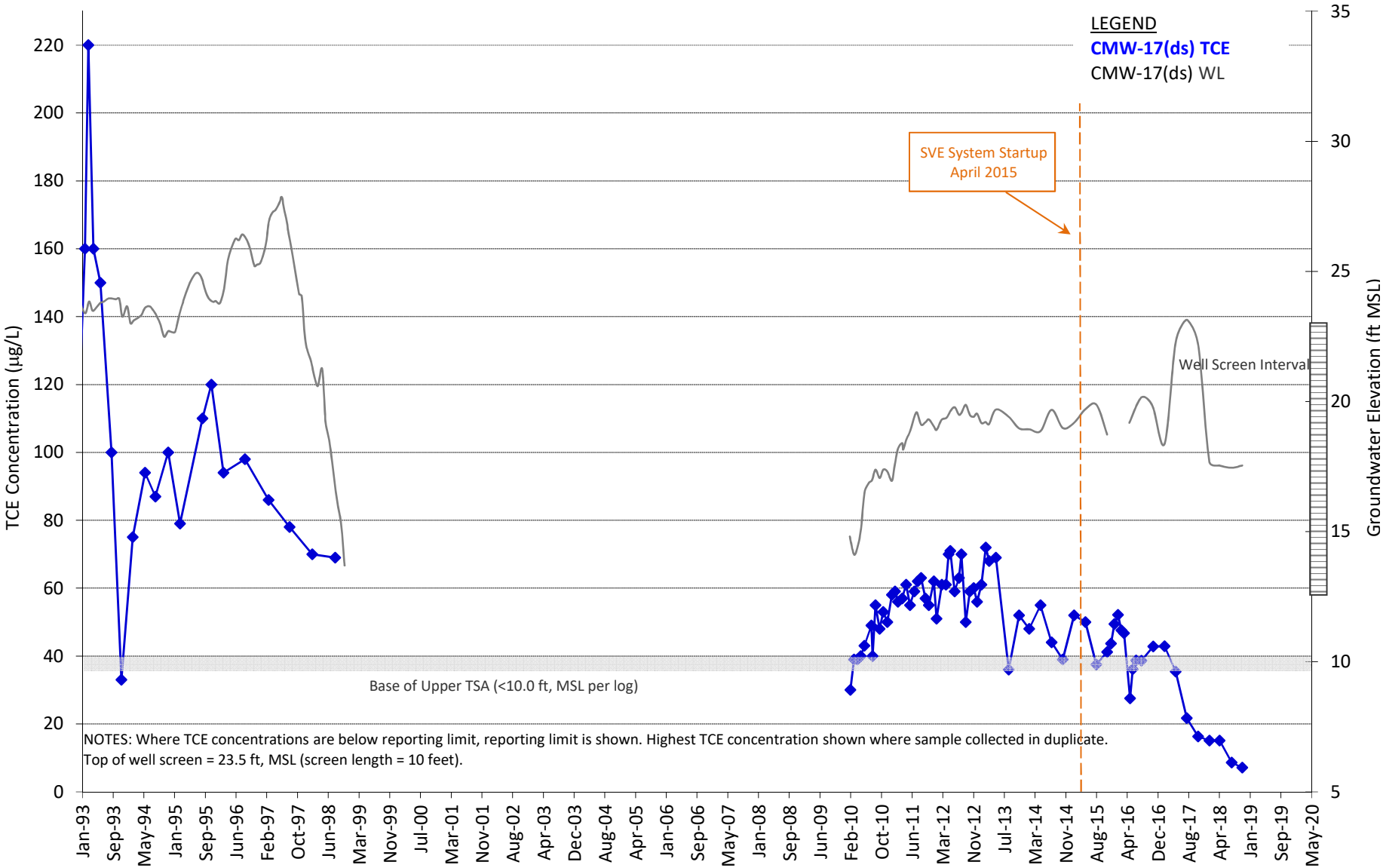
Table E-2
TCE Mass Removal - January 1998 through December 2018
TSA Remedy - East Multnomah County

Date	Pounds of TCE Removed Per Year	Cumulative Pounds of TCE Removed
Jan-98	0.00	0.00
Aug-98	116.00	116.00
Feb-00	110.00	226.00
Feb-01	55.00	281.00
Feb-02	51.20	332.20
Feb-03	32.30	364.50
Feb-08	81.00	445.50
Feb-09	8.10	453.60
Feb-10	6.11	459.71
Feb-11	4.59	464.30
Feb-12	5.48	469.79
Feb-13	7.17	476.96
Dec-13	3.39	480.35
Dec-14	3.46	483.81
Dec-15	2.98	486.80
Dec-16	3.25	490.04
Dec-17	2.53	492.58
Dec-18	1.28	493.86

Table E-3
TCE Mass Removal Per Extraction Well
TSA Remedy - East Multnomah County

Date	Pounds of TCE Removed Per Well										
	EW-1	EW-2	EW-3	EW-13	EW-14	EW-15	EW-16	EW-18	EW-22	EW-23	Total
Mar 2008-Feb 2009	1.02	2.03	1.54	0.47	1.69	0.60	0.08	0.13	0.12	0.43	8.10
Mar 2009-Feb 2010	0.68	1.93	1.07	0.20	1.52	0.21	0.04	0.08	0.00	0.38	6.11
Mar 2010-Feb 2011	0.79	1.70			1.41	0.03	0.05			0.61	4.59
Mar 2011-Feb 2012	1.86	1.60			1.58		0.00			0.46	5.48
Mar 2012-Feb 2013	1.72	3.10			1.36		0.22			0.77	7.17
Mar 2013-Dec 2013	0.80	1.34			0.83		0.05			0.37	3.39
2014	0.68	1.41			0.82		0.10			0.44	3.46
2015	0.60	1.22			0.74		0.00			0.43	2.98
2016	0.87	1.42			0.70		0.00			0.26	3.25
2017	0.67	0.98			0.60					0.28	2.53
2018	0.13	0.73			0.34					0.08	1.28
Total (5 years)	2.95	5.77	0.00	0.00	3.21	0.00	0.10	0.00	0.00	1.48	13.51
Total (10 years)	9.82	17.46	2.61	0.67	11.59	0.84	0.54	0.21	0.12	4.49	48.36

Notes
The amount of TCE removed by the extraction wells in the remedial systems was calculated by multiplying average monthly flow rates at each extraction well by estimated TCE concentration at the extraction wells at the mid-point of each month. The mid-monthly TCE concentrations were calculated by linear interpolation from the two near sampling dates.

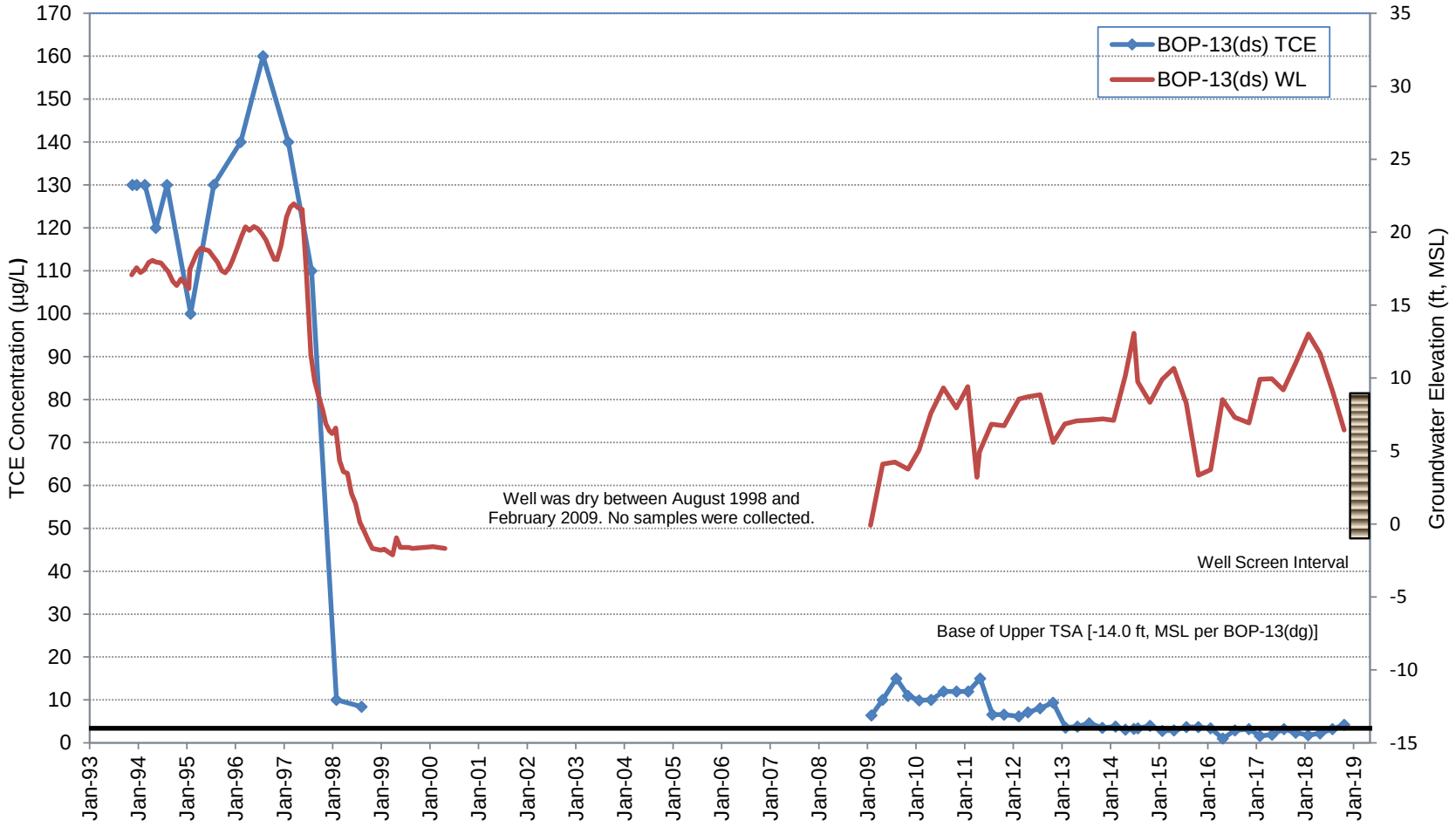


NOTES: Where TCE concentrations are below reporting limit, reporting limit is shown. Highest TCE concentration shown where sample collected in duplicate.
Top of well screen = 23.5 ft, MSL (screen length = 10 feet).

Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-17(ds)** **TSA Remedy**	Figure E-1

\\edmdata01\projects\025\116\WIP\T\TSA\Data Tables\BOP13ds-BOP31ds-TCE-WL



NOTES: Where TCE concentrations are below reporting limit, reporting limit is shown. Highest TCE concentration shown where sample collected in duplicate.
Top of well screen = 9.0 ft, MSL (screen length = 10 ft).

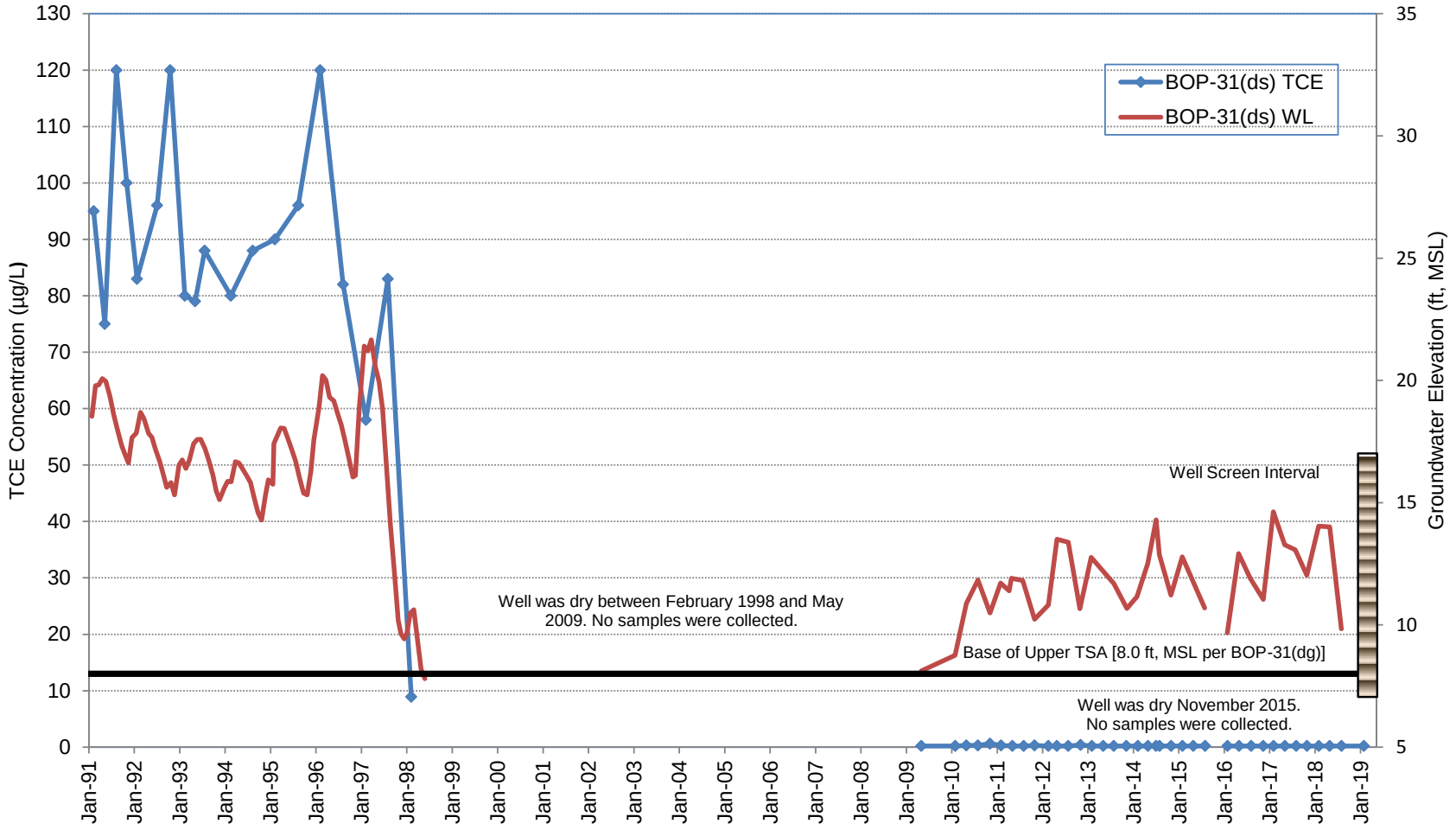
LANDAU ASSOCIATES

Boeing Portland TSA
Portland, Oregon

BOP-13ds
TCE and Groundwater Elevation

Figure
E-2

\\edmdata01\projects\025\116\WIP\T\TSA\Data Tables\BOP13ds-BOP31ds-TCE-WL



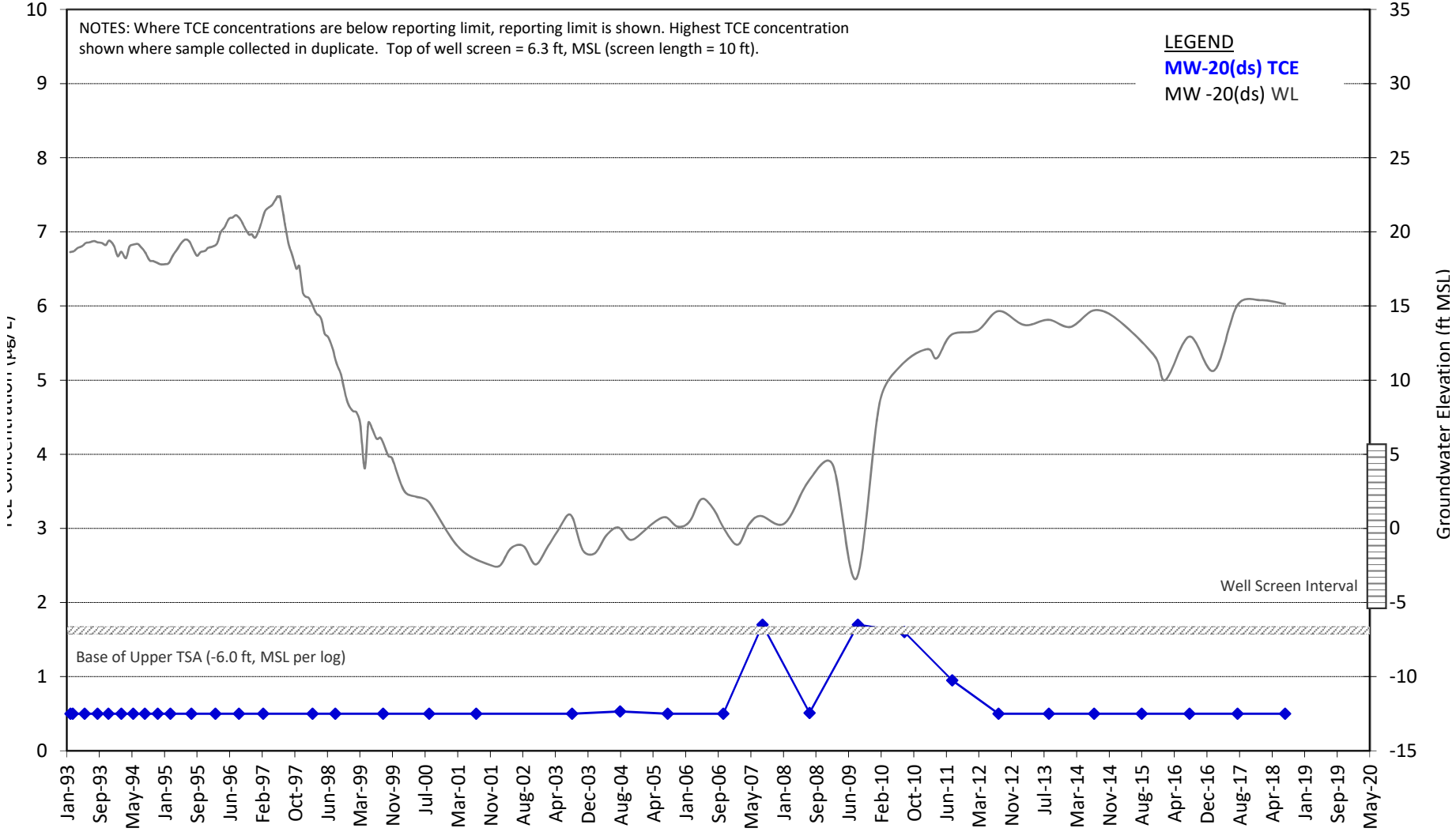
NOTES: Where TCE concentrations are below reporting limit, reporting limit is shown. Highest TCE concentration shown where sample collected in duplicate.
Top of well screen = 17.0 ft, MSL (screen length = 10 ft).

LANDAU ASSOCIATES

TSA
Portland, Oregon

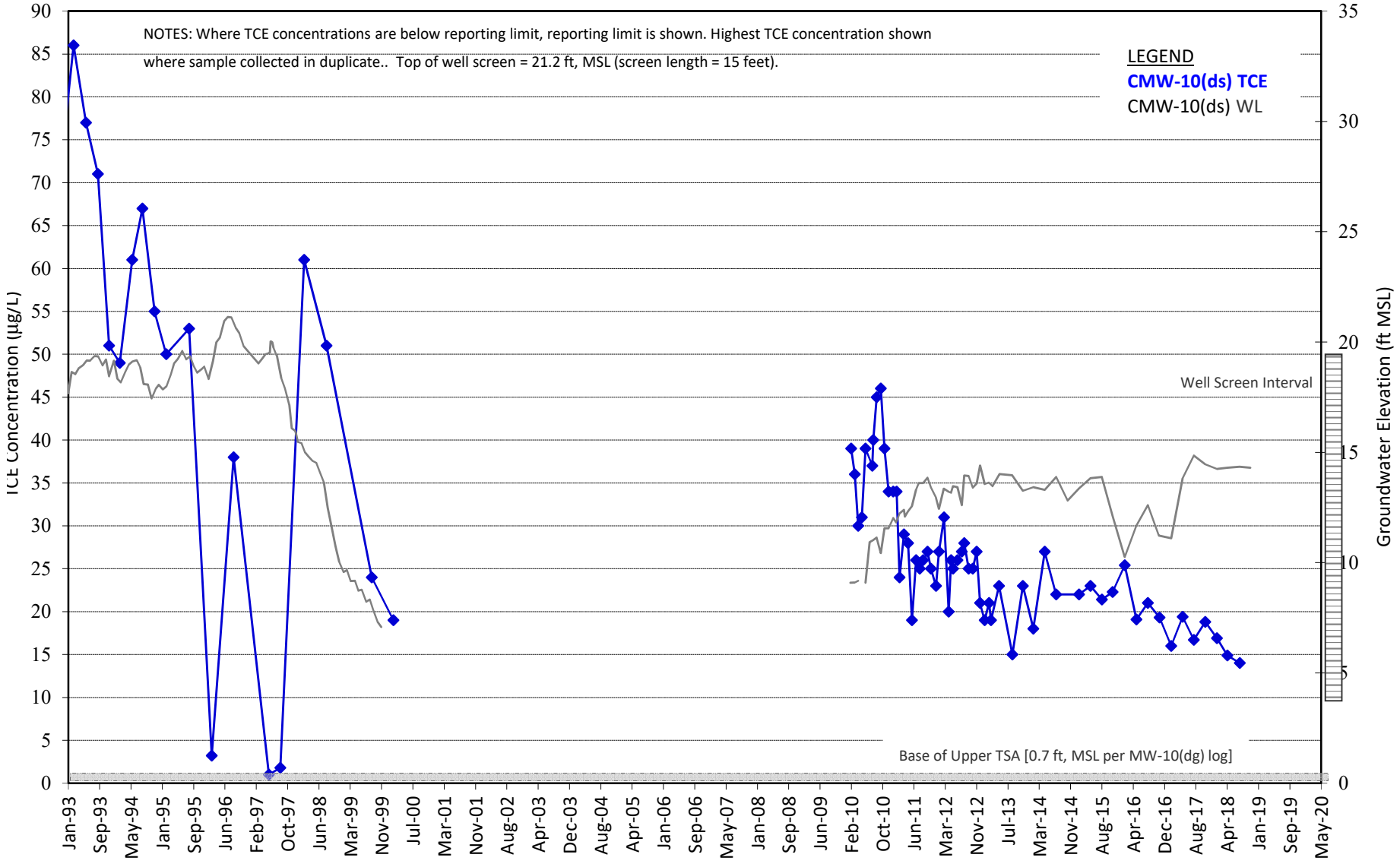
BOP-31ds
TCE and Groundwater Elevation

Figure
E-3



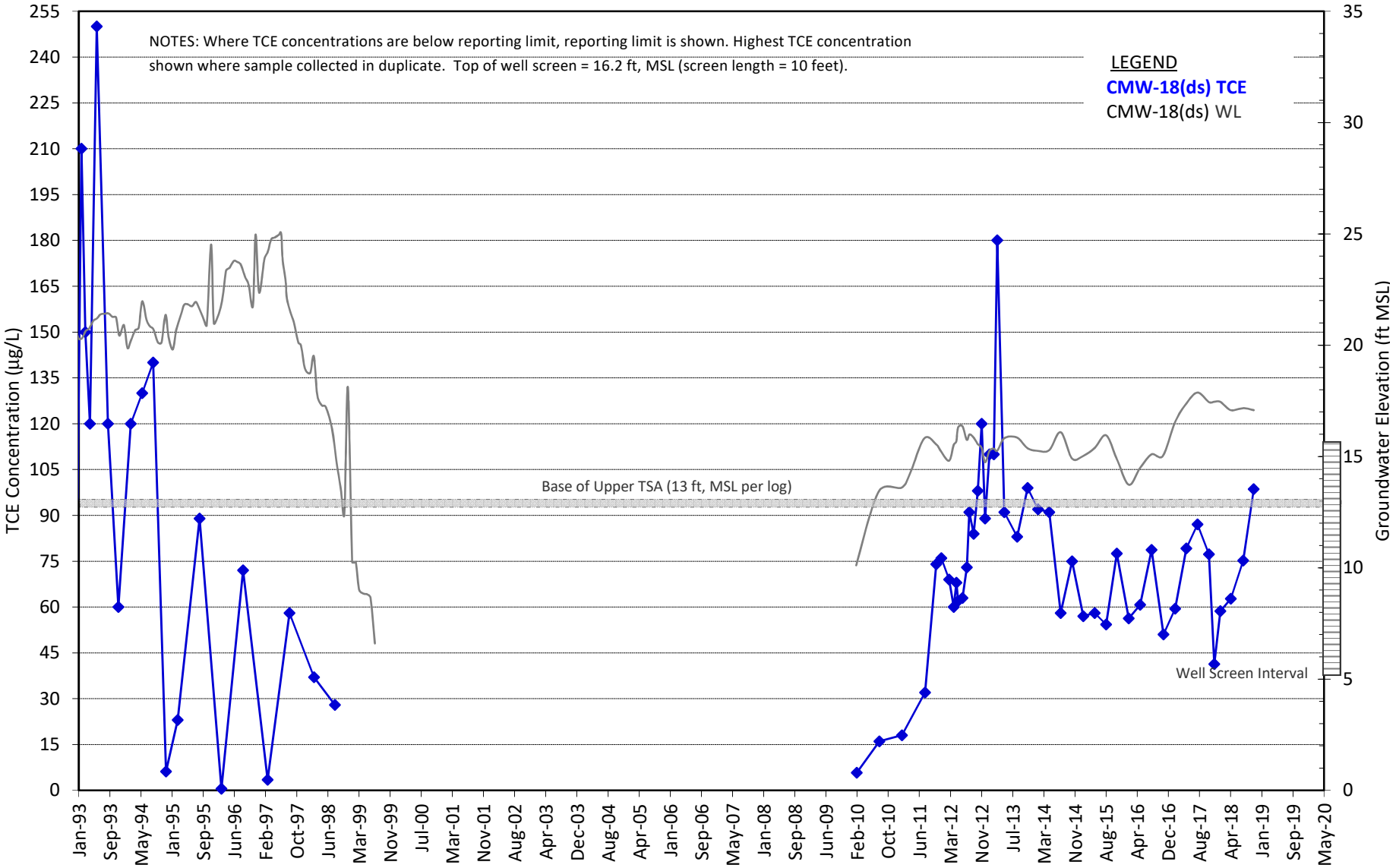
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-20(ds)** **TSA Remedy**	Figure E-4



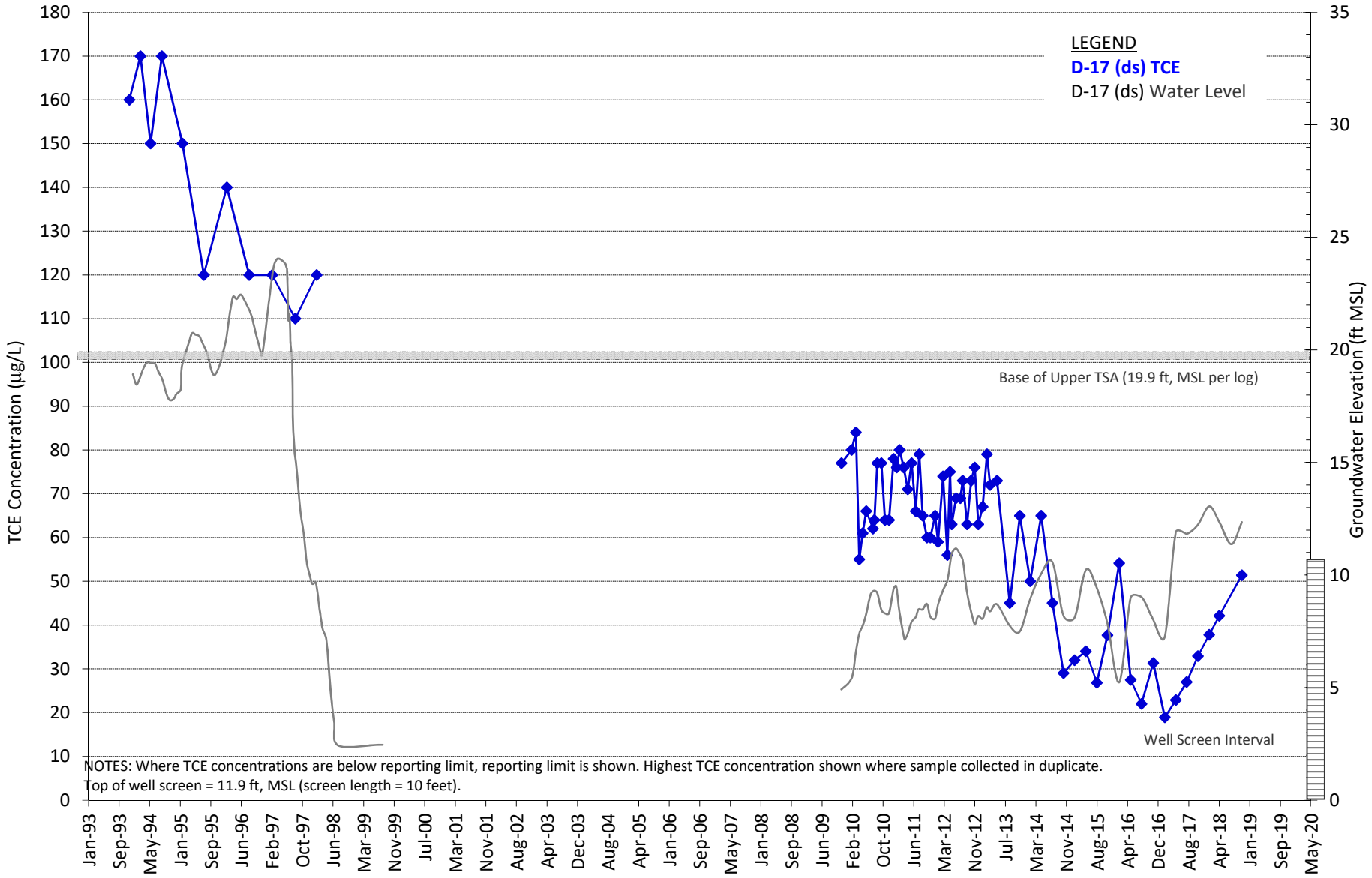
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-10(ds)** **TSA Remedy**	Figure E-5



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-18(ds)** **TSA Remedy**	Figure E-6



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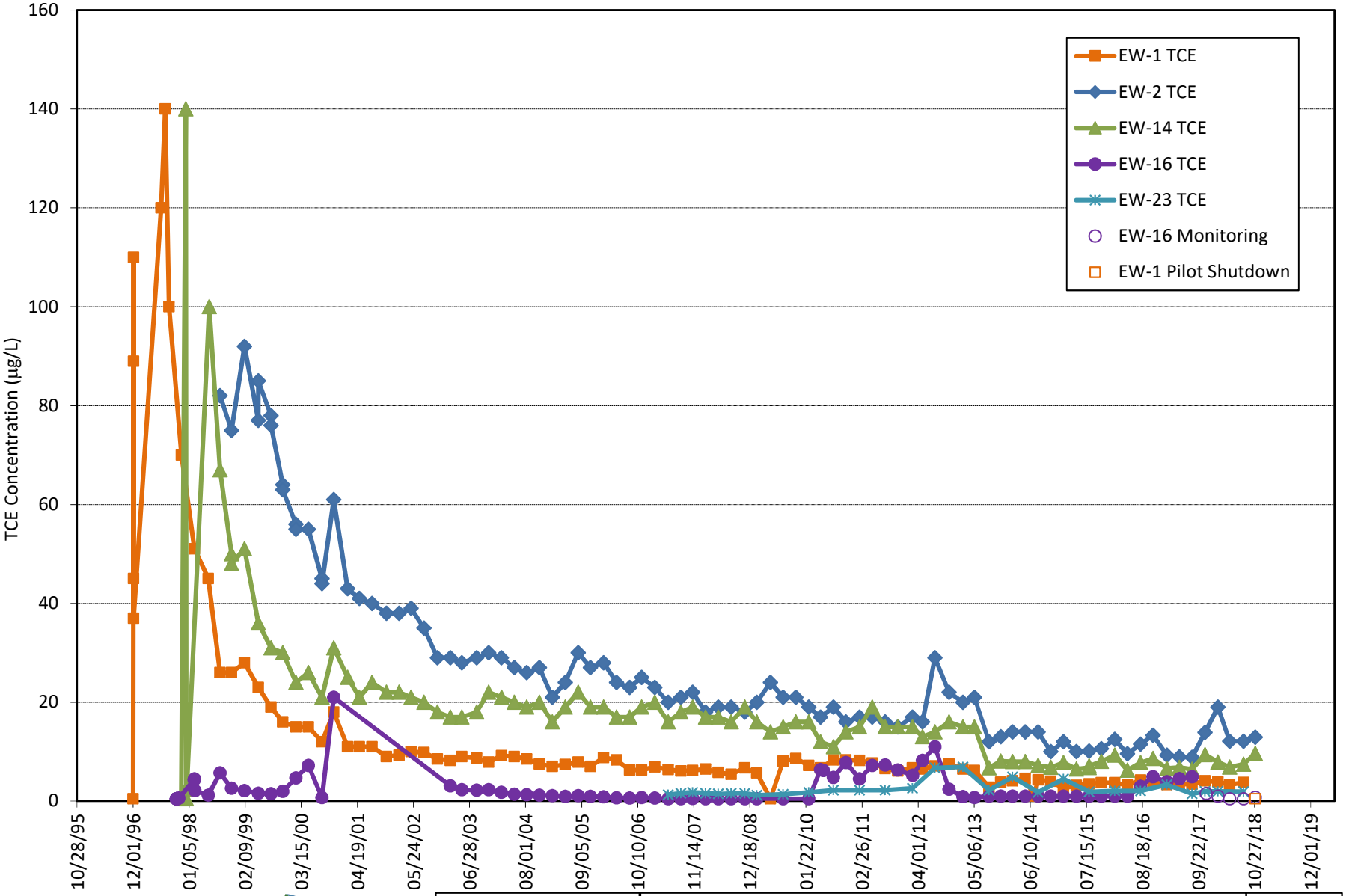
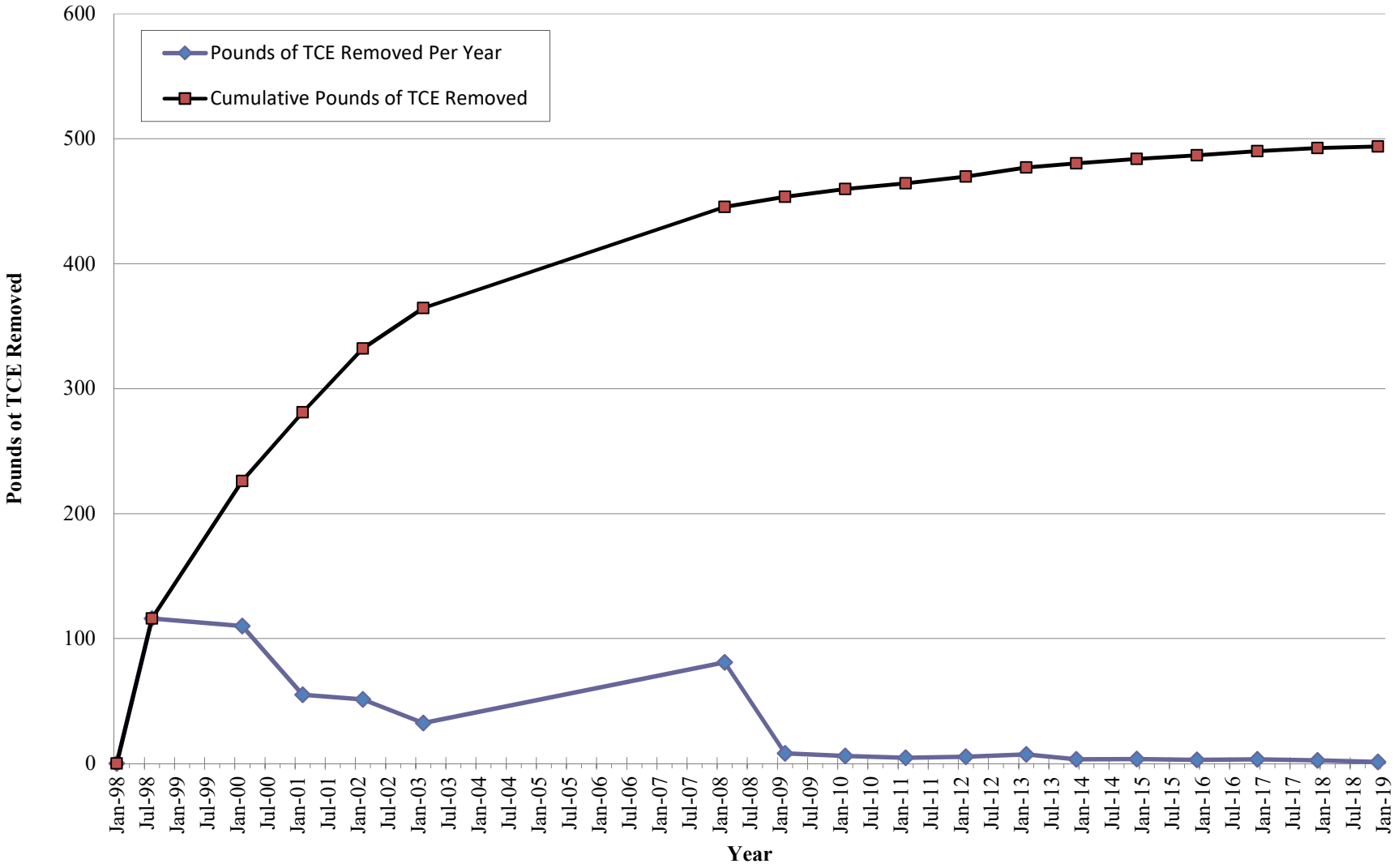
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile D-17(ds)** **TSA Remedy**	Figure E-7



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Operating Extraction Wells TCE Concentration Profiles TSA Remedy**	Figure E-8



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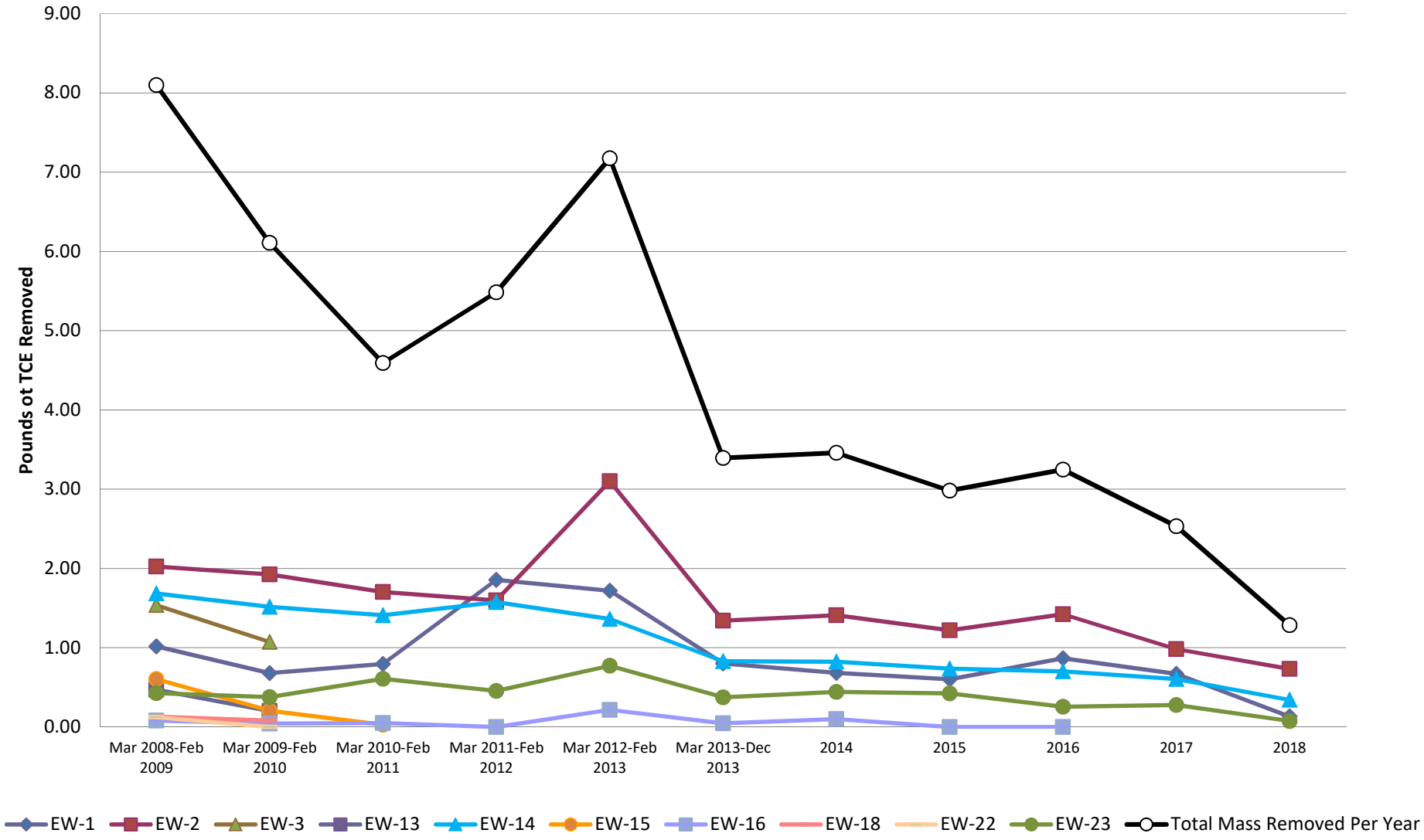
Cascade Corporation Gresham, Oregon	**TCE Mass Removal** **TSA Remedy**	Figure E-9



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Mass Removal per Extraction Well TSA Remedy**	Figure E-10

APPENDIX F

Data Validation Memoranda
Laboratory Reports (CD)
Historical Data Summary Tables – VOCs and
Groundwater Elevations (CD)

Geosyntec consultants

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Memorandum

Date:	6 September 2018
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Mike Patty
	Mary Tyler
	Julia Caprio
	Geosyntec Quality Assurance Group, Knoxville, Tennessee
Subject:	**Stage 2A Data Validations - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1016199, L1007465, L1016195, L1011440, L1019536, L1007325, L1016953 and L1020810 and ALS Environmental Service Request Number P1803074, P1803592 and P1804130**

SITE: Cascade Corp., Fairview Oregon; Job No: PNG0564S18-2.*

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-six water samples, three soil samples, three field duplicate samples and eight trip blanks, collected from 7/6/2018 to 8/24/2018, and eight air samples collected from 6/12/2018 to 8/7/2018, as part of the site investigation activities for the Cascade Corp., Fairview Oregon project.

The water and soil samples were analyzed by Pace Analytical [formerly ESC Lab Sciences (ESC)], Mt. Juliet, Tennessee for the following analytical test:

- EPA Method 8260B - Volatile Organic Compounds (VOCs)

The air samples were analyzed by ALS Environmental, Simi Valley, California for the following analytical test:

- EPA Method TO-15 – Selected VOCs (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride)

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives. Qualified data should be used within the limitations of the qualifications.

The data were reviewed based on the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002), the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
L1007325-01	PWB-1LTS-070218
L1007325-02	TRIP BLANK-070218
L1007465-01	D-16DG
L1007465-02	TRIP BLANK
L1011440-01	CMW36DG-072018
L1011440-02	TRIP BLANK#388
L1016195-01	TS-C-INF-080818
L1016195-02	TS-C-EFF-080818
L1016195-03	TS-C-EFF-080818-DUP
L1016195-04	TRIP BLANK #404
L1016199-01	CMW20DS-080818
L1016199-02	VMWA-080818
L1016199-03	VMWB-080818
L1016199-04	VMWC-080818
L1016199-05	VMWD-080818
L1016199-06	CMW19DS-080818
L1016199-07	CMW10DG-080818
L1016199-08	CMW10DS-080818
L1016199-09	CMW18DS-080818
L1016199-10	CMW18DS-080818-DUP
L1016199-11	CMW14RDS-080818
L1016199-12	CMW25DG-080818
L1016199-13	EW16-080818
L1016199-14	CMW24DG-080818-U
L1016199-15	CMW24DG-080818-L
L1016199-16	CMW26DG-080818
L1016199-17	EW12-080818-U

Laboratory ID	Client ID
L1016199-18	EW12-080818-L
L1016199-19	D17DG-080818
L1016199-20	D17DS-080818
L1016199-21	EW8-080818-U
L1016199-22	EW8-080818-L
L1016199-23	MW17DS-080818
L1016199-24	MW17DS-080818-DUP
L1016199-25	EW1-080818
L1016199-26	EW2-080818
L1016199-27	EW14-080818
L1016199-28	EW23-080818
L1016199-29	TRIP BLANK LOT #404
L1016953-01	RBE-081018
L1016953-03	RBC-081018
L1016953-04	TRIP BLANK
L1016953-06	RBW-081018
L1019536-01	CMW-36DG-082018
L1019536-02	TRIP BLANK LOT #404
L1020810-01	PWB1-LTS-082418
L1020810-02	TRIP BLANK
P1804130-001	VMWEFF-080718
P1804130-002	VMW95.5-080718
P1804130-003	VMWA-080718
P1804130-004	VMWB-080718
P1804130-005	VMWC-080718
P1804130-006	VMWD-080718
P1803592-001	VMWEFF-071018

Laboratory ID	Client ID
P1803074-001	VMWEFF-061218

The water and soil samples were received at the laboratory within the validation criteria of 0-6ºC.

Incorrect error corrections were observed on the chain of custody (COC) forms, instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

It was noted that the COCs were not paginated as part of the Pace Analytical laboratory reports.

No times of collection were listed on the COCs for the trip blanks reported in laboratory reports L1016199, L1016195, L1011440, L1019536, and L1020810; the laboratory assigned collection times of 00:00.

1.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

The water and soil samples were analyzed for VOCs per EPA Method 8260B.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

✓ Overall Assessment
✓ Holding Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
⊗ Laboratory Control Sample
✓ Surrogates
✓ Field Duplicate
✓ Trip Blank
✓ Sensitivity
✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid

analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for these sample sets is 100%.

The soil samples in report L1016953 were reported on a dry weight basis. QC samples were reported for the percent solids analyses; these QC did not result in qualification of data.

1.2 Holding Time

The holding time for the VOC analysis of a preserved water sample is 14 days from collection to analysis. The holding times for the VOC analysis of a soil sample are 48 hours from collection to preservation and 14 days from collection to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Ten method blanks were reported (batches WG1150348, WG1150503, WG1135539, WG1141579, WG1155525, WG1134953, WG1151151, WG1152857, WG1157573 and WG1161008). VOCs were not detected in the method blanks above the method detection limits (MDLs), with the following exceptions.

Acrylonitrile was detected at an estimated concentration greater than the MDL and less than the reported detection limit (RDL) in the method blank in batch WG1150503. Since acrylonitrile was not detected in the associated samples or detected at a concentration greater than the RDL, no qualifications were applied to the data.

Hexachlorobutadiene was detected at an estimated concentration greater than the MDL and less than the RDL in the method blank in batch WG1134953. Since hexachlorobutadiene was not detected in the associated samples, no qualifications were applied to the data.

Naphthalene was detected at an estimated concentration greater than the MDL and less than the RDL in the method blank in batch WG1157573. Since naphthalene was not detected in the associated samples, no qualifications were applied to the data.

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Batch MS/MSD pairs were reported. Since these were batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCSs and six LCS/LCS duplicate (LCSD) pairs were reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exceptions.

The recoveries of hexachlorobutadiene in the LCS/LCSD in batch WG1135539 were high and outside the laboratory specified acceptance criteria. Since hexachlorobutadiene was not detected in the associated samples, no qualifications were applied to the data.

The recovery of 1,2-dichlorobenzene in the LCSD in batch WG1151151 was high and outside the laboratory specified acceptance criteria. Since 1,2-dichlorobenzene was not detected in the associated samples, no qualifications were applied to the data.

The recovery of naphthalene in the LCS in batch WG1155525 was low and outside the laboratory specified acceptance criteria. Therefore, based on professional and technical judgement, the nondetect naphthalene results in the associated samples were UJ qualified as estimated less than the MDLs.

Sample ID	Compound	Laboratory Concentration (mg/L)	Laboratory Flag	Validation Concentration (mg/L)	Validation Qualifier*	Reason Code**
CMW-36DG-082018	Naphthalene	0.000174	U,J4	0.000174	UJ	5
TRIP BLANK LOT #404	Naphthalene	0.000174	U,J4	0.000174	UJ	5

mg/L- milligram per liter
U-not detected at the MDL
J4-laboratory flag indicating the associated batch QC was outside the established quality control range for accuracy
* Validation qualifiers are defined in Attachment 1 at the end of this report
**Reason codes are defined in Attachment 2 at the end of this report

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

Three field duplicates were collected with the sample sets, TS-C-EFF-080818-DUP, MW17DS-080818-DUP, and CMW18DS-080818-DUP. Acceptable precision (RPD $\leq$30%) was demonstrated between the field duplicates and the original samples, TS-C-EFF-080818, MW17DS-080818 and CMW18DS-080818, respectively.

1.8 Trip Blank

Eight trip blanks accompanied the sample shipments: TRIP BLANK-070218, TRIP BLANK #404, TRIP BLANK LOT #404 (collected 8/8/18), TRIP BLANK LOT #404 (collected 8/20/18), TRIP BLANK (collected 7/6/18), TRIP BLANK#388, TRIP BLANK (collected 8/10/18), and TRIP BLANK (collected 8/24/18). VOCs were not detected in the trip blanks above the MDLs, with the following exception.

Acrylonitrile was detected at concentration greater than the RDL in trip blank TRIP BLANK LOT #404 (collected 8/8/18). Since acrylonitrile was not detected in the associated samples, no qualifications were applied to the data.

1.9 Sensitivity

The sample results were reported to the MDLs. Elevated non-detect results were reported for the soil samples due to the dilutions analyzed.

1.10 Electronic Data Deliverables (EDDs) Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. It was noted that the data were reported in units of parts per million (ppm) in the EDDs, while the sample data were reported in units of parts per billion (or microgram per liter, µg/L) in the level II reports. This did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

The air samples were analyzed for selected VOCs per EPA Method TO-15 (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Laboratory Duplicate

- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for these sample sets is 100%.

2.2 Holding Time

The holding time for the VOC analysis of a sample collected in a SUMMA® canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four method blanks were reported (batches P180618, P180723, P180724, and P180813). VOCs were not detected in the method blanks above the method reporting limits (MRLs).

2.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCSs were reported. The recovery results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

A laboratory duplicate was not reported.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Field Duplicate

A field duplicate was not collected with the air samples.

2.8 Trip Blank

A trip blank was not shipped with the air sample sets.

2.9 Sensitivity

The sample results were reported to the MRLs. Elevated non-detect results were reported due to the sample dilutions analyzed.

2.10 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II report; both the MRLs and the MDLs were listed in the EDD. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDD, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II report. This did not affect the quality of the data. No other discrepancies were identified between the level II report and the EDD.

---

* * * * *

ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Upon application of the U qualifier to a reported result, the definition changes to "not detected at or above the reported result".

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

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 results are 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.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits and RPD outside limits (LCS/LCSD)
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

Geosyntec consultants

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Memorandum

Date:	3 May 2018
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Mary Tyler
	Julia Caprio
	Geosyntec Quality Assurance Group, Knoxville, Tennessee
Subject:	**Stage 2A Data Validations - Level II Data Deliverables – ESC Lab Sciences Work Orders L969286 and L929293 and ALS Environmental Service Request Numbers P1706266, P1800143, P1800595 and P1801113**

SITE: Cascade Corp, Fairview Oregon; Job No: PNG0564S18

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of twenty-six water samples, two field duplicate samples and one trip blank, collected February 7-8, 2018, and nine soil vapor samples, collected December 12, 2017, January 9, 2018, February 6, 2018 and March 6, 2018, as part of the site investigation activities for the Cascade Corp, Fairview Oregon project. The samples were analyzed for the following tests:

- EPA Method 8260B - Volatile Organic Compounds (VOCs)
- EPA Method TO-15 – Selected VOCs (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride)

The samples were analyzed by EPA method 8260B at ESC Lab Sciences (ESC), Mt. Juliet, Tennessee and by EPA method TO-15 at ALS Environmental, Simi Valley, California.

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The data were reviewed based on the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002), the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
L969286-01	CMW19DS-020718
L969286-02	CMW10DS-020718
L969286-03	CMW18DS-020718
L969286-04	CMW14RDS-020718
L969286-05	EW16-020718
L969286-06	CMW26DG-020718
L969286-07	CMW17DS-020718
L969286-08	CMW17DS-020718-DUP
L969286-09	EW1-020718
L969286-10	EW2-020718
L969286-11	EW14-020718
L969286-12	EW23-020718
L969286-13	D17DG-020718
L969286-14	D17DS-020718
L969286-15	EW12-020718-U
L969286-16	EW12-020718-L
L969286-17	CMW25DG-020718
L969286-18	CMW24DG-020818-U
L969286-19	CMW24DG-020818-L

Laboratory ID	Client ID
L969286-20	EW8-020818-U
L969286-21	EW8-020818-L
L969286-22	VMWA-020818
L969286-23	VMWB-020818
L969286-24	VMWC-020818
L969286-25	VMWD-020818
L969286-26	TRIP BLANK LOT 383
L969293-01	TS-C-EFF-020718
L969293-02	TS-C-EFF-020718-DUP
L969293-03	TS-C-INF-020718
P1706266-001	VMWEFF-121217
P1800143-001	VMWEFF-010918
P1800595-001	VMWEFF-020618
P1800595-002	VMW95.5-020618
P1800595-003	VMWA-020618
P1800595-004	VMWC-020618
P1800595-005	VMWB-020618
P1800595-006	VMWD-020618
P1801113-001	VMWEFF-030618

The water samples were received at the laboratory at 2.3ºC, within the validation criteria of 0-6ºC.

Incorrect error corrections were observed on the chain of custody (COC) forms in laboratory reports L969286, L929293 and P1801113, instead of the proper procedure of a single strike through, correction and initials and date of person making the corrections.

The collection time on the COC for sample CMW17DS-020718-DUP was 12:21; the sample was originally logged in with a collection time of 12:01. The report was revised on 4/24/18 to correct the sample collection time to 12:21. The revised report was not identified as a revision.

No time of collection was listed on the COCs for the trip blank reported in laboratory report L969286; the laboratory assigned a collection time of 00:00.

1.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

The water samples were analyzed for VOCs per EPA Method 8260B.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for these sample sets is 100%.

1.2 Holding Time

The holding time for the VOC analysis of a preserved water sample is 14 days from collection to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Three method blanks were reported (batches WG1072544,

WG1072564 and WG1072685). VOCs were not detected in the method blanks above the method detection limits (MDLs), with the following exception.

Hexachlorobutadiene was detected at an estimated concentration greater than the MDL and less than the reported detection limit (RDL) in the method blank in batch WG1072685. Since hexachlorobutadiene was not detected in the associated samples, no qualifications were applied to the data.

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were not reported.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS and one LCS/LCS duplicate (LCSD) pair were reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exception.

The LCS recovery of 1,1,2,2-tetrachloroethane in batch WG1072685 was high and outside the laboratory specified acceptance criteria. Since 1,1,2,2-tetrachloroethane was not detected in the associated samples, no qualifications were applied to the data.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

Two field duplicates were collected with the sample sets, CMW17DS-020718-DUP and TS-C-EFF-020718-DUP. Acceptable precision (RPD $\leq$30%) was demonstrated between the field duplicates and the original samples CMW17DS-020718 and TS-C-EFF-020718, respectively.

1.8 Trip Blank

One trip blank accompanied the sample shipment, TRIP BLANK LOT 383. VOCs were not detected in the trip blank above the MDLs.

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1.9 Sensitivity

The sample results were reported to the MDLs. No elevated non-detect results were reported.

1.10 Electronic Data Deliverables (EDDs) Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. It was noted that the data were reported in units of parts per million (ppm) in the EDDs, while the sample data were reported in units of parts per billion (or microgram per liter, µg/L) in the level II reports. This did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

The soil vapor samples were analyzed for selected VOCs per EPA Method TO-15 (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Laboratory Duplicate
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

2.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for these sample sets is 100%.

2.2 Holding Time

The holding time for the VOC analysis of a sample collected in a SUMMA® canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Six method blanks were reported (batches P171215, P180115, P180212, P180213, P180320 and P180321). VOCs were not detected in the method blanks above the method reporting limits (MRLs).

2.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Six LCSs were reported. The recovery results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

Laboratory duplicates were not reported.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Field Duplicate

A field duplicate was not collected with the soil vapor samples.

2.8 Trip Blank

A trip blank was not shipped with the soil vapor sample sets.

2.9 Sensitivity

The sample results were reported to the MRLs. Elevated non-detect values were reported for the samples due to the sample dilutions analyzed.

2.10 Electronic Data Deliverables Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II reports; both the MRLs and the MDLs were listed in the EDDs. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDDs, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II reports. This did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS
AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA 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.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

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 results are 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.

DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits and RPD outside limits (LCS/LCSD)
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

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Memorandum

Date:	21 June 2018
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Kristoffer Henderson
	Julia Caprio
	Geosyntec Quality Assurance Group, Knoxville, Tennessee
Subject:	**Stage 2A Data Validations - Level II Data Deliverables – ESC Lab Sciences Work Orders L990332 and L990344 and ALS Environmental Service Request Number P1802423**

SITE: Cascade Corp, Fairview Oregon; Job No: PNG0564S18

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of eighteen water samples, two field duplicate samples and one trip blank collected 1 May 2018, and six air samples collected 9 May 2018, as part of the site investigation activities for the Cascade Corp, Fairview Oregon project.

The water samples were analyzed by ESC Lab Sciences (ESC), Mt. Juliet, Tennessee for the following analytical test:

- EPA Method 8260B - Volatile Organic Compounds (VOCs)

The air samples were analyzed by ALS Environmental, Simi Valley, California for the following analytical test:

- EPA Method TO-15 – Selected VOCs (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride)

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The data were reviewed based on the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002), the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
L990332-01	EW1-050118
L990332-02	EW2-050118
L990332-03	EW14-050118
L990332-04	VMWA-050118
L990332-05	VMWB-050118
L990332-06	VMWC-050118
L990332-07	VMWD-050118
L990332-08	EW12-050118-U
L990332-09	EW12-050118-L
L990332-10	EW16-050118
L990332-11	D17DS-050118
L990332-12	CMW10DS-050118
L990332-13	CMW17DS-050118
L990332-14	CMW18DS-050118

Laboratory ID	Client ID
L990332-15	CMW18DS-050118-DUP
L990332-16	CMW19DS-050118
L990332-17	CMW26DG-050118
L990332-18	TRIP BLANK LOT 394
L990344-01	TS-C-EFF-0501118
L990344-02	TS-C-EFF-050118-D
L990344-03	TS-C-INF-050118
P1802423-001	VMW EFF-050918
P1802423-002	VMW 95.5-050918
P1802423-003	VMWA-050918
P1802423-004	VMWB-050918
P1802423-005	VMWC-050918
P1802423-006	VMWD-050918

The water samples were received at the laboratory at 1.4ºC, within the validation criteria of 0-6ºC.

TRIP BLANK LOT 394 was listed on both the chain of custody (COC) forms for laboratory reports L990032 and L990344; but was only reported in laboratory report L990032.

No time of collection was listed on the COCs for the trip blank reported in laboratory report L990332; the laboratory assigned a collection time of 00:00.

The COC in report L990332 was not completed correctly. The sample receiving person at ESC signed for laboratory receipt with their printed name and documented the receipt date in the relinquishing field and then signed and printed their name and documented the receipt time in the receiving field.

1.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

The water samples were analyzed for VOCs per EPA Method 8260B.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for these sample sets is 100%.

1.2 Holding Time

The holding time for the VOC analysis of a preserved water sample is 14 days from collection to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches WG1106166 WG1106043). VOCs were not detected in the method blanks above the method detection limits (MDLs), with the following exceptions.

Hexachlorobutadiene was detected at an estimated concentration greater than the MDL and less than the reported detection limit (RDL) in the method blank in batch WG1106166. Since hexachlorobutadiene was not detected in the associated samples, no qualifications were applied to the data.

Hexachlorobutadiene and 1,2,3-trichlorobenzene were detected at estimated concentrations greater than the MDLs and less than the RDLs in the method blank in batch WG1106043. Since hexachlorobutadiene and 1,2,3-trichlorobenzene were not detected in the associated samples, no qualifications were applied to the data.

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were not reported.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS and one LCS/LCS duplicate (LCSD) pair were reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

Two field duplicates were collected with the sample sets, CMW18DS-050118-DUP and TS-C-EFF-050118-D. Acceptable precision (RPD $\leq$30%) was demonstrated between the field duplicates and the original samples CMW18DS-050118 and TS-C-EFF-0501118, respectively.

1.8 Trip Blank

One trip blank accompanied the sample shipment, TRIP BLANK LOT 394. VOCs were not detected in the trip blank above the MDLs.

1.9 Sensitivity

The sample results were reported to the MDLs. No elevated non-detect results were reported.

1.10 Electronic Data Deliverables (EDDs) Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. It was noted that the data were reported in units of parts per million (ppm) in the EDDs, while the sample data were reported in units of parts per billion (or microgram per liter, µg/L) in the level II reports. This

did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

The air samples were analyzed for selected VOCs per EPA Method TO-15 (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Laboratory Duplicate
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for this sample set is 100%.

2.2 Holding Time

The holding time for the VOC analysis of a sample collected in a SUMMA® canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch P180516). VOCs were not detected in the method blank above the method reporting limits (MRLs).

2.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS was reported. The recovery results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

One sample set specific laboratory duplicate was reported, using sample VMWC-050918. The RPD results were within the laboratory specified acceptance criteria.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Field Duplicate

A field duplicate was not collected with the air samples.

2.8 Trip Blank

A trip blank was not shipped with the air sample sets.

2.9 Sensitivity

The sample results were reported to the MRLs. Elevated non-detect values were reported for the samples due to the sample dilutions analyzed.

2.10 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II report; both the MRLs and the MDLs were listed in the EDD. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDD, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II report. This did not affect the quality of the data. No other discrepancies were identified between the level II report and the EDD.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Upon application of the U qualifier to a reported result, the definition changes to "not detected at or above the reported result".

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

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 results are 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.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits and RPD outside limits (LCS/LCSD)
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

Geosyntec consultants

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Memorandum

Date: 13 December 2018

To: Cindy Bartlett, RG, LG

Geosyntec Consultants, Portland, Oregon

From: Mary Tyler

Julia Caprio

Geosyntec Quality Assurance Group, Knoxville, Tennessee

Subject: Stage 2A Data Validations - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1040991 and L1040992, and ALS Environmental Service Request Number P1804757, P1805452 and P1806158

SITE: Cascade Corp., Fairview Oregon; Job No: PNG0564S18-2.*

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of eighteen groundwater samples, two field duplicate samples and one trip blank, collected 11/1-2/2018, and eight air samples collected on 9/10/18, 10/9/18 and 11/6/18, as part of the site investigation activities for the Cascade Corp., Fairview Oregon project.

The water samples were analyzed by Pace Analytical [formerly ESC Lab Sciences (ESC)], Mt. Juliet, Tennessee for the following analytical test:

- EPA Method 8260B - Volatile Organic Compounds (VOCs)

The air samples were analyzed by ALS Environmental, Simi Valley, California for the following analytical test:

- EPA Method TO-15 – Selected VOCs (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride)

EXECUTIVE SUMMARY

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data are usable for meeting project objectives.

The data were reviewed based on the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002), the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data sets:

Laboratory ID	Client ID
L1040991-01	TS-C-EFF-110118
L1040991-02	TS-C-EFF-110118-DUP
L1040991-03	TS-C-INF-110118
L1040992-01	EW16-110118
L1040992-02	EW14-110118
L1040992-03	EW2-110118
L1040992-04	EW1-110118
L1040992-05	CMW17DS-110118
L1040992-06	CMW18DS-110118
L1040992-07	CMW18DS-110118-DUP
L1040992-08	CMW19DS-110118
L1040992-09	CMW10DS-110118
L1040992-10	D17DS-110118
L1040992-11	CMW36DG-110118
L1040992-12	PWB1LTS-110118

Laboratory ID	Client ID
L1040992-13	VMWA-110118
L1040992-14	VMWC-110118
L1040992-15	VMWB-110118
L1040992-16	VMWD-110118
L1040992-17	PWB1UTS-110218
L1040992-18	TRIP BLANK #413
P1804757-001	VMWEFF-091018
P1805452-001	VMW EFF - 100918
P1806158-001	VMW EFF-110618
P1806158-002	VMW 95.5-110618
P1806158-003	VMW A-110618
P1806158-004	VMW C-110618
P1806158-005	VMW B-110618
P1806158-006	VMW D-110618

The water samples were received at the laboratory within the temperature criteria of 0-6^{o}C.

Incorrect error corrections were observed on the chain of custody (COC) forms, instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

It was noted that the COCs were not paginated as part of the Pace Analytical laboratory reports.

No collection time was documented on the COC for the trip blank; the laboratory assigned a collection time of 00:00.

1.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

The water samples were analyzed for VOCs per EPA Method 8260B.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues

were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for the sample set is 100%.

1.2 Holding Time

The holding time for the VOC analysis of a preserved water sample is 14 days from collection to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches WG1191349 and WG1191489). VOCs were not detected in the method blanks above the reported detection limits (RDLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were not reported.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS/LCS duplicate (LCSD) pairs were reported. The recovery and

relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exceptions.

The recoveries of acrolein in the LCS/LCSD in batch WG1191349 were high and outside the laboratory specified acceptance criteria. Since acrolein was not detected in the associated samples, no qualifications were applied to the data.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

Two field duplicates were collected with the sample sets, CMW18DS-110118-DUP and TS-C-EFF-110118-DUP. Acceptable precision (RPD $\leq$30%) was demonstrated between the field duplicates and the original samples, CMW18DS-110118 and TS-C-EFF-110118, respectively.

1.8 Trip Blank

One trip blank accompanied the sample shipment, TRIP BLANK #413. VOCs were not detected in the trip blank above the RDLs.

1.9 Sensitivity

The sample results were reported to the RDLs. No elevated non-detect results were reported.

1.10 Electronic Data Deliverables (EDDs) Review

Results and sample IDs in the EDDs were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. It was noted that the data were reported in units of parts per million (ppm) in the EDDs, while the sample data were reported in units of parts per billion (or microgram per liter, µg/L) in the level II reports. This did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

The air samples were analyzed for selected VOCs per EPA Method TO-15 (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Laboratory Duplicate
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for the sample set is 100%.

2.2 Holding Time

The holding time for the VOC analysis of a gaseous sample collected in a SUMMA® canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four method blanks were reported (batches P181022, P181128, P181129, and P180918). VOCs were not detected in the method blanks above the method reporting limits (MRLs).

2.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCSs were reported. The recovery results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

A laboratory duplicate was not reported.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Field Duplicate

A field duplicate was not collected with the air samples.

2.8 Trip Blank

A trip blank was not shipped with the air sample sets.

2.9 Sensitivity

The sample results were reported to the MRLs. Elevated non-detect results were reported due to the sample dilutions analyzed.

2.10 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II report; both the MRLs and the MDLs were listed in the EDD. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDD, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II report. This did not affect the quality of the data. No other discrepancies were identified between the level II report and the EDD.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Upon application of the U qualifier to a reported result, the definition changes to "not detected at or above the reported result".

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

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 results are 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.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits and RPD outside limits (LCS/LCSD)
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

Geosyntec consultants

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Memorandum

Date: 09 January 2019

To: Cindy Bartlett, RG, LG

Geosyntec Consultants, Portland, Oregon

From: Mary Tyler

Julia Caprio

Geosyntec Quality Assurance Group, Knoxville, Tennessee

Subject: Stage 2A Data Validations - Level II Data Deliverables – Pace Analytical Sample Delivery Group L1028320 and ALS Environmental Service Request Number P1806900

SITE: Cascade Corp., Fairview Oregon; Job No: PNG0564S18-2.*

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of three water samples collected on 9/20/2018, and one air sample collected on 12/12/18, as part of the site investigation activities for the Cascade Corp., Fairview Oregon project.

The water samples were analyzed by Pace Analytical [formerly ESC Lab Sciences (ESC)], Mt. Juliet, Tennessee for the following analytical test:

- EPA Method 8260B - Volatile Organic Compounds (VOCs)

The air sample was analyzed by ALS Environmental, Simi Valley, California for the following analytical test:

- EPA Method TO-15 using Selected Ion Monitoring (SIM) – Selected VOCs (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride)

EXECUTIVE SUMMARY

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below and based on the information provided, the data are usable for meeting project objectives.

The data were reviewed based on the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002), the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data sets:

Laboratory ID	Client ID
L1028320-01	CMW36DG-092018
L1028320-02	PWB1LTS-092018

Laboratory ID	Client ID
L1028320-03	PWB1UTS-092018
P1806900-001	VMWEFF-121218

The water samples were received at the laboratory within the temperature criteria of 0-6°C.

A trip blank was listed on the chain of custody (COC) sent to Pace Analytical; the laboratory noted in the sample receiving documentation that the trip blank was not received..

It was noted that the COC was not paginated as part of the Pace Analytical laboratory report.

1.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

The water samples were analyzed for VOCs per EPA Method 8260B.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid

analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for the sample set is 100%.

1.2 Holding Time

The holding time for the VOC analysis of a preserved water sample is 14 days from collection to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch WG1171023). VOCs were not detected in the method blank above the method detection limits (MDLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One batch MS/MSD pair was reported. Since these are batch QC, the results do not affect the samples in this sample set and qualifications were not applied to the samples.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS/LCS duplicate (LCSD) pair was reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

Field duplicates were not collected with the sample set.

1.8 Trip Blank

A trip blank did not accompany the sample shipment.

1.9 Sensitivity

The sample results were reported to the MDLs. No elevated non-detect results were reported.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. It was noted that the data were reported in units of parts per million (ppm) in the EDDs, while the sample data were reported in units of parts per billion (or microgram per liter, µg/L) in the level II report. This did not affect the quality of the data. No other discrepancies were identified between the level II report and the EDD.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

The air sample was analyzed for selected VOCs per EPA Method TO-15 using SIM (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Laboratory Duplicate
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. The analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for the sample set is 100%.

2.2 Holding Time

The holding time for the VOC analysis of an air sample collected in a SUMMA® canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch P181227). VOCs were not detected in the method blank above the method reporting limits (MRLs).

2.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS was reported. The recovery results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

A laboratory duplicate was not reported.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Field Duplicate

A field duplicate was not collected with the air samples.

2.8 Trip Blank

A trip blank did not accompany the sample shipment.

2.9 Sensitivity

The sample results were reported to the MRLs. No elevated non-detect results were reported.

2.10 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II report; both the MRLs and the MDLs

were listed in the EDD. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDD, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II report. This did not affect the quality of the data. No other discrepancies were identified between the level II report and the EDD.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

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J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

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ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

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6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: April 2, 2018

RE: **Boeing Portland (TSA)**
First Quarter 2018 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 6 groundwater samples and 1 trip blank collected during the first quarter 2018 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (LLI), located in Lancaster, Pennsylvania. This data quality evaluation covers LLI data package 1906304. Samples submitted to LLI were analyzed for volatile organic compounds ([VOCs]; US Environmental Protection Agency [EPA] Method SW8260C).

The verification and validation check was conducted with guidance from applicable portions of EPA's *National Functional Guidelines for Organic Data Review* (EPA 2016). Landau Associates performed an EPA-equivalent Level IIa verification and validation check on each laboratory data package, which included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).
- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below. All data was found to be acceptable with no qualifications.

Chain-of-Custody Records

A signed chain-of-custody (COC) record was attached to the data packages. The laboratory received all samples in good condition. All analyses were performed as requested. No special cleanups or handling methods were requested.

Upon receipt by LLI, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. The coolers were received with temperatures within the EPA-recommended limit of ≤6°C. No qualification of the data was necessary.

Holding Times

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA- and project-specified holding times. No qualification of the data was necessary.

Blank Results

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples for VOCs analysis. Target analytes were not detected at concentrations greater than the reporting limits in the associated method blanks. No qualification of the data was necessary.

Field Trip Blanks and Field Equipment Blanks

One trip blank was submitted to the laboratory for VOC analysis with each sample batch. Target analytes were not detected at concentrations greater than the reporting limits in the associated trip blanks. No qualification of the data was necessary.

No field equipment blanks were submitted for analysis with this sample batch.

Surrogate Recoveries

Appropriate compounds were used as surrogate spikes for the VOCs analysis. Recovery values for the surrogate spikes were within the current laboratory-specified control limits. No qualification of the data was necessary.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) and Laboratory Replicate Results

No matrix spikes were analyzed with this sample batch. No qualification of the data was determined necessary.

Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS/LCSD) Results

At least one laboratory control sample and/or laboratory control sample duplicate (LCS/LCSD) was analyzed with each batch of samples for VOCs analysis. Recoveries and RPDs for the laboratory control samples and associated duplicates were within the current laboratory-specified control limits. No qualification of the data was necessary.

Blind Field Duplicate Results

As specified in the QAPP, blind field duplicate samples were collected at a rate of one blind field duplicate sample per 20 samples, but not less than one blind field duplicate per sampling round. One pair of blind field duplicate water samples (BOP-Z-0218/BOP-13ds-0218) was submitted for analysis with data package 1906304.

A project-specified control limit of 20 percent was used to evaluate the RPDs between the duplicate samples except when the sample results were within five times the reporting limit. In these cases, a project-specified control limit of plus or minus the reporting limit was used. RPDs for the duplicate sample pairs submitted for analysis were within the project-specified control limits. No qualification of the data was necessary.

Quantitation Limits

Project-specified quantitation limits were met for all samples except for instances where high concentrations required dilution of the sample extracts.

Audit/Corrective Action Records

No audits were performed or required. No corrective action records were generated for this sample batch. Based on the laboratory's case narratives, continuing calibration verification (CCV) recovery results were within laboratory-specified control limits. No qualification of the data was necessary.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates and blind field duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.

Kristi Schultz
Data Specialist

Danille Jorgensen
Environmental Data Manager

DRJ/kes
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References

EPA. 2016. National Functional Guidelines for Organic Superfund Methods Data Review. edited by Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, DC: US Environmental Protection Agency.

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: June 1, 2018

RE: **Boeing Portland (TSA)**
Second Quarter 2018 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 2 groundwater samples and 1 trip blank collected during the second quarter 2018 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (LLI), located in Lancaster, Pennsylvania. This data quality evaluation covers LLI data package 1940145. Samples submitted to LLI were analyzed for volatile organic compounds ([VOCs]; US Environmental Protection Agency [EPA] Method SW8260C).

The verification and validation check was conducted with guidance from applicable portions of EPA's *National Functional Guidelines for Organic Data Review* (EPA 2016). Landau Associates performed an EPA-equivalent Level IIa verification and validation check on each laboratory data package, which included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).
- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below. All data was found to be acceptable with no qualifications.

Chain-of-Custody Records

A signed chain-of-custody (COC) record was attached to the data packages. The laboratory received all samples in good condition. All analyses were performed as requested. No special cleanups or handling methods were requested.

Upon receipt by LLI, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. The coolers were received with temperatures within the EPA-recommended limit of ≤6°C. No qualification of the data was necessary.

Holding Times

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA- and project-specified holding times. No qualification of the data was necessary.

Blank Results

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples for VOCs analysis. Target analytes were not detected at concentrations greater than the reporting limits in the associated method blanks. No qualification of the data was necessary.

Field Trip Blanks and Field Equipment Blanks

One trip blank was submitted to the laboratory for VOC analysis with each sample batch. Target analytes were not detected at concentrations greater than the reporting limits in the associated trip blanks. No qualification of the data was necessary.

No field equipment blanks were submitted for analysis with this sample batch.

Surrogate Recoveries

Appropriate compounds were used as surrogate spikes for the VOCs analysis. Recovery values for the surrogate spikes were within the current laboratory-specified control limits. No qualification of the data was necessary.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) and Laboratory Replicate Results

At least one MS and/or laboratory duplicate sample were analyzed with the VOC analyses. The recovery values for each required spiking compound and/or the relative percent differences (RPDs) between the laboratory duplicate results were within the current project-specified and/or laboratory-specified control limits for all project samples with the following exceptions:

- The MS/MSD recoveries for 1,1-dichloroethene associated with the VOC analysis of sample BOP-31ds-0518 exceeded the laboratory-specified control limit. 1,1-Dichloroethene was not detected at a concentrated greater than the reporting limit in the associated sample; therefore, no qualification of the data was necessary.
- The MS recovery for trans-1,2-dichloroethene associated with the VOC analysis of sample BOP-31ds-0518 exceeded the laboratory-specified control limit. The corresponding MSD recovery was within control limits; no qualification of the data was necessary.

Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS/LCSD) Results

At least one laboratory control sample and/or laboratory control sample duplicate (LCS/LCSD) was analyzed with each batch of samples for VOCs analysis. Recoveries and RPDs for the laboratory control samples and associated duplicates were within the current laboratory-specified control limits. No qualification of the data was necessary.

Blind Field Duplicate Results

No blind field duplicate samples were submitted with this sample batch. No qualification of the data was determined necessary.

Quantitation Limits

Project-specified quantitation limits were met for all samples except for instances where high concentrations required dilution of the sample extracts.

Audit/Corrective Action Records

No audits were performed or required. No corrective action records were generated for this sample batch. Based on the laboratory's case narratives, continuing calibration verification (CCV) recovery results were within laboratory-specified control limits. No qualification of the data was necessary.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates and blind field duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.

Kristi Schultz
Data Specialist

Danille Jorgensen
Environmental Data Manager

DRJ/kes
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References

EPA. 2016. National Functional Guidelines for Superfund Organic Methods Data Review. edited by Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, DC: US Environmental Protection Agency.

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: September 14, 2018

RE: **Boeing Portland (TSA)**
Third Quarter 2018 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 21 groundwater samples and 1 trip blank collected during the third quarter 2018 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (LLI), located in Lancaster, Pennsylvania. This data quality evaluation covers LLI data package 1974796. Samples submitted to LLI were analyzed for volatile organic compounds ([VOCs]; US Environmental Protection Agency [EPA] Method SW8260C).

The verification and validation check was conducted with guidance from applicable portions of EPA's *National Functional Guidelines for Organic Data Review* (EPA 2016). Landau Associates performed an EPA-equivalent Level IIa verification and validation check on each laboratory data package, which included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).
- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below. Data validation qualifiers are summarized in Table 1.

Chain-of-Custody Records

A signed chain-of-custody (COC) record was attached to the data packages. The laboratory received all samples in good condition. All analyses were performed as requested. No special cleanups or handling methods were requested.

Upon receipt by LLI, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. The coolers were received with temperatures within the EPA-recommended limit of ≤6°C. No qualification of the data was necessary.

Holding Times

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA- and project-specified holding times. No qualification of the data was necessary.

Blank Results

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples for VOCs analysis. Target analytes were not detected at concentrations greater than the reporting limits in the associated method blanks. No qualification of the data was necessary.

Field Trip Blanks and Field Equipment Blanks

One trip blank was submitted to the laboratory for VOC analysis with each sample batch. Target analytes were not detected at concentrations greater than the reporting limits in the associated trip blanks. No qualification of the data was necessary.

No field equipment blanks were submitted for analysis with this sample batch.

Surrogate Recoveries

Appropriate compounds were used as surrogate spikes for the VOCs analysis. Recovery values for the surrogate spikes were within the current laboratory-specified control limits. No qualification of the data was necessary.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) and Laboratory Replicate Results

At least one MS and/or laboratory duplicate sample were analyzed with the VOC analyses. The recovery values for each required spiking compound and/or the relative percent differences (RPDs) between the laboratory duplicate results were within the current project-specified and/or laboratory-specified control limits for all project samples with the following exceptions:

- The MS or MSD recoveries for acetone and trans-1,2-dichloroethene associated with the VOC analysis of sample BOP-13dg-0518 either exceeded or were less than the laboratory-specified control limit. The corresponding MSD or MS recovery was within the laboratory-specified control limits; therefore, no qualification of the data was necessary.

Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS/LCSD) Results

At least one laboratory control sample and/or laboratory control sample duplicate (LCS/LCSD) was analyzed with each batch of samples for VOCs analysis. Recoveries and RPDs for the laboratory control samples and associated duplicates were within the current laboratory-specified control limits. No qualification of the data was necessary.

Blind Field Duplicate Results

As specified in the QAPP, blind field duplicate samples were collected at a rate of one blind field duplicate sample per 20 samples, but not less than one blind field duplicate per sampling round. Two pairs of blind field duplicate water samples (BOP-Y-00818/BOP-21ds-0818 and BOP-Z-0818/BOP-20dg-0818) were submitted for analysis with data package 1974796.

A project-specified control limit of 20 percent was used to evaluate the RPDs between the duplicate samples except when the sample results were within five times the reporting limit. In these cases, a project-specified control limit of plus or minus the reporting limit was used. RPDs for the duplicate sample pairs submitted for analysis were within the project-specified control limits, with the following exceptions:

- The RPDs for acetone associated with field duplicate pairs BOP-Y-00818/BOP-21ds-0818 and BOP-Z-0818/BOP-20dg-0818 in data package 1974796 exceeded the project-specified control limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.

Quantitation Limits

Project-specified quantitation limits were met for all samples except for instances where high concentrations required dilution of the sample extracts.

Audit/Corrective Action Records

No audits were performed or required. No corrective action records were generated for this sample batch. Based on the laboratory's case narratives, continuing calibration verification (CCV) recovery results were within laboratory-specified control limits, with the following exceptions:

- The laboratory case narrative indicated the CCV recovery was high for bromomethane associated with several samples in data package 1974796; bromomethane was not detected at concentrations greater than the reporting limit in the associated samples. No qualification of the data was necessary.
- The laboratory case narrative indicated the CCV recoveries were low for 1,2-dichloroethane, 4-methyl-2-pentanone, and 2-hexanone associated with several samples in data package 1974796. The associated samples were qualified as estimated (J, UJ), as indicated in Table 1.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates and blind field duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.

Kristi Schultz
Data Specialist

Danille Jorgensen
Environmental Data Manager

DRJ/kes
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References

EPA. 2016. National Functional Guidelines for Superfund Organic Methods Data Review. edited by Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, DC: US Environmental Protection Agency.

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Analyte	Result	Qualifier	Sample Number	Reason
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-13ds-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-13ds-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-13ds-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-31ds-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-31ds-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-31ds-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-61ds-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-61ds-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-61ds-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-62ds-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-62ds-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-62ds-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-65ds-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-65ds-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-65ds-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-66ds-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-66ds-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-66ds-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	EW-3-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	EW-3-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	EW-3-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	EW-13-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	EW-13-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	EW-13-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-20ds-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-20ds-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-20ds-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-20dg-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-20dg-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-20dg-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-21ds-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-21ds-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-21ds-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-22Rds-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-22Rds-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-22Rds-0818	Low continuing calibration recovery
1974796	1,2-Dichloroethane	0.2 U	UJ	BOP-23dg-0818	Low continuing calibration recovery
1974796	4-Methyl-2-pentanone	5.0 U	UJ	BOP-23dg-0818	Low continuing calibration recovery
1974796	2-Hexanone	5.0 U	UJ	BOP-23dg-0818	Low continuing calibration recovery
1974796	Acetone	40	J	BOP-21ds-0818	High field duplicate RPD
1974796	Acetone	31	J	BOP-Y-0818	High field duplicate RPD
1974796	Acetone	59	J	BOP-20dg-0818	High field duplicate RPD
1974796	Acetone	80	J	BOP-Z-0818	High field duplicate RPD
1974796	Acetone	360 E	DNR	EW-3-0818	Do not report; use dilution reanalysis
1974796	Benzene	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Bromodichloromethane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Bromoform	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Bromomethane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	2-Butanone	50 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Carbon Disulfide	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Carbon Tetrachloride	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Chlorobenzene	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Chloroethane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Chloroform	2.0 U	DNR	EW-3-0818	Do not report; use original analysis

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Analyte	Result	Qualifier	Sample Number	Reason
1974796	Chloromethane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Dibromochloromethane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	1,1-Dichloroethane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	1,2-Dichloroethane	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	1,1-Dichloroethene	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	cis-1,2-Dichloroethene	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	trans-1,2-Dichloroethene	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	1,2-Dichloropropane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	cis-1,3-Dichloropropene	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	trans-1,3-Dichloropropene	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Ethylbenzene	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	2-Hexanone	50 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	4-Methyl-2-pentanone	50 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Methylene Chloride	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Styrene	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	1,1,2,2-Tetrachloroethane	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Tetrachloroethene	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Toluene	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	1,1,2-Trichloro-1,2,2-trifluoroethane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	1,1,1-Trichloroethane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	1,1,2-Trichloroethane	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Trichloroethene	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Trichlorofluoromethane	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Vinyl Acetate	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	Vinyl Chloride	2.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	m,p-Xylene	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	o-Xylene	5.0 U	DNR	EW-3-0818	Do not report; use original analysis
1974796	2-Butanone	270 E	DNR	BOP-22Rds-0818	Do not report; use dilution reanalysis
1974796	Acetone	50 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Benzene	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Bromodichloromethane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Bromoform	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Bromomethane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Carbon Disulfide	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Carbon Tetrachloride	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Chlorobenzene	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Chloroethane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Chloroform	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Chloromethane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Dibromochloromethane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	1,1-Dichloroethane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	1,2-Dichloroethane	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	1,1-Dichloroethene	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	cis-1,2-Dichloroethene	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	trans-1,2-Dichloroethene	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	1,2-Dichloropropane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	cis-1,3-Dichloropropene	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	trans-1,3-Dichloropropene	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Ethylbenzene	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	2-Hexanone	50 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	4-Methyl-2-pentanone	50 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Methylene Chloride	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Styrene	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	1,1,2,2-Tetrachloroethane	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Analyte	Result	Qualifier	Sample Number	Reason
1974796	Tetrachloroethene	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Toluene	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	1,1,2-Trichloro-1,2,2-trifluoroethane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	1,1,1-Trichloroethane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	1,1,2-Trichloroethane	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Trichloroethene	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Trichlorofluoromethane	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Vinyl Acetate	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	Vinyl Chloride	2.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	m,p-Xylene	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis
1974796	o-Xylene	5.0 U	DNR	BOP-22Rds-0818	Do not report; use original analysis

J = Indicates 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 in the sample; the reported sample reporting limit is an estimate.

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: December 14, 2018

RE: **Boeing Portland (TSA)**
Fourth Quarter 2018 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 3 groundwater samples and 1 trip blank collected during the fourth quarter 2018 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (LLI), located in Lancaster, Pennsylvania. This data quality evaluation covers LLI data package 2005482. Samples submitted to LLI were analyzed for volatile organic compounds ([VOCs]; US Environmental Protection Agency [EPA] Method SW8260C).

The verification and validation check was conducted with guidance from applicable portions of EPA's *National Functional Guidelines for Organic Data Review* (EPA 2016). Landau Associates performed an EPA-equivalent Level IIa verification and validation check on each laboratory data package, which included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).
- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below. Data validation qualifiers are summarized in Table 1.

Chain-of-Custody Records

A signed chain-of-custody (COC) record was attached to the data packages. The laboratory received all samples in good condition. All analyses were performed as requested. No special cleanups or handling methods were requested.

Upon receipt by LLI, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. The coolers were received with temperatures within the EPA-recommended limit of ≤6°C. No qualification of the data was necessary.

Holding Times

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA- and project-specified holding times. No qualification of the data was necessary.

Blank Results

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples for VOCs analysis. Target analytes were not detected at concentrations greater than the reporting limits in the associated method blanks. No qualification of the data was necessary.

Field Trip Blanks and Field Equipment Blanks

One trip blank was submitted to the laboratory for VOC analysis with each sample batch. Target analytes were not detected at concentrations greater than the reporting limits in the associated trip blanks. No qualification of the data was necessary.

No field equipment blanks were submitted for analysis with this sample batch.

Surrogate Recoveries

Appropriate compounds were used as surrogate spikes for the VOCs analysis. Recovery values for the surrogate spikes were within the current laboratory-specified control limits. No qualification of the data was necessary.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) and Laboratory Replicate Results

No matrix spikes were analyzed with this sample batch. No qualification of the data was determined necessary.

Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS/LCSD) Results

At least one laboratory control sample and/or laboratory control sample duplicate (LCS/LCSD) was analyzed with each batch of samples for VOCs analysis. Recoveries and RPDs for the laboratory control samples and associated duplicates were within the current laboratory-specified control limits. No qualification of the data was necessary.

Blind Field Duplicate Results

No blind field duplicate samples were submitted with this sample batch. No qualification of the data was determined necessary.

Quantitation Limits

Project-specified quantitation limits were met for all samples except for instances where high concentrations required dilution of the sample extracts.

Audit/Corrective Action Records

No audits were performed or required. No corrective action records were generated for this sample batch. Based on the laboratory's case narratives, continuing calibration verification (CCV) recovery results were within laboratory-specified control limits, with the following exceptions:

- The laboratory case narrative indicated the CCV recovery was low for 2-butanone associated with multiple samples in data package 2005482. The associated sample results were qualified as estimated (UJ), as indicated in Table 1.
- The laboratory case narrative indicated the CCV recovery was high for cis-1,2-dichloroethene and trichloroethene associated with sample BOP-13dg-1118 in data package 2005482. The associated sample detections were qualified as estimated (J), as indicated in Table 1.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.

Kristi Schultz
Data Specialist

Danille Jorgensen
Environmental Data Manager

DRJ/kes
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References

EPA. 2016. National Functional Guidelines for Superfund Organic Methods Data Review. edited by Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, DC: US Environmental Protection Agency.

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Analyte	Result	Qualifier	Sample Number	Reason
2005482	2-Butanone	5.0 U	UJ	BOP-31dg-1118	Low continuing calibration recovery
2005482	2-Butanone	5.0 U	UJ	BOP-13dg-1118	Low continuing calibration recovery
2005482	Trichloroethene	0.2	J	BOP-13dg-1118	High continuing calibration recovery
2005482	2-Butanone	5.0 U	UJ	BOP-13ds-1118	Low continuing calibration recovery

J = Indicates 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 in the sample; the reported sample reporting limit is an estimate.