Prepared for:

Cascade Corporation
2201 NE 201st Avenue
Fairview, Oregon 97024

The Boeing Company
P.O. Box 2207, M/S 7A-XA
Seattle, WA 98124

ANNUAL PERFORMANCE REPORT
1 JANUARY 2021 – 31 DECEMBER 2021

EAST MULTNOMAH COUNTY, TROUTDALE SANDSTONE AQUIFER REMEDY
ECSI 1479

Prepared by:

Geosyntec Consultants, Inc.
920 SW 6th Avenue, Suite 600
Portland, OR 97204

Landau Associates, Inc.
155 NE 100th St Ste 302,
Seattle, WA 98125

S.S. Papadopulos & Associates, Inc.
7944 Wisconsin Avenue
Bethesda, MD 20814

May 2022

Geosyntec consultants

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF APPENDICES (Continued)

LIST OF ACRONYMS AND ABBREVIATIONS

µg/m^3	micrograms per cubic meter
µg/L	micrograms per liter
BGal	billion gallons
bgs	below ground surface
BLA	Blue Lake Aquifer
Boeing	The Boeing Company
Cascade	Cascade Corporation
CU1	Confining Unit 1
CSSWF	Columbia South Shore Well Field
CTS	Central Treatment System
DCE	1,2-dichloroethene
DEQ	Oregon Department of Environmental Quality
EMC	East Multnomah County
EW	extraction well
ft	foot, feet
GET	groundwater extraction treatment system
gpm	gallons per minute
LAI	Landau Associates, Inc.
lbs	pounds
MCL	maximum contaminant level
NFA	No Further Action
NOAA	National Oceanic and Atmospheric Administration
PCE	tetrachloroethene
PID	photoionization detector
PLC	programmable logistics controller
PUD	People's Utility District
PVC	polyvinyl chloride
PWB	Portland Water Bureau
RBCs	risk-based concentrations
ROD	Record of Decision
scfm	standard cubic feet per minute

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

SGA	Sand and Gravel Aquifer
SSPA	S.S. Papadopulos & Associates, Inc.
SU	standard units
SVE	soil vapor extraction
TCE	trichloroethene
TGA	Troutdale Gravel Aquifer
TSA	Troutdale Sandstone Aquifer
VC	vinyl chloride
VOC	volatile organic compound

Annual Performance Report
1 January 2021 – 31 December 2021

East Multnomah County Troutdale Sandstone Aquifer Remedy

Prepared by:

6.1.23

Cindy Bartlett, R.G.
Geosyntec Consultants

05/11/2022
Date

Evelyn Ives

Evelyn Ives, P.E.
Landau Associates

05/11/2022
Date

Reviewed by:

Brent Miller

Brent Miller, P.E.
Geosyntec Consultants

05/11/2022
Date

Charles B Andrews

Charles Andrews, Ph.D.
S.S. Papadopulos & Associates, Inc.

05/11/2022
Date

1.0 INTRODUCTION

This report, submitted on behalf of Cascade Corporation (Cascade) and The Boeing Company (Boeing), summarizes performance and monitoring data for the East Multnomah County (EMC), Troutdale Sandstone Aquifer (TSA) remedy project. Data presented in this report were collected during the period of 1 January 2021 through 31 December 2021 as part of the joint remedy being implemented under the Oregon Department of Environmental Quality (DEQ) Consent Order No. WMCSR-NWR-96-08 (DEQ, 1997) and conditions in the Record of Decision (ROD) (DEQ, 1996) to remediate dissolved volatile organic compound (VOC) comingled plumes in the direct vicinity of the Boeing and Cascade properties.

EMC Site discovery and groundwater investigations of the TSA and underlying Sand and Gravel Aquifer (SGA) began in 1986, and initial groundwater extraction using pump and treat methods commenced in 1993. Results of early investigations indicated the presence of groundwater VOC concentrations above maximum contaminant levels (MCLs) for trichloroethene (TCE), tetrachloroethene (PCE), cis-1,2-dichloroethene (DCE), 1,1-dichloroethane, 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. Groundwater extraction and treatment systems (GETs) have been operational since 1997 (interim operation prior to 1997) and have been successful in removing VOC mass from the saturated zone and greatly decreasing the size of the dissolved VOC plume. In addition to GETs, a soil vapor extraction (SVE) system has been operational since 2015 with the goal of removing VOC mass from the unsaturated zone within the mound area of the Site. The ROD defined the primary source of contamination to the TSA as contaminated groundwater from the overlying Troutdale Gravel Aquifer (TGA), along with other secondary sources (i.e., natural springs and former supply wells screened across the Confining Unit 1 (CU1) between the TGA and the TSA).

Low-level TCE concentrations were discovered in areas of the SGA, underlying the TSA. The SGA-dissolved mass was remediated by the GETs between 1998 and 2007 and associated post-remedy groundwater monitoring ceased in 2013. All but one SGA well [BOP-44(usg)] have been decommissioned. DEQ is in the process of preparing a partial No Further Action (NFA) for the SGA (DEQ, 2021a).

1.1 Purpose of Report

The reporting period for the TSA remedy Annual Performance Report presents data through calendar year 2021. 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;
- The GETs and the SVE system (remedy technique added after the Consent Order);

- An assessment of the aquifer restoration progress; and
- Recommendations and future planned activities.

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

1.2 Background

The original study area for the EMC Site was an area of approximately 2,300 acres that is bound by the Columbia River to the north, Northeast Fairview Avenue and Northeast 223rd Avenue to the east, Northeast Halsey Street to the south, and Northeast 181st Avenue to the West (Figure 1-1). The EMC Site is located in Sections 19, 20, 28, and 29 in Township 1 North, Range 3 East. Surface elevation at the EMC Site is highest to the south and descends in a series of river/flood cut terraces northward to the Columbia River. The EMC Site discovery and groundwater investigations of the TSA and the SGA began in 1986. Between 1994 and 1996, remedial investigations and a feasibility study were conducted that indicated groundwater VOC concentrations above the MCLs for TCE (5 micrograms per liter [µg/L]), PCE (5 µg/L), cis-1,2-DCE (70 µg/L), 1,1-DCE (7 µg/L), and VC (2 µg/L), with an aerial extent of approximately 400 acres in the TSA.

Four TSA remedial areas were described in the ROD and subsequently assigned letters, as shown in Figure 1-2. A summary of the TSA remedial zones is given below:

TSA Remedial Zone	Zone Location
Zone A	Area north of Sandy Boulevard
Zone B	Area south of Sandy Boulevard in the western portion of the Boeing facility
Zone C	Area south of Sandy Boulevard, directly east of Zone B and west of N.E. 205th Avenue
Zone D	Area south of Sandy Boulevard, directly east of Zone C and area east of N.E. 205th Avenue

Between 1993 and 2000, six GETs were installed to provide hydraulic capture of the dissolved VOC plume and to remove VOC mass. The GETs systems have been successful at reducing VOC concentrations and shrinking the size of the dissolved plume to about 15 acres. Treatment systems have been sequentially shut down as areas achieve cleanup levels. The systems have been decommissioned except for the Central Treatment System (CTS), which was installed to capture groundwater in the TSA mound area in Zone C and started operation in 1997. The approximate locations of the five former (decommissioned) GETs and the remaining GET are shown in Figure 3-1. The CTS continues to operate to provide hydraulic capture of the dissolved VOC

plume. A total of 11 Lower TSA extraction wells (EW-1, -2, -4, -5, -8, -11, -12, -14, -15, -16, -18, and -23) have routed groundwater to the system since system startup. Currently, EW-2 and EW-14 are actively operated while EW-1 and EW-23 are in pilot shutdown mode. Wells EW-4, EW-8, EW-15, and EW-18 have been decommissioned with DEQ approval based on TCE concentrations meeting cleanup levels, and the remaining wells were converted into groundwater monitoring wells.

In 2014, an SVE pilot study was commenced in the TSA mound area (Zone C) to evaluate enhanced removal of VOC s in the vadose zone that may contribute mass to the groundwater plume as the water table rises. The system was successful in removing VOC mass, and full-scale operation of the system was implemented in 2015. The system was expanded in 2016, 2019, and February 2022. By the end of 2021, approximately 84 pounds of VOCs had been removed (discussed in Section 3.5, below). The current SVE wells are shown in Figure 3-2.

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 is presented in Table 2-3.

2.1 Monitoring Program and Schedule Modifications

Monitoring schedule modifications implemented during the reporting period were presented in the *Annual Performance Report 1 January 2020 – 31 December 2020 East Multnomah County, Troutdale Sandstone Aquifer Remedy ECSI 1479* (Geosyntec Consultants, Inc. [Geosyntec], Landau Associates, Inc [LAI], and S.S. Papadopulos & Associates, Inc. [SSPA], 2021). DEQ approved the modifications listed below on 18 May 2021 (DEQ, 2021a):

- Decommissioned EW-8 and EW-15;
- Placed EW-23 in pilot shutdown mode on 5 April 2021; and
- Continued pilot shutdown of EW-1 (since August 2018).

Additional modifications recommended previously in the 2019 Annual Report (Geosyntec, Landau, and SSPA, 2020), which DEQ approved (DEQ, 2020a), that are still pending in 2021, include the decommissioning of Upper TSA wells BOP-21(ds) and BOP-42(ds) along with Lower TSA wells BOP-42(dg) and BOP-60(dg). These four wells have met remedy decommissioning criteria, as the locations are redundant to several other wells located closer to the leading edge of the dissolved VOC plume. These four wells were not yet decommissioned pending DEQ's potential requests for 1,4-dioxane sampling. The wells have been removed from the monitoring network and, therefore, no samples were collected from these wells in 2021.

Additional modifications recommended previously in the 2018 Annual Report (Geosyntec, Landau, and SSPA, 2019), which DEQ approved (DEQ, 2019a), that are still pending in 2021, include the decommissioning of CMW-8(dg) and CMW-10(dg). These two wells were also not decommissioned pending DEQ's potential request for 1,4-dioxane sampling. However, the wells have been removed from the monitoring network and, therefore, no samples were collected from these wells in 2021.

Additional modifications recommended previously in the 2017 Annual Report (Geosyntec, Landau, and SSPA, 2018), which DEQ approved (DEQ, 2018), that are still pending in 2021, include the decommissioning of 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 these wells, the schedule for decommissioning has been delayed pending DEQ

approval for a conditional NFA determination for Remedy Zone A. Samples were not collected from these wells in 2021.

2.2 Municipal Well Field Operations

The City of Portland utilizes the Bull Run Reservoir as a primary drinking water source. Periodically, additional water is required, and the City of Portland augments supply from the Columbia South Shore Well Field (CSSWF) municipal production wells (shown in Figure 1-1). The CSSWF is operated by the Portland Water Bureau (PWB).

During 2021, the CSSWF was operated for the three pumping events listed below (PWB, 2022).

- Summer augmentation usage of the CSSWF from 3 August 2021 through 27 August 2021 (24 days):
  - Total gallons pumped from TSA: 0.119 billion gallons (BGal) or approximately 9% of total production.
  - Total gallons pumped from SGA: 0.584 BGal or approximately 43% of total production.
  - Total gallons pumped from the Blue Lake Aquifer (BLA): 0.661 BGal or approximately 48% of total production.
- BLA hydraulic control operations in the CSSWF from 28 September 2021 through 12 October 2021 (14 days). Total gallons pumped from BLA 0.177 BGal or approximately 100% of total production.
- November emergency event usage of the CSSWF from 15 November 2021 through 17 November 2021 (2 days):
  - Total gallons pumped from TSA: 0.0139 BGal or approximately 10% of total production.
  - Total gallons pumped from SGA: 0.0828 BGal or approximately 59% of total production.
  - Total gallons pumped from BLA: 0.0427 BGal or approximately 31% of total production.

Due to the close vicinity of the CSSWF to the EMC Site, PWB pumping events are closely monitored, and additional contingency monitoring is established pursuant to the PWB Contingency Monitoring Plan (LAI, 2019) and approved by DEQ (DEQ, 2020b). Water levels were collected continuously using pressure transducers with weekly manual checks to confirm data. Per the PWB Contingency Monitoring Plan for short-term PWB pumping events, no additional groundwater samples were collected by EMC related to the PWB pumping event.

In 2021, Rockwood People's Utility District (PUD) extracted 454 million gallons of groundwater between May and September with a peak of 155 million gallons in July (Rockwood PUD, 2022).

The groundwater system was turned on during other months for maintenance, but no volume information was provided. Groundwater is extracted from the SGA.

2.3 1,4-Dioxane Reconnaissance-Level Investigation

In March 2021, DEQ requested a reconnaissance-level groundwater sampling event for 1,4 dioxane to evaluate whether it is present at concentrations above the DEQ risk-based cleanup standards (DEQ 2018d). A work plan with selected wells and procedures for sample collection using Dual Membrane Passive Diffusion Bag (DMPDB™) samplers was prepared (LAI, 2021) and subsequently approved by DEQ with the request that results be compared to the DEQ risk-based concentrations (RBCs) for groundwater ingestion and inhalation from tap water for a residential scenario (0.46 µg/L; DEQ 2021a). Results of the reconnaissance-level investigation (Table E-4) indicate that 1,4-dioxane concentrations at Upper TSA wells BOP-61(ds), CMW-17(ds), CMW-18(ds), and BOP-44(ds), along with Lower TSA wells BOP-44(dg) and CMW-36(dg) were below the RBC (0.46 µg/L).

In early 2022, DEQ approved the results of the 1,4-dioxane reconnaissance-level investigation, but requested additional confirmation sampling at BOP-44(ds) and CMW-17(ds) (DEQ, 2022). Cascade and Boeing are following up with DEQ on this request.

3.0 EXTRACTION AND TREATMENT SYSTEMS

This section summarizes the operation and performance of the CTS GET, as well as the SVE system constructed in 2015 in the mound area. Historically, six GETs were operated across the EMC site and over time, extraction wells were shut down once TCE concentrations were consistently below the MCL and no longer needed for hydraulic capture of the dissolved VOC plume. Individual GETs were closed down and decommissioned with DEQ's approval, since each treatment area had achieved cleanup levels. After the extraction wells are shut down, they are typically utilized for groundwater monitoring or decommissioned. Upper TSA extraction well EW-3 and Lower TSA extraction wells EW-1, EW-5, EW-11, EW-12, EW-13, EW-16, and EW-23 remain in use as monitoring wells. The one remaining GET is the CTS, which operates to remove VOC mass and maintain hydraulic control of the remaining 14-acre TSA plume by the operation of two Lower TSA extraction wells in Zone C (Figure 1-2). Current operating extraction wells are EW-2 and EW-14, located in the mound area near the CTS. EW-23, located on the Boeing property in Zone C, operated until switching to pilot shutdown mode in April 2021. The locations of the current and former GETs, treated water lines, and extraction and monitoring wells are shown in Figure 3-1.. Well construction and location details for current monitoring and extraction wells are summarized in Table 3-1.

3.1 CTS Operational Summary

In 2021, the CTS was operated to treat and capture groundwater through the operation of three Lower TSA extraction wells (EW-2, EW-14, and EW-23 (only January-April for EW-23). Daily flow data from each well are recorded by the automated programmable logistics controller (PLC) system. Data from the PLC are downloaded, and manual inspections and field system field checks are 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.

The CTS and the extraction wells were operated during the 12-month reporting period, except as discussed below. Planned shutdowns for system maintenance occurred as follows:

- 5 April 2021: EW-23 pump turned off, start of pilot shutdown;
- 20 September 2021: EW-2 shutdown for sonar cleaning and motor replacement. Pump turned back on September 22, 2021;
- 30 November 2021: New manual flow meter was installed in EW-2; and
- 14 to 17 December 2021: EW-14 shut off for hydraulic testing.

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

- 18 January 2021: EW-23 vault flooded, causing the pump to shut down;
- 22 February 2021: EW-23 vault flooded, causing the pump to shut down;

- 20 September 2021: Voltage spike caused EW-2 pump to shut down; and
- 18 to 22 November 2021: EW-2 and EW-14 shut down due to PLC stopping recording after data were downloaded remotely.

Repair and cleaning events for the operating TSA extraction wells in 2021 are noted in Figures A-1 through A-3 of Appendix A. Upgrades to the CTS and PLC in recent years have included significant updates to the computer programs (2017 and 2019), power supply protection for stability during power surges from lightning and power grid fluctuations (2018 and 2019), and water level controls (new transducers and a barometer in 2019 and 2020).

3.2 Groundwater Extraction Rates

Target flow rates for the extraction wells have been established to maintain hydraulic capture of the dissolved VOC plume. The 2021 target extraction rates were: EW-2 at 25 gallons per minute (gpm); EW-14 at 20 gpm; and EW-23 at 30 gpm (EW-23 only operated from 1 January 2021 to 5 April 2021).

Flows at EW-2, EW-14, and EW-23 averaged 31, 21, and 26 gpm, respectively. From the summer of 2020 to the summer of 2021, the EW-2 pumping rate steadily declined, which prompted sonic cleaning of the well as part of the routine extraction well maintenance program. After the cleaning event and replacement of the pump motor, EW-2 exhibited a marked increase in flow rate and a resulting decrease in groundwater elevations (Figures A-1 and A-2). EW-23 was placed in pilot shutdown mode starting in April 2021, which resulted in a decrease in the total CTS extraction rate (Figure A-4). Flow rates were sufficient to maintain hydraulic capture in the mound area of the Site, as demonstrated by groundwater elevations and gradients (discussed in Section 4.2) and TCE concentrations in nearby wells (discussed in Section 4.3).

Flow rate and water level data for the extraction wells are provided in Appendix A, with average monthly extraction well flow rates over the most recent five-year period provided in Figures A-1, A-2, and A-3 and combined average monthly flow for all wells in Figure A-4. 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. The permit to discharge treated groundwater effluent to the Columbia Slough from the CTS is presented in Attachment C to the TSA Remedy Consent Order (DEQ 1997). 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).

CTS data for the reporting period are as follows:

- The total average flow during the 12-month period, January through December 2021, was 60 gpm (Appendix A, Table A-1). There is no permit limit based on flow.
- Effluent pH ranged from 7.61 to 7.97 standard units (SU) and remained within the effluent limits of 6 to 9 SU.
- Effluent temperature ranged from 60 to 68 degrees Fahrenheit. There is no permit limit based on temperature.
- VOCs were not detected at the respective laboratory reporting limits in quarterly effluent samples. Permit limits for VOC concentrations are the same as the EMC cleanup levels (equal to the MCL).

As shown on Table A-2, performance data for 2021 were in compliance with permit limits.

3.4 Well Decommissioning

No wells were decommissioned in 2021. However, the wells listed below have previously been approved by DEQ for decommissioning. Samples were not collected from these wells in 2021.

- Decommissioning of EW-8 and EW-15 was approved in 2021, and DEQ approved the well decommissioning work plan in December 2021 (DEQ, 2021f). The well decommissionings were completed in February 2022 and will be described in the 2022 Annual Report.
- Decommissioning of Upper TSA wells BOP-21(ds) and BOP-42(ds), along with Lower TSA wells BOP-42(dg) and BOP-60(dg), was approved in 2020, but have not been decommissioned yet.
- Decommissioning of Lower TSA wells CMW-8(dg) and CMW-10(dg) was approved in 2019, but have not been decommissioned yet.
- Decommissioning of SGA well BOP-44(usg), and TSA wells BOP-44(dg), BOP-44(ds), and EMC-2(dg), which are located in Remedy Zone A, was approved in 2018. Although DEQ approved decommissioning these wells, the schedule for decommissioning has been delayed pending DEQ approval for a conditional NFA determination for Remedy Zone A.

Well CMW-26(dg) was decommissioned in October 2020 and summarized in the 2020 Annual Report. However, the generated soil cuttings were stored near the CTS building pending disposal. DEQ granted a No Longer Contained In Determination letter in 2021 (DEQ, 2021b), and the 12 drums were disposed of at the Hillsboro Landfill, Inc. on 2 September 2021 (Waste Tracking Numbers 311675/D379350 and 311675/D379351). Landfill disposal receipts are provided in Appendix B.

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 in the groundwater have responded slower to the pump and treat remedy than in other areas. Beginning in 2014, SVE was pilot-tested at three vapor monitoring wells (VW-17D-42.5, VW-17D-75, and VW-17D-95.5), and following favorable results, full-scale SVE commenced at these vapor wells in 2015. The SVE system was expanded in 2016 with four vapor extraction wells (VMW-A through VMW-D) and again in Spring 2019 with installation of three wells (VMW-E, VMW-F, and VMW-G) that are angled towards groundwater monitoring well CMW-18(ds) and one vertical well (VMW-H) to the west of VMW-C. SVE testing for six wells installed in 2020 (VMW-I, -J2, -K, -L, -M, and -N) was conducted in May and June 2021 to determine which, if any, should be connected to the existing SVE system. As reported in the SVE Expansion Work Plan (Geosyntec, 2021c), the results of the baseline sampling indicated that only VMW-J2 and VMW-K exhibited significant TCE vapor concentrations above 1,000 micrograms per cubic meter (µg/m^3). The other wells contained TCE below 500 µg/L (Geosyntec, 2021c). Based on these results, VMW-J2 and VMW-K were selected for connection to the SVE system. DEQ approved the SVE Expansion Work Plan (DEQ, 2021e), and the wells were connected in March 2022.

SVE has been discontinued at a number of wells after mass removal reached asymptotic levels. Vapor extraction at the two shallow wells (VW-17D-42.5 and VW-17D-75) was discontinued in 2016, and these wells were subsequently decommissioned in 2018. Shutdown and rebound testing for SVE wells VMW-A, VMW-B, and VMW-D was conducted in 2019. Based on the results, the wells have not been utilized for SVE since October 2019; however, the wells have not been decommissioned and could be utilized as either vapor or groundwater monitoring wells, if needed.

The SVE system wells and underground piping are shown in Figure 3-2.

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 eight vapor extraction wells (VMW-A though VMW-H) via belowground PVC piping. Extracted vapors are sampled quarterly and discharged into the atmosphere through a PVC exhaust stack at a height of approximately 8 feet (ft). The SVE system maintained an average flow rate of around 379 standard cubic feet per minute (scfm) in 2021, and average weekly flow rates are shown on Table C-1 and Figure C-2.

Currently, VMW-A, VMW-B, and VMW-D are disconnected from the SVE system and are not being monitored as a result of SVE rebound testing in 2019 that showed no TCE mass removal from these wells (Geosyntec, Landau Associates, and SSPA, 2020). The SVE system is not a part of the ROD remedy; however, DEQ approved the shutdown.

3.5.2 SVE System Monitoring

Routine SVE system monitoring was conducted in six of the nine SVE wells (VMW-C, VMW-E, VMW-F, VMW-G, VMW-H, and VW-17D-95.5). The 2021 monitoring schedule is summarized in the table below:

Well Name	Vapor Monitoring (PID)	Vapor Sampling (Summa)	Temperature, Pressure, Flow Rate
VMW-17D-95.5 (soil vapor only)	Quarterly	Quarterly	Weekly
VMW-A	NM[1]	NM[1]	NM[1]
VMW-B	NM[1]	NM[1]	NM[1]
VMW-C	Quarterly	Quarterly	Weekly
VMW-D	NM[1]	NM[1]	NM[1]
VMW-E	Quarterly	Quarterly	Weekly
VMW-F	Quarterly	Quarterly	Weekly
VMW-G	Quarterly	Quarterly	Weekly
VMW-H	Quarterly	Quarterly	Weekly
Effluent	Monthly	Monthly	Weekly

The monitoring for the six actively operated SVE wells and the system outlet consisted of the following:

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

VOC vapor results from photoionization detector (PID) measurements in parts per million (ppm) (outlet only) and laboratory testing in µg/m3 (outlet and wells) 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 Monitoring Results

The 2021 quarterly analytical results for the actively operated SVE wells indicate that the highest TCE vapor concentration was measured during August in VMW-C (1,500 µg/m³) (Figure 3-3). Of the operating SVE wells, VMW-C had the highest average TCE vapor concentration and ranged from 900 to 1,500 µg/m³. The highest measured TCE vapor concentration was 9,300 µg/m³ in VMW-K, which was not connected to the SVE system in 2021. The average TCE vapor concentration for the SVE system effluent was 652 µg/m³. Groundwater samples collected from

[1]NM = not monitored for vapor. Vapor extraction at well is currently shut down. Well is utilized for groundwater monitoring.

the SVE wells indicate that the highest TCE concentrations were detected at angled well VMW-E and ranged from 7.59 to 22.6 µg/L (groundwater results are discussed in Section 4.3, below). The vapor extraction operational values and manual PID measurements are presented in Table C-1 (outlet), vapor analytical results are summarized in Table C-2 (outlet and wells), and groundwater analytical results are summarized in Table E-1.

3.5.4 SVE System Mass Removal

The SVE system removed approximately 8.2 pounds (lbs) of VOCs (7.1 lbs of TCE) in 2021 (based on laboratory analyses) and a total of approximately 84.2 lbs of VOC (72.5 lbs of TCE) from the TSA mound area since the startup of the SVE Pilot Study in 2014 (Table C-3). VOC mass removal in 2021 (8.2 lbs/year) was approximately equal to the 2020 removal rate (7.6 lbs/year). Operational data for the SVE system 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 through C-3, and in Figures C-1 through C-3.

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 either monthly, quarterly, semi-annually, or 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 CMW-36(dg) and CMW-22(dg) (Figure D-2). 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 operation of municipal well fields PWB and Rockwood PUD in 2021, drawdown was approximately 5.3 ft in the upper TSA well BOP-65(ds), 4.9 ft in the Lower TSA well EW-13, and 2.3 ft in Lower TSA well CMW-36dg. These wells are located along the western and northern portions of the remedy area.

Groundwater depths and groundwater elevations are summarized in Appendix D, Table D-1. Groundwater elevation hydrographs and precipitation data for the wells with pressure transducers along with precipitation data are included in Appendix D in Figures D-1 and D-2. Precipitation during the 2021 12-month reporting period was approximately 35.6 inches, which is approximately equal to the normal 36.0 inches of annual precipitation at the Portland Airport (National Oceanic and Atmospheric Administration [NOAA], 2020).

During February 2021, CMW-24(dg)/EW-5 was covered by several feet of soil as the result of earthmoving operations on the property, and the well could not be accessed. The soil was removed, and the well was sampled in March 2021, but the water level was inadvertently not recorded. In August 2021, EW-11 was blocked by a vehicle, and the depth to water could not be measured. Three attempts on different days were made to measure the water level in EW-11 with no success.

4.2 Groundwater Flow and Hydraulic Capture

As defined in the ROD, 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 continued in 2021 due to ongoing remedy pumping. Groundwater contours for the semiannual water level measurement event (February 2021) and the annual event (August 2021) are provided in Figures 4-1a,b and 4-2a,b.

Groundwater flow in the Upper TSA exhibits a radial or mounded flow pattern in the vicinity of the TSA mound area with localized flow to the south. Lower TSA inward hydraulic gradients towards the extraction wells are indicative of hydraulic capture and demonstrate the effectiveness of Lower TSA extraction wells EW-2, EW-14, and EW-23 (in pilot shutdown mode since April 2021) in achieving and maintaining capture. Groundwater flow directions in the Lower TSA in the mound area do not vary significantly from the wet to dry seasons and are strongly influenced by the operating extraction wells. These extraction wells capture groundwater from areas with VOC concentrations above the respective cleanup level. Hydraulic capture of the dissolved VOC plume is also exhibited by spatial VOC concentration trends, as discussed below.

4.3 Groundwater Quality

Groundwater quality is evaluated against the MCL for the Site chemicals of concern. TCE, the predominant chemical by mass, is used to evaluate remedy progress and has an MCL of 5 µg/L.

Groundwater samples are collected for analytical testing on a quarterly, semi-annual, annual, or biennial frequency, based on the DEQ-approved Performance Monitoring Schedule (Table 2-2). Sampling events occur in February, May, August, and November of each year, with August (Annual/Biennial event) being the most inclusive sampling event. Biennial analytical monitoring is conducted in August of odd number calendar years (e.g., 2021 and 2023); therefore, biennial sampling was conducted in 2021. The Performance Monitoring Schedule is reviewed annually to ensure compliance with the ROD and develop recommendations for the monitoring program for DEQ approval.

Analytical results for groundwater samples collected during this 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 three operating extraction wells are presented in Appendix E, Figures E-1 through E-6. TCE concentration contours for the February and August sampling events 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 remained above the MCL in the Upper TSA mound area (located in Remedy Zone C) during the monitoring period (January through December 2021). TCE concentrations in the Upper TSA wells located outside of the mound area were below the MCL, and some were below the laboratory reporting limits. TCE concentrations in the western portion of the site (Remedy Zone B) have consistently been below the MCL since 2019. TCE concentration contours for February and August 2021 are shown in Figures 5-1a and 5-2a. The area of the Upper TSA TCE plume with concentrations over the MCL (5 µg/L) is estimated at 15 acres.

Below is a brief discussion of TCE concentrations in the Upper TSA mound area wells.

- CMW-17(ds): TCE concentrations ranged from 30.5 to 35.6 µg/L (Figure E-1);
- CMW-10(ds): TCE concentrations ranged from 8.55 to 9.38 µg/L (Figure E-2);

- CMW-18(ds): TCE concentrations ranged from 58.0 to 83.3 µg/L (Figure E-3);
- Groundwater TCE concentrations in soil vapor monitoring wells (VMW-A through VMW-H) ranged from non-detect at the laboratory reporting limit (VMW-H, VMW-G, and VMW-F) and up to 22.6 µg/L at VMW-E; and
- Groundwater TCE concentrations in the new soil vapor monitoring wells (VMW-I through VMW-N): ranged from non-detect at the laboratory reporting limit (VMW-L) up to 89.4 µg/L at VMW-J2 (during routine monitoring when the SVE system is operational).

TCE concentrations for the Upper TSA remain the highest at wells CMW-18(ds), VMW-K, and VMW-J2.

4.3.2 Lower TSA

In 2021, TCE concentrations remained above the MCL in wells located in the mound area, while the other remaining wells were either non-detect at the laboratory reporting limit or below the MCL. As noted above, well EW-11 was blocked by a car during repeated attempts to sample in August 2021.

In the mound area, Remedy Zone C, well D-17(ds) continued to exhibit the highest TCE concentration in the Lower TSA with concentrations rangeing from 22.2 to 30.7 µg/L (Appendix E, Figure E-6) in 2021. TCE concentrations at D-17(ds) generally decreased after aquifer resaturation in 2009 through 2016. However, TCE concentrations steadily increased starting in May 2017 and reached a maximum concentration of 61.2 µg/L in May 2019. Since reaching that maximum, TCE concentrations steadily decreased to 22.2 µg/L in August 2021, before rising to 30.7 µg/L in November 2021. Monitoring well D-17(ds) is screened at the top of the Lower TSA across the water table (110 to 120 ft below ground surface [bgs]), while well D-17(dg) is screened in the lower portion of the Lower TSA (152 to 172 feet bgs). TCE concentrations at D-17(dg) have been consistently below the MCL since August 2016, indicating that groundwater impacts in this area are localized to the upper portion of the Lower TSA.

During the period 2019 through 2021, TCE concentrations were below the MCL at non-pumping extraction wells used for monitoring (EW-1 and EW-12), with the exception of the November 2019 sampling event at EW-1 (7.14 µg/L). In 2021, TCE concentrations at EW-1 (pilot shutdown in 2018) were below the laboratory reporting limit (0.5 ug/L) for three of the quarterly sampling events and was only slightly over over the reporting limit (0.533 µg/L) in February 2021. TCE concentrations at operating extraction wells EW-2 (7.85 to 9.11 µg/L) and EW-14 (5.16 to 6.43 µg/L) were above the TCE MCL (Figure E-7).

In the eastern portion of the Site (Remedy Zone D), TCE concentrations in the Lower TSA former extraction wells (now used for monitoring) have been below the MCL at EW-11 (since 2009, although not sampled in 2021) and EW-16 (since 2013).

TCE concentrations for the Lower TSA wells sampled in 2021 are shown in Figures 5-1b and 5-2b. The approximate area of the Lower TSA TCE plume with concentrations over the MCL (5 µg/L) is estimated at 14 acres, a 97% decrease from the initial 400-acre plume area.

4.4 TCE Mass Removal in Saturated TSA

TCE mass removal estimates are based on groundwater VOC concentrations and average quarterly groundwater extraction flow. In 2021, approximately 1.7 lbs of TCE was removed through the GETs. Since startup of the GETs in 1996, an estimated total of 502 lbs of VOCs have been removed from the TSA and SGA. Mass removal rates declined markedly during the first decade following startup, but have remained relatively constant for the past nine years ranging from 1.7 to 3.4 lbs annually (Figure E-9). The tailing off of mass removal is likely due to low pore volume exchange in the low transmissive Upper TSA where the VOC mass remains. The consistent VOC removal rates could be from pumping relatively clean groundwater from the more transmissive Lower TSA (conglomerate/gravel) where extraction wells are screened, and migration of Upper TSA VOC mass down into the Lower TSA. TCE annual mass removal estimates for the TSA remedy are summarized in Appendix E (Table E-2 and Figure E-8), and TCE mass removal estimates for each extraction well are summarized in Appendix E (Table E-3 and Figure E-9).

5.0 PERFORMANCE SUMMARY

The EMC TSA remedy has been effective at reducing TCE plume size and magnitude since implementation in 1993. The TCE plume in the TSA has reduced in size from an original approximate 400 acres in the mid-1990s to approximately 14 acres in the Lower TSA and 15 acres in the Upper TSA in 2021. The area where the remedy selection has been less effective is the mound area in Remedy Zone C. Modifications to the GETs and installation of an SVE system have been implemented to improve performance in this area of the site. EMC TSA groundwater and SVE systems removed 1.7 lbs and 7.1 lbs of TCE, respectively, in 2021. The total remedy TCE mass removal since remedy implementation, is estimated at 502 lbs from the saturated zone and 72.5 lbs from the unsaturated zone. Additional wells installed in the mound area in 2020 as part of a data gap investigation are being utilized to refine a focused remedial approach in the mound area.

TCE concentrations were above the MCL at:

- Four out of 31 total groundwater monitoring wells: CMW-10ds, CMW-17ds, CMW-18ds, and D-17ds. These wells are located in the mound area; and
- Two out of three total extraction wells: EW-14 and EW-2, and eight out of 14 total vapor/groundwater monitoring wells located in the mound area: VMW-B, VMW-C, VMW-E, VMW-I, VMW-J2, VMW-K, VMW-M, and VMW-N.

Significant remedy performance findings are summarized below.

- ROD remedy objectives for hydraulic capture were achieved in 2021. Groundwater flow directions in the Upper and Lower TSA indicate ongoing inward and downward flow towards the operating extraction wells (Figures 4-1a,b and 4-2a,b).
- Average flow rates at extraction wells continue to operate at or above target as follows: EW-2 (31 gpm), EW-14 (21 gpm), and EW-23 (26 gpm until pilot shutdown on 5 April 2021). As the plume decreased from effective treatment, extraction wells were identified for shutdown and approved by DEQ. Accordingly, the 12-month average flow rate from the operating extraction wells also decreased with fewer pumping wells being operated and was a total of 60 gpm versus during the previous reporting period (85 gpm). This decrease was due to the pilot shutdown of EW-23.
- Upgrades to the CTS and PLC in recent years have strengthened the GETs against outages related to power surges and aging infrastructure.
- TCE concentrations in in the Upper TSA wells, except those in the mound area, are either non-detect at the reporting limit or below the MCL. TCE concentrations continue to be above the MCL in the mound area (Remedy Zone C) at Upper TSA wells CMW-17(ds), CMW-10(ds), and CMW-18(ds), and VMW-B, VMW-C, VMW-E, VMW-I, VMW-J2, VMW-K, VMW-M, and VMW-N in 2021, with the highest concentrations at CMW-18(ds), VMW-J2, and VMW-K.

- In the Lower TSA, the highest TCE concentrations remaining are located in the mound area at well D-17(ds). TCE concentrations at Lower TSA wells located outside the mound area are either non-detect at the laboratory reporting limit or below the MCL.
- TCE concentrations for Lower TSA extraction wells EW-2, EW-14, and EW-23 remained generally stable and consistent with previous years. TCE concentrations were above the MCL at EW-2 and EW-14. Consistent with the last 10 years, the highest TCE concentrations measured in the extraction wells during this reporting period were at EW-2 (Figure E-7). TCE concentrations were below the MCL at extraction well EW-23.
- In 2021, the GETs removed approximately 1.7 lbs of TCE. For comparison, 2.5 lbs were removed in 2020 when two additional extraction wells were operated. As expected, annual mass removal has decreased slowly since 2008 due to a smaller plume size and reduction in the number of active GETs extraction wells as the result of meeting the MCL at those locations (Figure E-8). The system has removed a total of 502 lbs of TCE from the saturated zone since pumping began in 1997.
- In 2021, the SVE system removed approximately 7.1 lbs of TCE. The SVE system has removed a total of approximately 72.5 lbs of TCE from the unsaturated zone near the mound area since pilot test startup in 2014.

6.0 RECOMMENDATIONS AND FUTURE PLANNED ACTIVITIES

6.1 Previous Recommendations In Progress

Previous recommendations that are in progress are summarized below.

As reported in 2018, 2019, and 2020 (Geosyntec, et al, 2018, 2019, 2020, and 2021), water-quality restoration has been achieved in the SGA and in the Upper and Lower TSA north of Sandy Boulevard (Remedy Zone A). DEQ agreed conceptually to proceeding with a conditional NFA for Remedy Zone A (DEQ, 2018), including decommissioning of four remaining wells located in Remedy Zone A (BOP-44(ds), BOP-44(dg), BOP-44(usg), and EMC-2(dg)). The conditional NFA request was submitted to DEQ on 23 April 2020 (Landau and Geosyntec 2020). DEQ's formal approval of the conditional NFA for Remedy Zone A and the entire SGA request is pending.

The SVE system has been effective at removing VOC mass from the unsaturated zone. Based on SVE baseline testing of six vapor/groundwater monitoring wells (VMW-I through VMW-N) installed in 2020, VMW-J2 and VMW-K were selected for connection to the SVE system. The wells were connected to the system in March 2022.

6.2 Recommended Changes for Treatment Systems

The CTS continues to operate and maintain hydraulic control of the dissolved VOC plume. It is recommended to continue operation of wells EW-2 and EW-14. Pilot shutdown of EW-1 and EW-23, as previously approved by DEQ, will continue through 2022. Continued groundwater monitoring at EW-1 and EW-23 will be conducted to evaluate if resumed pumping is needed, per the Remedy Well Network Criteria (Table 2-1).

6.3 Recommend Changes to Monitoring Program and Schedule Modifications

The following monitoring program and schedule modifications are for wells that meet TSA Remedy Criteria and are recommended for DEQ approval:

- Decrease monitoring frequency for groundwater elevation and groundwater quality monitoring for Remedy Zone B wells BOP-13(ds), BOP-13(dg), BOP-31(ds), and BOP-31(dg) from quarterly to semiannually. VOC concentrations in these four wells have been below the respective MCLs and stable since 2015. The four wells are located near the mound area and provide information on hydraulic capture and potential changes in VOC concentrations; however, the monitoring data has become stable enough that quarterly monitoring is unecessary.
- Decrease groundwater quality monitoring frequency at Lower TSA well BOP-20(dg) from annual to biennial. The well is located in Remedy Zone B, far from the leading edge of the current dissolved VOC plume, with several monitoring wells located between BOP-20(dg) and the plume. TCE concentrations have not been detected above laboratory reporting limits since 2016; therefore, annual sampling is no longer necessary. It should

also be noted that the well has been selected to provide additional data during prolonged PWB pumping events of the CSSWF and will continue to be monitored for that purpose.

- Reduce groundwater quality monitoring frequency from quarterly to semiannually at Lower TSA former extraction well EW-12 that is now used for monitoring only. The water level monitoring will be monitored semiannually (no change from current schedule). TCE concentrations have been below the MCL since 2013 and stable between 1 and 2 µg/L since 2016; therefore, quarterly monitoring is no longer necessary. This well is located in Zone C along the Boeing and Dermody property lines.
- Conduct water quality monitoring at former extraction well EW-11 in August 2022. This well was inaccessible for biennial sampling in August 2021.
- Decommission former extraction well EW-16 that is now used for monitoring. TCE concentrations at EW-16 have been below the MCL since February 2013 and below the method reporting limit (0.5 µg/L) since February 2018, with one exception of 0.77 µg/L detected in November 2018. EW-16 was placed into pilot shutdown mode in November 2014 and converted to monitoring status in October 2017.

We request DEQ concurrence for the proposed changes to optimize the monitoring programs and remedy performance.

6.4 Partial NFA and Zone Closure Requests

We recommend closure of remedy zones that have met cleanup criteria in accordance with the ROD be approved by DEQ as a precursor to eventual site closure (NFA Determination). The zone closures will unencumber land development on parcels owned by other individuals or corporations by removing controls established for the remedy area in the DEQ-approved Institutional Control Plan (Landau Associates, Prowell Environmental, 1999). Because portions of the Remedy Zones are located with the CSSWF, the DEQ has authority to evaluate and approve future water utilization applications. 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. In 2017, the closure of Remedy Zone A and the SGA was initially recommended to DEQ. The conditional No Further Action of Remedy Zone A and the SGA has been verbally authorized by DEQ with a public comment period slated for early 2022. Currently, we are requesting partial NFA determinations and closures of Remedy Zone B and D, as discussed below.

6.4.1 Zone B Closure Request

Remedy Zone B is located along the western portion of the Site and is approximately 250 ft downgradient from the current leading edge of the dissolved VOC plume in the mound area. Groundwater restoration has been achieved in Zone B as VOC concentrations have consistently been below the MCLs since 2019. Historically, Upper TSA extraction well EW-3 and Lower TSA extraction well EW-13 were operated to provide groundwater remediation in Zone B; however, operation of the extraction wells ceased in 2009 when DEQ approved the pilot shutdown of the

wells due to consistent low mass removal rates. It should be noted that the two wells have been utilized as monitoring wells since 2013. Based on the Zone B VOC concentrations, the previously DEQ-approved pilot shutdown of extraction well EW-23 (located on the border of Remedy Zones B and C) commenced in the second quarter 2021. Since then, concentrations in Zone B have continued to decrease and are below MCLs. Because the Zone has achieved remedy cleanup levels and no rebound has occurred after EW-23 shutdown, we recommend a Partial NFA determination and closure of this area of the remedy.

Currently, groundwater elevation monitoring and groundwater quality sampling are being conducted at the Upper TSA and Lower TSA wells in the Remedy Zone B area on a quarterly basis (at wells located closest to the mound area) or either annual or biennial frequency based on the well location compared to the leading edge of the dissolved VOC plume in the mound area. Groundwater elevation data are evaluated for capture of the dissolved VOC plume; however, the majority of the wells are located too far to the west of the dissolved plume to be useful in providing detailed data on localized groundwater flow patterns near the mound area. Groundwater quality data continue to indicate that VOC concentrations in this area of the remedy are either non-detect at laboratory reporting limits or below the MCLs identified in the ROD (Figure 6-1a). Upper TSA well BOP-61(ds) and Lower TSA well BOP-61(dg) are paired wells (wells located in the direct vicinity of each other) and were the last Remedy Zone B wells to decrease below TCE MCL. The maximum TCE concentrations at Upper TSA well BOP-61(ds) and Lower TSA well BOP-61(dg) were 28 µg/L in May 1995 and 29 µg/L in August 1998, respectively. TCE concentrations in both wells gradually decreased to below the MCL in February 2019 and have remained at or below 4.3 µg/L since. A TCE concentration profile for the two wells is shown in Figure 6-1b.

6.4.2 Zone D Closure Request

Remedy Zone D is located in the eastern portion of the Site, east of Northeast 205th Avenue and between I-84 and Sandy Boulevard. Zone D currently contains one well, former extraction well EW-16, which is recommended in this report for decommissioning, as TCE levels have been below laboratory reporting limits since 2018. TCE concentrations in Zone D wells are shown in Figure 6-2.

Groundwater treatment in this area was from Lower TSA extraction wells EW-11 and EW-15 (located in Zone C near the border of Zone D), EW-16, and Upper TSA extraction well EW-21 (located in Zone D south of EW-16). A brief summary of these wells is provided below.

- Groundwater pumping at EW-15 ceased in 2009, when TCE concentrations decreased below the MCL. TCE concentrations decreased and remained below laboratory reporting limits starting in November 2010, and EW-15 was decommissioned in February 2022.
- Pumping at EW-11 ceased in 2008. TCE concentrations have been below the MCL since September 2009 and have been stable since, at 1 to 2 µg/L. Currently, EW-11 is monitored for water levels semi-annually and water quality biennially. Water quality

monitoring at EW-11 is recommended for August 2022, since this well was inaccessible during biennial sampling in August 2021. This well is located in the eastern portion of Zone C, closer to the mound area where TCE concentrations persist above the MCL.

- EW-16 was pilot shutdown from 2010 to 2012, turned back on from 2012 to 2014, and shut off again in 2014 when TCE concentrations again fell below remedy criteria and stayed consistently below the MCL.
- Pumping at EW-21 ceased in 2007 when TCE concentrations declined to below the MCL. EW-21 was a private water supply well that had been incorporated into the TSA remedy, so following DEQ's shutdown approval, the TSA pump/motor was removed, and the well returned to the property owner for their use (lawn irrigation).

A discussion of Zone D monitoring and extraction wells, including TCE concentrations at downgradient monitoring wells, was provided in the June 2020 CMW-26dg Decommissioning letter (Geosyntec, 2020a). In summary, operation of Upper and Lower TSA extraction wells EW-11, EW-15, EW-16, and EW-21 resulted in the cleanup of Upper TSA groundwater at CMW-26ds and Lower TSA groundwater at CMW-26dg and two private water supply wells PMX-196 and PMX-198 (used for TSA water quality and water level monitoring). TSA monitoring at PMX-196 and PMX-198 ceased in 2013 due to low TCE concentrations that met remedy performance criteria, and these wells were removed from the TSA Remedy monitoring network and returned to the property owners for their use (irrigation). Lower TSA well CMW-26dg was installed in March 1994, along with Upper TSA well CMW 26ds. The well pair was installed to evaluate the eastern extent of TCE in the Upper and Lower TSA groundwater in the eastern portion of the remedy area. The four Zone-D extraction wells were located to the east of the CMW-26 well pair. CMW-26ds was decommissioned in 2005 after TCE concentrations fell below the MCL, and CMW-26dg was decommissioned in 2020 after being damaged.

The former extraction and monitoring wells in Zone D have either been decommissioned or returned to private use. TCE concentrations at former monitoring well CMW-26dg were slightly above the MCL (6.27 to 6.51 µg/L) at the time it was decommissioned in 2020. DEQ concurred that EW-16 and nearby well EW-11 would provide sentinel monitoring for Zone D groundwater (DEQ, 2020c). Based on continued non-detect results at EW-16 and low concentrations detected in nearby well EW-11 (to be confirmed in 2022), groundwater restoration has been achieved in Zone D. We recommend closure of Zone D and a partial NFA determination for Zone D.

7.0 REFERENCES

Geosyntec, 2020a. CMW-26dg Monitoring Well Rehabilitation and Decommissioning Request. 26 June 2020.

Geosyntec, 2021c. East Multnomah County Groundwater TSA Remedy (ECSI 1479) SVE System Expansion and Hydraulic Testing Work Plan. 12, November 2021.

Geosyntec, Landau Associates, and SSPA, 2018. Annual Performance Report: 1 January 2017 through 31 December 2017, Troutdale Sandstone Aquifer Remedy. 3 April 2018.

Geosyntec, Landau Associates, and SSPA, 2019. Annual Performance Report: 1 January 2018 through 31 December 2018, Troutdale Sandstone Aquifer Remedy. 31 May 2019.

Geosyntec, Landau Associates, and SSPA, 2020. Annual Performance Report: 1 January 2019 through 31 December 2019, Troutdale Sandstone Aquifer Remedy. 4 May 2020.

Landau Associates, Inc. and Geosyntec Consultants, 2020. Partial No Further Action Request East Multnomah County Troutdale Sandstone Aquifer Remedy, Zone A and SGA ECSI 1479. 23 April 2020.

Landau Associates, Inc. (LAI), 2019. 2019 Monitoring and Contingency Plan for PWB Pumping Events, East Multnomah County Troutdale Sandstone Aquifer Remedy, Gresham, Oregon, ECSI # 1479. 7 July 2019.

Landau Associates, Prowell Environmental, 1999. Email from Gilles Bruce. Subject: Institutiona Controls Plan Approval. 27, October.

LAI, 2021. RE: 1,4-Dioxane Reconnaissance-Level Investigation Work Plan East Multnomah County Cleanup Project Portland, Oregon ECSI #1479. 13, July 2021.

National Oceanic and Atmospheric Administration (NOAA), 2020. National Oceanic and Atmospheric Administration, https://www.wrh.noaa.gov/pqr/pdxclimate/pg92.pdf, website accessed January 2021.

Oregon Department of Environmental Quality (DEQ), 1996. Remedial Action Record of Decision for the East Multnomah county Groundwater Contamination Site, Troutdale Sandstone Aquifer. 31 December 1996.

DEQ, 1997. TSA Remedy Order on Consent, WMCSR-NWR-96-08, 14 February 1997.

DEQ, 2018. Email from K. Thiessen RE: EMC TSA Remedy: Annual Performance Report 2017 [Partial approval of 2017 Annual Report]; 2 August 2018.

DEQ, 2019a. Letter from K. Thiessen, DEQ Approval of Annual Performance Report for 2018 and Five-Year Remedy Performance Evaluation. East Multnomah County Troutdale Sandstone Aquifer Remedy. ECSI #1479. 3 July 2019.

DEQ, 2020a. Letter from K. Thiessen, DEQ: DEQ Approval of Annual Performance Report for 2019. East Multnomah County Troutdale Sandstone Aquifer Remedy. ECSI #1479. 11 September 2020.

DEQ, 2020b. Email from K. Thiessen, DEQ: DEQ approval of: EMC TSA Remedy, 2019 PWB Contingency Plan (ECSI #1479)

DEQ, 2020c. Letter from K. Thiessen, DEQ: DEQ Approval of CMW-26dg Monitoring Well Rehabilitation and Decommissioning Request. 11 August 2020.

DEQ, 2021b. Personal communication from K. Thiessen, DEQ - meeting

DEQ, 2021a. Letter from K. Thiessen, DEQ: DEQ Approval of Annual Performance Report for 2020. East Multnomah County Troutdale Sandstone Aquifer Remedy. ECSI #1479. 18 May 2021.

DEQ, 2021b. No Longer Contained-In Determination East Multnomah County Troutdale Sandstone Aquifer Remedy, 2525 NE 201st Ave. Gresham, Oregon. (ECSI #1479). 9 August.

DEQ, 2021c. Letter from K. Thiessen, DEQ: Request for Reconnaissance-level groundwater sampling for 1, 4-Dioxane at Corporation Fairview, Oregon facility. ECSI #1479. 17, March 2021.

DEQ, 2018d. Risk-Based Concentrations for Individual Chemicals. May.

DEQ, 2021e. Subject: DEQ approval of EMC Groundwater TSA Remedy SVE System Expansion and Hyd. Testing Work Plan. 24, November.

DEQ, 2021f. Email from K. Thiessen. Subject: RE: EMC TSA - Well Decommissioning Work Plan. 27, December.

DEQ, 2022. 1,4 dioxane resampling letter

PWB, 2022. Email from J. Dahl, Portland Water Bureau, RE: PWB SSWF 2021 Pumping Dates and Volumes (email provided pumping information for the CSSWF). 3 March 2022.

Rockwood PUD. 2022. Memorandum. Rockwood Water People's Utility District, Board of Directors Meeting Packets for 2022. From Andy Crocker, District Superintendent, to Board of Directors. Re: *Operations Update*. Available at: https://rwpud.org/board-agendas-and-minutes/

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 2021 through 31 December 2021
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 (pilot shutdown)	Lower TSA	Monthly	Semiannually	Cascade
TSA Monitoring Wells				
BOP-13(ds)	Upper TSA	Quarterly to Semiannually	Quarterly to Semiannually	Boeing
BOP-13(dg)	Lower TSA	Quarterly to Semiannually	Quarterly to Semiannually	Boeing
BOP-20(ds)	Upper TSA	Annually PWB Monitoring	Biennial PWB Monitoring	Boeing
BOP-20(dg)	Lower TSA	Annually PWB Monitoring	Annually to Biennial PWB Monitoring	Boeing
BOP-23(dg)	Lower TSA	Biennial PWB Monitoring	Biennial PWB Monitoring	Boeing
BOP-31(ds)	Upper TSA	Quarterly to Semiannually	Quarterly to Semiannually	Boeing
BOP-31(dg)	Lower TSA	Quarterly to Semiannually	Quarterly to Semiannually	Boeing
BOP-61(ds)	Upper TSA	Annually	Annually	Boeing
BOP-61(dg)	Lower TSA	Annually	Annually	Boeing
BOP-62(ds)	Upper TSA	Biennial PWB Monitoring	Biennial PWB Monitoring	Boeing
BOP-65(ds)	Upper TSA	Biennial PWB Monitoring	Biennial PWB Monitoring	Boeing
BOP-66(ds)	Upper TSA	Annually	Annually	Boeing
D-17(ds)	Lower TSA	Quarterly	Quarterly	Cascade
D-17(dg)	Lower TSA	Quarterly	Quarterly	Cascade
EW-3 (monitoring only)	Upper TSA	Biennial	Biennial	Boeing
EW-11 (monitoring only)	Lower TSA	Annually	Biennial*	Cascade
EW-12 (monitoring only)	Lower TSA	Semiannually	Quarterly to Semiannually	Cascade
EW-13 (monitoring only)	Lower TSA	Biennial PWB Monitoring	Biennial PWB Monitoring	Boeing
EW-16 (monitoring only)	Lower TSA	Semiannually to Decommission	Annually to Decommission	Cascade
CMW-10(ds)	Upper TSA	Quarterly	Quarterly	Cascade
CMW-14R(ds)	Lower TSA	Semiannually	Semiannually	Cascade
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 PWB Monitoring	Biennial PWB Monitoring	Cascade
CMW-24(dg)/EW-5	Lower TSA	Semiannually	Semiannually	Cascade
CMW-25(dg)	Lower TSA	Semiannually	Semiannually	Cascade
CMW-36(dg)	Lower TSA	PWB Monitoring	PWB Monitoring	Cascade
Soil Vapor and Groundwater Monitoring Wells				
VMW-17d-95.5 (soil vapor only)	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

Table 2-2
Performance Monitoring Schedule - 1 January 2021 through 31 December 2021
TSA Remedy - East Multnomah County

Well	Aquifer	Water Level Measurements	Water Quality Sampling	Responsibility
VMW-F	Upper TSA	Quarterly	Quarterly	Cascade
VMW-G	Upper TSA	Quarterly	Quarterly	Cascade
VMW-H	Upper TSA	Quarterly	Quarterly	Cascade
VMW-I	Upper TSA	Quarterly	Quarterly	Cascade
VMW-J2	Upper TSA	Quarterly	Quarterly	Cascade
VMW-K	Upper TSA	Quarterly	Quarterly	Cascade
VMW-L	Upper TSA	Quarterly	Quarterly	Cascade
VMW-M	Upper TSA	Quarterly	Quarterly	Cascade
VMW-N	Upper TSA	Quarterly	Quarterly	Cascade

NOTES:

Annual monitoring performed in August; semiannual in February and August; quarterly in February, May, August, and November. Next biennial sampling event planned for August 2023.

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.

*EW-11 will be monitored in August 2022 since the well was inaccessible for biennial monitoring in August 2021.

Table 2-3
Significant Remedy Documents – 1 January 2021 through 31 December 2021
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
3/17/2021	Letter	DEQ	Request for Reconnaissance-level groundwater sampling for 1, 4-Dioxane at Corporation Fairview, Oregon facility. ECSI #1479	DEQ requests a workplan for the collection of groundwater samples for the analysis of 1,4-dioxane.
4/12/2021	Report	Geosyntec, Landau, S. S. Papadopulos & Associates	Annual Performance Report for 2020. East Multnomah County Troutdale Sandstone Aquifer Remedy. ECSI #1479	Annual Report recommends: • Continued operation of EW-2 and EW-14 and pilot shutdown of EW-23 and continued monitoring. • Decommissioning of EW-15 and EW-8. • Change monitoring EW-16 (water level and chemistry) to annual basis. • Reduce groundwater elevation monitoring to an annual frequency at BOP-20(ds), BOP-61(ds), BOP-61(dg), BOP-66(ds). • Reduce groundwater elevation monitoring frequency to biennial at BOP-23(dg), BOP-62(ds), BOP-65(ds), EW-3, and EW-13. • Reduce groundwater quality sampling to an annual frequency at BOP-61(ds), BOP-61(dg), and BOP-66(ds). • Reduce groundwater quality sampling to biennial frequency for wells BOP-20(ds), BOP-65(ds), and EW-13.
5/18/2021	Letter	DEQ	Annual Performance Report for 2020. East Multnomah County Troutdale Sandstone Aquifer Remedy. ECSI #1479	DEQ approved the recommendations in the 2020 Annual Report.

Table 2-3
Significant Remedy Documents – 1 January 2021 through 31 December 2021
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
5/20/2021	Email	Geosyntec	RE: DEQ 1 4-Dioxane Cascade FINAL.pdf	Email documenting a conversation between DEQ and Geosyntec that the 1,4-dioxane sampling request from the Troutdale Gravel Aquifer was an error. 1,4-dioxane sampling only needs to take place in the Troutdale Sandstone Aquifer.
5/21/2021	Email	Geosyntec	Cascade Corp TSA - IDW disposal approval	Present documentation to DEQ of IDW generation, IDW profiling, and landfill acceptance for IDW generated from decommissioning of CMW-26dg. Ask for DEQ approval for disposal.
7/13/2021	Memorandum	Landau	RE: 1,4-Dioxane Reconnaissance-Level Investigation Work Plan East Multnomah County Cleanup Project Portland, Oregon ECSI #1479	Workplan for the sampling of 1,4-dioxane in groundwater samples collected from the TSA.
7/15/2021	Letter	DEQ	RE: 1, 4-Dioxane Reconnaissance-Level Investigation Work Plan, East Multnomah County Cleanup Project, Portland, Oregon. ECSI #1479	Approval of: 1,4-Dioxane Reconnaissance-Level Investigation Work Plan, East Multnomah County Cleanup Project, Portland, Oregon, dated July 13, 2021 DEQ stated that the Residential risk based concentration for groundwater ingestion and inhalation from tap water for 1,4-dioxane of 0.46 µg/L would be a more appropriate screening level for the Portland Groundwater Protection Area. DEQ requests clarification in the summary technical memorandum for the 1,4-dioxane sampling, how the monitoring wells chosen represent both upgradient and downgradient (with respect to the original VOC source) areas of the aquifer.

Table 2-3
Significant Remedy Documents – 1 January 2021 through 31 December 2021
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
7/26/2021	Memorandum	Geosyntec Landau	East Multnomah County TSA Groundwater Remedy (ESCI 1497) Data Gaps Memorandum	Technical memorandum summarizing findings from the 2020 Data Gaps Investigation which included installing 6 new vapor monitoring wells in the groundwater mound area of the EMC TSA Site.
8/4/2021	Letter	DEQ	East Multnomah County TSA Groundwater Remedy (ECSI #1479) Data Gaps Investigation	DEQ Approval of report. "The document and its hydrogeological analysis of this complex site is beautifully prepared."
8/10/2021	Letter	DEQ	No Longer Contained-In Determination East Multnomah County Troutdale Sandstone Aquifer Remedy, 2525 NE 201st Ave. Gresham, Oregon. (ECSI #1479)	DEQ found that the IDW from CMW-26dg does not exhibit characteristics of hazardous waste and approves disposal at Waste Management Hillsboro Landfill.
11/3/2021	Memorandum	Geosyntec Landau	1,4-Dioxane Reconnaissance-Level Investigation Summary Technical Memorandum East Multnomah County Cleanup Project Portland, Oregon ECSI #1479	Groundwater from six wells was sampled for 1,4-dioxane and all of the samples were non-detect at the reporting limit and below the RBC for ingestion and inhalation from tap water of 0.46 µg/L.
11/12/2021	Memorandum	Geosyntec	East Multnomah County Groundwater TSA Remedy (ECSI 1479) SVE System Expansion and Hydraulic Testing Work Plan	Proposal to expand the SVE system by connecting VMW-K and VMW-J2 to the existing SVE system. Also, proposed hydraulic testing including slug testing of wells in the groundwater mound area and recovery/pumping tests of EW-2 and EW-14.

Table 2-3
Significant Remedy Documents – 1 January 2021 through 31 December 2021
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
11/24/2021	Email	DEQ	Subject: DEQ approval of EMC Groundwater TSA Remedy SVE System Expansion and Hyd. Testing Work Plan	DEQ approveed the work proposed to expand the SVE system to include two additional wells and to perform additional aquifer testing to better understand hydrogeological characteristics of the mound area in Remedy Zone C.
12/22/2021	Memorandum	Geosyntec	EW-8 and EW-15 Well Decommissioning Work Plan Cascade Troutdale Sandstone Aquifer Remedy Fairview, Oregon ECSI No. 1479	Workplan to decommission EW-8 and EW-15.
12/27/2021	Email	DEQ	RE: EMC TSA - Well Decommissioning Work Plan	DEQ approval of Work Plan

Table 3-1
Well Construction Data - 1 January 2021 through 31 December 2021
TSA Remedy - East Multnomah County

		NAD 1983 State Plane Oregon (ft)		Elevations (ft MSL)				
Well	**Aquifer Screened**	**X Coordinate**	**Y Coordinate**	**Ground Surface**	**Measuring Point**	**Top of Screen**	**Bottom of Screen**	**Depth of Boring (ft bgs)**
Extraction Wells								
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[2]	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-21(ds)	Upper TSA	7697591.5	691105.0	77.1	78.02	-88.0	-108.0	192
BOP-20(dg)	Lower TSA	7698381.4	691042.6	78.1	77.32	-105.0	-125.0	209
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-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
EMC-2(dg)	Lower TSA	7701014.5	692008.0	44.8	43.51	-75.0	-85.0	140
EW-1	Lower TSA	7699560.1	689504.6	124.1	124.04	-27.8	-57.8	183
EW-3	Upper TSA	7697737.4	690313.3	97.1	94.26	-77.9	-102.9	205
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-16	Lower TSA	7702424.1	689665.5	84.2	83.71	-40.3	-80.3	198
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
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
BOP-44(usg)2	SGA	7698996.3	691888.8	24.6	34.25	-181.0	-191.0	219

Table 3-1
Well Construction Data - 1 January 2021 through 31 December 2021
TSA Remedy - East Multnomah County

		NAD 1983 State Plane Oregon (ft)		Elevations (ft MSL)				
Well	**Aquifer Screened**	**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

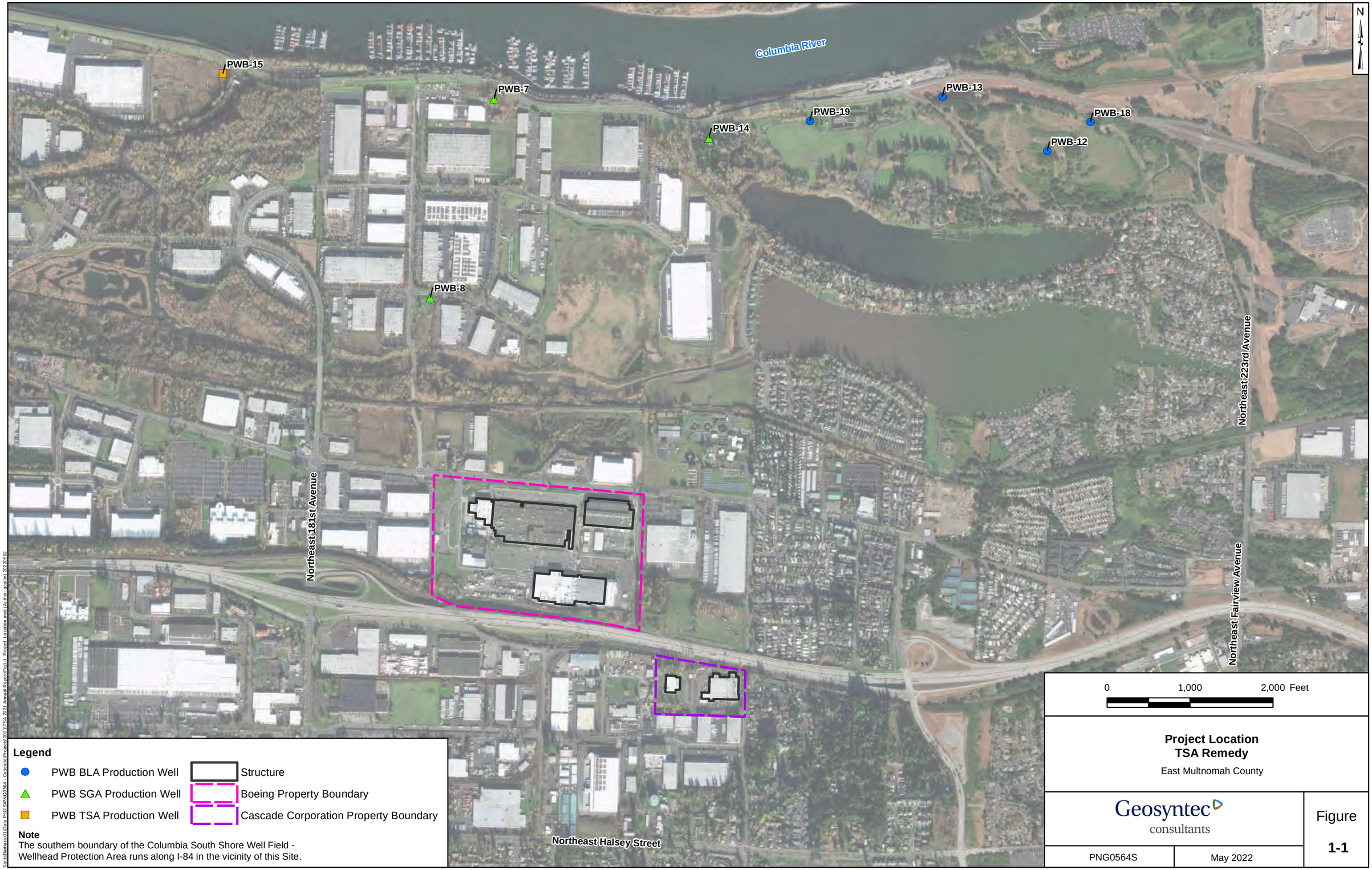
NOTES:

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.

2. EW-23 was approved for pilot shutdown in September 2020 and was shutdown in April 2021.

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

FIGURES



Project Location
TSA Remedy

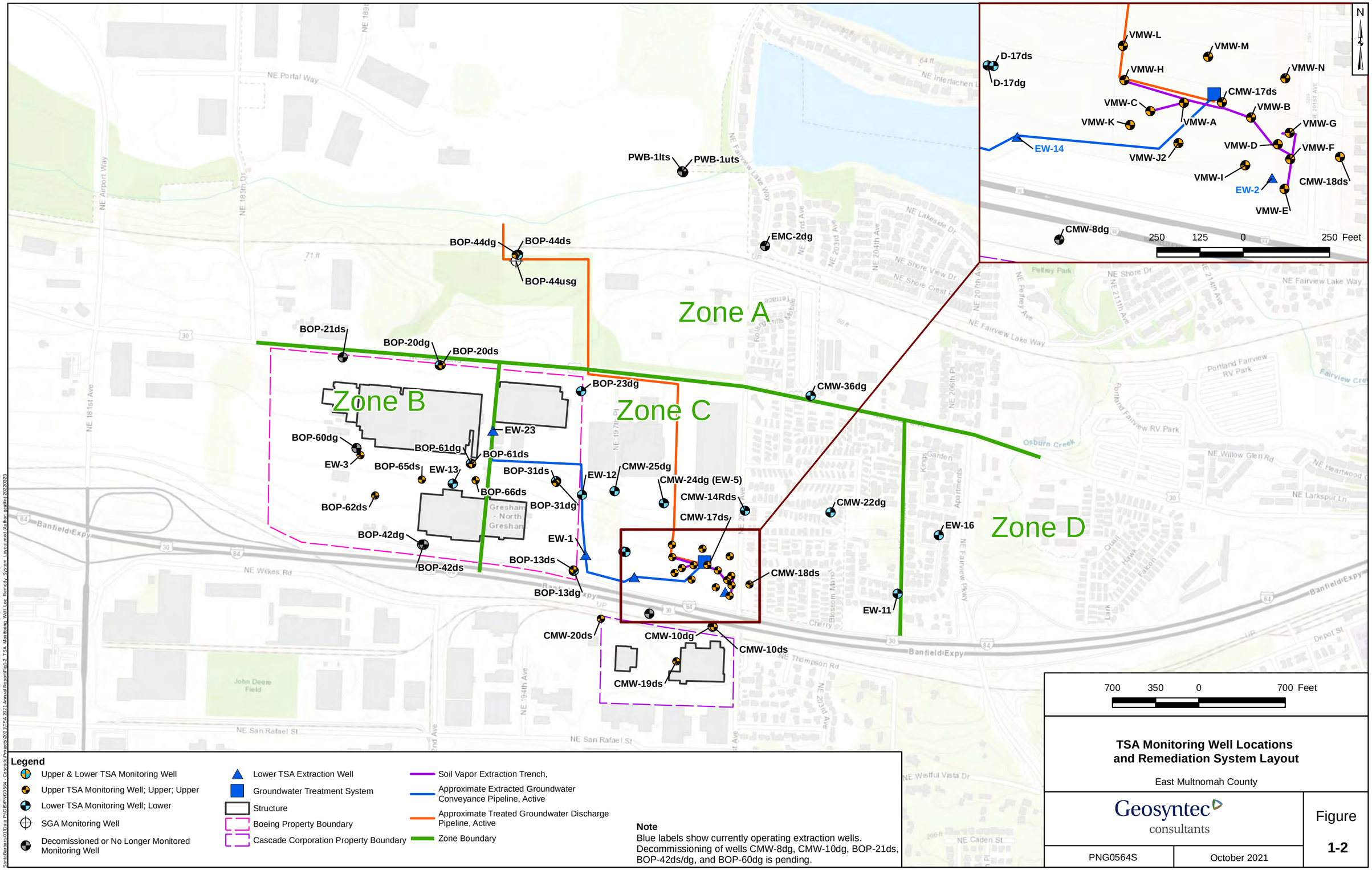
East Multnomah County

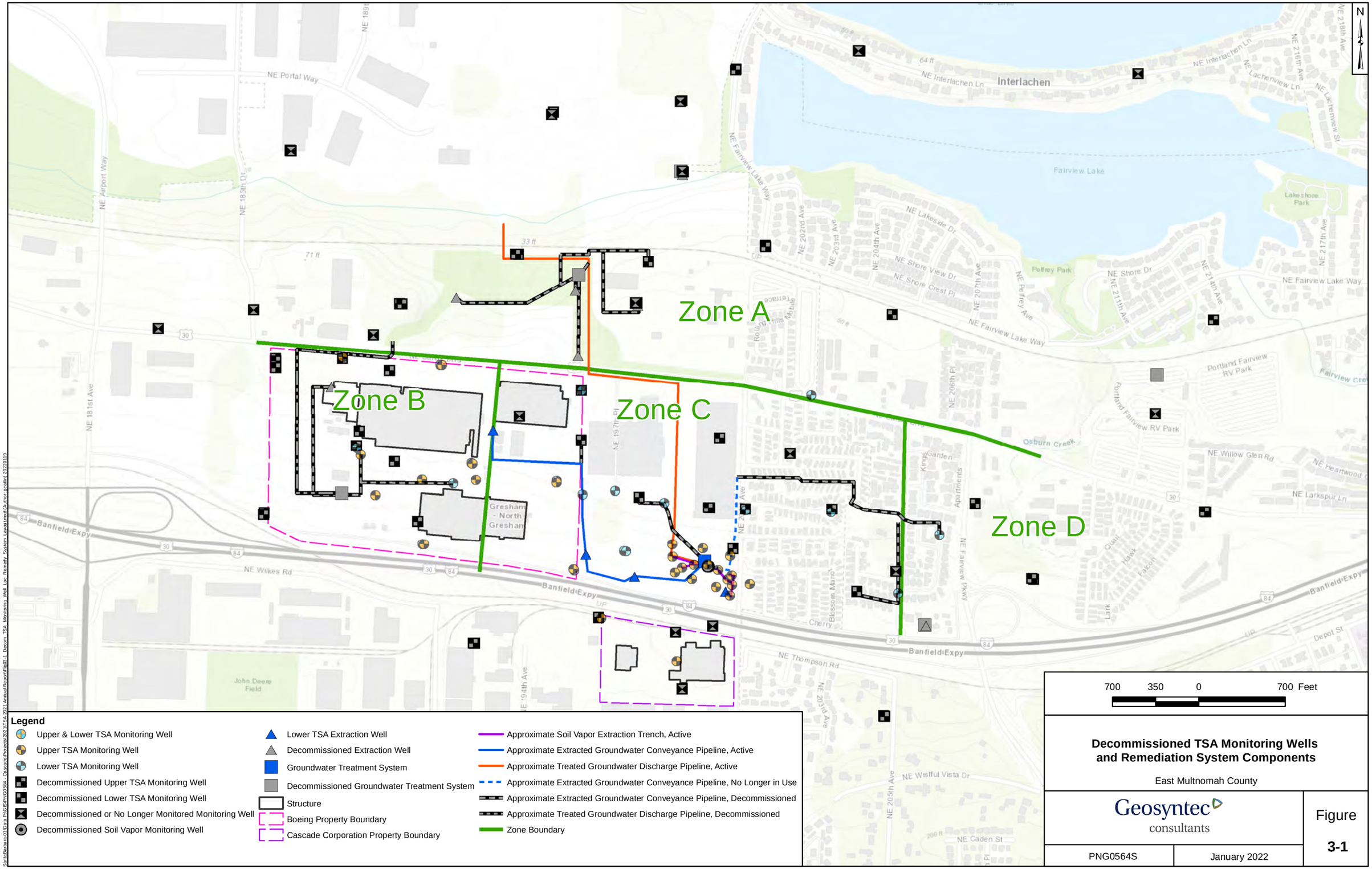
Geosyntec consultants

PNG0564S	May 2022

Figure **1-1**

SantaBarbara-01\Data P:\GIS\PNG\0564 - Cascade\Projects\2021\TSA 2021 Annual Report\Fig1-1 Project Location.mxd (Author: gcatlin) 2022/05/02


PWB-1lts
PWB-1uts
BOP-44dg
BOP-44ds
BOP-44usg
EMC-2dg
Zone A
BOP-21ds
BOP-20dg
BOP-20ds
BOP-23dg
CMW-36dg
Zone B
Zone C
EW-23
BOP-60dg
BOP-61dg
BOP-61ds
EW-3
BOP-65ds
EW-13
BOP-31ds
EW-12
CMW-25dg
CMW-24dg (EW-5)
BOP-66ds
BOP-62ds
BOP-31dg
CMW-14Rds
CMW-22dg
CMW-17ds
BOP-42dg
EW-1
EW-16
Zone D
BOP-42ds
BOP-13ds
CMW-18ds
BOP-13dg
EW-11
CMW-20ds
CMW-10dg
CMW-10ds
CMW-19ds
D-17ds
D-17dg
VMW-L
VMW-M
VMW-H
VMW-N
CMW-17ds
VMW-C
VMW-B
VMW-K
VMW-A
VMW-G
EW-14
VMW-D
VMW-F
VMW-J2
VMW-I
CMW-18ds
EW-2
VMW-E
CMW-8dg
250 125 0 250 Feet
N
700 350 0 700 Feet
NE Portal Way
NE Airport Way
NE 18th Dr
NE 181st Ave
NE Fairview Lake Way
NE Shore Dr
NE Shore View Dr
NE Shore Crest Dr
NE Peffley Park
NE 207th Ave
NE 211th Ave
NE 214th Ave
NE 204th Ave
NE 203rd Ave
NE 206th Pl
NE 197th Pl
Portland Fairview RV Park
Osburn Creek
NE Willow Glen Rd
NE Heartwood Ct
NE Larkspur Ln
Banfield Expy
NE Wilkes Rd
NE Thompson Rd
NE San Rafael St
NE 194th Ave
NE 202nd Ave
NE Wistful Vista Dr
NE Caden St
Depot St
John Deere Field
Gresham - North Gresham
Kings Garden Apartments
Blossom Manor
Cherry
Lark
Quail
Hawk
Falcon
UP
Legend
Upper & Lower TSA Monitoring Well
Upper TSA Monitoring Well; Upper; Upper
Lower TSA Monitoring Well; Lower
SGA Monitoring Well
Decomissioned or No Longer Monitored Monitoring Well
Lower TSA Extraction Well
Groundwater Treatment System
Structure
Boeing Property Boundary
Cascade Corporation Property Boundary
Soil Vapor Extraction Trench,
Approximate Extracted Groundwater Conveyance Pipeline, Active
Approximate Treated Groundwater Discharge Pipeline, Active
Zone Boundary
Note
Blue labels show currently operating extraction wells.
Decommissioning of wells CMW-8dg, CMW-10dg, BOP-21ds, BOP-42ds/dg, and BOP-60dg is pending.
TSA Monitoring Well Locations and Remediation System Layout
East Multnomah County
Geosyntec consultants
PNG0564S
October 2021
Figure 1-2
S:\SantaBarbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2021\TSA 2021 Annual Report\Fig1-2_TSA_Monitoring_Well_Loc_Remedy_System_Layout.mxd (Author: pcatlin) 20220323



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

700 350 0 700 Feet

Decommissioned TSA Monitoring Wells and Remediation System Components

East Multnomah County

Geosyntec consultants

Figure **3-1**

PNG0564S | January 2022

S:\SantaBarbara-01\Data P:\GIS\PNG\0564 - Cascade\Projects\2021\TSA 2021 Annual Report\Fig03-1 Decom_TSA_Monitoring_Well_Loc_Remedy_System_Layout.mxd (Author: qcallin) 20220119

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 or No Long Monitored Lower TSA Monitoring Well
- Lower TSA Extraction Well
- Decommissioned Extraction Well
- Groundwater Treatment System
- Soil Vapor Extraction Piping,
- Soil Vapor Extraction Trench
- Angled Well Screen

Vapor Monitoring Well Locations and Piping

East Multnomah County

Geosyntec consultants

PNG0564S16 | January 2022

Figure 3-2

SantaBarbara-01\Data P:\GIS\PNG\0564 - Cascade\Projects\2021\TSA 2021 Annual Report\Fig03-2_Vapor_MW_Locs_TSA_SVE_Wells_Piping.mxd (Author: gcatlin) 20220119

VMW-L
11

VMW-M
280

VMW-H
590

VMW-N
420

Central Treatment System

VMW-A
NM

CMW-17ds

VMW-C
1500

VW-17d-95.5
460

VMW-B
NM

VMW-K
9300

VMW-G
320

EW-14

VMW-D
NM

VMW-J2
2500

VMW-F
110

CMW-18ds

VMW-I
< 1.1

EW-2

VMW-E
1200

CMW-8dg

CMW-10ds

N

70 35 0 70 Feet

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 or No Long Monitored Lower TSA Monitoring Well
- Lower TSA Extraction Well
- Decommissioned Extraction Well
- Groundwater Treatment System
- Soil Vapor Extraction Piping,
- Soil Vapor Extraction Trench
- Angled Well Screen

Notes

VMW-H = Soil Vapor Monitoring Well Location ID
590 = TCE Concentration (µg/m^3)
NM = Not Monitored
< 1.1 = Less than Reporting Limit (non-detect result)

Maximum Soil Vapor TCE Concentration 2021

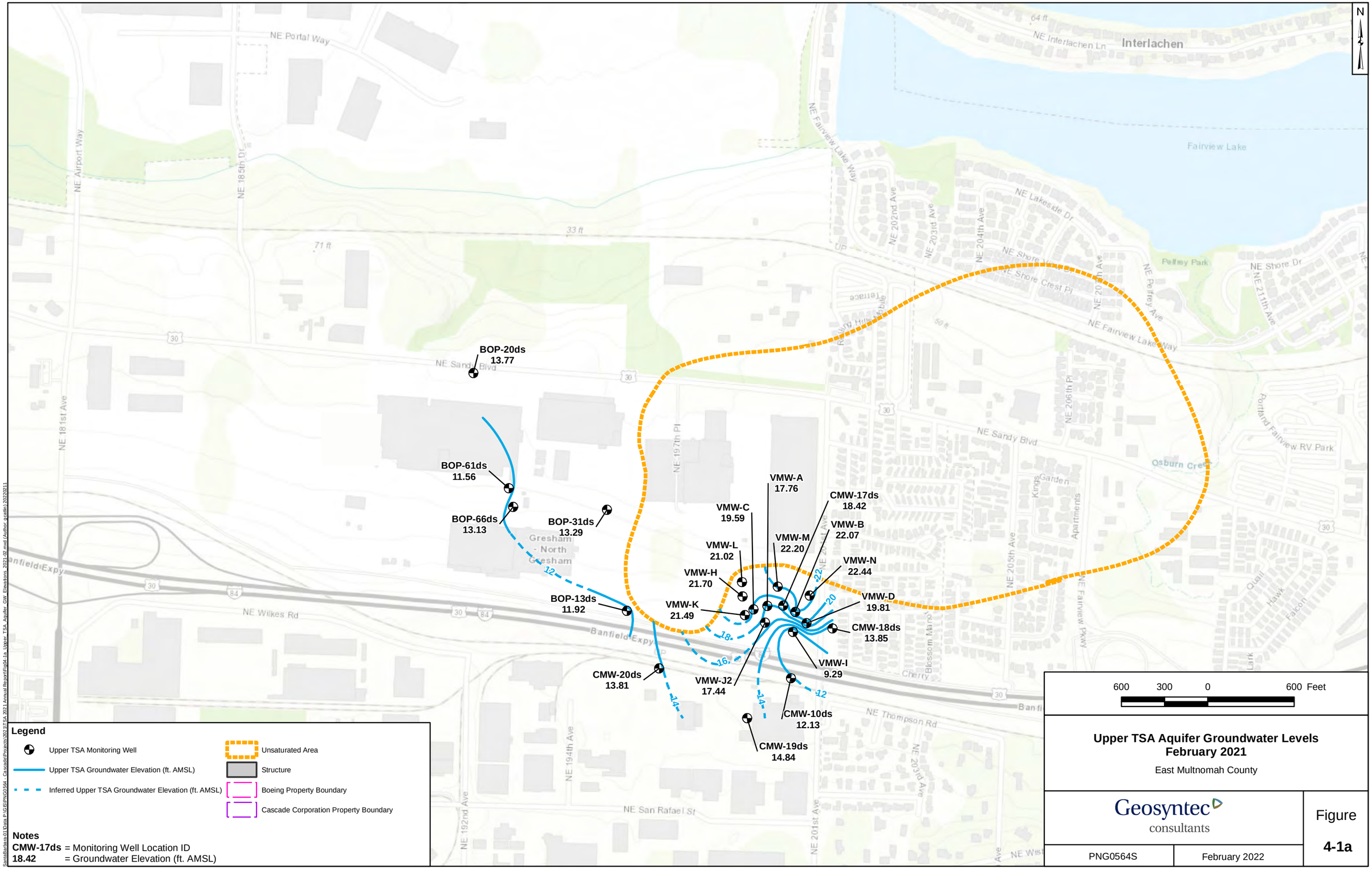
East Multnomah County

Geosyntec consultants

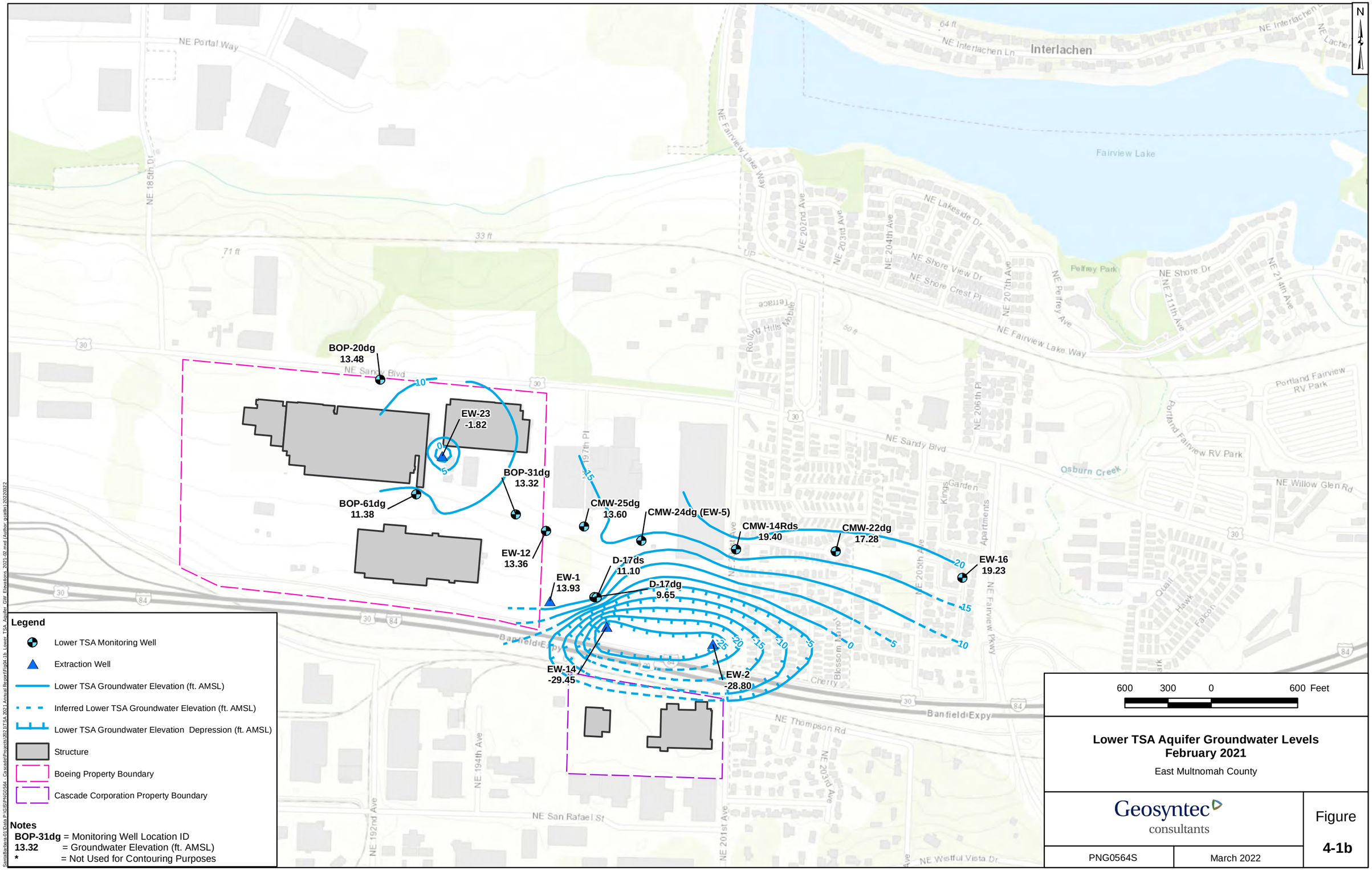
PNG0564S16 | March 2022

Figure 3-3

SantaBarbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2022 ITSA 2021 Annual Report\Fig03-3_Maximum_Soil_Vapor_TCE_Concentration.mxd (Author: rpatlin) 20220322



S:\Santa Barbara-01\Data P\GIS\PNG\0564 - Cascade\Projects\2021\TSA 2021 Annual Report\Fig04-1a_Upper_TSA_Aquifer_GW_Elevations_2021-02.mxd (Author: qcallin) 20220211



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
13.32 = Groundwater Elevation (ft. AMSL)
***** = Not Used for Contouring Purposes

600 300 0 600 Feet

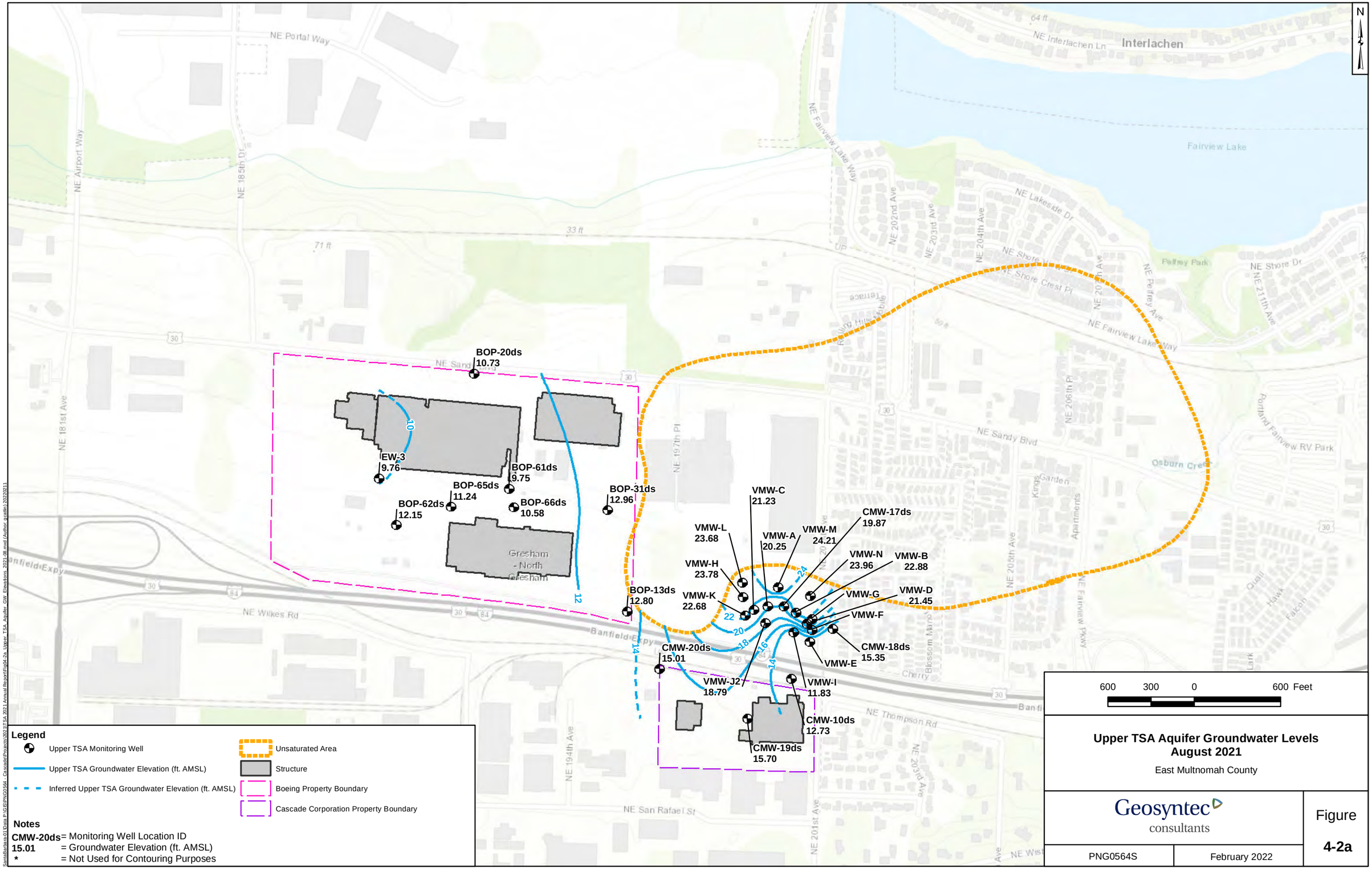
Lower TSA Aquifer Groundwater Levels February 2021

East Multnomah County

Geosyntec consultants

PNG0564S | March 2022

Figure **4-1b**



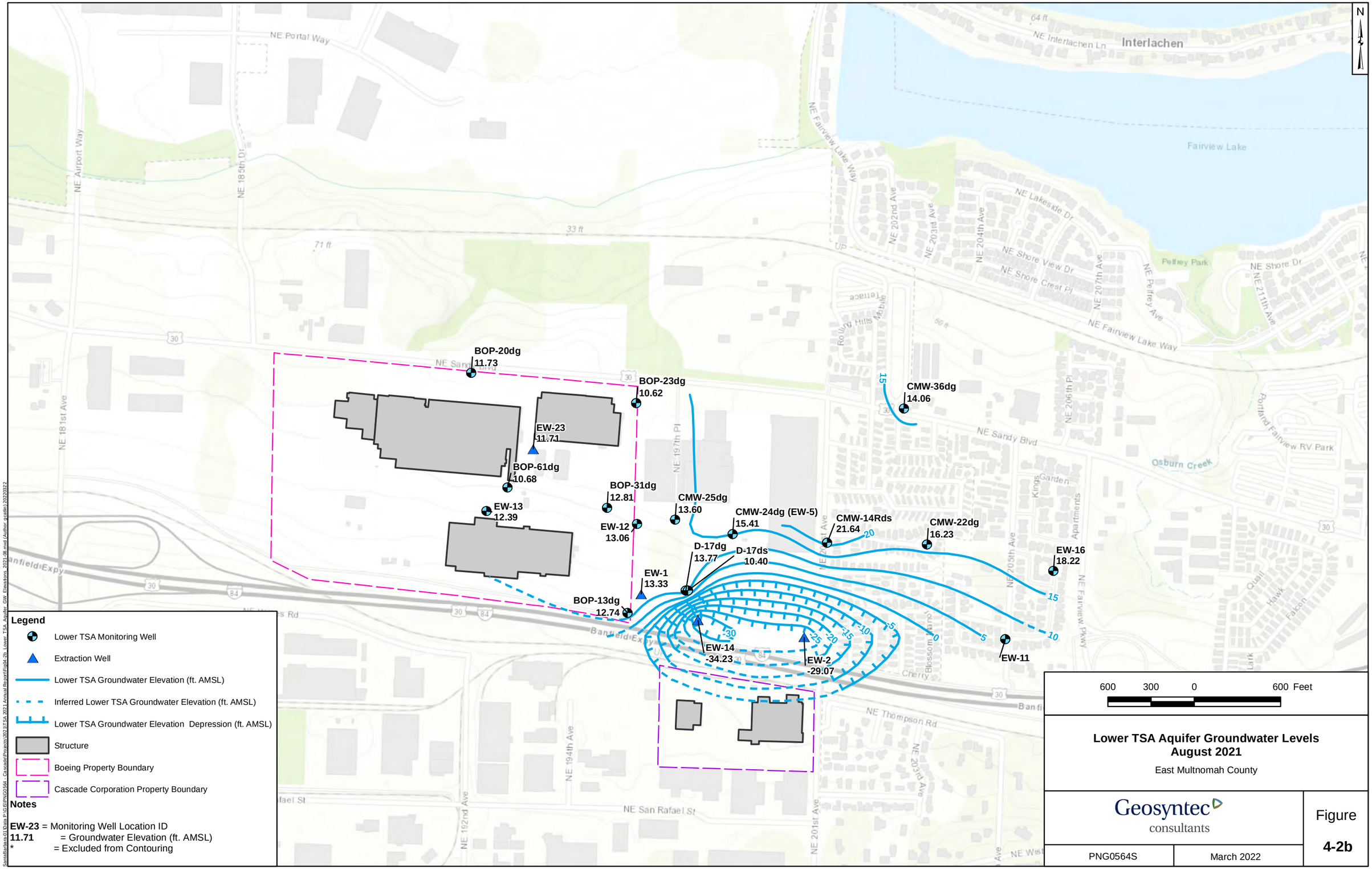
Upper TSA Aquifer Groundwater Levels August 2021

East Multnomah County

Geosyntec consultants

PNG0564S | February 2022

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

EW-23 = Monitoring Well Location ID
11.71 = Groundwater Elevation (ft. AMSL)
* = Excluded from Contouring

Lower TSA Aquifer Groundwater Levels August 2021

East Multnomah County

Geosyntec consultants

PNG0564S | March 2022

Figure **4-2b**

SantaBarbara-01\Data P:\GIS\PNG\0564 - Cascade\Projects\2021\TSA 2021 Annual Report\Fig04-2b_Lower_TSA_Aquifer_GW_Elevations_2021-08.mxd (Author: gcatlin) 2022/2022

N

BOP-61ds
3.5

BOP-66ds
1.7

BOP-31ds
< 0.20

BOP-13ds
2.1

VMW-C
3.84

VMW-A
4.16

VMW-M
4.5

VMW-B
18.7

VMW-L
< 0.50

CMW-17ds
33.3

VMW-N
6.78

VMW-G
3.36

VMW-H
< 0.50

VMW-D
0.831

VMW-K
68.6

VMW-J2
89.4

CMW-18ds
59.7

VMW-E
7.59

VMW-F
< 0.50

VMW-I
37

CMW-19ds
1.06

CMW-10ds
9.01

5
25
45
65

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
59.7 = 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.

500 250 0 500 Feet

Upper TSA Aquifer Trichloroethene Concentrations February 2021

East Multnomah County

Geosyntec consultants

PNG0564S | April 2022

Figure **5-1a**

SantaBarbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2021\TSA 2021 Annual Report\Fig5-1a Upper TSA Aquifer TCE Contours 2021-02.mxd (Author: rcastle) 20220405

EW-23
1.33

BOP-61dg
4.0

BOP-31dg
2.7

EW-12
1.76

CMW-25dg
< 0.50

CMW-14Rds
< 0.50

D-17ds
29.8

5

25

EW-1
0.533

D-17dg
3.69

BOP-13dg
0.46

EW-14
5.19

EW-2
8.06

EW-16
< 0.50

N

Fairview Lake

NE Sandy Blvd

NE Fairview Lake Way

NE Shore Dr

NE Clestview Dr

Portland Fairview RV Park

Osburn Creek

Banfield Expy

NE Thompson Rd

NE San Rafael St

Legend

- Lower TSA Monitoring Well
- Extraction Well
- Decomissioned or No Longer Monitored Monitoring Well
- Lower TSA Trichloroethene Contour (µg/L)
- Inferred Lower TSA Trichloroethene Contour (µg/L)
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

D-17dg = Monitoring Well Location ID
3.69 = 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.

500 250 0 500 Feet

Lower TSA Aquifer Trichloroethene Concentrations February 2021

East Multnomah County

Geosyntec consultants

Figure **5-1b**

PNG0564S | February 2022

SantaBarbara-01\Data P\GIS\PNG0564 - Cascade\Projects\2021\TSA 2021 Annual Report\Fig5-1b_Lower_TSA_Aquifer_TCE_Contours_2021_02.mxd (Author: gcatlin) 20220211

Legend

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

Notes

CMW-10ds = Monitoring Well Location ID
8.67 = 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.

Upper TSA Aquifer Trichloroethene Concentrations August 2021

East Multnomah County

Geosyntec consultants

Figure **5-2a**

PNG0564S | March 2022

BOP-20dg
< 0.20

BOP-23dg
0.85

EW-23
1.95

BOP-61dg
3.2

BOP-31dg
2.6

EW-13
< 1.0

EW-12
2.06

CMW-25dg
< 0.500

CMW-24dg
(EW-5)
< 0.500

CMW-36dg
< 0.500

CMW-14Rds
< 0.500

CMW-22dg
< 0.500

EW-16
< 0.500

D-17ds
22.2

D-17dg
3.91

EW-1
< 0.500

BOP-13dg
0.36

EW-14
5.69

EW-2
9.11

5

20

NE Sandy Blvd

NE Fairview Lake Way

NE Shore Dr

NE Shore View Dr

NE Shore Crest Pl

Tyler Ln

Adam Ln

Jacob Ln

Pebble Ln

Osburn Loop

NE Crestview Dr

Fairview Lake

Pelfrey Park

Portland Fairview RV Park

Osburn Creek

Estates Mobile Home Park

Rolling Hills Mobile Terrace

Kings Garden Apartments

Banfield Expy

NE Thompson Rd

NE San Rafael St

NE 192nd Ave

NE 194th Ave

NE 201st Ave

NE 202nd Ave

NE 203rd Ave

NE 204th Ave

NE 205th Ave

NE 206th Ave

NE 207th Ave

NE 208th Ave

NE 211th Ave

NE 263rd Ave

NE 257th Pl

NE 19th Dr

NE 15th Pl

NE Fairview Pkwy

Cherry

Hawk

Fashion

Quail

Lark

Bassham Manor

157 ft

71 ft

53 ft

33 ft

N

Legend

- Lower TSA Monitoring Well
- Extraction Well
- Decomissioned or No Longer Monitored Monitoring 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
3.91 = 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.

500 250 0 500 Feet

Lower TSA Aquifer Trichloroethene Concentrations August 2021

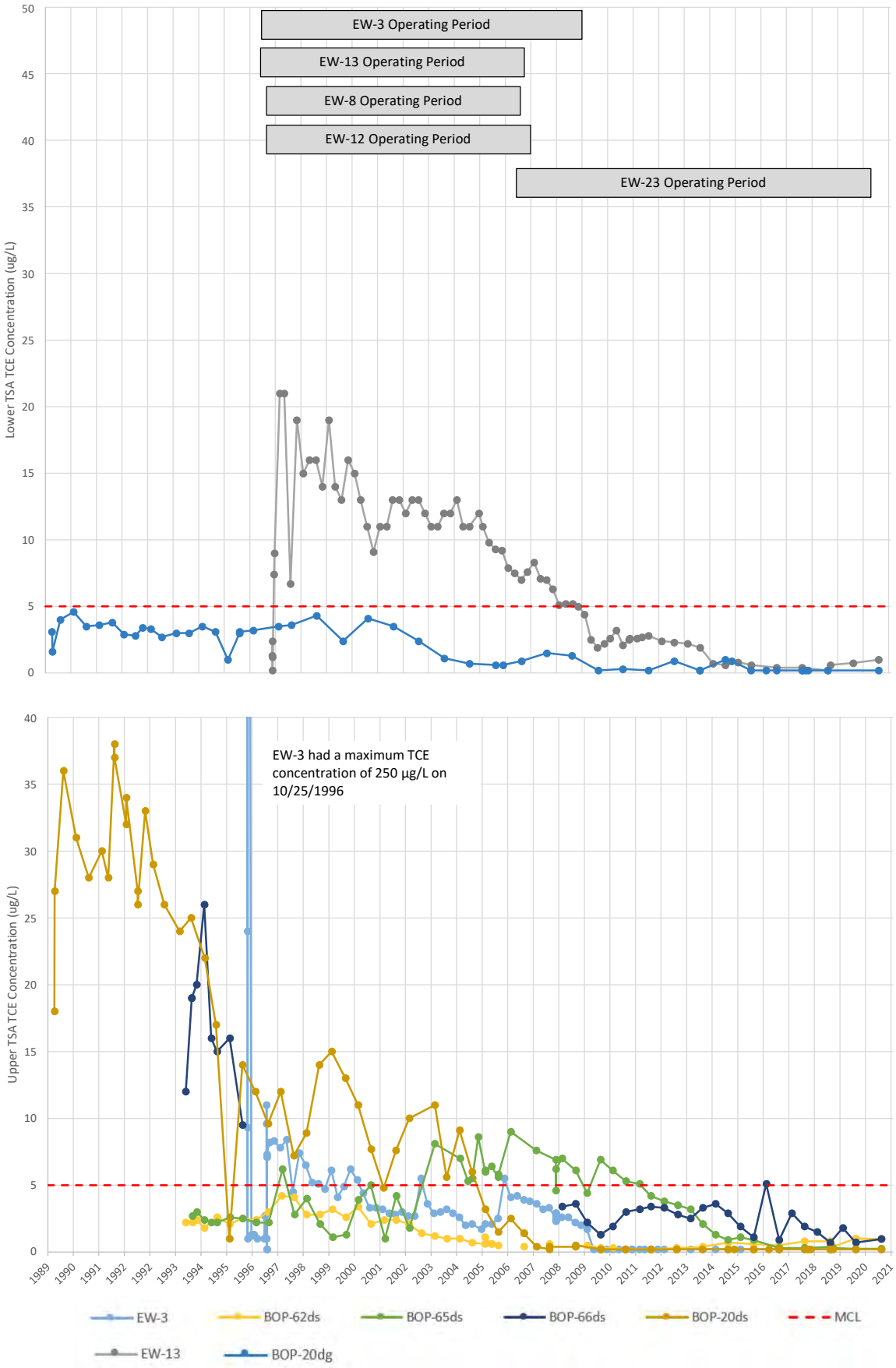
East Multnomah County

Geosyntec consultants

PNG0564S

February 2022

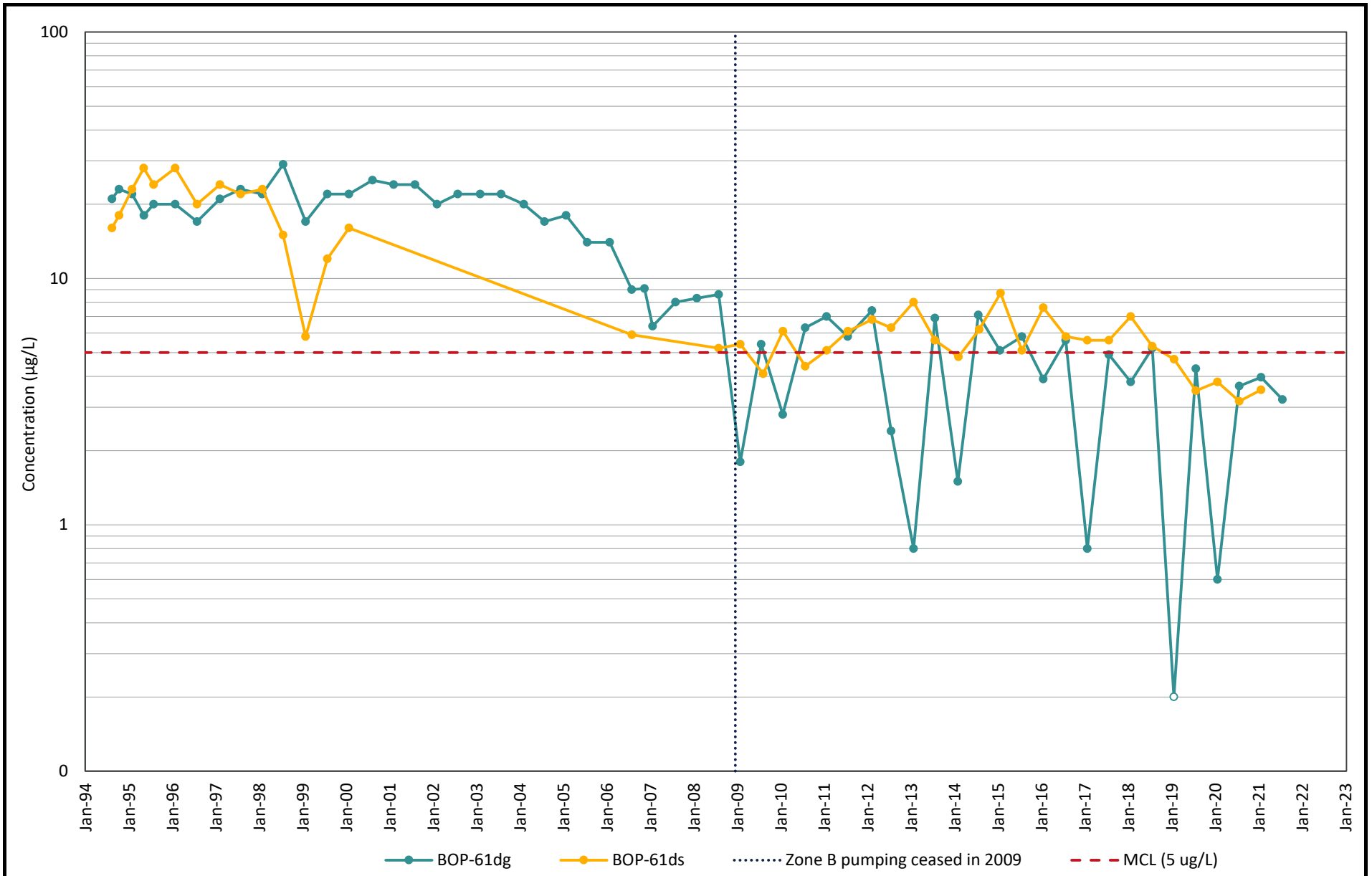
Figure **5-2b**



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Zone B TCE concentrations** Note: Only presents wells currently being monitored.	Figure 6-1

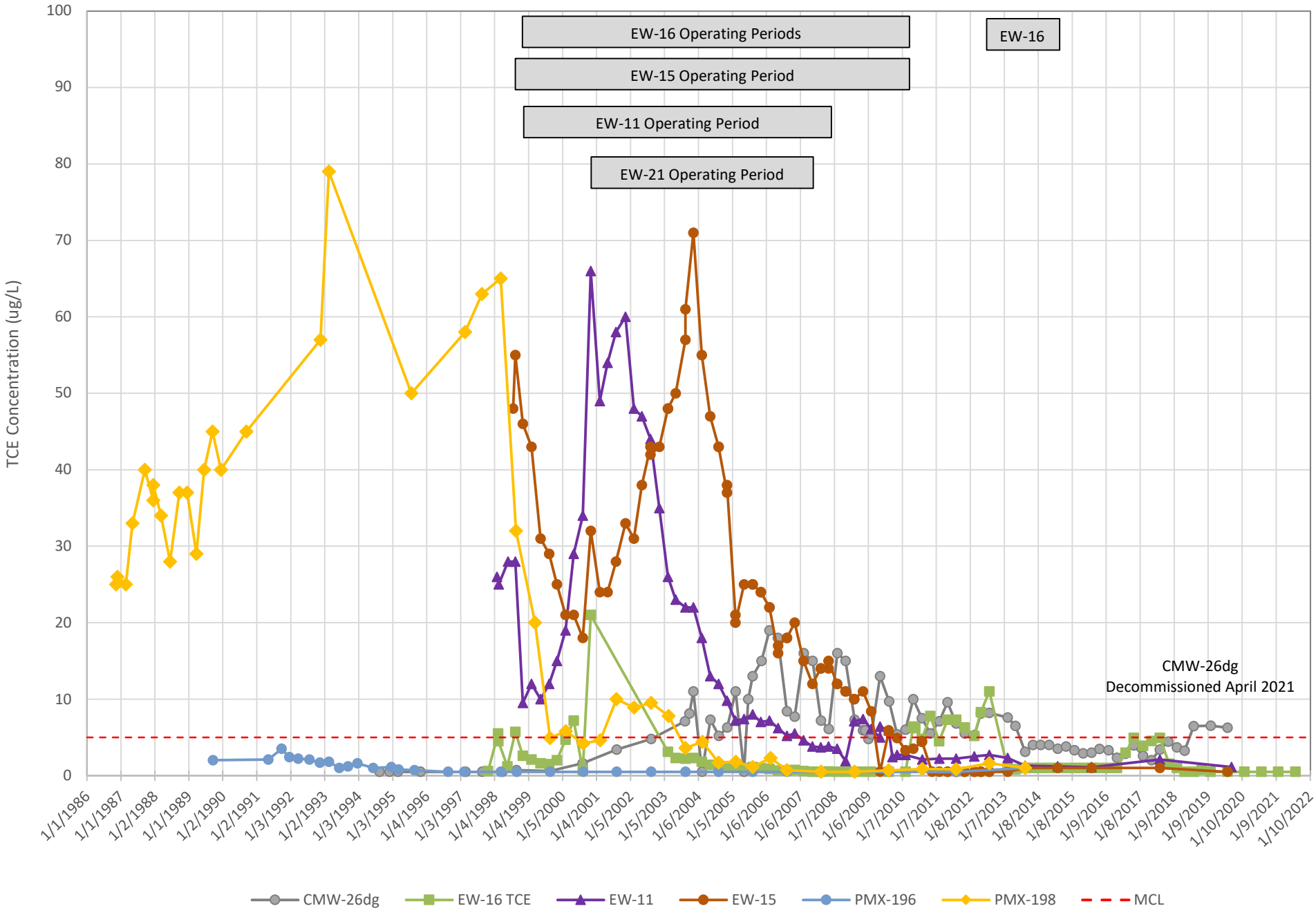
\\edmdata01\projects\025\116\WIP\T\Data\Tables\WorkingTables\TSA\AR_TSA_Fig6-1_BOP61dgdsTCE



Open symbol = nondetect
Closed symbol = detect

LANDAU ASSOCIATES	Boeing Portland Troutdale, Oregon	**BOP-61(ds,dg)** **Trichloroethene Profile**

Figure
6-1b



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Zone D TCE Concentrations** Note: EW-11 and EW-15 are in Zone C.	Figure 6-2

APPENDIX A
Extraction Rates

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

Parameter	Discharge Limitations[a]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
Jan-21								
pH	6.0 – 9.0	su	—	7.88	7.88	7.89	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	75	--	—	Daily
Feb-21								
Trichloroethene	5.0	µg/L	2/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	2/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	2/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	2/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	2/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.84	7.88	7.89	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	81	--	—	Daily
Mar-21								
pH	6.0 – 9.0	su	—	7.88	7.90	7.97	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	80	--	—	Daily
Apr-21								
pH	6.0 – 9.0	su	—	7.84	7.87	7.89	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	79	--	—	Daily
May-21								
Trichloroethene	5.0	µg/L	5/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	5/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	5/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	5/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	5/5/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.77	7.84	7.89	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	48	--	—	Daily
Jun-21								
pH	6.0 – 9.0	su	—	7.61	7.76	7.88	0	Weekly
Temperature	—	ºF	—	60	63	68	—	Weekly
Flow[#]	—	gpm	—	--	47	--	—	Daily
Jul-21								
pH	6.0 – 9.0	su	—	7.70	7.80	7.84	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	46	--	—	Daily
Aug-21								
Trichloroethene	5.0	µg/L	8/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	8/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	8/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	8/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	8/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.83	7.86	7.89	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	45	--	—	Daily

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

Parameter	Discharge Limitations[a]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
Sep-21								
pH	6.0 – 9.0	su	—	7.86	7.87	7.88	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	45	--	—	Daily
Oct-21								
pH	6.0 – 9.0	su	—	7.83	7.85	7.88	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	60	--	—	Daily
Nov-21								
Trichloroethene	5.0	µg/L	11/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	11/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	11/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	11/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	11/4/2020	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.81	8.86	7.88	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	59	--	—	Daily
Dec-21								
pH	6.0 – 9.0	su	—	7.84	7.87	7.89	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	55	--	—	Daily

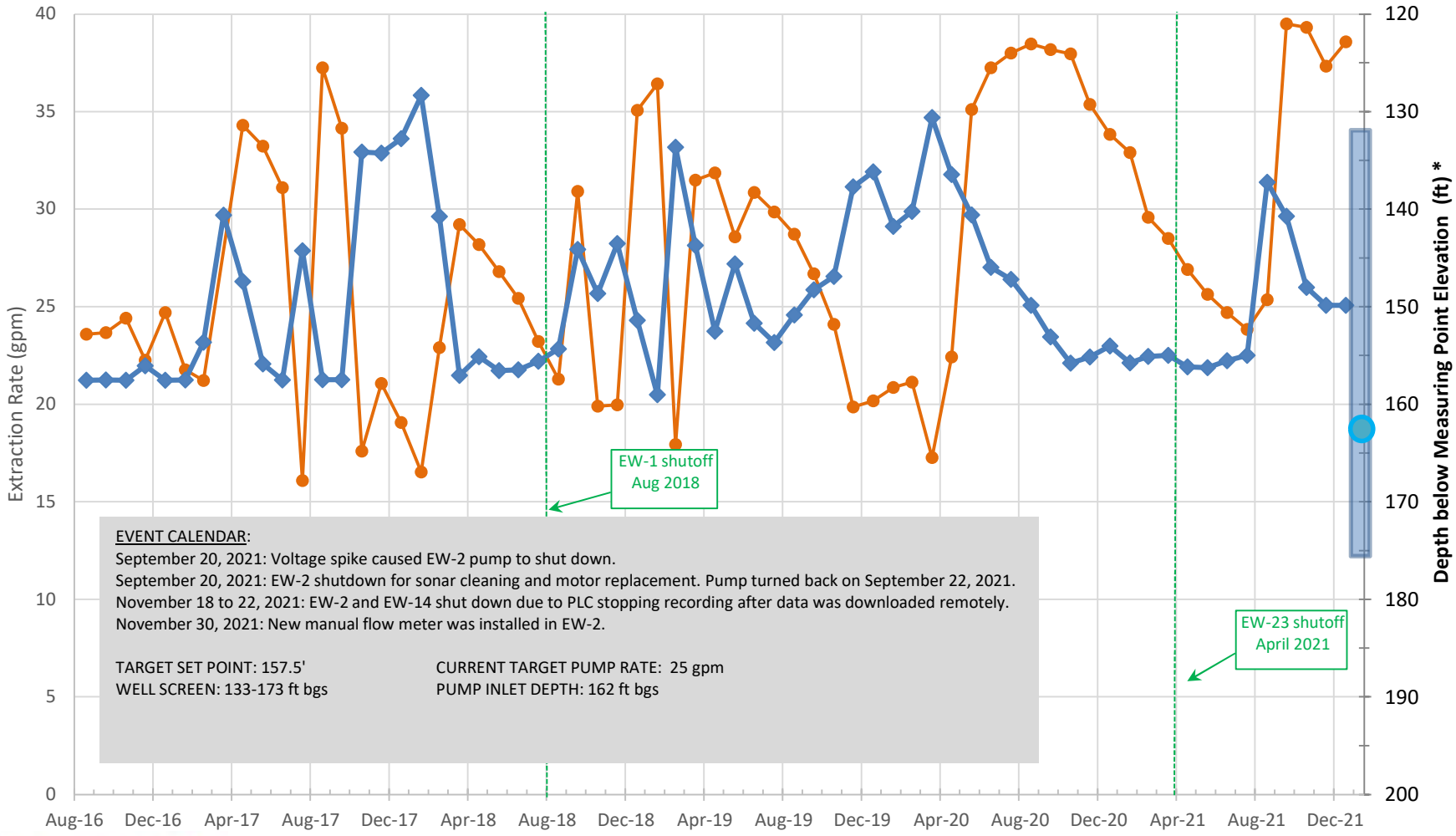
NOTES:

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

The effluent VOC sample is identified as TS-C-Eff.

[#]Flow includes EW-2 and EW-14, and EW-23 through early April 2021.

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



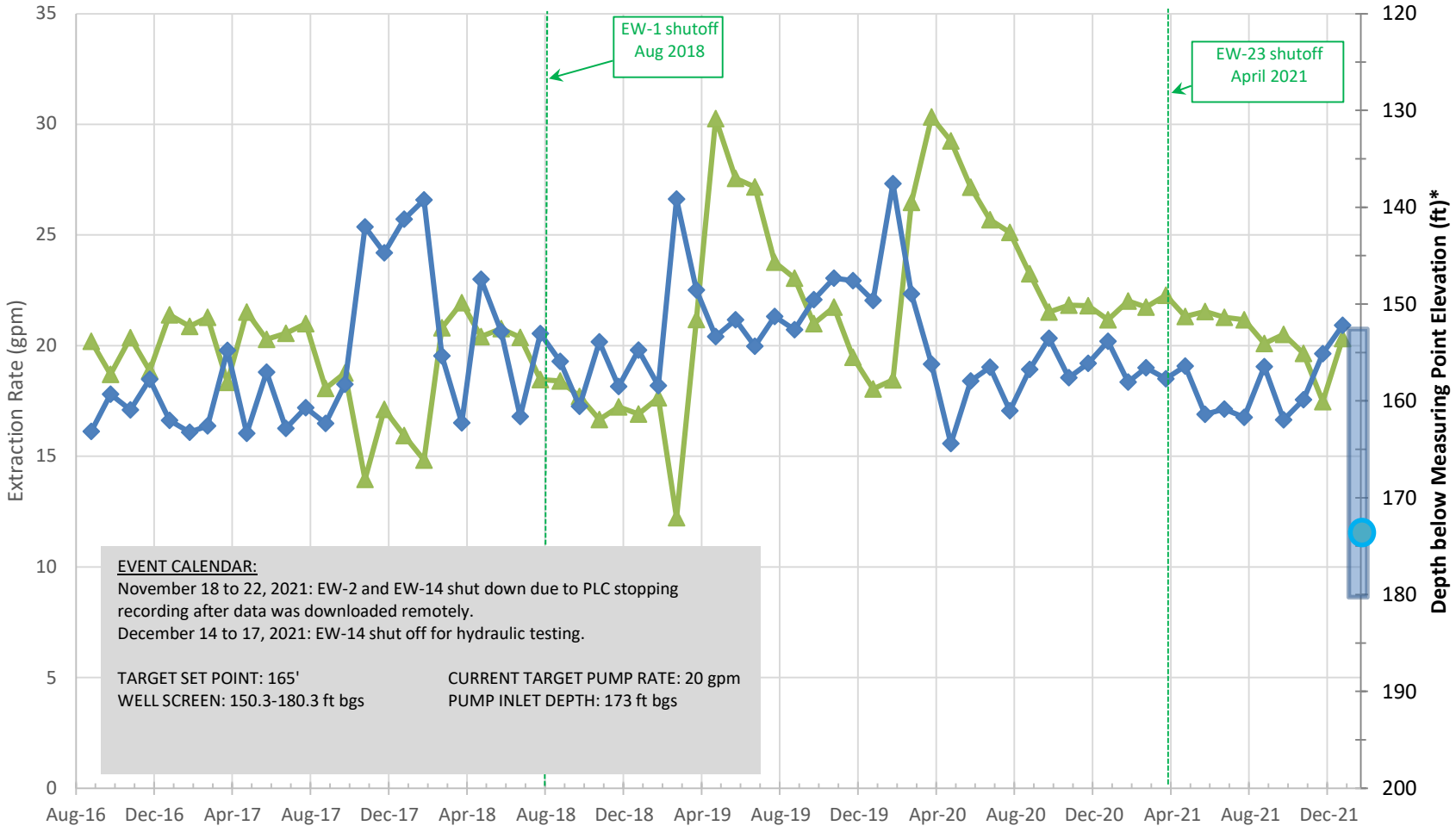
Geosyntec consultants

Cascade Corporation
Gresham, Oregon

EW-2 Monthly Average Flowrate and Water Level

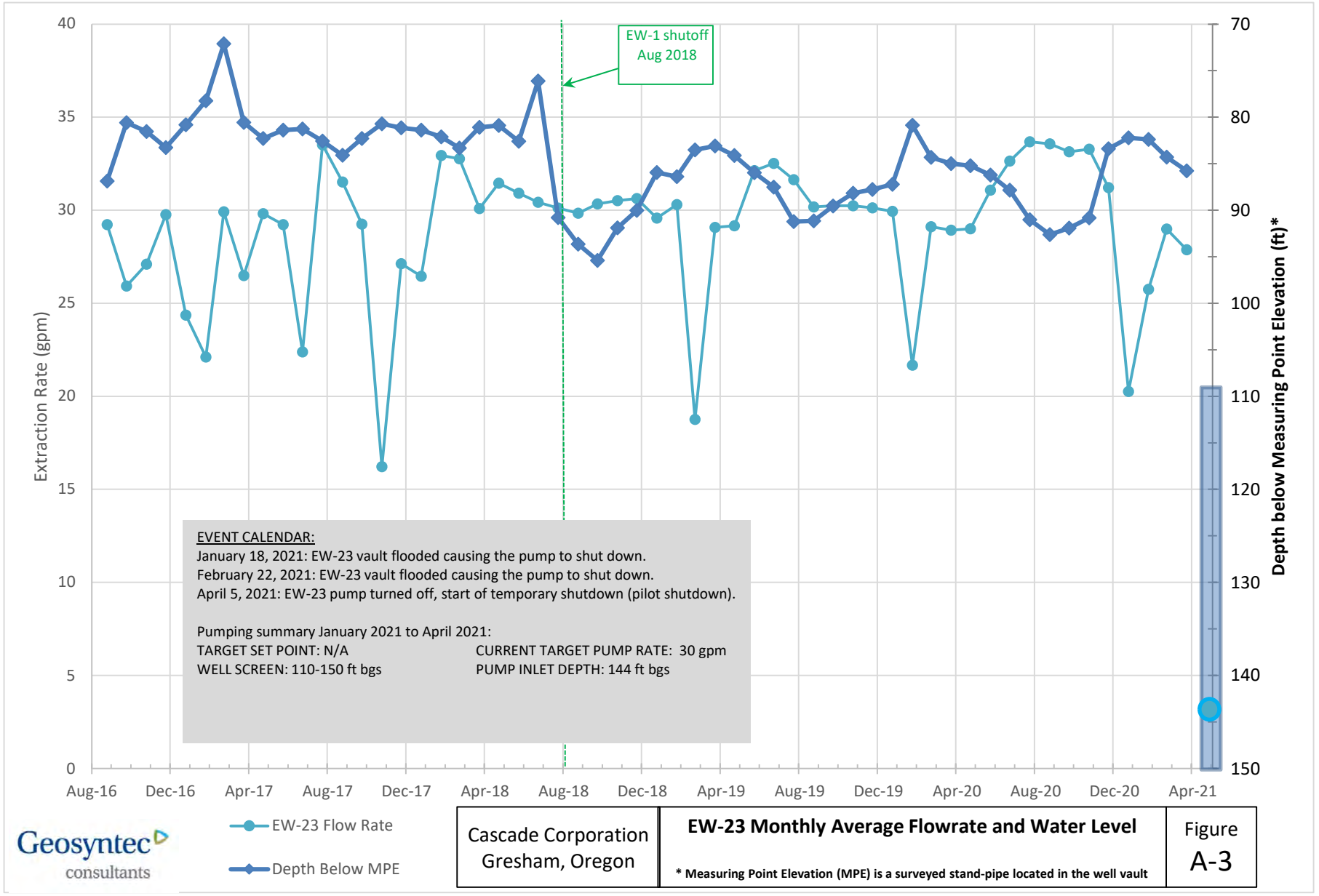
*** Measuring Point Elevation (MPE) is a surveyed stand-pipe located in the well vault.**

Figure
A-1



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-14 Monthly Average Flowrate and Water Level** *** Measuring Point Elevation (MPE) is a surveyed stand-pipe located in the well vault**	Figure A-2



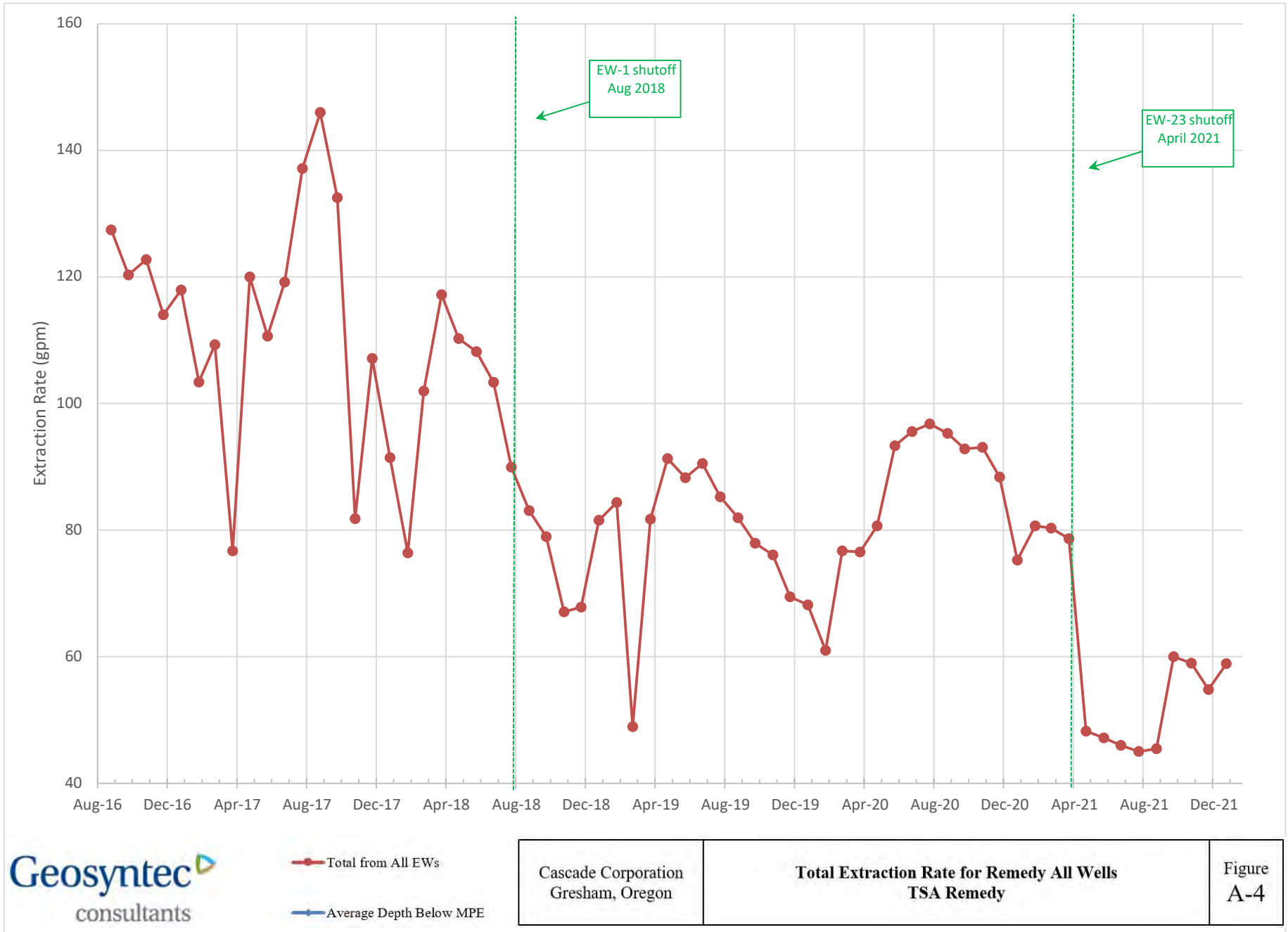
Geosyntec consultants

Cascade Corporation
Gresham, Oregon

EW-23 Monthly Average Flowrate and Water Level

*** Measuring Point Elevation (MPE) is a surveyed stand-pipe located in the well vault**

Figure
A-3



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Total Extraction Rate for Remedy All Wells TSA Remedy**	Figure A-4

EW-Total Monthly Average Extraction Rate
3/23/2022

Geosyntec consultants

APPENDIX B
Well Decommissioning

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	311675/D379350

GENERATOR

5. Generator's Name and Mailing Address

Geosyntec Consultants
900 Broken Sound Parkway NW, Suite 200
Boca Raton, FL 33487-3575
Generator's Phone: 253-334-9256

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

Cascade Corporation
2525 NE 201st Ave
Fairview, OR 97030

6. Transporter 1 Company Name: Advanced Chemical Transport Inc./DBA ACTenviro
U.S. EPA ID Number: CAR000070540

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

8. Designated Facility Name and Site Address

Waste Managment (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-RCRA/Non-DOT Regulated Material Solid (SOIL CUTTINGS)	12	DM	6000	P	
2.						
3.						
4.						

13. Special Handling Instructions and Additional Information

Project Number 311675 Document #: D379350

1) 135365OR GEW-12X55

14. **GENERATOR'S CERTIFICATION:** I certify the materials described above on this manifest are not subject to federal regulations for reporting proper disposal of Hazardous Waste.

Generator's/Offeror's Printed/Typed Name: Pat YADON
Signature: Patrick E. Yodar
Month: 09 Day: 02 Year: 21

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: LOLLIE K. THOMAS
Signature: Lollie K Thomas
Month: 09 Day: 02 Year: 21

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: Jennifer Jerome
Signature
Month: 9 Day: 2 Year: 21

Printed in USA by GC Labels
1-800-997-6966

DESIGNATED FACILITY TO GENERATOR

Reorder Part# MANIFEST-C6NHW
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	311675/D379351

5. Generator's Name and Mailing Address

Geosyntec Consultants
900 Broken Sound Parkway NW, Suite 200
Boca Raton, FL 33487-3575
Generator's Phone: 253-334-9256

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

Cascade Corporation
2525 NE 201st Ave
Fairview, OR 97030

6. Transporter 1 Company Name: Advanced Chemical Transport Inc./DBA ACTenviro — U.S. EPA ID Number: CAR000070540

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

8. Designated Facility Name and Site Address

Advanced Chemical Transport, Inc. (OR)
13600 SE Ambler Road
Clackamas, OR 97015
Facility's Phone: (971) 279-6780

U.S. EPA ID Number: ORQ000032731

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	
1	Non-RCRA/Non-DOT Regulated Material Solid (EMPTY DRUMS)	7	DM	70	P	
2.						
3.						
4.						

13. Special Handling Instructions and Additional Information

Project Number 311675 Document#: D379351

1) Empty Drums GEA-2X55

14. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to federal regulations for reporting proper disposal of Hazardous Waste.

Generator's/Offeror's Printed/Typed Name: PAT YADON — Signature: Patrick E. Yadon — Month 09 Day 02 Year 21

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: LOUIE K. THOMAS — Signature: Louie K Thomas — Month 09 Day 02 Year 21

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 9 Day 2 Year 21

Printed in USA by GC Labels
1-800-997-6966

DESIGNATED FACILITY TO GENERATOR

Reorder Part# MANIFEST-C6NHW
913-897-6966

WASTE MANAGEMENT

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

Original
Ticket# 1617109

Customer Name ACTENVIRONMENTAL ACT ENVIRONM
Ticket Date 09/02/2021
Payment Type Credit Account
Manual Ticket#
Hauling Ticket#
Route
State Waste Code
Manifest 311675/D379351 & D379350
Destination
PO 303 Kyle S
Profile 135365OR (LF01 - Non-Hazardous Waste Solids, Soil Cuttings)
Generator OR-CASCADE CORPORATION CASCADE CORPORATION 2525 NE 201ST AVE GRESHAM OR 9702

Carrier ACT
Vehicle# T-113
Container
Driver PETER
Check#
Billing # 0003432
Gen EPA ID N/A
Grid

Volume

	Time	Scale	Operator	Inbound		
In	09/02/2021 13:42:52	Inbound 1	JPRIME		Gross	31560 lb
Out	09/02/2021 14:03:49	Outbound	JPRIME		Tare	27020 lb
					Net	4540 lb
					Tons	2.27

Comments

Consumer Comments? We want to know. Please call.

	Product	LD%	Qty	UOM	Rate	Tax	Amount	Origin
1	Special Misc-Each-	100	14.00	Each				MULT-IN
2	EVF-P10-Environmen	100		%				

Total Tax
Total Ticket

Driver's Signature

Geosyntec consultants

APPENDIX C
SVE Data

Table C-1
Soil Vapor Extraction 1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

Well ID	Date	Time (hrs)	Temperature (degrees F)	Flow Rate[1] (scfm)	PID Measurement (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet						
SVE System Outlet	**1/5/2021**	**10:20**	**95**	**377**	**0.3**	**1.8**
SVE System Outlet	1/12/2021	13:10	90	378	0.4	2.3
SVE System Outlet	1/19/2021	11:40	90	389	0.3	1.8
SVE System Outlet	1/26/2021	12:00	95	396	0.3	1.8
SVE System Outlet	**2/2/2021**	**15:00**	**90**	**390**	**0.3**	**1.8**
SVE System Outlet	2/9/2021	13:00	95	378	0.3	1.8
SVE System Outlet	2/16/2021	11:00	80	368	0.3	1.8
SVE System Outlet	2/23/2021	10:00	90	384	0.3	1.8
SVE System Outlet	**3/2/2021**	**11:15**	**95**	**349**	**0.3**	**1.8**
SVE System Outlet	3/9/2021	9:15	100	398	0.3	1.8
SVE System Outlet	3/16/2021	16:00	---	361	0.3	1.8
SVE System Outlet	3/23/2021	13:00	90	378	0.3	1.8
SVE System Outlet	3/30/2021	12:40	110	386	0.3	1.8
SVE System Outlet	**4/6/2021**	**8:30**	**90**	**390**	**0.4**	**2.3**
SVE System Outlet	4/13/2021	12:00	100	387	0.4	2.3
SVE System Outlet	4/20/2021	14:30	110	375	0.5	2.9
SVE System Outlet	4/27/2021	12:00	100	388	0.5	2.9
SVE System Outlet	**5/4/2021**	**9:40**	**95**	**379**	**0.4**	**2.3**
SVE System Outlet	5/11/2021	13:30	100	390	0.4	2.3
SVE System Outlet	5/18/2021	10:05	95	365	0.4	2.3
SVE System Outlet	6/29/2021	13:10	130	397	---	---
SVE System Outlet	**7/6/2021**	**10:00**	**110**	**388**	**---**	**---**
SVE System Outlet	7/13/2021	9:00	100	374	---	---
SVE System Outlet	7/20/2021	15:00	110	378	---	---
SVE System Outlet	7/27/2021	7:50	90	389	0.3	1.8
SVE System Outlet	**8/3/2021**	**8:00**	**95**	**379**	**0.3**	**1.8**
SVE System Outlet	8/10/2021	14:30	120	360	0.3	1.8
SVE System Outlet	8/17/2021	13:00	100	370	0.3	1.8
SVE System Outlet	8/24/2021	12:40	110	378	0.3	1.8
SVE System Outlet	8/31/2021	13:50	95	386	0.3	1.8
SVE System Outlet	**9/7/2021**	**13:00**	**110**	**379**	**0.2**	**1.2**
SVE System Outlet	9/13/2021	11:30	110	382	0.2	1.2
SVE System Outlet	9/21/2021	7:45	100	378	0.2	1.2
SVE System Outlet	9/28/2021	14:30	100	396	0.4	2.3
SVE System Outlet	**10/5/2021**	**17:10**	**100**	**389**	**0.4**	**2.3**
SVE System Outlet	10/11/2021	12:30	95	379	0.4	2.3

Table C-1
Soil Vapor Extraction 1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

Well ID	Date	Time (hrs)	Temperature (degrees F)	Flow Rate[1] (scfm)	PID Measurement (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet						
SVE System Outlet	10/18/2021	14:30	--	377	0.3	1.8
SVE System Outlet	10/26/2021	15:00	95	392	0.3	1.8
SVE System Outlet	**11/2/2021**	**8:15**	**90**	**379**	**0.3**	**1.8**
SVE System Outlet	11/9/2021	14:00	90	372	0.3	1.8
SVE System Outlet	11/16/2021	15:00	95	388	0.4	2.3
SVE System Outlet	11/23/2021	15:40	90	373	0.4	2.3
SVE System Outlet	11/30/2021	16:40	95	375	0.4	2.3
SVE System Outlet	**12/7/2021**	**11:00**	**90**	**380**	**0.4**	**2.3**
SVE System Outlet	12/21/2021	16:05	80	357	0.4	2.3
SVE System Outlet	12/28/2021	15:30	80	360	0.3	1.8

Notes:

ID = identification
hrs = hours
F = Fahrenheit
ppm = parts per million
µg/L = micrograms per liter
VOC = volatile organic compounds
--- = Measurement not available

Bold text indicates sample for lab analysis was taken at the same time and is shown on Table C-2

[1] Flow measurements taken using a hot-wire anomometer. SVE system inlet flow measurements are presented as a result of high SVE system outlet temperatures interfering with the effluent measurement.

[2] The SVE system was shutdown for baseline testing of the newly constructed soil-vapor wells between 5/18 until 6/24.

[3] The SVE system was shutdown during the groundwater well slug tests from 12/8 until 12/21.

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

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)[1]
System Outlet	1/5/21	50	480	40	570	377.4
	2/2/21	44	420	43	507	389.6
	3/2/21	57	600	61	718	348.9
	4/6/21	43	520	61	624	389.8
	5/4/21	51	640	51	742	378.6
	7/6/21	47	770	57	874	388.1
	8/3/21	42	910	56	1008	378.6
	9/7/21	48	720	51	819	378.8
	10/5/21	56	760	59	875	388.9
	11/2/21	44	700	48	792	378.6
	12/8/21	47	650	53	750	380.1
Well VW17D-95.5	2/2/21	39	300	26	365	62.7
	5/4/21	37	310	26	373	61.1
	8/3/21	33	460	28	521	60.1
	11/2/21	34	370	25	429	63.9
Well VMW-C	2/2/21	48	900	79	1027	61.2
	5/4/21	51	1100	93	1244	60.8
	8/3/21	40	1500	99	1639	60.4
	11/2/21	44	1300	86	1430	64.6
Well VMW-E	2/2/21	46	610	70	726	74.1
	5/4/21	77	1200	97	1374	72.1
	8/3/21	< 0.4	1.4	< 0.7	2.51	72.3
	11/2/21	59	1200	83	1342	73.6
Well VMW-F	2/2/21	< 13.5	< 13.5	< 13.5	< 40.5	72.6
	5/4/21	13	110	23	146	72.6
	8/3/21	< 0.4	< 0.6	< 0.7	< 1.7	73.3
	11/2/21	< 0.4	< 0.5	< 0.6	< 1.4	73.2
Well VMW-G	2/2/21	56	320	44	420	73.1
	5/4/21	< 0.4	< 0.6	< 0.7	< 1.7	72.4
	8/3/21	< 0.4	< 0.6	< 0.7	< 1.7	72.8
	11/2/21	11	81	9.8	101.8	73.3
Well VMW-H	2/2/21	< 1.0	< 1.0	< 1.0	< 3.0	70.6
	5/4/21	< 0.4	< 0.6	< 0.7	< 1.7	71.9
	8/3/21	< 0.4	< 0.6	< 0.7	< 1.7	68.6
	11/2/21	72	590	21	683	70.1

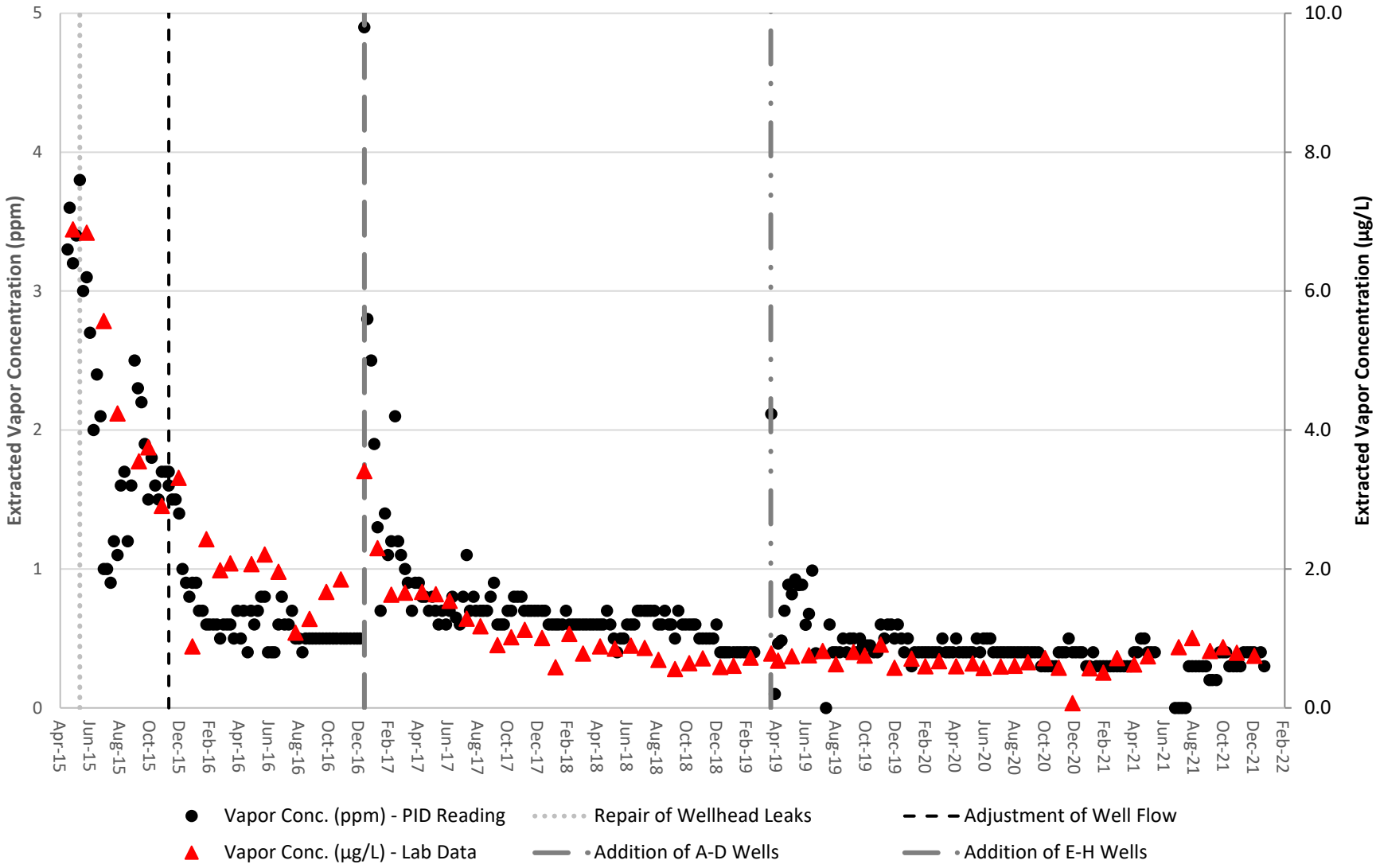
Notes:
ID = identification
scfm = standard cubic feet per minute
$\mu g/m^3$ = micrograms per cubic meter
VOC = volatile organic compounds
Total VOCs are the cal Total VOCs are the calculated sum of the three VOCs shown
[1] Flowrates associated with the analytical data for 12/8/21 were measured on 12/7/21

Table C-3
Soil Vapor Extraction VOC Mass Removal - April 2015 through December 2021
East Multnomah County TSA Remedy

Date	Pounds of TCE Removed Per Sampling Period	Cumulative Pounds of TCE Removed	Pounds of VOCs Removed Per Sampling Period	Cumulative Pounds of VOCs Removed	TCE percentage of mass removal Per Sampling Period
04/16/15	0.00	0.00	0.00	0.00	0%
04/28/15	1.13	1.13	1.30	1.30	87%
05/26/15	2.57	3.71	2.95	4.25	87%
06/30/15	2.46	6.17	2.80	7.05	88%
07/28/15	1.44	7.60	1.64	8.69	88%
09/10/15	1.68	9.29	1.93	10.62	87%
09/29/15	0.79	10.08	0.90	11.52	88%
10/27/15	0.95	11.03	1.09	12.61	87%
11/30/15	1.31	12.33	1.50	14.11	87%
12/28/15	0.84	13.17	0.96	15.07	87%
01/26/16	0.84	14.01	0.98	16.04	86%
02/23/16	1.07	15.08	1.24	17.28	86%
03/15/16	0.73	15.81	0.85	18.13	86%
04/27/16	1.51	17.32	1.74	19.88	87%
05/24/16	1.05	18.37	1.21	21.09	86%
06/21/16	0.98	19.35	1.14	22.23	86%
07/26/16	0.91	20.27	1.05	23.28	87%
08/24/16	0.59	20.86	0.69	23.97	86%
09/27/16	0.84	21.70	1.00	24.96	85%
10/27/16	0.85	22.55	1.00	25.96	85%
12/14/16	1.84	24.40	2.11	28.07	87%
01/10/17	1.51	25.91	1.73	29.80	87%
02/07/17	1.95	27.86	2.25	32.05	86%
03/07/17	1.66	29.52	1.95	34.00	85%
04/11/17	1.85	31.37	2.20	36.20	84%
05/09/17	1.48	32.85	1.75	37.95	85%
06/06/17	1.51	34.35	1.77	39.72	85%
07/11/17	1.63	35.99	1.92	41.64	85%
08/08/17	1.16	37.15	1.36	43.00	85%
09/12/17	1.24	38.39	1.46	44.46	85%
10/10/17	0.92	39.31	1.08	45.54	85%
11/07/17	0.98	40.29	1.14	46.68	86%
12/12/17	1.31	41.60	1.52	48.20	86%
01/09/18	0.74	42.34	0.87	49.07	85%
02/06/18	0.78	43.12	0.90	49.97	87%
03/06/18	0.89	44.00	1.01	50.98	88%
04/10/18	1.00	45.01	1.15	52.13	87%
05/10/18	0.79	45.80	0.91	53.04	87%
06/12/18	1.05	46.85	1.20	54.25	87%
07/10/18	0.85	47.70	0.97	55.22	87%
08/07/18	0.76	48.46	0.87	56.09	87%
09/10/18	0.75	49.21	0.86	56.95	87%
10/09/18	0.62	49.83	0.72	57.67	87%
11/06/18	0.69	50.52	0.79	58.46	87%
12/12/18	0.84	51.36	0.98	59.44	86%

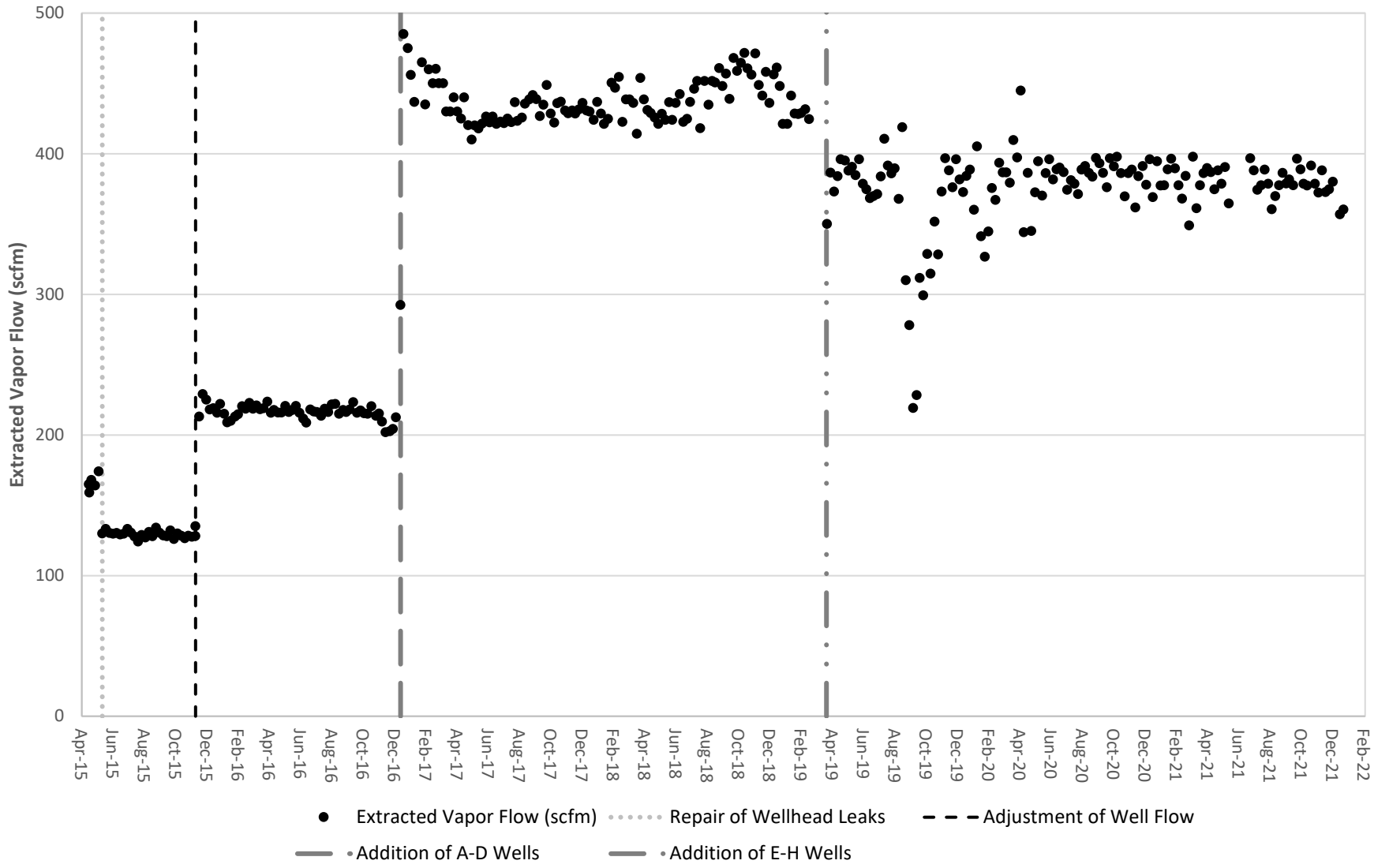
Table C-3
Soil Vapor Extraction VOC Mass Removal - April 2015 through December 2021
East Multnomah County TSA Remedy

Date	Pounds of TCE Removed Per Sampling Period	Cumulative Pounds of TCE Removed	Pounds of VOCs Removed Per Sampling Period	Cumulative Pounds of VOCs Removed	TCE percentage of mass removal Per Sampling Period
01/08/19	0.58	51.94	0.66	60.10	87%
02/12/19	0.83	52.77	0.96	61.06	86%
03/26/19	1.07	53.83	1.24	62.29	86%
04/09/19	0.31	54.14	0.36	62.66	85%
05/07/19	0.56	54.70	0.67	63.33	84%
06/11/19	0.78	55.48	0.91	64.24	85%
07/09/19	0.63	56.11	0.75	65.00	84%
08/05/19	0.56	56.67	0.67	65.67	83%
09/10/19	0.70	57.37	0.83	66.50	84%
10/03/19	0.36	57.73	0.42	66.92	84%
11/05/19	0.70	58.43	0.81	67.73	86%
12/03/19	0.56	58.99	0.66	68.39	85%
01/07/20	0.64	59.63	0.77	69.16	83%
02/04/20	0.51	60.14	0.60	69.77	85%
03/03/20	0.50	60.64	0.59	70.35	85%
04/07/20	0.64	61.28	0.77	71.13	83%
05/11/20	0.61	61.89	0.73	71.86	83%
06/02/20	0.39	62.28	0.46	72.32	84%
07/07/20	0.60	62.88	0.71	73.03	85%
08/05/20	0.49	63.37	0.57	73.61	86%
09/01/20	0.53	63.90	0.62	74.22	85%
10/06/20	0.71	64.61	0.84	75.06	84%
11/03/20	0.53	65.14	0.63	75.69	84%
12/01/20	0.25	65.39	0.31	76.00	82%
01/05/21	0.32	65.71	0.38	76.38	84%
02/02/21	0.44	66.15	0.53	76.91	84%
03/02/21	0.48	66.64	0.58	77.49	83%
04/06/21	0.66	67.29	0.79	78.28	83%
05/04/21	0.56	67.85	0.66	78.94	85%
07/06/21	0.63	68.48	0.72	79.66	87%
08/03/21	0.81	69.29	0.90	80.56	89%
09/08/21	0.98	70.27	1.09	81.66	89%
10/05/21	0.71	70.98	0.82	82.47	87%
11/02/21	0.70	71.67	0.79	83.27	88%
12/08/21	0.81	72.49	0.93	84.20	88%



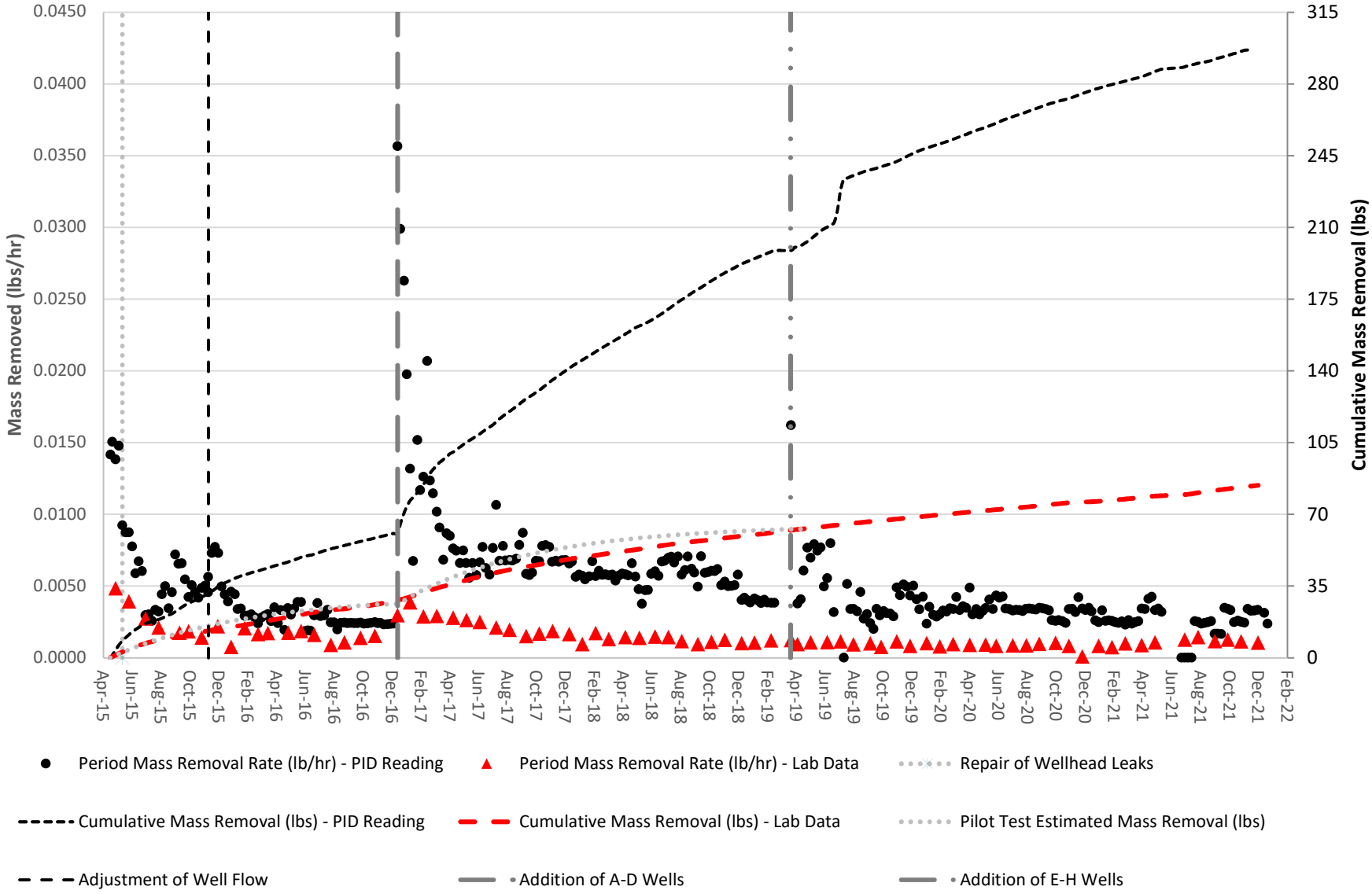
Geosyntec consultants

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

Geosyntec consultants

APPENDIX D
Groundwater Elevation Data

Table D-1
Groundwater Elevations - 1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

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-14	2/1/2021	10:18	127.63	157.08	-29.45
Lower	EW-14	5/3/2021	9:35	127.63	153.06	-25.43
Lower	EW-14	8/2/2021	7:54	127.63	161.86	-34.23
Lower	EW-14	11/3/2021	10:25	127.63	159.18	-31.55
Lower	EW-2	2/1/2021	2:52	126.01	154.81	-28.80
Lower	EW-2	5/3/2021	9:30	126.01	156.09	-30.08
Lower	EW-2	8/2/2021	7:50	126.01	155.08	-29.07
Lower	EW-2	11/2/2021	10:01	126.01	152.48	-26.47
Lower	EW-23	2/1/2021	9:15	83.93	85.75	-1.82
Lower	EW-23	5/3/2021	8:50	83.93	63.18	20.75
Lower	EW-23	8/2/2021	9:58	83.93	72.22	11.71
Monitoring Wells						
Upper	BOP-13ds	2/2/2021	14:48	128.94	117.02	11.92
Upper	BOP-13ds	5/4/2021	10:22	128.94	115.72	13.22
Upper	BOP-13ds	8/2/2021	9:18	128.94	116.14	12.80
Upper	BOP-13ds	11/2/2021	16:21	128.94	118.2	10.74
Upper	BOP-20ds	2/1/2021	17:22	77.45	63.68	13.77
Upper	BOP-20ds	8/2/2021	10:36	77.45	66.72	10.73
Upper	BOP-31ds	2/2/2021	13:47	99.04	85.75	13.29
Upper	BOP-31ds	5/4/2021	10:10	99.04	85.04	14.00
Upper	BOP-31ds	8/2/2021	9:30	99.04	86.08	12.96
Upper	BOP-31ds	11/2/2021	16:49	99.04	87.16	11.88
Upper	BOP-44ds	8/2/2021	12:47	35.24	24.46	10.78
Upper	BOP-61ds	2/2/2021	12:58	94.64	83.08	11.56
Upper	BOP-61ds	8/2/2021	9:50	94.64	84.89	9.75
Upper	BOP-62ds	8/2/2021	10:23	112.29	100.14	12.15
Upper	BOP-65ds	8/2/2021	10:10	104.22	92.98	11.24
Upper	BOP-66ds	2/2/2021	13:54	102.97	89.84	13.13
Upper	BOP-66ds	8/2/2021	10:00	102.97	92.39	10.58
Upper	CMW-10ds	2/1/2021	13:22	134.54	122.41	12.13
Upper	CMW-10ds	5/3/2021	10:46	134.54	121.96	12.58
Upper	CMW-10ds	8/2/2021	14:12	134.54	121.81	12.73
Upper	CMW-10ds	11/8/2021	12:50	134.54	122.31	12.23
Upper	CMW-17ds	2/1/2021	10:58	121.89	103.47	18.42
Upper	CMW-17ds	5/3/2021	8:55	121.89	102.58	19.31
Upper	CMW-17ds	8/2/2021	8:26	121.89	102.02	19.87
Upper	CMW-17ds	11/9/2021	12:10	121.89	102.64	19.25
Upper	CMW-18ds	2/1/2021	12:05	117.66	103.81	13.85
Upper	CMW-18ds	5/3/2021	10:32	117.66	102.89	14.77
Upper	CMW-18ds	8/2/2021	11:33	117.66	102.31	15.35
Upper	CMW-18ds	11/10/2021	12:22	117.66	103.05	14.61
Upper	CMW-19ds	2/1/2021	13:06	144.08	129.24	14.84
Upper	CMW-19ds	5/3/2021	10:40	144.08	128.59	15.49
Upper	CMW-19ds	8/2/2021	14:00	144.08	128.38	15.70
Upper	CMW-19ds	11/11/2021	12:45	144.08	129.1	14.98
Upper	CMW-20ds	2/1/2021	13:34	152.72	138.91	13.81
Upper	CMW-20ds	8/2/2021	13:47	152.72	137.71	15.01
Upper	EW-3	8/2/2021	9:40	94.26	84.5	9.76
Lower	BOP-13dg	5/4/2021	10:26	128.71	115.49	13.22

Table D-1
Groundwater Elevations - 1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Lower	BOP-13dg	8/2/2021	9:15	128.71	115.97	12.74
Lower	BOP-13dg	11/2/2021	16:35	128.71	117.97	10.74
Lower	BOP-20dg	2/2/2021	13:26	77.32	63.84	13.48
Lower	BOP-20dg	8/2/2021	10:56	77.32	65.59	11.73
Lower	BOP-23dg	8/2/2021	10:30	76.96	66.34	10.62
Lower	BOP-31dg	2/2/2021	13:44	98.51	85.19	13.32
Lower	BOP-31dg	5/4/2021	10:05	98.51	84.56	13.95
Lower	BOP-31dg	8/2/2021	9:35	98.51	85.7	12.81
Lower	BOP-31dg	11/2/2021	16:54	98.51	86.88	11.63
Lower	BOP-44dg	8/2/2021	12:44	35.15	24.47	10.68
Lower	BOP-61dg	2/2/2021	13:03	94.43	83.05	11.38
Lower	BOP-61dg	8/2/2021	9:52	94.43	83.75	10.68
Lower	CMW-14Rds	2/1/2021	12:11	83.48	64.08	19.40
Lower	CMW-14Rds	8/2/2021	11:51	83.48	61.84	21.64
Lower	CMW-22dg	2/1/2021	12:00	81.65	64.37	17.28
Lower	CMW-22dg	8/2/2021	12:03	81.65	65.42	16.23
Lower	CMW-24dg (EW-5)	2/1/2021	A	77.74	A	A
Lower	CMW-24dg (EW-5)	8/2/2021	13:34	77.74	62.33	15.41
Lower	CMW-25dg	2/1/2021	12:19	75.28	61.68	13.60
Lower	CMW-25dg	8/2/2021	13:16	75.28	61.68	13.60
Lower	CMW-36dg	8/2/2021	12:18	78.84	64.78	14.06
Lower	D-17dg	2/1/2021	10:36	124.61	114.96	9.65
Lower	D-17dg	5/3/2021	10:00	124.61	112.14	12.47
Lower	D-17dg	8/2/2021	8:20	124.61	110.84	13.77
Lower	D-17dg	11/7/2021	11:43	124.61	115.31	9.30
Lower	D-17ds	2/1/2021	10:38	123.28	112.18	11.10
Lower	D-17ds	5/3/2021	10:05	123.28	110.65	12.63
Lower	D-17ds	8/2/2021	8:15	123.28	112.88	10.40
Lower	D-17ds	11/6/2021	11:46	123.28	113.03	10.25
Lower	EW-1	2/1/2021	10:24	124.04	110.11	13.93
Lower	EW-1	5/3/2021	9:41	124.04	109.61	14.43
Lower	EW-1	8/2/2021	9:10	124.04	110.71	13.33
Lower	EW-1	11/1/2021	10:15	124.04	113.32	10.72
Lower	EW-11	8/2/2021	B	114.73	B	B
Lower	EW-12	2/1/2021	10:30	94.14	80.78	13.36
Lower	EW-12	5/3/2021	9:46	94.14	79.92	14.22
Lower	EW-12	8/2/2021	9:02	94.14	81.08	13.06
Lower	EW-13	8/2/2021	10:05	103.59	91.2	12.39
Lower	EW-16	2/1/2021	9:00	83.71	64.48	19.23
Lower	EW-16	8/2/2021	12:31	83.71	65.49	18.22
Lower	EW-8	2/1/2021	12:44	77.16	62.41	14.75
Vapor Monitoring Wells						
Upper	VMW-A	2/1/2021	11:14	123.34	105.58	17.76
Upper	VMW-A	5/3/2021	11:43	123.34	103.77	19.57
Upper	VMW-A	8/2/2021	15:14	123.34	103.09	20.25
Upper	VMW-A	11/12/2021	13:42	123.34	103.62	19.72
Upper	VMW-B	2/1/2021	11:41	123.25	101.18	22.07
Upper	VMW-B	5/3/2021	11:06	123.25	100.21	23.04
Upper	VMW-B	8/2/2021	14:27	123.25	100.37	22.88
Upper	VMW-B	11/13/2021	13:28	123.25	100.38	22.87
Upper	VMW-C	2/1/2021	11:20	124.17	104.58	19.59

Table D-1
Groundwater Elevations - 1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

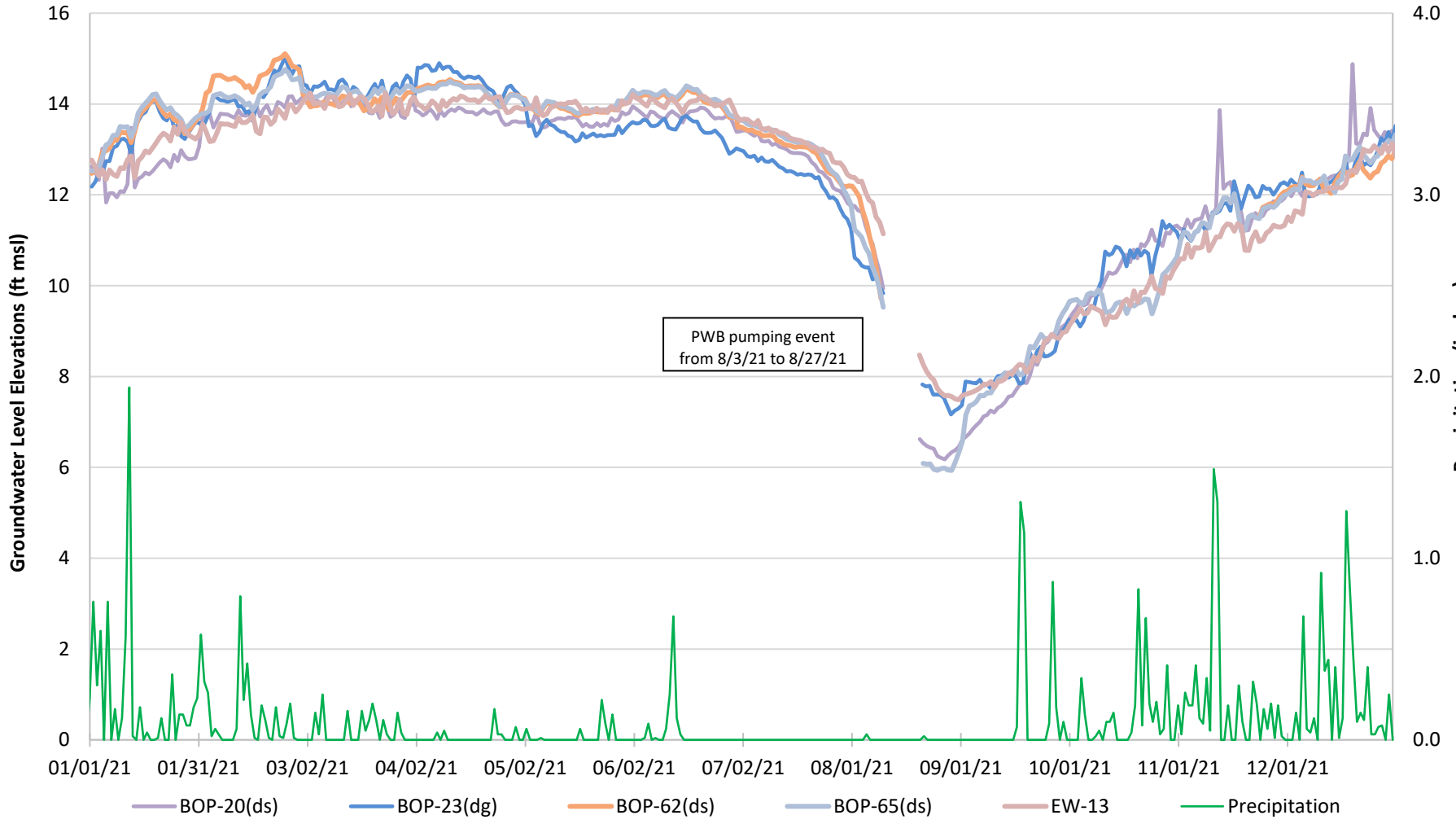
TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Upper	VMW-C	5/3/2021	11:39	124.17	103.34	20.83
Upper	VMW-C	8/2/2021	14:58	124.17	102.94	21.23
Upper	VMW-C	11/14/2021	13:49	124.17	103.24	20.93
Upper	VMW-D	2/1/2021	11:36	126.78	106.97	19.81
Upper	VMW-D	5/3/2021	11:12	126.78	105.78	21.00
Upper	VMW-D	8/2/2021	14:18	126.78	105.33	21.45
Upper	VMW-D	11/15/2021	13:04	126.78	105.87	20.91
Upper	VMW-E	C		132.39	C	C
Upper	VMW-F	C		127.51	C	C
Upper	VMW-G	C		123.14	C	C
Upper	VMW-H	2/1/2021	10:40	126.88	105.18	21.70
Upper	VMW-H	5/3/2021	11:30	126.88	102.38	24.50
Upper	VMW-H	8/2/2021	14:46	126.88	103.1	23.78
Upper	VMW-H	11/19/2021	14:15	126.88	103.98	22.90
Upper	VMW-I	2/1/2021	11:32	131.98	122.69	9.29
Upper	VMW-I	5/3/2021	11:17	131.98	120.41	11.57
Upper	VMW-I	8/2/2021	14:34	131.98	120.15	11.83
Upper	VMW-I	11/20/2021	13:12	131.98	125.24	6.74
Upper	VMW-J2	2/1/2021	11:28	130.12	112.68	17.44
Upper	VMW-J2	5/3/2021	11:21	130.12	111.79	18.33
Upper	VMW-J2	8/2/2021	14:39	130.12	111.33	18.79
Upper	VMW-J2	11/21/2021	13:15	130.12	112.58	17.54
Upper	VMW-K	2/1/2021	11:23	129.80	108.31	21.49
Upper	VMW-K	5/3/2021	11:25	129.80	107.71	22.09
Upper	VMW-K	8/2/2021	14:42	129.80	107.12	22.68
Upper	VMW-K	11/22/2021	13:21	129.80	107.88	21.92
Upper	VMW-L	2/1/2021	10:44	115.23	94.21	21.02
Upper	VMW-L	5/3/2021	11:35	115.23	92.01	23.22
Upper	VMW-L	8/2/2021	14:51	115.23	91.55	23.68
Upper	VMW-L	11/23/2021	14:00	115.23	93.49	21.74
Upper	VMW-M	2/1/2021	10:51	114.72	92.52	22.20
Upper	VMW-M	5/3/2021	12:00	114.72	90.81	23.91
Upper	VMW-M	8/2/2021	15:06	114.72	90.51	24.21
Upper	VMW-M	11/24/2021	13:38	114.72	92.24	22.48
Upper	VMW-N	2/1/2021	11:47	115.77	93.33	22.44
Upper	VMW-N	5/3/2021	12:14	115.77	91.85	23.92
Upper	VMW-N	8/2/2021	15:28	115.77	91.81	23.96
Upper	VMW-N	11/25/2021	13:34	115.77	93.27	22.50

Notes:
ft MSL = feet above mean sea level
TOC = top of casing

A - CMW-24(dg) was covered by feet of soil as the result of earthmoving operations on the property, and the well could not be accessed in February.

B - EW-11 was blocked by a vehicle and depth to water could not be measured. Three attempts on different days were made.

C - Wells VMW-E, VMW-F, and VMW-G are angled wells and depth to water cannot be measured manually.



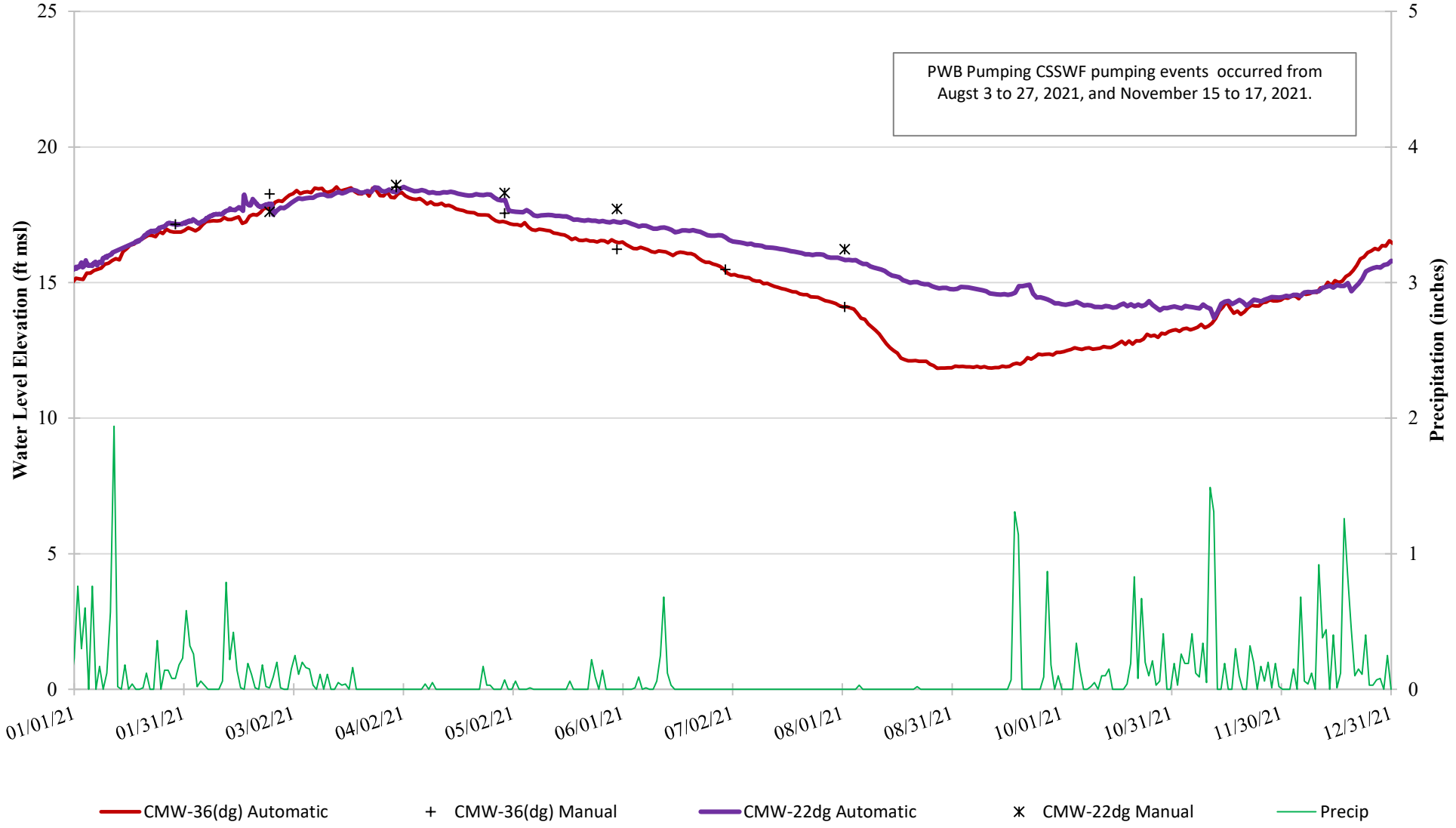
Notes:
BOP 62(ds) datalogger malfunction from 8/11-11/22.
No data from 8/11-8/20 for multiple dataloggers.

LANDAU ASSOCIATES

East Multnomah County Cleanup

Hydrograph for Zone B TSA Wells
January - December 2021

Figure
D-1



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Hydrograph for TSA Wells** **1 January 2021 through 31 December 2021** *** Manual water levels were not collected after August 2021.**	Figure D-2

Geosyntec consultants

APPENDIX E
Groundwater Quality Data

Table E-1
Groundwater Analytical Results
1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride	Duplicate sample
System Influent/Effluent									
Lower	TS-C-Eff	TS-C-EFF-020221-DUP	2/2/2021	< 0.50	< 0.50	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Eff	TS-C-EFF-020221	2/2/2021	< 0.50	< 0.50	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-050521	5/5/2021	< 0.500	< 0.500	< 0.50	< 0.50	< 0.50	
Lower	TS-C-Eff	TS-C-EFF-050521-DUP	5/5/2021	< 0.500	< 0.500	< 0.50	< 0.50	< 0.50	Yes
Lower	TS-C-Eff	TS-C-EFF-080521	8/5/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-080521-DUP	8/5/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Eff	TS-C-EFF-110221-DUP	11/2/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Eff	TS-C-EFF-110221	11/2/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-020221	2/2/2021	**4.97**	< 0.50	**0.542**	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-050521	5/5/2021	**3.54**	< 0.500	< 0.50	< 0.50	< 0.50	
Lower	TS-C-Inf	TS-C-INF-080521	8/5/2021	**7.40**	**0.559**	**0.807**	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-110221	11/2/2021	**5.51**	**0.373 J**	**0.347 J**	< 0.500	< 0.500	
Extraction Wells									
Lower	EW-14	EW14-020221	2/2/2021	**5.19**	< 0.50	**0.753**	< 0.500	< 0.500	
Lower	EW-14	EW14-050421	5/4/2021	**5.16**	< 0.500	**0.725**	< 0.50	< 0.50 J	
Lower	EW-14	EW14-080521	8/5/2021	**5.69**	**0.441 J**	**0.762**	< 0.500	< 0.500	
Lower	EW-14	EW14-110221	11/2/2021	**6.43**	**0.358 J**	**0.756**	< 0.500	< 0.500	
Lower	EW-2	EW2-020221	2/2/2021	**8.06**	**0.731 J**	**0.797**	< 0.500	< 0.500	
Lower	EW-2	EW2-050421	5/4/2021	**7.85**	**0.612**	**0.799**	< 0.50	< 0.50 J	
Lower	EW-2	EW2-080521	8/5/2021	**9.11**	**0.692**	**0.799**	< 0.500	< 0.500	
Lower	EW-2	EW2-110221	11/2/2021	**8.86**	**0.702**	**0.673**	< 0.500	< 0.500	
Lower	EW-23	EW23-020221	2/2/2021	**1.33**	< 0.50	< 0.500	< 0.500	< 0.500	
Lower	EW-23	EW23-050421	5/4/2021	**1.40**	< 0.500	< 0.50	< 0.50	< 0.50 J	
Lower	EW-23	EW23-080321	8/3/2021	**1.95**	< 0.500	**0.212 J**	< 0.500 J	< 0.500 J	
Monitoring Wells									
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0221;20210203	2/3/2021	**2.0**	< 0.20	**0.31**	< 0.20	< 0.20	
Upper	BOP-13ds	BOP-13DS;BOP-Z-0221;20210203	2/3/2021	**2.1**	< 0.20	**0.33**	< 0.20	< 0.20	Yes
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0521;20210504	5/4/2021	**2.3**	< 0.20	**0.32**	< 0.20	< 0.20	
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0821;20210803	8/3/2021	**1.9**	< 0.20	**0.29**	< 0.20	< 0.20	
Upper	BOP-13ds	BOP-13DS;BOP-13DS-1121;20211102	11/2/2021	**2.2**	< 0.20	**0.30**	< 0.20	< 0.20	
Upper	BOP-20ds	BOP-20DS;BOP-20DS-0821;20210804	8/4/2021	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0221;20210204	2/4/2021	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0521;20210504	5/4/2021	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0821;20210803	8/3/2021	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-1121;20211102	11/2/2021	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-44ds	BOP-44DS-080421	8/4/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	BOP-61ds	BOP-61DS;BOP-61DS-0221;20210205	2/5/2021	**3.5**	< 0.20	**0.36**	< 0.20	< 0.20	
Upper	BOP-62ds	BOP-62DS;BOP-62DS-0821;20210804	8/4/2021	**0.97**	< 0.20	**0.28**	< 0.20	< 0.20	
Upper	BOP-65ds	BOP-65DS;BOP-65DS-0821;20210805	8/5/2021	**0.25**	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-66ds	BOP-66DS;BOP-66DS-0221;20210205	2/5/2021	**1.7**	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-66ds	BOP-66DS;BOP-66DS-0821;20210804	8/4/2021	**0.97**	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	CMW-10ds	CMW10DS-020221	2/2/2021	**9.01**	< 0.50	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-050521	5/5/2021	**9.22**	< 0.500	< 0.50	< 0.50	< 0.50 J	
Upper	CMW-10ds	CMW10DS-080421	8/4/2021	**8.67**	**0.394 J**	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-080421-DUP	8/4/2021	**8.55**	**0.435 J**	< 0.500	< 0.500	< 0.500	Yes
Upper	CMW-10ds	CMW10DS-110221-DUP	11/2/2021	**9.38 J**	**0.355 J**	< 0.500	< 0.500	< 0.500	Yes
Upper	CMW-10ds	CMW10DS-110221	11/2/2021	**9.25 J**	< 0.500	< 0.500	< 0.500	< 0.500	

Table E-1
Groundwater Analytical Results
1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride	Duplicate sample
Upper	CMW-17ds	CMW17DS-020221-DUP	2/2/2021	**33.2**	**2.1 J**	**4.37**	< 0.500	< 0.500	(A) Yes
Upper	CMW-17ds	CMW17DS-020221	2/2/2021	**33.3**	**2.13 J**	**4.41**	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-050521	5/5/2021	**35.6**	**1.86**	**4.61**	< 0.50	< 0.50 J	
Upper	CMW-17ds	CMW17DS-050521-DUP	5/5/2021	**35.4**	**1.89**	**4.53**	< 0.50	< 0.50 J	Yes
Upper	CMW-17ds	CMW17DS-080421	8/4/2021	**35.3**	**1.97**	**3.99**	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-110221	11/2/2021	**30.5 J**	**1.70**	**4.25**	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-020221	2/2/2021	**59.7**	**2.89 J**	**8.47**	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-020221-DUP	2/2/2021	**58.6**	**2.48 J**	**8.29**	< 0.500	< 0.500	Yes
Upper	CMW-18ds	CMW18DS-050521	5/5/2021	**83.3**	**2.28**	**12.4**	< 0.50	< 0.50 J	
Upper	CMW-18ds	CMW18DS-050521-DUP	5/5/2021	**80.4**	**2.46**	**11.6**	< 0.50	< 0.50 J	Yes
Upper	CMW-18ds	CMW18DS-080421	8/4/2021	**58.0**	**1.61**	**10.9**	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-110221	11/2/2021	**82.5 J**	**3.75**	**11.6**	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-020221	2/2/2021	**1.06**	< 0.50	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-050521	5/5/2021	< 0.500	< 0.500	< 0.50	< 0.50	< 0.50 J	
Upper	CMW-19ds	CMW19DS-080421	8/4/2021	**0.326 J**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-110221	11/2/2021	**0.864 J**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-20ds	CMW20DS-080421	8/4/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	EW-3	EW-3;EW-3-0821;20210804	8/4/2021	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0221;20210203	2/3/2021	**0.46**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0521;20210504	5/4/2021	**0.26**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0821;20210803	8/3/2021	**0.36**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-1121;20211102	11/2/2021	**0.55**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-20dg	BOP-20DG;BOP-20DG-0821;20210803	8/3/2021	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-23dg	BOP-23DG;BOP-23DG-0821;20210804	8/4/2021	**0.85**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0221;20210204	2/4/2021	**2.7**	**0.38**	**0.26**	< 0.20	< 0.20	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0521;20210504	5/4/2021	**2.7**	**0.40**	**0.24**	< 0.20	< 0.20	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0821;20210803	8/3/2021	**2.6**	**0.39**	**0.24**	< 0.20	< 0.20	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-1121;20211102	11/2/2021	**2.8**	**0.43**	**0.27**	< 0.20	< 0.20	
Lower	BOP-44dg	BOP44DG-080421	8/4/2021	**0.521**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	BOP-61dg	BOP-61DG;BOP-61DG-0221;20210205	2/5/2021	**4.0**	< 0.20	**0.50**	< 0.20	< 0.20	
Lower	BOP-61dg	BOP-61DG;BOP-61DG-0821;20210804	8/4/2021	**3.2**	< 0.20	**0.20**	< 0.20	< 0.20	
Lower	CMW-14Rds	CMW14RDS-020221	2/2/2021	< 0.50	< 0.50	< 0.500	< 0.500	< 0.500	
Lower	CMW-14Rds	CMW14RDS-080421	8/4/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-22dg	CMW22DG-080421	8/4/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-24dg (EW-5)	CMW24DG-030921	3/9/2021	< 0.50	< 0.50	< 0.500	< 0.500	< 0.500	
Lower	CMW-24dg (EW-5)	CMW24DG-080521	8/5/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-25dg	CMW25DG-020221	2/2/2021	< 0.50	< 0.50	< 0.500	< 0.500	< 0.500	
Lower	CMW-25dg	CMW25DG-080521	8/5/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-36dg	CMW36DG-080421-DUP	8/4/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	CMW-36dg	CMW36DG-080421	8/4/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-020221	2/2/2021	**3.69**	< 0.50	**0.523**	< 0.500	< 0.500	
Lower	D-17dg	D17DG-050521	5/5/2021	**3.31**	< 0.500	< 0.50	< 0.50	< 0.50 J	
Lower	D-17dg	D17DG-080521	8/5/2021	**3.91**	< 0.500	**0.827**	< 0.500	< 0.500	
Lower	D-17dg	D17DG-110221	11/2/2021	**4.47 J**	< 0.500	**0.724**	< 0.500	< 0.500	
Lower	D-17ds	D17DS-020221	2/2/2021	**29.8**	**0.834 J**	**8.39**	< 0.500	< 0.500	
Lower	D-17ds	D17DS-050521	5/5/2021	**22.9**	**0.824**	**7.05**	< 0.50	< 0.50 J	
Lower	D-17ds	D17DS-080521	8/5/2021	**22.2**	**0.688**	**6.68**	< 0.500	< 0.500	
Lower	D-17ds	D17DS-110221	11/2/2021	**30.7 J**	**0.855**	**8.35**	< 0.500	< 0.500	

Table E-1
Groundwater Analytical Results
1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride	Duplicate sample
Lower	EW-1	EW1-020221	2/2/2021	**0.533**	< 0.50	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-050421	5/4/2021	< 0.500	< 0.500	< 0.50	< 0.50	< 0.50 J	
Lower	EW-1	EW1-080321	8/3/2021	< 0.500	< 0.500	< 0.500	< 0.500 J	< 0.500 J	
Lower	EW-1	EW1-110221	11/2/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-11	B	2/2/2021	B	B	B	B	B	
Lower	EW-12	EW12-020221	2/2/2021	**1.76**	< 0.50	< 0.500	< 0.500	< 0.500	
Lower	EW-12	EW12-050521	5/5/2021	**1.83**	< 0.500	< 0.50	< 0.50	< 0.50 J	
Lower	EW-12	EW12-080521	8/5/2021	**2.06**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-12	EW12-110221	11/2/2021	**1.95 J**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-13	EW-13;EW-13-0821;20210804	8/4/2021	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Lower	EW-16	EW16-020221	2/2/2021	< 0.50	< 0.50	< 0.500	< 0.500	< 0.500	
Lower	EW-16	EW16-080521	8/5/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Vapor Monitoring Wells									
Upper	VMW-A	VMWA-020321	2/3/2021	**4.16**	< 0.50	< 0.500	< 0.500	< 0.500	
Upper	VMW-A	VMWA-050521	5/5/2021	**2.67**	< 0.500	< 0.50	< 0.50	< 0.50 J	
Upper	VMW-A	VMWA-080321	8/3/2021	**2.36**	< 0.500	**0.243 J**	< 0.500 J	< 0.500 J	
Upper	VMW-A	VMWA-110321	11/3/2021	**2.12**	< 0.500	**0.349 J**	< 0.500	< 0.500	
Upper	VMW-B	VMWB-020321	2/3/2021	**18.7**	**0.813**	**2.61**	< 0.500	< 0.500	
Upper	VMW-B	VMWB-050521	5/5/2021	**15.8**	**0.714**	**2.37**	< 0.50	< 0.50 J	
Upper	VMW-B	VMWB-080321	8/3/2021	**2.47**	< 0.500	< 0.500	< 0.500 J	< 0.500 J	
Upper	VMW-B	VMWB-110321	11/3/2021	**12.4**	**0.564**	**2.19**	< 0.500	< 0.500	
Upper	VMW-C	VMWC-020321	2/3/2021	**3.84**	< 0.50	< 0.500	< 0.500	< 0.500	
Upper	VMW-C	VMWC-050521	5/5/2021	**2.77**	< 0.500	< 0.50	< 0.50	< 0.50 J	
Upper	VMW-C	VMWC-080321	8/3/2021	**14.4**	**0.769**	**2.19**	< 0.500 J	< 0.500 J	
Upper	VMW-C	VMWC-110321	11/3/2021	**2.12**	< 0.500	**0.214 J**	< 0.500	< 0.500	
Upper	VMW-D	VMWD-020321	2/3/2021	**0.831**	< 0.50	< 0.500	< 0.500	< 0.500	
Upper	VMW-D	VMWD-050521	5/5/2021	**0.708**	< 0.500	< 0.50	< 0.50	< 0.50 J	
Upper	VMW-D	VMWD-080321	8/3/2021	**0.583**	< 0.500	< 0.500	< 0.500 J	< 0.500 J	
Upper	VMW-D	VMWD-110321	11/3/2021	**0.466 J**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-E	VMWE-020321	2/3/2021	**7.59**	< 0.50	**1.58**	< 0.500	< 0.500	
Upper	VMW-E	VMWE-050521	5/5/2021	**22.6**	**1.76**	**2.95**	< 0.50	< 0.50 J	
Upper	VMW-E	VMWE-080321	8/3/2021	**21.5**	**1.49**	**2.45**	< 0.500 J	< 0.500 J	
Upper	VMW-E	VMWE-110321	11/3/2021	**21.8**	**1.54**	**3.39**	< 0.500	< 0.500	
Upper	VMW-F	VMWF-020321	2/3/2021	< 0.50	< 0.50	< 0.500	< 0.500	< 0.500	
Upper	VMW-F	VMWF-050521	5/5/2021	< 0.500	< 0.500	< 0.50	< 0.50	< 0.50 J	
Upper	VMW-F	VMWF-080321	8/3/2021	**0.260 J**	< 0.500	< 0.500	< 0.500 J	< 0.500 J	
Upper	VMW-F	VMWF-110321	11/3/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-G	VMWG-020321	2/3/2021	**3.36**	< 0.50	**0.766**	< 0.500	< 0.500	
Upper	VMW-G	VMWG-050521	5/5/2021	**2.12**	< 0.500	**0.78**	< 0.50	< 0.50	
Upper	VMW-G	VMWG-080321	8/3/2021	**2.67**	< 0.500	**0.945**	< 0.500 J	< 0.500 J	
Upper	VMW-G	VMWG-110321	11/3/2021	**2.07**	< 0.500	**0.541**	< 0.500	< 0.500	
Upper	VMW-H	VMWH-020321	2/3/2021	< 0.50	< 0.50	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-050521	5/5/2021	< 0.500	< 0.500	< 0.50	< 0.50	< 0.50	
Upper	VMW-H	VMWH-080321	8/3/2021	**1.18 J**	< 0.500	**0.956**	< 0.500	< 0.500	
Upper	VMW-H	VMWH-110321	11/3/2021	**0.374 J**	< 0.500	**0.165 J**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-020321-143.67	2/3/2021	**34.2**	**1.35**	**2.57**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-020321-137.25	2/3/2021	**29.5**	**1.15**	**2.11**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-020321-140.46	2/3/2021	**32.9**	**1.34**	**2.71**	< 0.500	< 0.500	

Table E-1
Groundwater Analytical Results
1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride	Duplicate sample
Upper	VMW-I	VMWI-020321-131.61	2/3/2021	**31.9**	**1.28**	**2.49**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-020321-126.4	2/3/2021	**37**	**1.44**	**2.80**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-020321-148.1	2/3/2021	**33.1**	**1.29**	**2.48**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-050521-148.10	5/5/2021	**30.4**	**1.51**	**2.13**	< 0.50	< 0.50	
Upper	VMW-I	VMWI-050521-140.46	5/5/2021	**36.0**	**1.72**	**2.51**	< 0.50	< 0.50	
Upper	VMW-I	VMWI-050521-126.40	5/5/2021	**32.9**	**1.56**	**2.19**	< 0.50	< 0.50	
Upper	VMW-I	VMWI-050521-131.62	5/5/2021	**27.1**	**1.24**	**1.77**	< 0.50	< 0.50	
Upper	VMW-I	VMWI-050521-137.25	5/5/2021	**28.5**	**1.33**	**1.9**	< 0.50	< 0.50	
Upper	VMW-I	VMWI-050521-143.68	5/5/2021	**33.3**	**1.60**	**2.44**	< 0.50	< 0.50	
Upper	VMW-I	VMWI-080421-143.7	8/4/2021	**32.0**	**1.50**	**1.68**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-110321-143.7	11/3/2021	**24.3**	**1.17**	**1.86**	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-020321-120.22	2/3/2021	**89.4**	**1.75**	**10.5**	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-050521-120.23	5/5/2021	**69.2**	**2.19**	**7.24**	< 0.50	< 0.50	
Upper	VMW-J2	VMWJ2-080421-120.25	8/4/2021	**59.5**	**1.81**	**5.25**	< 0.500	< 0.500	(C) Yes
Upper	VMW-J2	VMWJ2-080421-120.25	8/4/2021	**59.0**	**1.93**	**5.41**	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-110321-120.25	11/3/2021	**42.4**	**1.13**	**6.18**	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-110321-120.25-DUP	11/3/2021	**43.1**	**1.30**	**5.96**	< 0.500	< 0.500	Yes
Upper	VMW-K	VMWK-020321-114.25	2/3/2021	**68.6**	**2.1**	**8.66**	< 0.500	< 0.500	
Upper	VMW-K	VMWK-050521-114.25	5/5/2021	**68.0**	**2.33**	**7.98**	< 0.50	< 0.50	
Upper	VMW-K	VMWK-050521-110.0	5/5/2021	**71.0**	**2.55**	**8.3**	< 0.50	< 0.50	
Upper	VMW-K	VMWK-050521-119.0	5/5/2021	**67.4**	**2.45**	**7.76**	< 0.50	< 0.50	
Upper	VMW-K	VMWK-080421-114.25	8/4/2021	**70.3**	**2.50**	**7.04**	< 0.500	< 0.500	
Upper	VMW-K	VMWK-110321-114.25	11/3/2021	**50.4**	**1.92**	**6.55**	< 0.500	< 0.500	
Upper	VMW-L	VMWL-020321-103.25	2/3/2021	< 0.50	< 0.50	< 0.500	< 0.500	< 0.500	
Upper	VMW-L	VMWL-050521-103.25	5/5/2021	< 0.500	< 0.500	< 0.50	< 0.50	< 0.50	

Table E-1
Groundwater Analytical Results
1 January 2021 through 31 December 2021
East Multnomah County TSA Remedy

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride	Duplicate sample
Upper	VMW-L	VMWL-080421-103.25	8/4/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-L	VMWL-110321-103.25	11/3/2021	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-M	VMWM-020321-94	2/3/2021	**4.5**	< 0.50	**1.39**	< 0.500	< 0.500	
Upper	VMW-M	VMWM-050521-94.0	5/5/2021	**13.0**	**0.573**	**1.96**	< 0.50	< 0.50	
Upper	VMW-M	VMWM-080421-94	8/4/2021	**6.82**	**0.440 J**	**0.682**	< 0.500	< 0.500	
Upper	VMW-M	VMWM-110321-94	11/3/2021	**3.39**	< 0.500	**0.441 J**	< 0.500	< 0.500	
Upper	VMW-N	VMWN-020321-102.25	2/3/2021	**6.78**	**0.67**	**0.886**	< 0.500	< 0.500	
Upper	VMW-N	VMWN-050521-110.8	5/5/2021	**0.766**	< 0.500	< 0.50	< 0.50	< 0.50	
Upper	VMW-N	VMWN-080421-110.8	8/4/2021	**0.721**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-N	VMWN-110321-110.8	11/3/2021	**11.6**	**0.533**	**2.15**	< 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.

J=estimated concentration

< = 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.

Data validation reports are provided in Appendix F, and laboratory reports are presented on a disc in Appendix F.

N/A = not applicable

A - A primary sample/field duplicate pair was collected from CMW-17ds on 2/2/2021. However, the duplicate sample was not called out on the COC using the project nomenclature (e.g. CMW17DS-020221-DUP). Instead, both the primary and duplicate samples had identical names (CMW-17DS-020221).

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

B - EW-11 was blocked by a vehicle and a sample could not be collected. Three attempts on different days were made.

C - A primary sample/field duplicate pair was collected from VMW-J2 on 8/4/2021. However, the duplicate sample was not called out on the COC using the project nomenclature (e.g. VMWJ2-080421-120.25-DUP). Instead, both the primary and duplicate samples had identical names (VMWJ2-080421-120.25).

Table E-2
TCE Mass Removal - January 1998 through December 2021
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	2.65	495.23
Dec-19	2.43	497.66
Dec-20	2.52	500.18
Dec-21	1.70	501.88

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					0.43	2.98
2016	0.87	1.42			0.70					0.26	3.25
2017	0.67	0.98			0.60					0.28	2.53
2018	0.32	1.45			0.64					0.24	2.65
2019		1.52			0.67					0.24	2.43
2020		1.57			0.72					0.24	2.52
2021		1.15			0.51					0.04	1.70
Total (5 years)	0.99	6.67	0.00	0.00	3.14	0.00	0.00	0.00	0.00	1.04	11.83
Total (10 years)	5.66	15.16	0.00	0.00	7.59	0.00	0.36	0.00	0.00	3.32	32.10

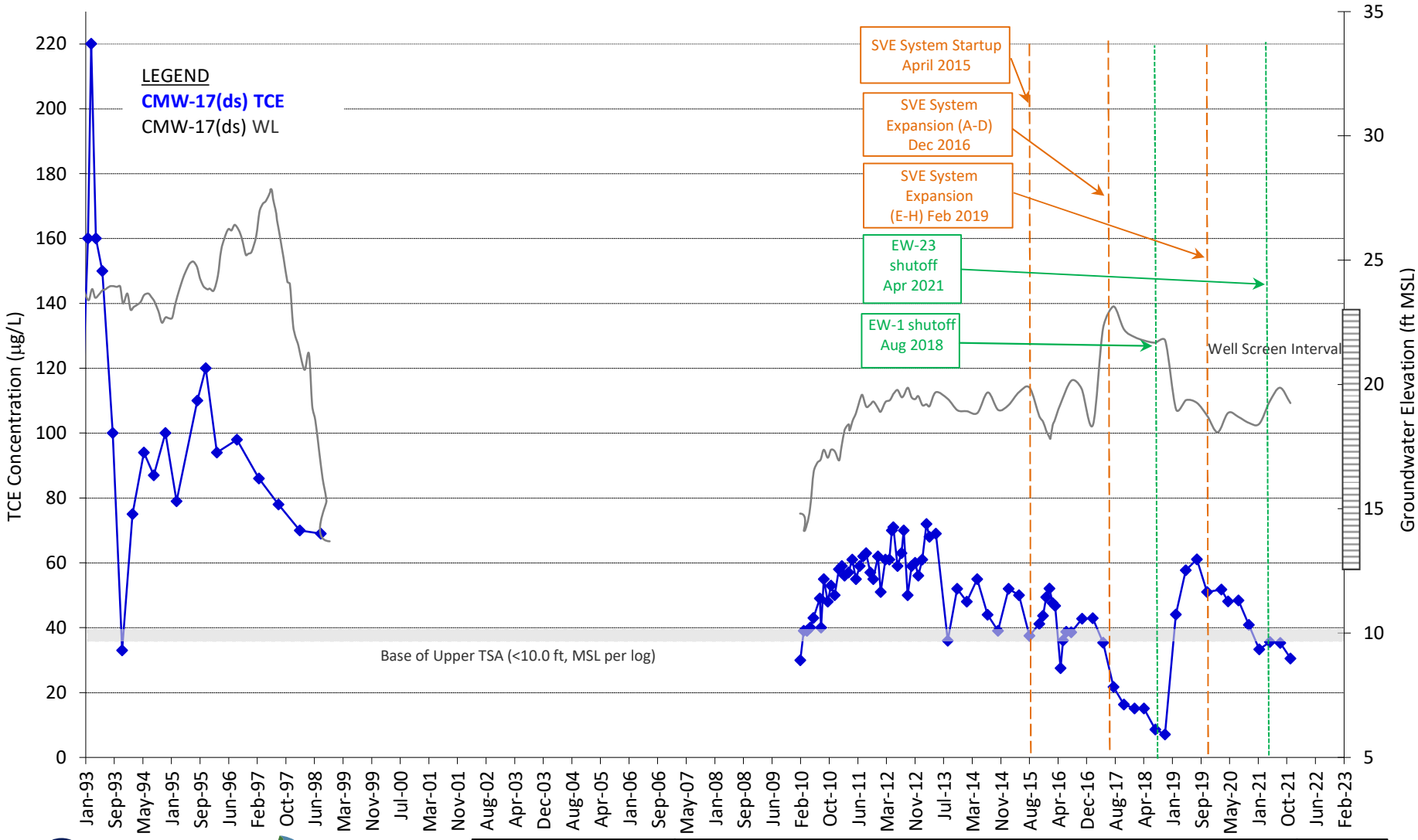
Notes
The amount of TCE removed by the extraction wells in the remedial systems was calculated using the average quarterly flow rates at each extraction well and the TCE concentration from samples collected on a quarterly basis. Note that the mass removal for 2018 was incorrectly reported as 1.28 lbs in the 2018 TSA Annual Report and has been corrected here to 2.65 lbs.

Table E-4
1,4-dioxane Groundwater Analytical Results
August 2021
East Multnomah County TSA Remedy

Company Responsible for Sample Collection (a)	Sample Location	Sample Date	Sample Type	Field Sample ID	SW-846 8270E SIM 1,4-dioxane	
					Result (b)	Qualifier
					µg/L	
RBC Ingestion and Inhalation from Tap Water:					**0.46**	
Cascade	BOP-44(dg)	8/4/2021	N	BOP44DG-080421	0.400	U
Cascade	BOP-44(ds)	8/4/2021	N	BOP-44DS-080421	0.400	U
Boeing	BOP-61(ds)	8/4/2021	N	BOP-61ds-0821	0.333	U
Boeing	BOP-61(ds)	8/4/2021	FD	BOP-Dup-0821	0.333	U
Cascade	CMW-17(ds)	8/4/2021	N	CMW17DS-080421	0.400	U
Cascade	CMW-18(ds)	8/4/2021	N	CMW18DS-080421	0.400	U
Cascade	CMW-36(dg)	8/4/2021	N	CMW36DG-080421	0.400	U
Cascade	CMW-36(dg)	8/4/2021	FD	CMW36DG-080421-DUP	0.400	U

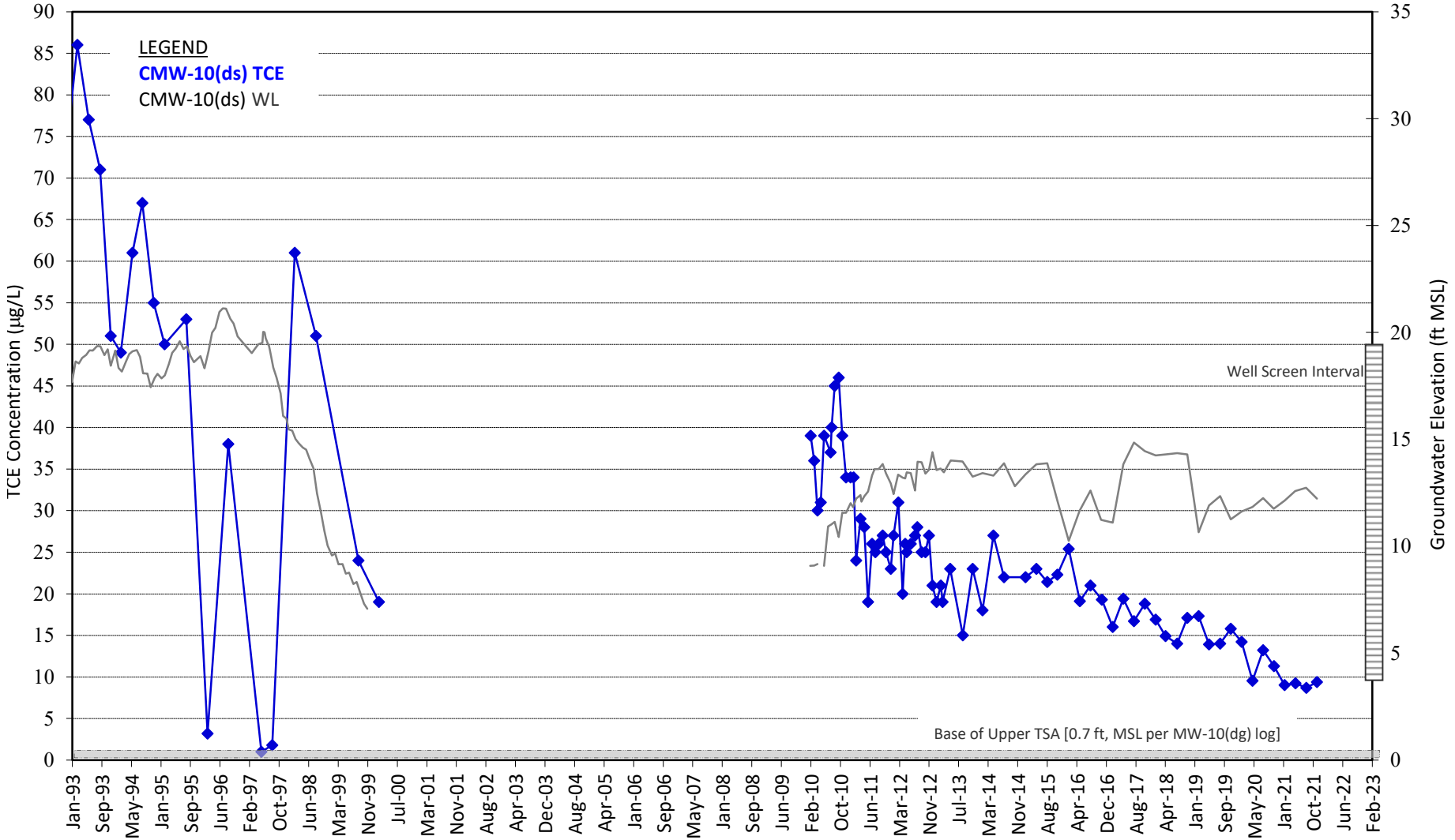
Notes
(a) Cascade-collected samples are reported to the method detection limit, Boeing-collected samples are reported to the reporting limit. All non-detect results are reported as the reporting limit.
(b) Result is reported relative to the reporting limit.
U = The analyte was analyzed for but was not detected above the reported sample quantitation limit.

Abbreviations and Acronyms:
µg/L = micrograms per liter
FD = field duplicate
ID = identification
N = primary sample
RBC = risk-based concentration
SIM = selected ion monitoring



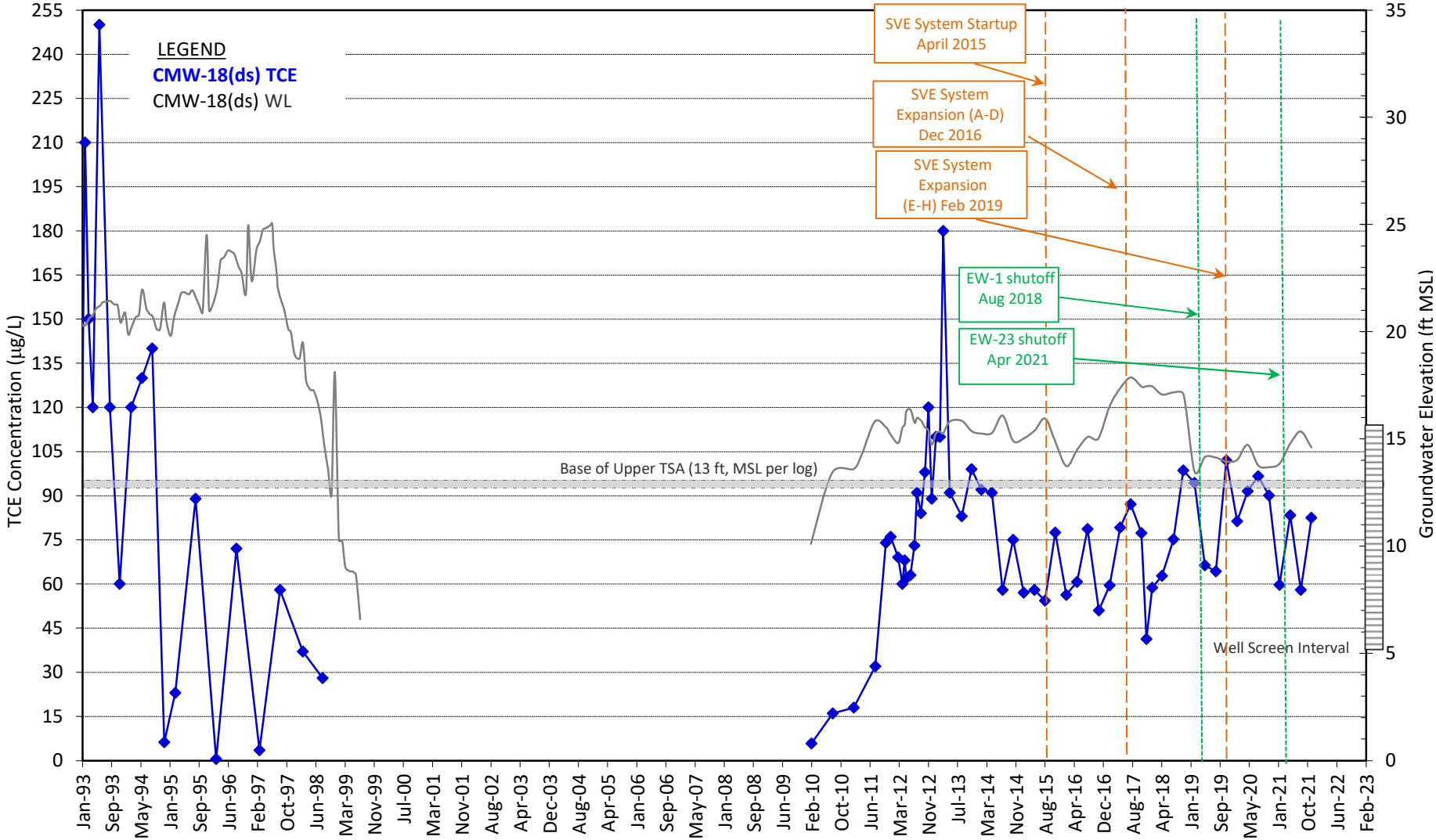
Geosyntec consultants

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



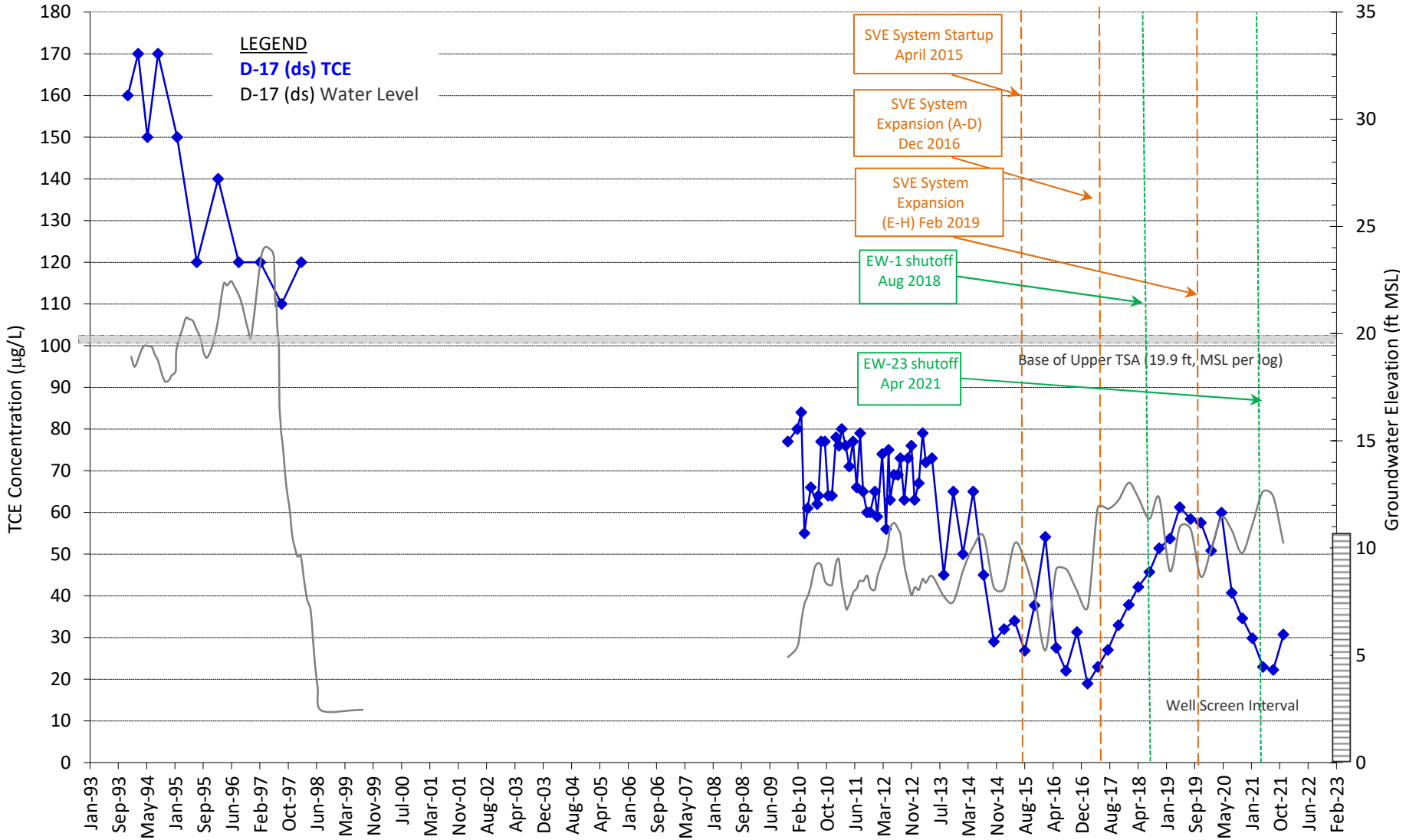
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-10(ds) TSA Remedy**	Figure E-2



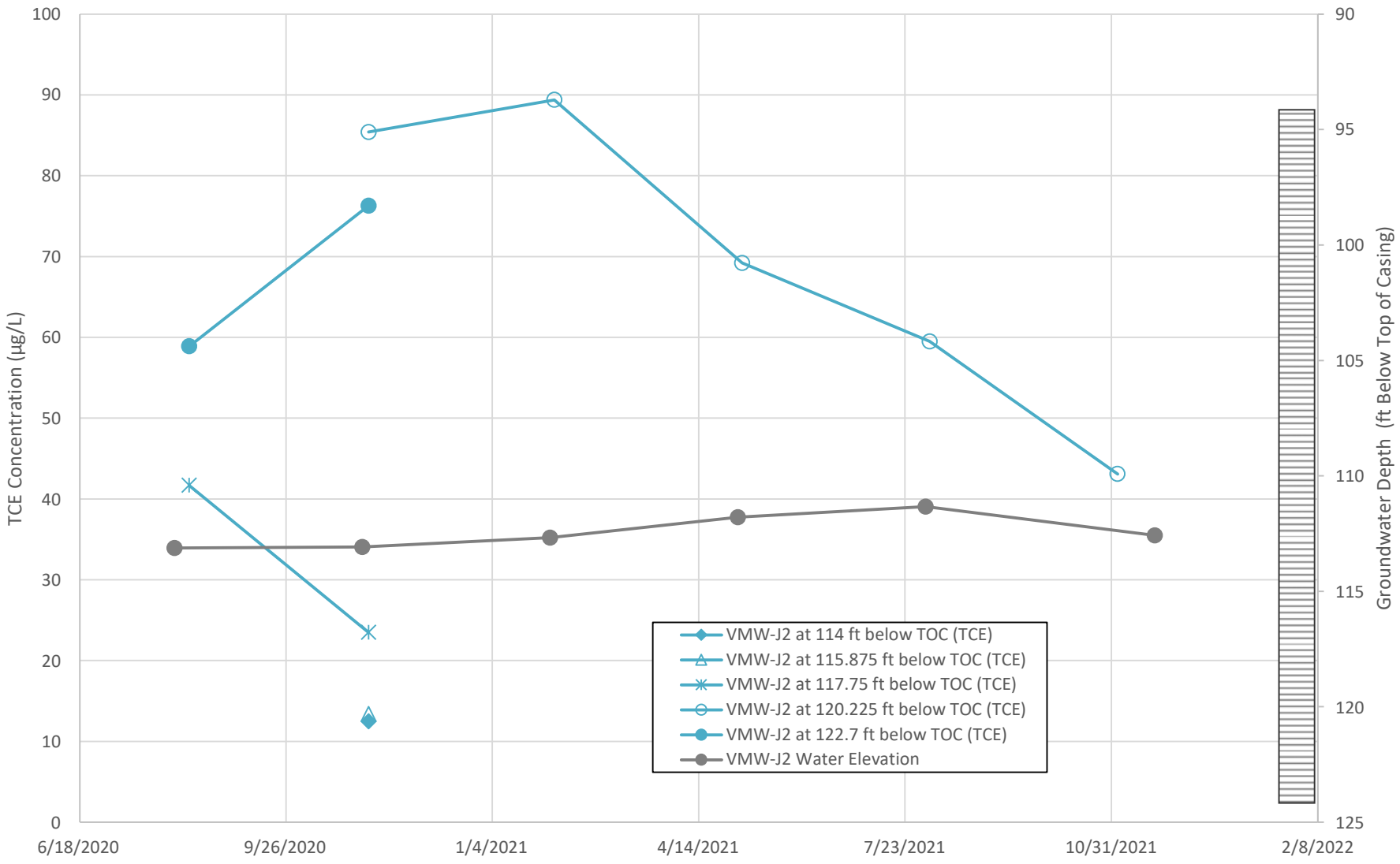
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-18(ds)** **TSA Remedy**	Figure E-3



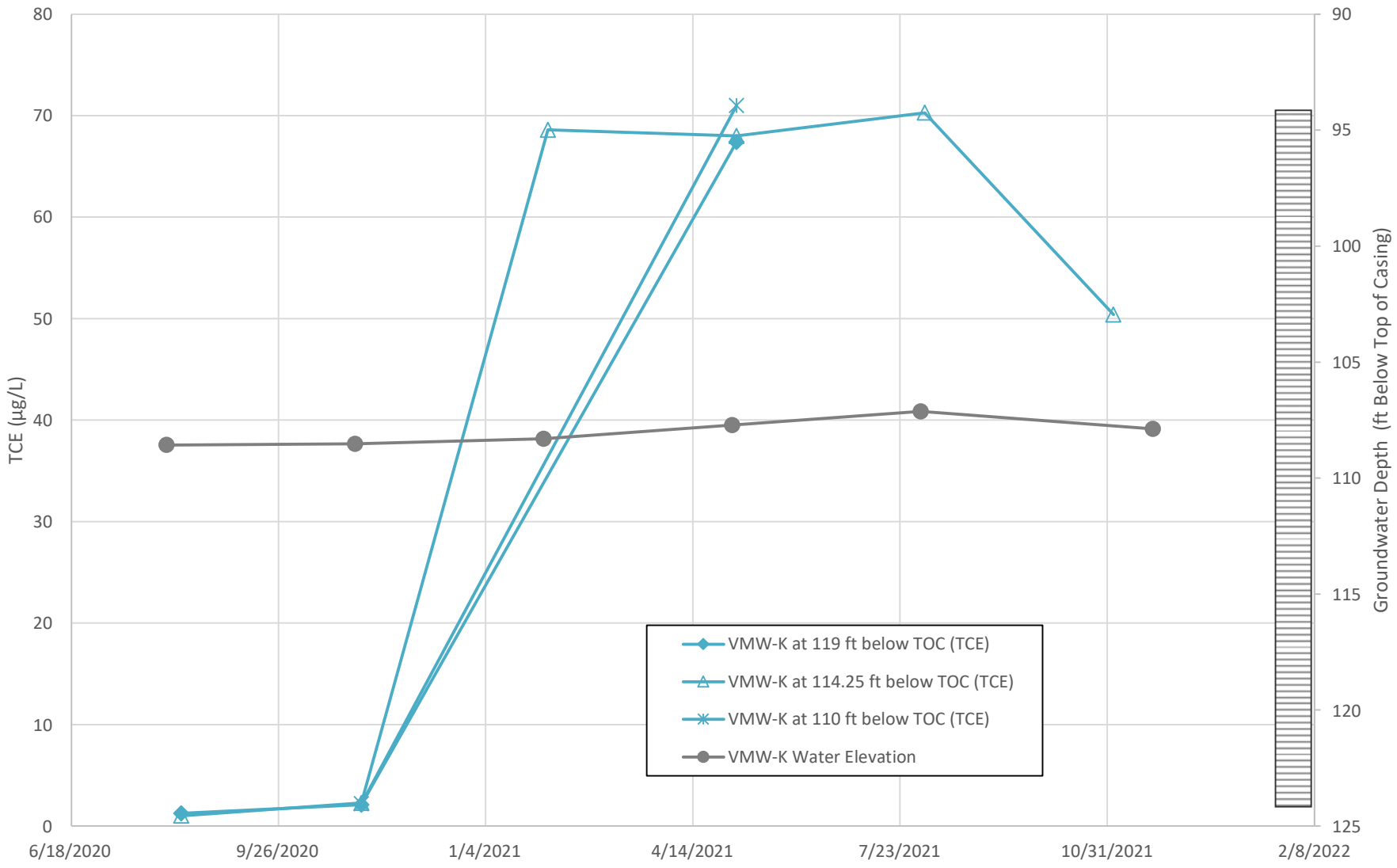
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile D-17(ds)** **TSA Remedy**	Figure E-4



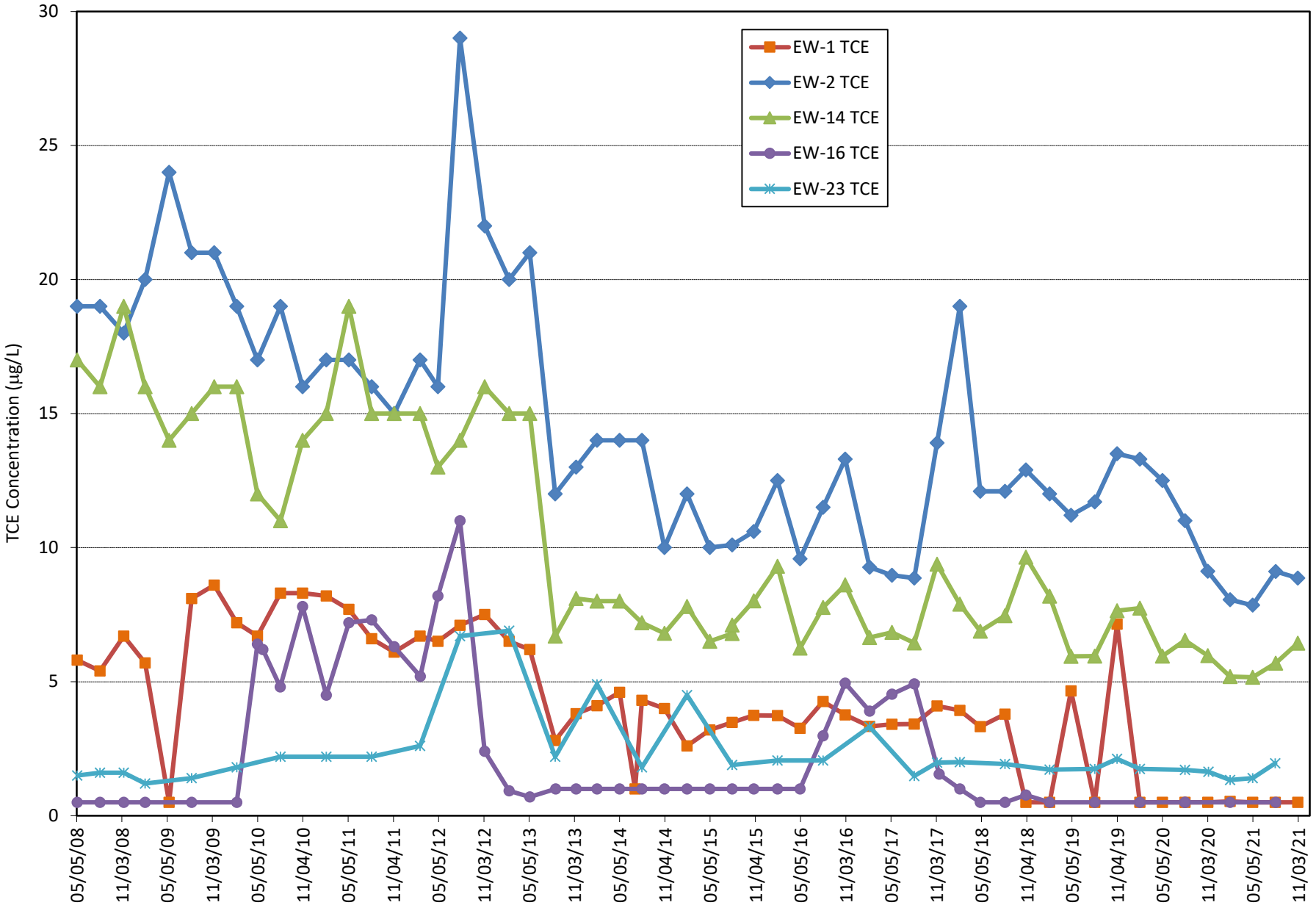
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile VMW-J2** **TSA Remedy**	Figure E-5



Geosyntec consultants

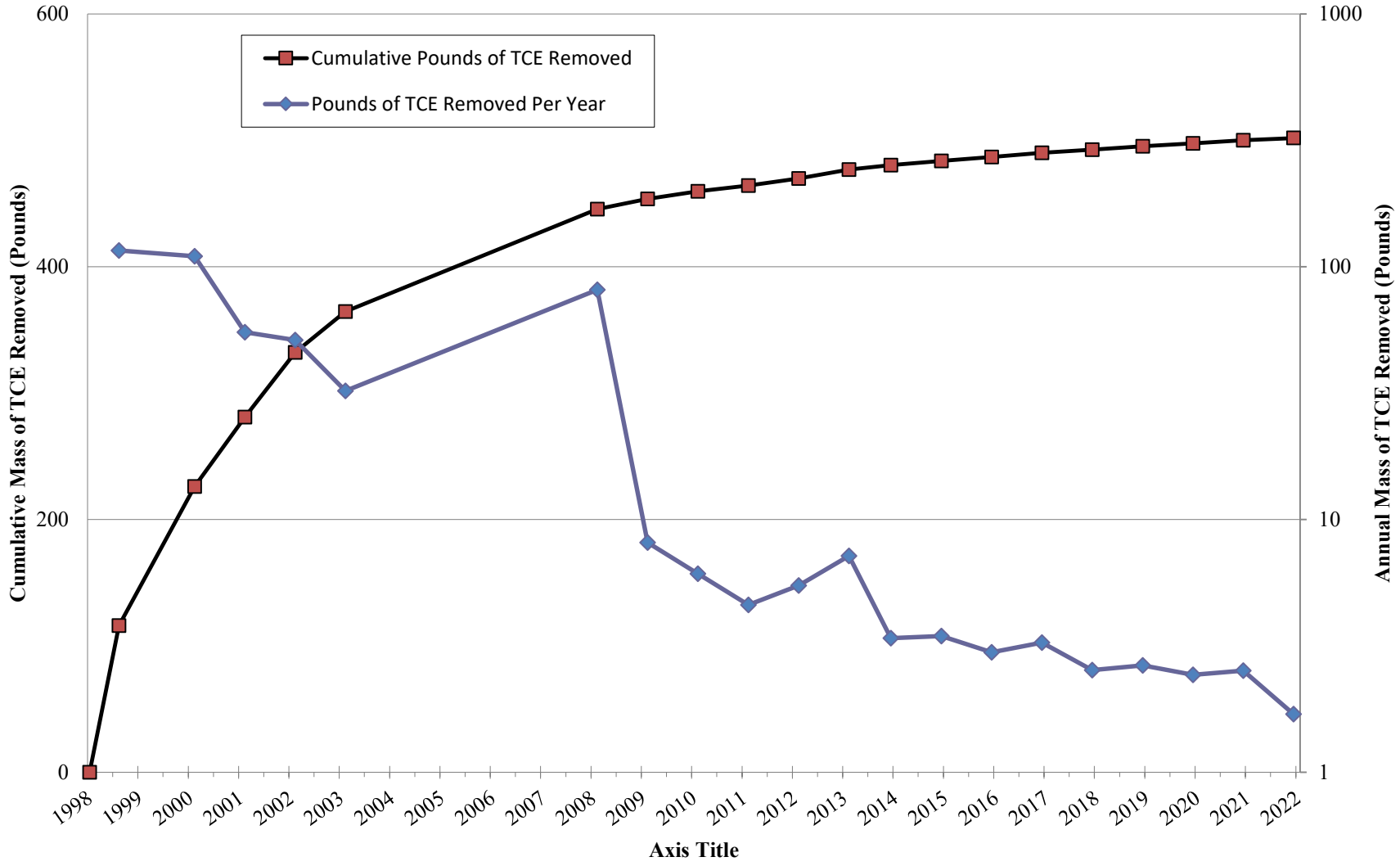
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile VMW-K** **TSA Remedy**	Figure E-6



Geosyntec consultants

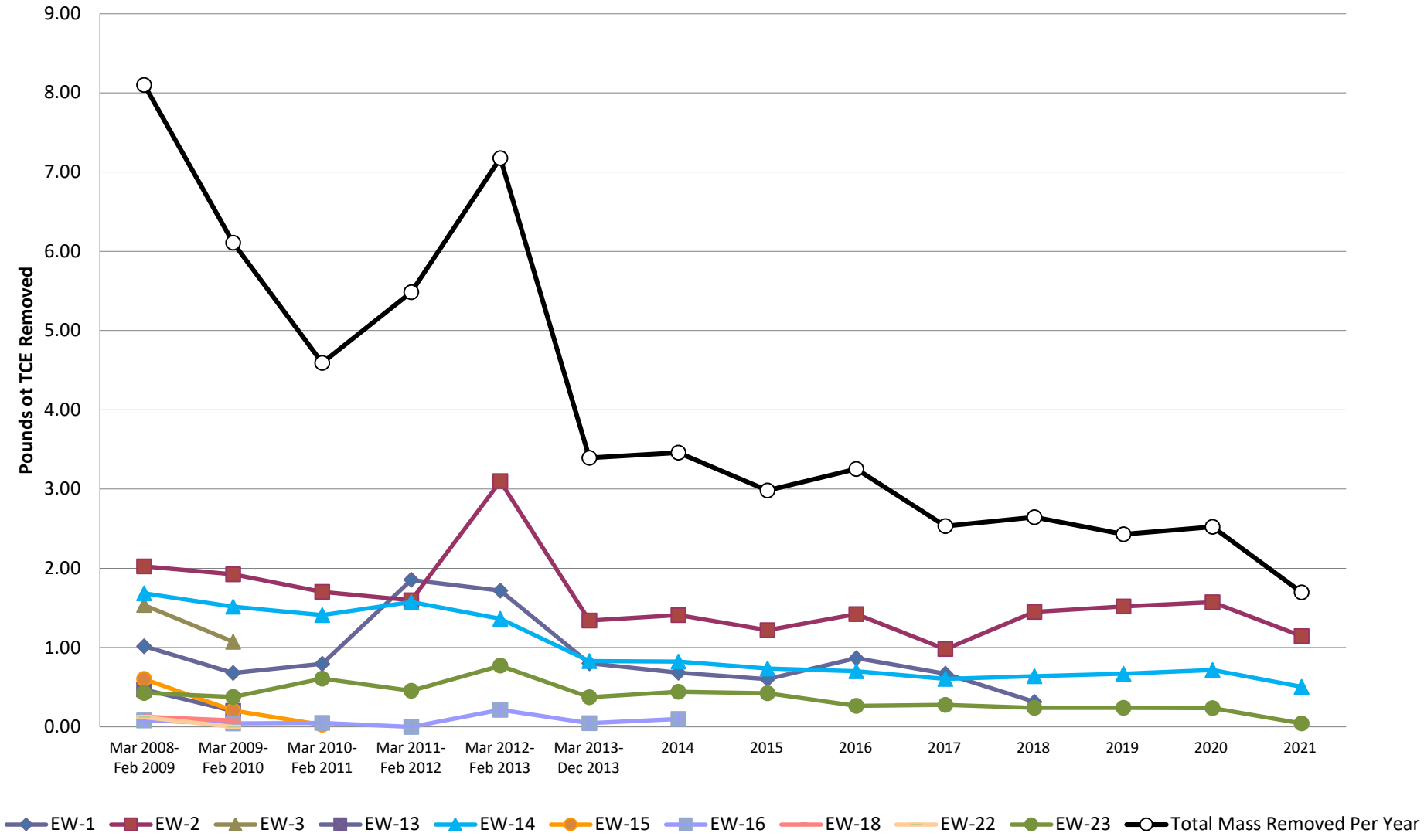
Cascade Corporation Gresham, Oregon	**Operating Extraction Wells TCE Concentration Profiles TSA Remedy**	Figure E-7

Draft TSA Master Mound TCE charts_11.17.21.xlsx



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Mass Removal** **TSA Remedy**	Figure E-8



Geosyntec consultants

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

APPENDIX F
Data Validation Memoranda, Annual Reporting Period

Data Validation Memoranda

Laboratory Reports (CD)

Historical Data Summary Tables - VOCs and Groundwater Elevations (CD)

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: March 20, 2021

RE: **Boeing Portland (TSA)**
First Quarter 2021 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 8 groundwater samples and 1 trip blank collected during the first quarter 2021 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (ELLE), located in Lancaster, Pennsylvania. This data quality evaluation covers ELLE data package 410-28724-1. Samples submitted to ELLE 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 2017). 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 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 ELLE, 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-0221/BOP-13ds-0221) was submitted for analysis with data package 410-28724-1.

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, with the following exceptions:

- The CCV recoveries associated with batch 93707 were high for 1,1,2,2-tetrachloroethane. The affected compound was not detected at concentrations greater than the laboratory reporting limit in the associated samples. No qualification of the data was necessary.
- The CCV recoveries associated with batch 94538 were low for 1,1-dichloroethane; 1,1-dichloroethene; carbon disulfide; methylene chloride; and trans-1,2-dichloroethene. Associated sample results 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. 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
[P:\025\116\FILERM\T\TSA\DATA\DV MEMOS TSA\2021\TSA 1Q21 TM.DOCX]

References

EPA. 2017. 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	Sample Number	Analyte	Result	Lab Qualifier	Data Qualifier	Reason
410-28724-1	BOP-31ds-0221	1,1-Dichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-31ds-0221	1,1-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-31ds-0221	Carbon Disulfide	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-31ds-0221	Methylene Chloride	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-31ds-0221	trans-1,2-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-31dg-0221	1,1-Dichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-31dg-0221	1,1-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-31dg-0221	Carbon Disulfide	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-31dg-0221	Methylene Chloride	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-31dg-0221	trans-1,2-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61ds-0221	1,1-Dichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61ds-0221	1,1-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61ds-0221	Carbon Disulfide	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61ds-0221	Methylene Chloride	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61ds-0221	trans-1,2-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61dg-0221	1,1-Dichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61dg-0221	1,1-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61dg-0221	Carbon Disulfide	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61dg-0221	Methylene Chloride	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-61dg-0221	trans-1,2-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-66ds-0221	1,1-Dichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-66ds-0221	1,1-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-66ds-0221	Carbon Disulfide	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-66ds-0221	Methylene Chloride	0.500	U	UJ	Low continuing calibration recovery
410-28724-1	BOP-66ds-0221	trans-1,2-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery

U = The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

Technical Memorandum

TO: Evelyn Ives, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: May 21, 2021

RE: **Boeing Portland (TSA)**
Second Quarter 2021 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 4 groundwater samples and 1 trip blank collected during the second quarter 2021 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (ELLE), located in Lancaster, Pennsylvania. This data quality evaluation covers ELLE data package 410-38377-1. Samples submitted to ELLE 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 2017). 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 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 ELLE, 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.

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 CCV recoveries associated with batch 124756 were low for vinyl acetate. Associated sample results 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. 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
[P:\025\116\FILERM\T\TSA\DATA\DV MEMOS TSA\2021\TSA 2Q21 TM.DOCX]

References

EPA. 2017. 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	Sample Number	Analyte	Result	Lab Qualifier	Data Qualifier	Reason
410-38377-1	BOP-13ds-0521	Vinyl Acetate	0.500	U	UJ	Low continuing calibration recovery
410-38377-1	BOP-13dg-0521	Vinyl Acetate	0.500	U	UJ	Low continuing calibration recovery
410-38377-1	BOP-31ds-0521	Vinyl Acetate	0.500	U	UJ	Low continuing calibration recovery
410-38377-1	BOP-31dg-0521	Vinyl Acetate	0.500	U	UJ	Low continuing calibration recovery

U = The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

Technical Memorandum

TO: Evelyn Ives, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: September 1, 2021

RE: **Boeing Portland (TSA)**
Third Quarter 2021 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 17 groundwater samples, one bag blank, and 3 trip blanks collected during the third quarter 2021 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (ELLE), located in Lancaster, Pennsylvania. This data quality evaluation covers ELLE data packages 410-47645-1, 410-50365-1, and 410-50369-1. Samples submitted to ELLE were analyzed for volatile organic compounds ([VOCs]; US Environmental Protection Agency [EPA] Method SW8260C) and/or 1,4-dioxane (EPA Method SW8270E with selected ion monitoring [SIM]).

The verification and validation check was conducted with guidance from applicable portions of EPA's *National Functional Guidelines for Organic Data Review* (EPA 2017). 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 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.

The laboratory noted in the case narratives for laboratory data packages 410-47645-1 and 410-50369-1 that the associated trip blank samples contained headspace. No qualification of the data was determined necessary.

Upon receipt by ELLE, 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. Three pairs of blind field duplicate water samples (BOP-Dup-0821 / BOP-61ds-0821, BOP-Y-0821 / BOP-62ds-0821, and BOP-Z-0821 / BOP-20ds-0821) were submitted for analysis with data packages 410-50365-1 and 410-50369-1.

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 or sample foaming during purging 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 CCV recoveries were low for acetone associated with batch 151977 in laboratory data package 410-47645-1 Associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

- The CCV recoveries for low for 1,1,2,2-tetrachloroethane; acetone; 2-butanone; 2-hexanone; and/or 4-methyl-2-pentanone associated with batches 158976 and 159902 in laboratory data package 410-50369-1. Associated sample results 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
[P:\025\116\FILERM\T\TSA\DATA\DV MEMOS TSA\2021\TSA 3Q21 TM.DOCX]

References

EPA. 2017. 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	Sample Number	Analyte	Result	Lab Qualifier	Data Qualifier	Reason
410-47645-1	TSABlank-0721	Acetone	5.00	U	UJ	Low continuing calibration recovery
410-50369-1	EW-3-0821	1,1,2,2-Tetrachloroethane	0.200	U	UJ	Low continuing calibration recovery
410-50369-1	EW-3-0821	2-Butanone	5.00	U	UJ	Low continuing calibration recovery
410-50369-1	EW-3-0821	4-Methyl-2-pentanone	5.00	U	UJ	Low continuing calibration recovery
410-50369-1	EW-3-0821	Acetone	242		J	Low continuing calibration recovery
410-50369-1	EW-13-0821	1,1,2,2-Tetrachloroethane	1.00	U	UJ	Low continuing calibration recovery
410-50369-1	EW-13-0821	2-Butanone	25.0	U	UJ	Low continuing calibration recovery
410-50369-1	EW-13-0821	4-Methyl-2-pentanone	25.0	U	UJ	Low continuing calibration recovery
410-50369-1	EW-13-0821	Acetone	25.0	U	UJ	Low continuing calibration recovery
410-50369-1	BOP-66ds-0821	1,1,2,2-Tetrachloroethane	0.200	U	UJ	Low continuing calibration recovery
410-50369-1	BOP-66ds-0821	2-Butanone	5.00	U	UJ	Low continuing calibration recovery
410-50369-1	BOP-66ds-0821	4-Methyl-2-pentanone	5.00	U	UJ	Low continuing calibration recovery
410-50369-1	BOP-66ds-0821	Acetone	5.00	U	UJ	Low continuing calibration recovery
410-50369-1	BOP-65ds-0821	1,1,2,2-Tetrachloroethane	0.200	U	UJ	Low continuing calibration recovery
410-50369-1	BOP-65ds-0821	2-Butanone	5.00	U	UJ	Low continuing calibration recovery
410-50369-1	BOP-65ds-0821	2-Hexanone	5.00	U	UJ	Low continuing calibration recovery
410-50369-1	BOP-65ds-0821	4-Methyl-2-pentanone	5.00	U	UJ	Low continuing calibration recovery
410-50369-1	BOP-65ds-0821	Acetone	5.00	U	UJ	Low continuing calibration recovery

U = The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

Technical Memorandum

TO: Evelyn Ives, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: December 15, 2021

RE: **Boeing Portland (TSA)**
Fourth Quarter 2021 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with four groundwater samples and 1 trip blank collected during the fourth quarter 2021 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (ELLE), located in Lancaster, Pennsylvania. This data quality evaluation covers ELLE data package 410-62319-1. Samples submitted to ELLE 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 2017). 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 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 ELLE, 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, with the following exception:

- Methylene chloride was detected in the trip blank at a concentration greater than the reporting limit. Methylene chloride was not detected at concentrations greater than the reporting limit in the associated samples. 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.

Quantitation Limits

Project-specified quantitation limits were met for all samples except for instances where high concentrations or sample foaming during purging 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 CCV recoveries were low for vinyl acetate associated with batch 194046 in laboratory data package 410-62319-1. Associated sample results 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
[P:\025\116\FILERM\T\TSA\DATA\DV MEMOS TSA\2021\TSA 4Q21 TM.DOCX]

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	Sample Number	Analyte	Result	Lab Qualifier	Data Qualifier	Reason
410-62319-1	BOP-13ds-1121	Vinyl Acetate	0.500	U	UJ	Low continuing calibration recovery
410-62319-1	BOP-13dg-1121	Vinyl Acetate	0.500	U	UJ	Low continuing calibration recovery
410-62319-1	BOP-31ds-1121	Vinyl Acetate	0.500	U	UJ	Low continuing calibration recovery
410-62319-1	BOP-31dg-1121	Vinyl Acetate	0.500	U	UJ	Low continuing calibration recovery

U = The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

Geosyntec consultants

180A Marketplace Blvd
Knoxville, TN 37922
PH 865.330.0037
www.geosyntec.com

Memorandum

Date: 17 June 2021

To: Cindy Bartlett, RG, LG

Geosyntec Consultants, Portland, Oregon

From: Jennifer Pinion

CC: J. Caprio

Subject: Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups 2105077, ~~L1313435,~~ L1349357 and P2101835

Correct ID is: L1349345

SITE: Cascade TSA Data Gaps; Job No: PNG0564519

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-five groundwater samples, two field duplicates, and two trip blanks collected May 4 and 5, 2021, as well as eight air samples, collected on April 6 and May 4, 2021, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

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

- United States Environmental Protection Agency (US EPA) Method 8260D – Volatile Organic Compounds (VOCs)

The air samples were analyzed by ALS, Simi Valley, California and Eurofins AirToxics, Folsom, California for the following analytical test:

- US EPA Method TO-15 - VOCs

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 as qualified are usable for supporting project objectives. The qualified data should be used within the limitations of the qualifications.

The data were reviewed based on the following documents, the pertinent method referenced by the data package and professional and technical judgment:

- US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005)

The following samples were analyzed in the data sets:

Laboratory IDs	Client IDs
2105077-01A	SVE-EFF-050421
2105077-02A	VW-17d-95.5-050421
2105077-03A	VMWG-050421
2105077-04A	VMWE-050421
2105077-05A	VMWF-050421
2105077-06A	VMWC-050421
2105077-07A	VMWH-050421
L1349345-01	EW1-050421
L1349345-02	EW2-050421
L1349345-03	EW14-050421
L1349345-04	EW23-050421
L1349345-05	D17DG-050521
L1349345-06	D17DS-050521
L1349345-07	EW12-050521
L1349345-08	CMW10DS-050521
L1349345-09	CMW17DS-050521
L1349345-10	CMW17DS-050521-DUP
L1349345-11	CMW18DS-050521
L1349345-12	CMW18DS-050521-DUP
L1349345-13	CMW19DS-050521
L1349345-14	VMWA-050521
L1349345-15	VMWB-050521
L1349345-16	VMWC-050521
L1349345-17	VMWD-050521
L1349345-18	VMWE-050521

Laboratory IDs	Client IDs
L1349345-19	VMWF-050521
L1349345-20	VMWG-050521
L1349345-21	VMWH-050521
L1349345-22	VMWI-050521-126.40
L1349345-23	VMWI-050521-131.62
L1349345-24	VMWI-050521-137.25
L1349345-25	VMWI-050521-140.46
L1349345-26	VMWI-050521-143.68
L1349345-27	VMWI-050521-148.10
L1349345-28	VMWJ2-050521-120.23
L1349345-29	VMWK-050521-110.0
L1349345-30	VMWK-050521-119.0
L1349345-31	VMWK-050521-114.25
L1349345-32	VMWL-050521-103.25
L1349345-33	VMWM-050521-94.0
L1349345-34	VMWN-050521-110.8
L1349345-35	TRIP BLANK LOT#460
L1349357-01	TS-C-EFF-050521
L1349357-02	TS-C-EFF-050521-DUP
L1349357-03	TS-C-INF-050521
L1349357-04	TRIP BLANK LOT#460
P2101835-001	SVE-EFF-040621

The groundwater samples were received at the laboratory within the temperature criteria of 0-6 degrees Celsius (ºC).

The following issues were noted on the chain of custody (COC) forms. No qualifications were applied to the data based on the issues discussed below.

- Incorrect error corrections were observed on the COC in laboratory reports L1349357 instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

- The canister ID listed on the canister for sample VMWH-050421 did not match the canister ID listed on the COC. The canister was labelled with the ID 0000003348 and the ID listed on the COC was 1L3348. The laboratory logged the sample in with the canister ID listed on the canister.

- There were no collection dates or times documented on the COCs for TRIP BLANK LOT#460. The laboratory assigned a collection dates and times of 5/5/2021, 00:00.

1.0 VOLATILE ORGANIC COMPOUNDS

The soil samples were analyzed for VOCs per US EPA method 8260D.

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 Times
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
⊗ Laboratory Control Sample
✓ Surrogate
✓ Field Duplicate
✓ Sensitivity
⊗ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these data packages are considered usable for supporting project objectives. The results are considered valid; 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%.

1.1.2 Analysis Anomaly

Additional information from the laboratory indicated that the percent differences (%Ds) for acrolein and vinyl chloride in the continuing calibration verifications (CCVs) in batch WG1667657, acrolein, carbon disulfide, 1,1,2-trichlorotrifluoroethane, 1,2,4-trichlorobenzene, 1,2,3-trimethylbenzene and vinyl chloride in the CCV batch WG1670227 and hexachloro-1,3-butadiene in the CCV batch WG1667865 were outside of the laboratory acceptance limits with low biases. Therefore, the non-detect results for acrolein, carbon disulfide, 1,1,2-trichlorotrifluoroethane, 1,2,4-trichlorobenzene, 1,2,3-trimethylbenzene, vinyl chloride and hexachloro-1,3-butadiene in the associated samples were UJ qualified as estimated less than the reported detection limit (RDL).

The %D of 1,2,3-trichlorobenzene in the CCVs in batches WG1667657 and WG1670227 were outside of the laboratory acceptance limits with high biases. Since 1,2,3-trichlorobenzene was not detected in the associated samples, no qualifications were applied to the data.

Sample ID	Compound	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier*	Reason Code**
EW12-050521	1,2,4-Trichlorobenzene	0.001	U,C3	0.001	UJ	9
CMW10DS-050521	Acrolein	0.05	U,C3	0.05	UJ	9
CMW17DS-050521	Acrolein	0.05	U,C3	0.05	UJ	9
CMW17DS-050521-DUP	Acrolein	0.05	U,C3	0.05	UJ	9
CMW18DS-050521	Acrolein	0.05	U,C3	0.05	UJ	9
CMW18DS-050521-DUP	Acrolein	0.05	U,C3	0.05	UJ	9
CMW19DS-050521	Acrolein	0.05	U,C3	0.05	UJ	9
D17DG-050521	Acrolein	0.05	U,C3	0.05	UJ	9
D17DS-050521	Acrolein	0.05	U,C3	0.05	UJ	9
EW1-050421	Acrolein	0.05	U,C3	0.05	UJ	9
EW12-050521	Acrolein	0.05	U,C3	0.05	UJ	9
EW14-050421	Acrolein	0.05	U,C3	0.05	UJ	9
EW2-050421	Acrolein	0.05	U,C3	0.05	UJ	9
EW23-050421	Acrolein	0.05	U,C3	0.05	UJ	9
VMWA-050521	Acrolein	0.05	U,C3	0.05	UJ	9
VMWB-050521	Acrolein	0.05	U,C3	0.05	UJ	9
VMWC-050521	Acrolein	0.05	U,C3	0.05	UJ	9
VMWD-050521	Acrolein	0.05	U,C3	0.05	UJ	9
VMWE-050521	Acrolein	0.05	U,C3	0.05	UJ	9
VMWF-050521	Acrolein	0.05	U,C3	0.05	UJ	9
EW12-050521	Carbon Disulfide	0.0005	U,C3	0.0005	UJ	9

Sample ID	Compound	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier*	Reason Code**
EW12-050521	Freon 113	0.0005	U,C3	0.0005	UJ	9
TRIP BLANK LOT#460	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
TRIP BLANK LOT#460	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
TS-C-EFF-050521	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
TS-C-EFF-050521-DUP	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
TS-C-INF-050521	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWG-050521	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWH-050521	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWI-050521-126.40	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWI-050521-131.62	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWI-050521-137.25	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWI-050521-140.46	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWI-050521-143.68	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWI-050521-148.10	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWJ2-050521-120.23	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWK-050521-110.0	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWK-050521-114.25	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWK-050521-119.0	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWL-050521-103.25	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWM-050521-94.0	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
VMWN-050521-110.8	Hexachlorobutadiene (HCBD)	0.001	U,C3	0.001	UJ	9
CMW10DS-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
CMW17DS-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
CMW17DS-050521-DUP	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
CMW18DS-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9

Sample ID	Compound	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier*	Reason Code**
CMW18DS-050521-DUP	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
CMW19DS-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
D17DG-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
D17DS-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
EW1-050421	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
EW12-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
EW14-050421	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
EW2-050421	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
EW23-050421	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
VMWA-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
VMWB-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
VMWC-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
VMWD-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
VMWE-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9
VMWF-050521	Vinyl Chloride	0.0005	U,C3	0.0005	UJ	9

ppm-parts per million
U-not detected at or above the RDL
C3-laboratory flag indicating the %D in the CCV was outside the laboratory specified acceptance criteria with a low bias
C5-laboratory flag indicating the %D in the CCV was outside the laboratory specified acceptance criteria with a high bias
J4-laboratory flag indicating the laboratory control sample (LCS) recovery was outside of the laboratory specified acceptance criteria
* 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

1.2 Holding Time

The holding time for the VOC analysis of a preserved groundwater 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). Four method blanks were reported (batches WG1667657, WG1667865 and WG1670227). VOCs were not detected in the method blanks above the method detection limits (MDLs).

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

MS/MSD pairs were not reported.

1.5 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 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 1,2,3-trimethylbenzene in the LCS/LCSD pair in batch WG1670277 were low and outside of the laboratory specified acceptance criteria. Therefore, the non-detect 1,2,3-trimethylbenzene result in sample EW12-050521 was UJ qualified as estimated less than the RDL.

Sample ID	Compound	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier*	Reason Code**
EW12-050521	1,2,3-Trimethylbenzene	0.0005	U,C3,J4	0.0005	UJ	5

ppm-parts per million
U-not detected at or above the RDLs
C3- laboratory flag indicating the CCV standard recovery for the report compound was outside the laboratory specified acceptance criteria with a low bias
J4-laboratory flag indicating the LCS was outside the laboratory specified acceptance criteria

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

Two trip blanks were submitted with the sample set, both using TRIP BLANK LOT # 460. VOCs were not detected in the trip blanks greater than the RDLs.

1.8 Field Duplicate

Three field duplicates were collected with the sample set, TS-C-EFF-050521-DUP, CMW17DS-050521-DUP and CMW18DS-050521-DUP. Acceptable precision (RPD $\leq$ 30%) was demonstrated between the field duplicates and the original samples TS-C-EFF-050521, CMW17DS-050521 and CMW18DS-050521, respectively.

1.9 Sensitivity

The water sample results were reported to the RDLs. Elevated non-detect results were not 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 samples were reported to the RDLs and the method blank QC was reported to the method detection limits (MDLs) in the level II report; both the RDLs and the MDLs were listed in the EDD. It was also noted that the data were reported in units of parts per million (ppm) in the EDD, while the sample data were reported in units of 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 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA Method TO-15.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable or not applicable. 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
✓ Sensitivity
⊗ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in this package are considered usable for supporting project objectives. The results are considered valid; 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 data set is 100%.

2.2 Holding Time

The holding time for the TO-15 analysis of an air sample collected in a 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). Two method blanks were reported (batches 20051008c and P210423). 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). One LCS and one LCS/LCSD pair were reported. The RPDs were not reported by the laboratory; therefore, the RPDs were calculated by the validator based on the recovery results. The recovery and RPD results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

Laboratory duplicates were not reported.

2.6 Surrogates

The surrogate recoveries were within the laboratory specified acceptance criteria.

2.7 Sensitivity

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

2.8 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. The results were reported in both parts per billion by volume (ppbv) and micrograms per cubic meter ($\mu g/m^3$) in the laboratory reports; the results were reported in $\mu g/m^3$ in the EDDs. No other discrepancies were identified between the level II reports and the EDDs.

---

* * * * *

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	Extraction or 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
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
14	Lab flag removed or modified: no validation qualification required

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample duplicate
RPD - Relative percent difference

Geosyntec consultants

180A Marketplace Blvd
Knoxville, TN 37922
PH 865.330.0037
www.geosyntec.com

Memorandum

Date:	31 August 2021
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Jennifer Pinion
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1313435, L1313450, L1313991, L1325319, P2100105, P2100633R and P2101095**

SITE: Cascade TSA Data Gaps; Job No: PNG0564519

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-seven groundwater samples, two field duplicate samples, four trip blanks and nine air samples, collected on January 5, 2021, February 2 and 3, 2021, March 2 and 9, 2021 as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

The groundwater samples were analyzed by Pace Analytical, Mt. Juliet, Tennessee for the following analytical test:

- United States Environmental Protection Agency (US EPA) Method 8260D – Volatile Organic Compounds (VOCs)

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

- US EPA Method TO-15 – Selected VOCs

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 as qualified are usable for supporting project objectives, with the following exceptions.

Due to the final canister vacuum at laboratory receipt, 0.01 pound per square inch gauge (psig) and based on professional and technical judgment, the non-detect results and concentrations in sample SVE-EFF-020221 were R qualified as rejected.

The qualified data that were not rejected should be used within the limitations of the qualifications.

The data were reviewed based on the US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005), the pertinent methods referenced by the laboratory reports and professional and technical judgment.

The following samples were analyzed in the data sets:

Laboratory IDs	Client IDs
L1313435-01	TS-C-EFF-020221
L1313435-02	TS-C-EFF-020221-DUP
L1313435-03	TS-C-INF-020221
L1313435-04	TRIP BLANK LOT # 460
L1313450-01	EW2-020221
L1313450-02	EW14-020221
L1313450-03	EW23-020221
L1313450-04	EW1-020221
L1313450-05	EW16-020221
L1313450-06	CMW17DS-020221
L1313450-07	CMW17DS-020221
L1313450-08	D17DS-020221
L1313450-09	D17DG-020221
L1313450-10	EW12-020221
L1313450-11	CMW14RDS-020221
L1313450-12	CMW18DS-020221
L1313450-13	CMW18DS-020221-DUP
L1313450-14	CMW25DG-020221
L1313450-15	CMW19DS-020221
L1313450-16	CMW10DS-020221
L1313450-17	TRIP BLANK LOT# 460
L1313991-01	VMWB-020321
L1313991-02	VMWA-020321
L1313991-03	VMWC-020321
L1313991-04	VMWH-020321
L1313991-05	VMWD-020321

Laboratory IDs	Client IDs
L1313991-06	VMWE-020321
L1313991-07	VMWF-020321
L1313991-08	VMWG-020321
L1313991-09	VMWJ2-020321-120.22
L1313991-10	VMWK-020321-114.25
L1313991-11	VMWI-020321-126.4
L1313991-12	VMWI-020321-131.61
L1313991-13	VMWI-020321-137.25
L1313991-14	VMWI-020321-140.46
L1313991-15	VMWI-020321-143.67
L1313991-16	VMWI-020321-148.1
L1313991-17	VMWL-020321-103.25
L1313991-18	VMWM-020321-94
L1313991-19	VMWN-020321-102.25
L1313991-20	TRIP BLANK #460
L1325319-01	CMW24DG-030921
L1325319-02	TRIPBLANK #444
P2100105-001	SVE-EFF-010521
P2100633-001	SVE-EFF-020221
P2100633-002	VW-17d-95.5-020221
P2100633-003	VMWC-020221
P2100633-004	VMWE-020221
P2100633-005	VMWF-020221
P2100633-006	VMWG-020221
P2100633-007	VMWH-020221
P2101095-001	SVE-EFF-030221

The groundwater samples were received at the laboratory within the temperature criteria of 0-6 degrees Celsius (°C).

The following issues were noted on the chain of custody (COC) forms. No qualifications were applied to the data based on the issues discussed below.

- Incorrect error corrections were observed on the COCs in laboratory reports P2100105 and P2100633R, instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

- There was no collection time documented on the COC for TRIP BLANK #444. The laboratory assigned a collection time of 00:00.

- The client changed the sample ID for sample L1313991-19 to VMWN-020321-102.25, per an email request, which was included in report L1313991.

Report P2100633 was revised on 24 February 2021 to include an explanation for the elevated reporting limits (RL) in samples VMWC-020221 and VMWF-020221. The revised report was identified as P2100633R.

1.0 VOLATILE ORGANIC COMPOUNDS, US EPA METHOD 8260D

The groundwater samples were analyzed for VOCs per US EPA method 8260D.

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 Times
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
⊗ Laboratory Control Sample
✓ Surrogate
✓ Field Duplicate
✓ Sensitivity
⊗ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these laboratory reports are considered usable for supporting project objectives. The results are considered valid; 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%.

1.1.2 Analysis Anomaly

L1313435 and L1313450: The 4-methyl-2-pentanone (MIBK), acetone, di-isopropyl ether and 2-butanone (MEK) data were flagged with C3 in batch WG1616659, to indicate the percent differences (%Ds) in the associated continuing calibration verification (CCV) were high and outside the method specified acceptance criteria, with low biases. Additional information from the laboratory indicated that the %Ds were 30.0%D for 4-methyl-2-pentanone (MIBK), 29.9%D acetone, 23.0%D for di-isopropyl ether and 35.5%D for 2-butanone (MEK). Since these %Ds were within the validation specified acceptance criteria and based on professional and technical judgment, no qualifications were applied to the 4-methyl-2-pentanone (MIBK), acetone, di-isopropyl ether and 2-butanone (MEK) data.

L1313991: The 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and hexachlorobutadiene (HCBD) data were flagged with C3 in batch WG1617488 to indicate the %Ds in the associated CCV were high and outside the method specified acceptance criteria, with low biases. Additional information from the laboratory indicated that the %Ds were 17.9%D for 1,2,3-trichlorobenzene, 19.0%D for 1,2,4-trichlorobenzene and 20.6%D for hexachlorobutadiene (HCBD). Since these %Ds were within the validation specified acceptance criteria and based on professional and technical judgment, no qualifications were applied to the 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and hexachlorobutadiene (HCBD) data.

L1325319: The acrolein data in batch WG1634532 were flagged with C5, to indicate the CCV %D was high and outside the method specified acceptance criteria, with a high bias. Since acrolein was not detected in the associated samples, no qualifications were applied to the acrolein data.

L1313991, **L1313450, L1325319:** The %Ds of tetrachloroethene (PCE) in the CCV in batch WG1616659 and acetone in batches WG1617115 and WG1634532 were flagged with C5, to indicate the CCV %Ds were high and outside the method specified acceptance criteria, with high biases. Therefore, the concentrations of PCE and acetone in the associated samples were J qualified as estimated.

Sample ID	Compound	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier*	Reason Code**
CMW17DS-020221	Tetrachloroethene (PCE)	0.0021	C5	0.0021	J	9
CMW18DS-020221	Tetrachloroethene (PCE)	0.00289	C5	0.00289	J	9
CMW18DS-020221-DUP	Tetrachloroethene (PCE)	0.00248	C5	0.00248	J	9
CMW24DG-030921	Acetone	0.0393	C5	0.0393	J	9
D17DS-020221	Tetrachloroethene (PCE)	0.000834	C5	0.000834	J	9

Sample ID	Compound	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier*	Reason Code**
EW2-020221	Tetrachloroethene (PCE)	0.000731	C5	0.000731	J	9
VMWI-020321-126.4	Acetone	0.0359	C5	0.0359	J	9
VMWI-020321-131.61	Acetone	0.0445	C5	0.0445	J	9
VMWI-020321-143.67	Acetone	0.0324	C5	0.0324	J	9
VMWI-020321-148.1	Acetone	0.036	C5	0.036	J	9

ppm-parts per million
C5-laboratory flag indicating the %D in the CCV was outside the method specified acceptance criteria with a high bias
* 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

1.2 Holding Time

The holding time for the VOC analysis of a preserved groundwater 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). Six method blanks were reported (batches WG1616659, WG1617115, WG1617488, WG1618603, WG1634532, WG1634946). VOCs were not detected in the method blanks above the method detection limits (MDLs), with the following exceptions.

Naphthalene and 1,2,3-trichlorobenzene were detected in the method blanks in batches WG1617115 and WG1617488 at estimated concentrations greater than the MDLs and less than the reported detection limits (RDLs). 1,2,3-Trichlorobenzene was detected in the method blank in batch WG1634532 at an estimated concentration greater than the MDL and less than the RDL. Since naphthalene and 1,2,3-trichlorobenzene were reported to the RDLs in the samples and were not detected, no qualifications were applied to the data.

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

One batch MS/MSD pair was 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). Three LCSs and three 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.

L1313435, L1313450: The recovery of 4-methyl-2-pentanone (MIBK) in the LCS in batch WG1616659 was low and outside the laboratory specified acceptance criteria. Therefore, the non-detect 4-methyl-2-pentanone (MIBK) results in the associated samples were UJ qualified as estimated less than the RDLs.

Sample ID	Compound	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier	Reason Code
TS-C-EFF-020221	Methyl Isobutyl Ketone (MIBK)	0.000478	U,C3,J4	0.000478	UJ	5
TS-C-EFF-020221-DUP	Methyl Isobutyl Ketone (MIBK)	0.000478	U,C3,J4	0.000478	UJ	5
TS-C-INF-020221	Methyl Isobutyl Ketone (MIBK)	0.000478	U,C3,J4	0.000478	UJ	5
TRIP BLANK LOT # 460	Methyl Isobutyl Ketone (MIBK)	0.000478	U,C3,J4	0.000478	UJ	5

µg/l-microgram per liter
U-not detected at or above the RDLs
C3- laboratory flag indicating the CCV standard recovery for the report compound was outside the laboratory specified acceptance criteria with a low bias
J4-laboratory flag indicating the LCS was outside the laboratory specified acceptance criteria

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

Four trip blanks were submitted with the groundwater samples, three using sample ID TRIP BLANK LOT # 460 and one using sample ID TRIPBLANK #444. VOCs were not detected in the trip blanks greater than the RDLs.

1.8 Field Duplicate

Two field duplicate samples were collected with the groundwater samples, TS-C-EFF-020221-DUP and CMW18DS-020221-DUP. Acceptable precision (RPD ≤ 30%) was demonstrated between the field duplicates and the original samples TS-C-EFF-020221 and CMW18DS-020221, respectively.

1.9 Sensitivity

The sample results were reported to the RDLs. Elevated non-detect results were not reported for the groundwater samples.

1.10 Electronic Data Deliverable (EDD) 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. The samples were reported to the RDLs and the method blanks were reported to the MDLs in the level II reports; both the RDLs and the MDLs were listed in the EDDs. It was also 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 microgram per liter (µg/L) in the level II reports. These observations did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

2.0 VOLATILE ORGANIC COMPOUNDS, TO-15

The air samples were analyzed for selected VOCs per US EPA Method TO-15.

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
✓ Sensitivity
⊗ Electronic Data Deliverable Review

2.1 Overall Assessment

2.1.1 Completeness

The VOC data reported in this package are considered usable for supporting project objectives, with the following exceptions. Due to the final canister vacuum at laboratory receipt, 0.01 psig, and based on professional and technical judgment, the non-detect results and concentrations in sample SVE-EFF-020221were R qualified as rejected.

Therefore, 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 data set is 88.9%.

2.1.2 Analysis Anomaly

The final canister vacuums for samples SVE-EFF-020221, VMWE-020221 and VMWF-020221 were -2.45 psig when shipped after sampling, and approximately atmospheric at 0.01, -0.11 and -0.61 psig, respectively, upon receipt by the laboratory. These losses in vacuums in comparison to the other canisters' vacuums in the batch, as well as the final measured vacuums at near ambient, indicates potential leaks. Therefore, based on professional and technical judgement, the non-detect results and concentrations in sample SVE-EFF-020221 were R qualified as rejected, the concentrations in samples VMWE-020221 and VMWF-020221 were J qualified as estimated and the non-detect results in samples VMWE-020221 and VMWF-020221 were UJ qualified as estimated less than the method reporting limits (MRLs).

Sample ID	Compound	Laboratory Result (µg/m3)	Laboratory Flag	Validation Result (µg/m3)	Validation Qualifier	Reason Code
SVE-EFF-020221	1,1-Dichloroethene	1.8	U	1.8	R	1
SVE-EFF-020221	Vinyl Chloride	1.9	U	1.9	R	1
SVE-EFF-020221	cis-1,2-Dichloroethene	44	NA	44	R	1
SVE-EFF-020221	Tetrachloroethene (PCE)	43	NA	43	R	1
SVE-EFF-020221	Trichloroethene (TCE)	420	D	420	R	1
VMWE-020221	1,1-Dichloroethene	1.8	U	1.8	UJ	1
VMWE-020221	cis-1,2-Dichloroethene	46	NA	46	J	1
VMWE-020221	Tetrachloroethene (PCE)	70	NA	70	J	1
VMWE-020221	Trichloroethene (TCE)	610	D	610	J	1
VMWE-020221	Vinyl Chloride	1.8	U	1.8	UJ	1
VMWF-020221	1,1-Dichloroethene	37	U	37	UJ	1
VMWF-020221	cis-1,2-Dichloroethene	37	U	37	UJ	1
VMWF-020221	Tetrachloroethene (PCE)	37	U	37	UJ	1
VMWF-020221	Trichloroethene (TCE)	37	U	37	UJ	1
VMWF-020221	Vinyl Chloride	38	U	38	UJ	1

µg/m3-microgram per cubic meter
U-not detected at or above the MRL
NA-not applicable
D-laboratory flag indicating the reported result is from a dilution

2.2 Holding Time

The holding time for the TO-15 analysis of an air sample collected in a 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 P210212, P210310 and P210311). VOCs were not detected in the method blanks above the 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

Laboratory duplicates were not reported.

2.6 Surrogates

The surrogate recoveries were within the laboratory specified acceptance criteria.

2.7 Sensitivity

The samples were reported to the MRLs. Elevated non-detect results were reported due to the dilutions analyzed. In addition, the P2100633R case narrative indicated that elevated non-detect results were reported for samples VMWC-020221 and VMWF-020221 due to the presence of non-target analytes and the volumes of these samples analyzed.

2.8 Electronic Data Deliverable (EDD) 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. The results were reported in both parts per billion by volume (ppbv) and micrograms per cubic meter ($\mu g/m^3$) in the laboratory report; the results were reported in $\mu g/m^3$ in the EDD. No other discrepancies were identified between the level II reports and the EDDs.

---

* * * * *

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	Extraction or 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
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
14	Lab flag removed or modified: no validation qualification required

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample duplicate
RPD - Relative percent difference

Geosyntec consultants

180A Marketplace Blvd
Knoxville, TN 37922
PH 865.330.0037
www.geosyntec.com

Memorandum

Date:	26 August 2021
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Jennifer Pinion
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1387227**

SITE: Cascade TSA Data Gaps; Job No: PNG0564519

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of five groundwater samples and one field duplicate collected August 4, 2021, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

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

- United States Environmental Protection Agency (US EPA) Method 8270E by Selective Ion Monitoring (SIM)– 1,4-Dioxane

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 supporting project objectives.

The data were reviewed based on the following documents, the pertinent method referenced by the data package and professional and technical judgment:

- US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005)

The following samples were analyzed in the data sets:

Laboratory IDs	Client IDs
L1387227-01	CMW17DS-080421
L1387227-02	CMW18DS-080421

Laboratory IDs	Client IDs
L1387227-03	CMW36DG-080421
L1387227-04	CMW36DG-080421-DUP

Laboratory IDs	Client IDs
L1387227-05	BOP-44DS-080421

Laboratory IDs	Client IDs
L1387227-06	BOP44DG-080421

The groundwater samples were received at the laboratory within the temperature criteria of 0-6 degrees Celsius (°C).

1.0 1,4-DIOXANE

The soil samples were analyzed for 1,4-dioxane per US EPA method 8270E SIM.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable or not applicable. 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 Times
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Surrogate
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

1.1 Overall Assessment

The 1,4-dioxane data reported in these data packages are considered usable for supporting project objectives. The results are considered valid; 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 times for the 1,4-dioxane analysis of a groundwater sample are 7 days from collection to extraction and 40 days from extraction 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 WG1719593). 1,4-Dioxane was not detected in the method blank above the method detection limit (MDL).

1.4 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.

1.5 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.6 Field Duplicate

One field duplicate was collected with the sample set, CMW36DG-080421-DUP. Acceptable precision (RPD $\leq$ 30%) was demonstrated between the field duplicate and the original sample CMW36DG-080421.

1.7 Sensitivity

The sample results were reported to the MDL. Elevated non-detect results were not reported.

1.8 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. No 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	Extraction or 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
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
14	Lab flag removed or modified: no validation qualification required

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample duplicate
RPD - Relative percent difference

Geosyntec consultants

180A Marketplace Blvd
Knoxville, TN 37922
PH 865.330.0037
www.geosyntec.com

Memorandum

Date:	16 October 2021
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Jennifer Pinion
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1378380, L1387152, L1387614 and L1387779 and Eurofins Air Toxics Work Order # 2108090 and 2107143**

SITE: Cascade TSA Data Gaps; Job No: PNG0564519

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-six groundwater samples and three field duplicates, collected July 12 and August 3-4 and 5, 2021, as well as three air samples, collected on July 6 and August 3, 2021, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

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

- United States (US) Environmental Protection Agency (EPA) Method 8260D – Volatile Organic Compounds (VOCs)
- US EPA Method 8270E using Selective Ion Monitoring (SIM) – 1,4-Dioxane

The air samples were analyzed by Eurofins Air Toxics, Folsom, California for the following analytical test:

- US 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 and based on the information provided, the data as qualified are usable for supporting project objectives. The qualified data should be used within the limitations of the qualifications.

The data were reviewed based on the following documents, the pertinent methods referenced by the data package and professional and technical judgment:

- US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005)

The following samples were analyzed in the data sets:

Laboratory IDs	Client IDs
L1378380-01	BAG BLANK-071221
L1387152-01	EW1-080321
L1387152-02	EW23-080321
L1387152-03	VMWA-080321
L1387152-04	VMWC-080321
L1387152-05	VMWB-080321
L1387152-06	VMWD-080321
L1387152-07	VMWE-080321
L1387152-08	VMWF-080321
L1387152-09	VMWG-080321
L1387152-10	VMWH-080321
L1387152-11	VMWI-080421-143.7
L1387152-12	VMWJ2-080421-120.25
L1387152-13	VMWJ2-080421-120.25
L1387152-14	VMWK-080421-114.25
L1387152-15	VMWL-080421-103.25
L1387152-16	VMWM-080421-94
L1387152-17	VMWN-080421-110.8
L1387152-18	CMW20DS-080421
L1387152-19	CMW22DG-080421
L1387152-20	TRIP BLANK#
L1387152-21	CMW17DS-080421
L1387152-22	CMW18DS-080421
L1387152-23	CMW36DG-080421
L1387152-24	CMW36DG-080421-DUP
L1387152-25	BOP-44DS-080421

Laboratory IDs	Client IDs
L1387152-26	BOP44DG-080421
L1387152-27	CMW10DS-080421
L1387152-28	CMW10DS-080421-DUP
L1387152-29	CMW14RDS-080421
L1387152-30	CMW19DS-080421
L1387614-01	CMW25DG-080521
L1387614-02	CMW24DG-080521
L1387614-03	EW16-080521
L1387614-04	D17DG-080521
L1387614-05	D17DS-080521
L1387614-06	EW12-080521
L1387614-07	EW2-080521
L1387614-08	EW14-080521
L1387614-14	TRIP BLANK LOT #440
L1387779-01	TS-C-EFF-080521
L1387779-02	TS-C-EFF-080521-DUP
L1387779-03	TS-C-INF-080521
L1387779-04	TRIP BLANK LOT #440
2107143-01A	SVE-EFF-070621
2108090-01A	SVE-EFF-080321
2108090-02A	VW-17-95.5-080321
2108090-03A	VMWC-080321
2108090-04A	VMWE-080321
2108090-05A	VMWF-080321
2108090-06A	VMWG-080321
2108090-07A	VMWH-080321

The groundwater samples were received at the laboratory within the temperature criteria of 0-6 degrees Celsius (°C).

The following issues were noted on the chain of custody (COC) forms. No qualifications were applied to the data based on the issues discussed below.

- Incorrect error corrections were observed on the COCs in laboratory reports L1378380, L1387152, L1387614, L1387779, 2107143 and 2108090 instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

- There were no collection dates or times documented on the COCs for TRIP BLANK#, TRIP BLANK LOT#440. The laboratory assigned a collection dates and times of 8/3/2021 and 8/5/2021, 00:00.

- The sampler noted that only one sample container was supplied for the trip blank, TRIP BLANK LOT#440, in laboratory report L1387614. An older sample container was used for the shipment.

- The sample IDs listed on the canister tags for samples SVE-EFF-080321 and VW-17-95.5-080321 did not match the sample IDs listed on the COC. The laboratory logged the sample in with the sample IDs listed on the COC.

1.0 VOLATILE ORGANIC COMPOUNDS

The water samples were analyzed for VOCs per US EPA method 8260D.

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 Times
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
⊗ Laboratory Control Sample
✓ Surrogate
✓ Trip Blank
⊗ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these data packages are considered usable for supporting project objectives. The results are considered valid; 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%.

1.1.2 Analysis Anomaly

Additional information from the laboratory indicated that the percent difference (%D) for acrolein in the continuing calibration verifications (CCVs) in batches WG1707452, WG1724497 and WG1721073; acetone, acrylonitrile, and 2-butanone (MEK) in batch WG1719388; 1,2-dibromo-3-chloropropane in batches WG1719352 and WG1719388; carbon disulfide, chloromethane, 1,1-dichloroethene, butylbenzene, vinyl chloride and naphthalene in batch WG1719352; methyl bromide, ethyl chloride, methylene chloride in batches WG1724497 and WG1721073; 1,2,3-trichlorobenzene and 1,2,4-trichlorobenzene in batches WG1724497, WG1719352, WG1719412 and WG1721073; and hexachlorobutadiene, naphthalene, butylbenzene in batch WG1719412 were outside of the laboratory acceptance limits with low biases. Therefore, the non-detect results for these compounds in the associated samples were UJ qualified as estimated less than the method detection limits (MDLs) and the concentrations of these compounds were J qualified as estimated. These qualifications are summarized in Attachment 3.

1.2 Holding Time

The holding time for the VOC analysis of a preserved groundwater 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). Nine method blanks were reported (batches WG1707452, WG1719352, WG1719388, WG1724214, WG1724497, WG1719412, WG1721073, WG1724941, and WG1721073). VOCs were not detected in the method blanks above the MDLs, with the following exceptions.

1,2,3-Trichlorobenzene was detected at an estimated concentration greater than the MDL and less than the reported detection limit (RDL) in the method blank in batch WG1724497. Since 1,2,3-

trichlorobenzene was not detected in the associated samples, no qualifications were applied to the data.

n-Butylbenzene, sec-butylbenzene, p-isopropyltoluene and naphthalene were detected at estimated concentrations greater than the MDLs and less than the RDLs in the method blank in batch WG1721073. Since n-butylbenzene, sec-butylbenzene, p-isopropyltoluene and naphthalene 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. Precision was assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pair.

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 LCS/LCSD pairs and five LCSs were reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exceptions.

The recoveries of chloroform and 2,2-dichloropropane in the LCS in batch WG1707452 were high and outside of the laboratory specified acceptance criteria. Since chloroform and 2,2-dichloropropane were not detected in the associated samples, no qualifications were applied to the data.

The RPDs of 1,2-dibromo-3-chloropropane, naphthalene and 1,2,3-trichlorobenzene in the LCS/LCSD pair in batch WG1719352 were high and outside of the laboratory specified acceptance criteria. Since 1,2-dibromo-3-chloropropane, naphthalene and 1,2,3-trichlorobenzene were not detected in the associated samples, no qualifications were applied to the data.

The recoveries of hexachloro-1,3-butadiene in the LCSD in batch WG1719352, acrolein in the LCS/LCSD in batch WG1719388; tert-butylbenzene, cis-1,2-dichloroethene, ethylbenzene, methylene chloride, toluene, vinyl chloride in the LCSD in batch WG1719388; and, cis-1,3-dichloropropene and trichloroethene in the LCSD in batch WG1724497 were high and outside of the laboratory specified acceptance criteria. Therefore, the concentration of trichloroethene in the associated sample was J qualified as estimated. No qualifications were applied to the non-detect hexachloro-1,3-butadiene, acrolein, tert-butylbenzene, cis-1,2-dichloroethene, ethylbenzene, methylene chloride, toluene, vinyl chloride and cis-1,3-dichloropropene results in the associated samples.

The recoveries of acrolein in the LCS/LCSD in batch WG1719412 and methylene chloride in the LCSD in batch WG1719412 were high and outside of the laboratory specified acceptance criteria.

Since acrolein and methylene chloride were not detected in the associated samples, no qualifications were applied to the data.

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
VMWH-080321	Trichloroethene (TCE)	1.18	C5 J4	1.18	J	5

µg/l-micrograms per liter
C5- laboratory flag indicating the CCV standard recovery for the report compound was outside the laboratory specified acceptance criteria with a high bias
J4-laboratory flag indicating the LCS was outside the laboratory specified acceptance criteria
* 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 Trip Blank

Two trip blanks were submitted with the sample sets, TRIP BLANK# and TRIP BLANK LOT #440. VOCs were not detected in the trip blanks greater than the MDLs.

1.8 Field Duplicate

Three field duplicates were collected with the sample set, CMW10DS-080421-DUP, CMW36DG-080421-DUP and TS-C-EFF-080521-DUP. Acceptable precision (RPD ≤ 30%) was demonstrated between the field duplicates and the original samples CMW10DS-080421, CMW36DG-080421 and TS-C-EFF-080521, respectively, with the following exception.

Methyl ethyl ketone was detected at an estimated concentration greater than the MDL and less than the RDL in sample TS-C-EFF-080521 and not detected greater than the MDL in the field duplicate, TS-C-EFF-080521-DUP, resulting in a non-calculable RPD. Therefore, based on professional and technical judgement, the concentration of methyl ethyl ketone in sample TS-C-EFF-080521 was J qualified as estimated and the non-detect methyl ethyl ketone result in the field duplicate was UJ qualified as estimated less than the MDL.

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier	Reason Code
TS-C-EFF-080521	Methyl ethyl ketone	2.15	J	2.15	J	7
TS-C-EFF-080521-DUP	Methyl ethyl ketone	1.19	U	1.19	UJ	7

µg/l-micrograms per liter
U-not detected at or above the MDLs

J-the result is less than RDL but greater than the MDL and the concentration is an approximate value

1.9 Sensitivity

The sample results were reported to the MDLs. Elevated non-detect results were not 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. No discrepancies were identified between the level II report and the EDD.

2.0 1,4-DIOXANE

The water sample in laboratory report L1378380 was analyzed for 1,4-dioxane per US EPA method 8270E SIM.

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 Times
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogate
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The 1,4-dioxane data reported in these data packages are considered usable for supporting project objectives. The results are considered valid; 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 1,4-dioxane analysis of a groundwater sample is 7 days from collection to extraction and 40 days from extraction 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 WG1706088). 1,4-Dioxane was not detected in the method blank above the MDL.

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

MS/MSD pairs were not reported. Precision was assessed using the LCS/LCSD pair.

2.5 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/LCSD pair was reported. The recovery and 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

Field duplicates were not collected for 1,4-dioxane analysis.

2.8 Sensitivity

The sample results were reported to the MDL. Elevated non-detect results were not reported.

2.9 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. No discrepancies were identified between the level II report and the EDD.

3.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA Method TO-15.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable or not applicable. 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
✓ Sensitivity
⊗ Electronic Data Deliverable Review

3.1 Overall Assessment

The VOC data reported in these laboratory reports are considered usable for supporting project objectives. The results are considered valid; 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 data set is 100%.

3.2 Holding Time

The holding time for the TO-15 analysis of an air sample collected in a canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

3.3 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 21070911c and v080906c). VOCs were not detected in the method blanks above the method reporting limits (MRLs).

3.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS/LCSD pairs were reported. The RPDs were not reported by

the laboratory; therefore, the RPDs were calculated by the validator based on the reported recovery results. The recovery and RPD results were within the laboratory specified acceptance criteria.

3.5 Laboratory Duplicate

Laboratory duplicates were not reported.

3.6 Surrogates

The surrogate recoveries were within the laboratory specified acceptance criteria.

3.7 Sensitivity

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

3.8 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. The results were reported in both parts per billion by volume (ppbv) and micrograms per cubic meter ($\mu g/m^3$) in the laboratory reports; the results were reported in $\mu g/m^3$ in the EDDs. No other discrepancies were identified between the level II reports and the EDDs.

---

* * * * *

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	Extraction or 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
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
14	Lab flag removed or modified: no validation qualification required

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample duplicate
RPD - Relative percent difference

ATTACHMENT 3
QUALIFICATIONS DUE TO CCV

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
BAG BLANK-071221	Acrolein	2.54	U,C3	2.54	UJ	9
BOP44DG-080421	Acetone	11.3	U,C3	11.3	UJ	9
BOP-44DS-080421	Acetone	11.3	U,C3	11.3	UJ	9
CMW17DS-080421	Acetone	11.3	U,C3	11.3	UJ	9
CMW18DS-080421	Acetone	11.3	U,C3	11.3	UJ	9
CMW36DG-080421	Acetone	11.3	U,C3	11.3	UJ	9
CMW36DG-080421-DUP	Acetone	11.3	U,C3	11.3	UJ	9
CMW10DS-080421	Acetone	11.3	U,C3	11.3	UJ	9
CMW10DS-080421-DUP	Acetone	11.3	U,C3	11.3	UJ	9
CMW14RDS-080421	Acetone	20.3	C3 J	20.3	J	9
CMW19DS-080421	Acetone	11.3	U,C3	11.3	UJ	9
CMW20DS-080421	Acetone	20.3	C3 J	20.3	J	9
CMW22DG-080421	Acetone	42	C3	42	J	9
VMWI-080421-143.7	Acetone	11.3	U,C3	11.3	UJ	9
VMWJ2-080421-120.25	Acetone	11.3	U,C3	11.3	UJ	9
VMWJ2-080421-120.25	Acetone	11.3	U,C3	11.3	UJ	9
VMWK-080421-114.25	Acetone	11.3	U,C3	11.3	UJ	9
VMWL-080421-103.25	Acetone	11.3	U,C3	11.3	UJ	9
VMWM-080421-94	Acetone	12.5	C3 J	12.5	J	9
VMWN-080421-110.8	Acetone	11.3	U,C3	11.3	UJ	9
TRIP BLANK#	Acetone	11.3	U,C3	11.3	UJ	9
BOP44DG-080421	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
BOP-44DS-080421	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
CMW17DS-080421	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
CMW18DS-080421	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
CMW36DG-080421	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
CMW36DG-080421-DUP	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
CMW10DS-080421	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
CMW10DS-080421-DUP	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
CMW14RDS-080421	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
CMW19DS-080421	Methyl ethyl ketone	2.07	C3 J	2.07	J	9
CMW20DS-080421	Methyl ethyl ketone	2.74	C3 J	2.74	J	9
CMW22DG-080421	Methyl ethyl ketone	3.97	C3 J	3.97	J	9
VMWI-080421-143.7	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
VMWJ2-080421-120.25	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
VMWJ2-080421-120.25	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
VMWK-080421-114.25	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
VMWL-080421-103.25	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
VMWM-080421-94	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
VMWN-080421-110.8	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
TRIP BLANK#	Methyl ethyl ketone	1.19	U,C3	1.19	UJ	9
BOP44DG-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
BOP-44DS-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW17DS-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW18DS-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW36DG-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW36DG-080421-DUP	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW10DS-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW10DS-080421-DUP	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW14RDS-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW19DS-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW20DS-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
CMW22DG-080421	acrylonitrile	0.671	U,C3	0.671	UJ	9
VMWI-080421-143.7	acrylonitrile	0.671	U,C3	0.671	UJ	9
VMWJ2-080421-120.25	acrylonitrile	0.671	U,C3	0.671	UJ	9
VMWJ2-080421-120.25	acrylonitrile	0.671	U,C3	0.671	UJ	9
VMWK-080421-114.25	acrylonitrile	0.671	U,C3	0.671	UJ	9

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
VMWL-080421-103.25	acrylonitrile	0.671	U,C3	0.671	UJ	9
VMWM-080421-94	acrylonitrile	0.671	U,C3	0.671	UJ	9
VMWN-080421-110.8	acrylonitrile	0.671	U,C3	0.671	UJ	9
TRIP BLANK#	acrylonitrile	0.671	U,C3	0.671	UJ	9
BOP44DG-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
BOP-44DS-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW17DS-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW18DS-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW36DG-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW36DG-080421-DUP	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW10DS-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW10DS-080421-DUP	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW14RDS-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW19DS-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW20DS-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
CMW22DG-080421	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
VMWI-080421-143.7	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
VMWJ2-080421-120.25	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
VMWJ2-080421-120.25	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
VMWK-080421-114.25	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
VMWL-080421-103.25	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
VMWM-080421-94	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
VMWN-080421-110.8	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
TRIP BLANK#	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
EW1-080321	Carbon Disulfide	0.0962	U,C3	0.0962	UJ	9
EW23-080321	Carbon Disulfide	0.0962	U,C3	0.0962	UJ	9
VMWA-080321	Carbon Disulfide	0.0962	U,C3	0.0962	UJ	9
VMWB-080321	Carbon Disulfide	0.0962	U,C3	0.0962	UJ	9
VMWC-080321	Carbon Disulfide	0.0962	U,C3	0.0962	UJ	9
VMWD-080321	Carbon Disulfide	0.0962	U,C3	0.0962	UJ	9
VMWE-080321	Carbon Disulfide	0.0962	U,C3	0.0962	UJ	9
VMWF-080321	Carbon Disulfide	0.0962	U,C3	0.0962	UJ	9
VMWG-080321	Carbon Disulfide	0.0962	U,C3	0.0962	UJ	9
EW1-080321	Chloromethane	0.96	U,C3	0.96	UJ	9
EW23-080321	Chloromethane	0.96	U,C3	0.96	UJ	9
VMWA-080321	Chloromethane	0.96	U,C3	0.96	UJ	9
VMWB-080321	Chloromethane	0.96	U,C3	0.96	UJ	9
VMWC-080321	Chloromethane	0.96	U,C3	0.96	UJ	9
VMWD-080321	Chloromethane	0.96	U,C3	0.96	UJ	9
VMWE-080321	Chloromethane	0.96	U,C3	0.96	UJ	9
VMWF-080321	Chloromethane	0.96	U,C3	0.96	UJ	9
VMWG-080321	Chloromethane	0.96	U,C3	0.96	UJ	9
EW1-080321	1,1-Dichloroethene	0.188	U,C3	0.188	UJ	9
EW23-080321	1,1-Dichloroethene	0.188	U,C3	0.188	UJ	9
VMWA-080321	1,1-Dichloroethene	0.188	U,C3	0.188	UJ	9
VMWB-080321	1,1-Dichloroethene	0.188	U,C3	0.188	UJ	9
VMWC-080321	1,1-Dichloroethene	0.188	U,C3	0.188	UJ	9
VMWD-080321	1,1-Dichloroethene	0.188	U,C3	0.188	UJ	9
VMWE-080321	1,1-Dichloroethene	0.188	U,C3	0.188	UJ	9
VMWF-080321	1,1-Dichloroethene	0.188	U,C3	0.188	UJ	9
VMWG-080321	1,1-Dichloroethene	0.188	U,C3	0.188	UJ	9
EW1-080321	Butylbenzene	0.157	U,C3	0.157	UJ	9
EW23-080321	Butylbenzene	0.157	U,C3	0.157	UJ	9
VMWA-080321	Butylbenzene	0.157	U,C3	0.157	UJ	9
VMWB-080321	Butylbenzene	0.157	U,C3	0.157	UJ	9
VMWC-080321	Butylbenzene	0.157	U,C3	0.157	UJ	9
VMWD-080321	Butylbenzene	0.157	U,C3	0.157	UJ	9
VMWE-080321	Butylbenzene	0.157	U,C3	0.157	UJ	9
VMWF-080321	Butylbenzene	0.157	U,C3	0.157	UJ	9
VMWG-080321	Butylbenzene	0.157	U,C3	0.157	UJ	9
EW1-080321	Vinyl Chloride	0.234	U,C3	0.234	UJ	9

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
EW23-080321	Vinyl Chloride	0.234	U,C3	0.234	UJ	9
VMWA-080321	Vinyl Chloride	0.234	U,C3	0.234	UJ	9
VMWB-080321	Vinyl Chloride	0.234	U,C3	0.234	UJ	9
VMWC-080321	Vinyl Chloride	0.234	U,C3	0.234	UJ	9
VMWD-080321	Vinyl Chloride	0.234	U,C3	0.234	UJ	9
VMWE-080321	Vinyl Chloride	0.234	U,C3	0.234	UJ	9
VMWF-080321	Vinyl Chloride	0.234	U,C3	0.234	UJ	9
VMWG-080321	Vinyl Chloride	0.234	U,C3	0.234	UJ	9
VMWH-080321	Acrolein	2.54	U,C3	2.54	UJ	9
VMWH-080321	Methyl Bromide	0.605	U,C3	0.605	UJ	9
VMWH-080321	Ethyl Chloride	0.192	U,C3	0.192	UJ	9
VMWH-080321	Methylene Chloride (DCM)	0.43	U,C3	0.43	UJ	9
EW1-080321	Naphthalene	0.174	U,C3 J3	0.174	UJ	9
EW23-080321	Naphthalene	0.174	U,C3 J3	0.174	UJ	9
VMWA-080321	Naphthalene	0.174	U,C3 J3	0.174	UJ	9
VMWB-080321	Naphthalene	0.174	U,C3 J3	0.174	UJ	9
VMWC-080321	Naphthalene	0.174	U,C3 J3	0.174	UJ	9
VMWD-080321	Naphthalene	0.174	U,C3 J3	0.174	UJ	9
VMWE-080321	Naphthalene	0.174	U,C3 J3	0.174	UJ	9
VMWF-080321	Naphthalene	0.174	U,C3 J3	0.174	UJ	9
VMWG-080321	Naphthalene	0.174	U,C3 J3	0.174	UJ	9
EW1-080321	1,2,3-Trichlorobenzene	0.164	U,C4 J3	0.164	UJ	9
EW23-080321	1,2,3-Trichlorobenzene	0.164	U,C4 J3	0.164	UJ	9
VMWA-080321	1,2,3-Trichlorobenzene	0.164	U,C4 J3	0.164	UJ	9
VMWB-080321	1,2,3-Trichlorobenzene	0.164	U,C4 J3	0.164	UJ	9
VMWC-080321	1,2,3-Trichlorobenzene	0.164	U,C4 J3	0.164	UJ	9
VMWD-080321	1,2,3-Trichlorobenzene	0.164	U,C4 J3	0.164	UJ	9
VMWE-080321	1,2,3-Trichlorobenzene	0.164	U,C4 J3	0.164	UJ	9
VMWF-080321	1,2,3-Trichlorobenzene	0.164	U,C4 J3	0.164	UJ	9
VMWG-080321	1,2,3-Trichlorobenzene	0.164	U,C4 J3	0.164	UJ	9
VMWH-080321	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW1-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
EW23-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWA-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWB-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWC-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWD-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWE-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWF-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWG-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWH-080321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
TRIP BLANK LOT #440	Acrolein	2.54	U,C3	2.54	UJ	9
TRIP BLANK LOT #440	Methyl Bromide	0.605	U,C3	0.605	UJ	9
TRIP BLANK LOT #440	Ethyl Chloride	0.192	U,C3	0.192	UJ	9
TRIP BLANK LOT #440	Methylene Chloride (DCM)	0.43	U,C3	0.43	UJ	9
CMW24DG-080521	Hexachlorobutadiene (HCBD)	0.337	U,C3	0.337	UJ	9
CMW25DG-080521	Hexachlorobutadiene (HCBD)	0.337	U,C3	0.337	UJ	9
D17DG-080521	Hexachlorobutadiene (HCBD)	0.337	U,C3	0.337	UJ	9
D17DS-080521	Hexachlorobutadiene (HCBD)	0.337	U,C3	0.337	UJ	9
EW12-080521	Hexachlorobutadiene (HCBD)	0.337	U,C3	0.337	UJ	9
EW14-080521	Hexachlorobutadiene (HCBD)	0.337	U,C3	0.337	UJ	9
EW16-080521	Hexachlorobutadiene (HCBD)	0.337	U,C3	0.337	UJ	9
EW2-080521	Hexachlorobutadiene (HCBD)	0.337	U,C3	0.337	UJ	9
CMW24DG-080521	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW25DG-080521	Naphthalene	0.174	U,C3	0.174	UJ	9
D17DG-080521	Naphthalene	0.174	U,C3	0.174	UJ	9
D17DS-080521	Naphthalene	0.174	U,C3	0.174	UJ	9

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
EW12-080521	Naphthalene	0.174	U,C3	0.174	UJ	9
EW14-080521	Naphthalene	0.174	U,C3	0.174	UJ	9
EW16-080521	Naphthalene	0.174	U,C3	0.174	UJ	9
EW2-080521	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW24DG-080521	Butylbenzene	0.157	U,C3	0.157	UJ	9
CMW25DG-080521	Butylbenzene	0.157	U,C3	0.157	UJ	9
D17DG-080521	Butylbenzene	0.157	U,C3	0.157	UJ	9
D17DS-080521	Butylbenzene	0.157	U,C3	0.157	UJ	9
EW12-080521	Butylbenzene	0.157	U,C3	0.157	UJ	9
EW14-080521	Butylbenzene	0.157	U,C3	0.157	UJ	9
EW16-080521	Butylbenzene	0.157	U,C3	0.157	UJ	9
EW2-080521	Butylbenzene	0.157	U,C3	0.157	UJ	9
CMW24DG-080521	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW25DG-080521	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
D17DG-080521	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
D17DS-080521	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW12-080521	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW14-080521	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW16-080521	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW2-080521	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
TRIP BLANK LOT #440	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW24DG-080521	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
CMW25DG-080521	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
D17DG-080521	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
D17DS-080521	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
EW12-080521	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
EW14-080521	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
EW16-080521	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
EW2-080521	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
TRIP BLANK LOT #440	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
TS-C-EFF-080521	Acrolein	2.54	U,C3	2.54	UJ	9
TS-C-EFF-080521-DUP	Acrolein	2.54	U,C3	2.54	UJ	9
TS-C-INF-080521	Acrolein	2.54	U,C3	2.54	UJ	9
TRIP BLANK LOT #440	Acrolein	2.54	U,C3	2.54	UJ	9
TS-C-EFF-080521	Ethyl Chloride	0.192	U,C3	0.192	UJ	9
TS-C-EFF-080521-DUP	Ethyl Chloride	0.192	U,C3	0.192	UJ	9
TS-C-INF-080521	Ethyl Chloride	0.192	U,C3	0.192	UJ	9
TRIP BLANK LOT #440	Ethyl Chloride	0.192	U,C3	0.192	UJ	9
TS-C-EFF-080521	Methyl Bromide	0.605	U,C3	0.605	UJ	9
TS-C-EFF-080521-DUP	Methyl Bromide	0.605	U,C3	0.605	UJ	9
TS-C-INF-080521	Methyl Bromide	0.605	U,C3	0.605	UJ	9
TRIP BLANK LOT #440	Methyl Bromide	0.605	U,C3	0.605	UJ	9
TS-C-EFF-080521	Methylene Chloride (DCM)	0.43	U,C3	0.43	UJ	9
TS-C-EFF-080521-DUP	Methylene Chloride (DCM)	0.43	U,C3	0.43	UJ	9
TS-C-INF-080521	Methylene Chloride (DCM)	0.43	U,C3	0.43	UJ	9
TRIP BLANK LOT #440	Methylene Chloride (DCM)	0.43	U,C3	0.43	UJ	9
VMWH-080321	Trichloroethene (TCE)	1.18	C5 J4	1.18	J	9

µg/l-microgram per liter
U-not detected at or above the MDLs
J-the result is less than RDL but greater than the MDL and the concentration is an approximate value
C3-laboratory flag indicating the %D in the CCV was outside the laboratory specified acceptance criteria with a low bias
C4-laboratory flag indicating the %D in the CCV was outside the laboratory specified acceptance criteria with a low bias
C5-laboratory flag indicating the %D in the CCV was outside the laboratory specified acceptance criteria with a high bias
J4-laboratory flag indicating the LCS recovery was outside of the laboratory specified acceptance criteria
* 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

Geosyntec consultants

180A Marketplace Blvd
Knoxville, TN 37922
PH 865.330.0037
www.geosyntec.com

Memorandum

Date:	14 January 2022
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Ashley Wilson
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1426442, L1426444 and L1427184 and Eurofins Air Toxics Work Order # 2110145, 2110174 and 2112369**

SITE: Cascade TSA Data Gaps; Job No: PNG0564S21

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-two groundwater samples, three field duplicates and three trip blanks, collected November 2-3, 2021, as well as nine air samples, collected on October 5, 2021, November 2, 2021, and December 8, 2021, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

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

- United States (US) Environmental Protection Agency (EPA) Method 8260D – Volatile Organic Compounds (VOCs)

The air samples were analyzed by Eurofins Air Toxics, Folsom, California for the following analytical test:

- US 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 and based on the information provided, the data as qualified are usable for supporting project objectives. The qualified data should be used within the limitations of the qualifications.

The data were reviewed based on the following documents, the pertinent methods referenced by the data package and professional and technical judgment:

- US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005)

The following samples were analyzed in the data sets:

Laboratory IDs	Client IDs
L1426442-01	TS-C-EFF-110221
L1426442-02	TS-C-EFF-110221-DUP
L1426442-03	TS-C-INF-110221
L1426442-04	TRIP BLANK LOT #472
L1426444-01	EW1-110221
L1426444-02	EW2-110221
L1426444-03	EW14-110221
L1426444-04	D17DG-110221
L1426444-05	D17DS-110221
L1426444-06	EW12-110221
L1426444-07	CMW10DS-110221
L1426444-08	CMW10DS-110221-DUP
L1426444-09	CMW18DS-110221
L1426444-10	CMW17DS-110221
L1426444-11	CMW19DS-110221
L1426444-13	TRIP BLANK LOT #472
L1427184-01	VMWA-110321
L1427184-02	VMWB-110321
L1427184-03	VMWC-110321
L1427184-04	VMWH-110321
L1427184-05	VMWJ2-110321-120.25

Laboratory IDs	Client IDs
L1427184-06	VMWJ2-110321-120.25-DUP
L1427184-07	VMWK-110321-114.25
L1427184-08	VMWL-110321-103.25
L1427184-09	VMWM-110321-94
L1427184-10	VMWN-110321-110.8
L1427184-11	VMWD-110321
L1427184-12	VMWG-110321
L1427184-13	VMWF-110321
L1427184-14	VMWE-110321
L1427184-15	VMWI-110321-143.7
L1427184-16	TRIP BLANK LOT#472
2110145-01A	SVE-EFF-100521
2111074-01A	SVE-EFF-110221
2111074-02A	VW-17d-95.5-110221
2111074-03A	VMWG-110221
2111074-04A	VMWF-110221
2111074-05A	VMWE-110221
2111074-06A	VMWC-110221
2111074-07A	VMWH-110221
2112369-01A	SVE-EFF-120821

The groundwater samples were received at the laboratory within the temperature criteria of 0-6 degrees Celsius (°C).

The following issues were noted on the chain of custody (COC) forms. No qualifications were applied to the data based on the issues discussed below.

- Incorrect error corrections were observed on the COCs in laboratory reports L1426444, 2110145 and 2111074 instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

- There were no collection times documented on the COCs for TRIP BLANK LOT#472. The laboratory assigned a collection time of 00:00.

- There was no received time documented on the COC for laboratory report 2112369.

1.0 VOLATILE ORGANIC COMPOUNDS

The water samples were analyzed for VOCs per US EPA method 8260D.

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 Times
⊗ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
⊗ Laboratory Control Sample
✓ Surrogate
✓ Trip Blank
⊗ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these data packages are considered usable for supporting project objectives. The results are considered valid; 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%.

1.1.2 Analysis Anomaly

L1426442 and L1426444: The non-detect results of 2,2-dichloropropane in samples TS-C-EFF-110221, TS-C-EFF-110221-DUP, TS-C-INF-110221, TRIP BLANK LOT #472, EW1-110221, EW14-110221, EW2-110221 and TRIP BLANK LOT #472 were flagged C3 to indicate the CCV was outside the laboratory specified acceptance criteria with low biases. The laboratory indicated the %D was 72.7%. Therefore, the non-detect results of 2,2-dichloropropane in samples TS-C-

EFF-110221, TS-C-EFF-110221-DUP, TS-C-INF-110221, TRIP BLANK LOT #472, EW1-110221, EW14-110221, EW2-110221 and TRIP BLANK LOT #472 were UJ qualified as estimated less than the MDL.

L1426444: The non-detect results of 1,2,3-trichlorobenzene and naphthalene in samples CMW10DS-110221, CMW10DS-110221-DUP, CMW17DS-110221, CMW18DS-110221, CMW19DS-110221, D17DG-110221, D17DS-110221 and EW12-110221 were flagged C3 to indicate the CCV was outside the laboratory specified acceptance criteria with low biases. The laboratory indicated the %Ds were 95.3% for naphthalene and 81.2% for 1,2,3-trichlorobenzene. Therefore, the non-detect results of 1,2,3-trichlorobenzene and naphthalene in samples CMW10DS-110221, CMW10DS-110221-DUP, CMW17DS-110221, CMW18DS-110221, CMW19DS-110221, D17DG-110221, D17DS-110221 and EW12-110221 were UJ qualified as estimated less than the MDLs.

L1427184: The non-detect results of 1,1,1,2-tetrachloroethane, 1,2,4-trichlorobenzene, bromoform, carbon tetrachloride, chlorodibromomethane, hexachlorobutadiene, methyl bromide and naphthalene in samples VMWA-110321, VMWB-110321, VMWC-110321, VMWH-110321, VMWJ2-110321-120.25, VMWJ2-110321-120.25-DUP and VMWK-110321-114.25 were flagged C3 to indicate the CCV was outside the laboratory specified acceptance criteria with low biases. The laboratory indicated the %Ds were 75.4% for 1,1,1,2-tetrachloroethane, 70% for 1,2,4-trichlorobenzene,71.5% for bromoform, 59.6% for carbon tetrachloride, 77.6% for chlorodibromomethane, 77.1% for hexachlorobutadiene, 31.3% for methyl bromide and 65.6% for naphthalene. Therefore, the non-detect results of 11,1,1,2-tetrachloroethane, 1,2,4-trichlorobenzene, bromoform, carbon tetrachloride, chlorodibromomethane, hexachlorobutadiene, methyl bromide and naphthalene in samples VMWA-110321, VMWB-110321, VMWC-110321, VMWH-110321, VMWJ2-110321-120.25, VMWJ2-110321-120.25-DUP and VMWK-110321-114.25 were UJ qualified as estimated less than the MDLs.

L1427184: The non-detect results of 1,2,3-trichlorobenzene in samples VMWA-110321, VMWB-110321, VMWC-110321, VMWD-110321, VMWE-110321, VMWF-110321, VMWG-110321, VMWH-110321, VMWI-110321-143.7, VMWJ2-110321-120.25, VMWJ2-110321-120.25-DUP, VMWK-110321-114.25, VMWL-110321-103.25, VMWM-110321-94, VMWN-110321-110.8 and TRIP BLANK LOT#472 were flagged C4 to indicate the CCV was outside the laboratory specified acceptance criteria with low biases. The laboratory indicated the %D was 94.7%. Therefore, the non-detect results of 1,2,3-trichlorobenzene in samples VMWA-110321, VMWB-110321, VMWC-110321, VMWD-110321, VMWE-110321, VMWF-110321, VMWG-110321, VMWH-110321, VMWI-110321-143.7, VMWJ2-110321-120.25, VMWJ2-110321-120.25-DUP, VMWK-110321-114.25, VMWL-110321-103.25, VMWM-110321-94, VMWN-110321-110.8 and TRIP BLANK LOT#472 were UJ qualified as estimated less than the MDL.

L1427184: The non-detect results of 1,2,4-trichlorobenzene in samples VMWD-110321, VMWE-110321, VMWF-110321, VMWG-110321, VMWI-110321-143.7, VMWL-110321-103.25, VMWM-110321-94, VMWN-110321-110.8 and TRIP BLANK LOT#472 were flagged C4 to indicate the CCV was outside the laboratory specified acceptance criteria with low biases. The laboratory indicated the %D was 92%. Therefore, the non-detect results of 1,2,4-trichlorobenzene in samples VMWD-110321, VMWE-110321, VMWF-110321, VMWG-110321, VMWI-110321-143.7, VMWL-110321-103.25, VMWM-110321-94, VMWN-110321-110.8 and TRIP BLANK LOT#472 were UJ qualified as estimated less than the MDL.

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
CMW10DS-110221	1,2,3-Trichlorobenzene	0.164	U,C3	0.164	UJ	9
CMW10DS-110221	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW10DS-110221-DUP	1,2,3-Trichlorobenzene	0.164	U,C3	0.164	UJ	9
CMW10DS-110221-DUP	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW17DS-110221	1,2,3-Trichlorobenzene	0.164	U,C3	0.164	UJ	9
CMW17DS-110221	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW18DS-110221	1,2,3-Trichlorobenzene	0.164	U,C3	0.164	UJ	9
CMW18DS-110221	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW19DS-110221	1,2,3-Trichlorobenzene	0.164	U,C3	0.164	UJ	9
CMW19DS-110221	Naphthalene	0.174	U,C3	0.174	UJ	9
D17DG-110221	1,2,3-Trichlorobenzene	0.164	U,C3	0.164	UJ	9
D17DG-110221	Naphthalene	0.174	U,C3	0.174	UJ	9
D17DS-110221	1,2,3-Trichlorobenzene	0.164	U,C3	0.164	UJ	9
D17DS-110221	Naphthalene	0.174	U,C3	0.174	UJ	9
EW1-110221	2,2-Dichloropropane	0.161	U,C3	0.161	UJ	9
EW12-110221	1,2,3-Trichlorobenzene	0.164	U,C3	0.164	UJ	9
EW12-110221	Naphthalene	0.174	U,C3	0.174	UJ	9
EW14-110221	2,2-Dichloropropane	0.161	U,C3	0.161	UJ	9
EW2-110221	2,2-Dichloropropane	0.161	U,C3	0.161	UJ	9
TS-C-EFF-110221	2,2-Dichloropropane	0.161	U,C3	0.161	UJ	9

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
TS-C-EFF-110221-DUP	2,2-Dichloropropane	0.161	U,C3	0.161	UJ	9
TS-C-INF-110221	2,2-Dichloropropane	0.161	U,C3	0.161	UJ	9
TRIP BLANK LOT #472 (L1426442)	2,2-Dichloropropane	0.161	U,C3	0.161	UJ	9
TRIP BLANK LOT #472 (l1426444)	2,2-Dichloropropane	0.161	U,C3	0.161	UJ	9
VMWA-110321	1,1,1,2-Tetrachloroethane	0.147	U,C3 J4	0.147	UJ	9
VMWA-110321	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWA-110321	1,2,4-Trichlorobenzene	0.481	U,C3	0.481	UJ	9
VMWA-110321	Bromoform	0.129	U,C3 J4	0.129	UJ	9
VMWA-110321	Carbon Tetrachloride	0.128	U,C3 J4	0.128	UJ	9
VMWA-110321	Chlorodibromomethane	0.140	U,C3	0.140	UJ	9
VMWA-110321	Hexachlorobutadiene	0.337	U,C3	0.337	UJ	9
VMWA-110321	Methyl Bromide	0.605	U,C3 J3	0.605	UJ	9
VMWA-110321	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWB-110321	1,1,1,2-Tetrachloroethane	0.147	U,C3 J4	0.147	UJ	9
VMWB-110321	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWB-110321	1,2,4-Trichlorobenzene	0.481	U,C3	0.481	UJ	9
VMWB-110321	Bromoform	0.129	U,C3 J4	0.129	UJ	9
VMWB-110321	Carbon Tetrachloride	0.128	U,C3 J4	0.128	UJ	9
VMWB-110321	Chlorodibromomethane	0.14	U,C3	0.14	UJ	9
VMWB-110321	Hexachlorobutadiene	0.337	U,C3	0.337	UJ	9
VMWB-110321	Methyl Bromide	0.605	U,C3 J3	0.605	UJ	9
VMWB-110321	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWC-110321	1,1,1,2-Tetrachloroethane	0.147	U,C3 J4	0.147	UJ	9

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWC-110321	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWC-110321	1,2,4-Trichlorobenzene	0.481	U,C3	0.481	UJ	9
VMWC-110321	Bromoform	0.129	U,C3 J4	0.129	UJ	9
VMWC-110321	Carbon Tetrachloride	0.128	U,C3 J4	0.128	UJ	9
VMWC-110321	Chlorodibromomethane	0.14	U,C3	0.14	UJ	9
VMWC-110321	Hexachlorobutadiene	0.337	U,C3	0.337	UJ	9
VMWC-110321	Methyl Bromide	0.605	U,C3 J3	0.605	UJ	9
VMWC-110321	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWD-110321	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWD-110321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWE-110321	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWE-110321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWF-110321	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWF-110321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWG-110321	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWG-110321	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWH-110321	1,1,1,2-Tetrachloroethane	0.147	U,C3 J4	0.147	UJ	9
VMWH-110321	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWH-110321	1,2,4-Trichlorobenzene	0.481	U,C3	0.481	UJ	9
VMWH-110321	Bromoform	0.129	U,C3 J4	0.129	UJ	9
VMWH-110321	Carbon Tetrachloride	0.128	U,C3 J4	0.128	UJ	9
VMWH-110321	Chlorodibromomethane	0.14	U,C3	0.14	UJ	9
VMWH-110321	Hexachlorobutadiene	0.337	U,C3	0.337	UJ	9
VMWH-110321	Methyl Bromide	0.605	U,C3 J3	0.605	UJ	9

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWH-110321	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWI-110321-143.7	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWI-110321-143.7	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWJ2-110321-120.25	1,1,1,2-Tetrachloroethane	0.147	U,C3 J4	0.147	UJ	9
VMWJ2-110321-120.25	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWJ2-110321-120.25	1,2,4-Trichlorobenzene	0.481	U,C3	0.481	UJ	9
VMWJ2-110321-120.25	Bromoform	0.129	U,C3 J4	0.129	UJ	9
VMWJ2-110321-120.25	Carbon Tetrachloride	0.128	U,C3 J4	0.128	UJ	9
VMWJ2-110321-120.25	Chlorodibromomethane	0.14	U,C3	0.14	UJ	9
VMWJ2-110321-120.25	Hexachlorobutadiene	0.337	U,C3	0.337	UJ	9
VMWJ2-110321-120.25	Methyl Bromide	0.605	U,C3 J3	0.605	UJ	9
VMWJ2-110321-120.25	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWJ2-110321-120.25-DUP	1,1,1,2-Tetrachloroethane	0.147	U,C3 J4	0.147	UJ	9
VMWJ2-110321-120.25-DUP	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWJ2-110321-120.25-DUP	1,2,4-Trichlorobenzene	0.481	U,C3	0.481	UJ	9
VMWJ2-110321-120.25-DUP	Bromoform	0.129	U,C3 J4	0.129	UJ	9
VMWJ2-110321-120.25-DUP	Carbon Tetrachloride	0.128	U,C3 J4	0.128	UJ	9
VMWJ2-110321-120.25-DUP	Chlorodibromomethane	0.14	U,C3	0.14	UJ	9
VMWJ2-110321-120.25-DUP	Hexachlorobutadiene	0.337	U,C3	0.337	UJ	9
VMWJ2-110321-120.25-DUP	Methyl Bromide	0.605	U,C3 J3	0.605	UJ	9

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWJ2-110321-120.25-DUP	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWK-110321-114.25	1,1,1,2-Tetrachloroethane	0.147	U,C3 J4	0.147	UJ	9
VMWK-110321-114.25	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWK-110321-114.25	1,2,4-Trichlorobenzene	0.481	U,C3	0.481	UJ	9
VMWK-110321-114.25	Bromoform	0.129	U,C3 J4	0.129	UJ	9
VMWK-110321-114.25	Carbon Tetrachloride	0.128	U,C3 J4	0.128	UJ	9
VMWK-110321-114.25	Chlorodibromomethane	0.14	U,C3	0.14	UJ	9
VMWK-110321-114.25	Hexachlorobutadiene	0.337	U,C3	0.337	UJ	9
VMWK-110321-114.25	Methyl Bromide	0.605	U,C3 J3	0.605	UJ	9
VMWK-110321-114.25	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWL-110321-103.25	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWL-110321-103.25	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWM-110321-94	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWM-110321-94	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
VMWN-110321-110.8	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWN-110321-110.8	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9
TRIP BLANK LOT#472 (L1427184)	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
TRIP BLANK LOT#472 (L1427184)	1,2,4-Trichlorobenzene	0.481	U,C4	0.481	UJ	9

µg/l-micrograms per liter
U-not detected at or above the MDL
C3-laboratory flag indicating CCV was low and outside the laboratory specified acceptance criteria; however, the method sensitivity check was acceptance
C4- laboratory flag indicating CCV was low and outside the laboratory specified acceptance criteria
J3- laboratory flag indicating the associated batch QC was outside the established quality control range for precision
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

1.2 Holding Time

The holding time for the VOC analysis of a preserved groundwater 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). Four method blanks were reported (batches WG1769441, WG1769740, WG1770432 and WG1770998). VOCs were not detected in the method blanks above the MDLs, with the following exceptions.

Carbon disulfide was detected at an estimated concentration greater than the MDL and less than the reported detection limit (RDL) in the method blank in batch WG1769441. Carbon disulfide was detected in the associated sample TS-C-EFF-110221-DUP. Therefore, the concentration of carbon disulfide in the associated sample was U qualified as not detected at or above the reported result due to blank contamination.

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
TS-C-EFF-110221-DUP	Carbon disulfide	0.11	B J	0	U	3

µg/l-micrograms per liter
B-the same analyte is found in the associated blank
J-the result is less than RDL but greater than the MDL and the concentration is an approximate value

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

MS/MSD pairs were not reported. Precision was assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pair.

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 LCS/LCSD pairs were reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exceptions.

The LCSD recovery of 1,2-dichloropropane in the LCS/LCSD pair in batch WG1769441 was high and outside the laboratory specified acceptance criteria. Since 1,2-dichloropropane was not detected in the associated samples, no qualifications were applied to the data.

The LCSD recoveries of 1,1,2,2-tetrachloroethane and 2,2-dichloropropane in the LCS/LCSD pair in batch WG1769740 were high and outside the laboratory specified acceptance criteria. Since 1,1,2,2-tetrachloroethane and 2,2-dichloropropane were not detected in the associated samples, no qualifications were applied to the data.

The recoveries of trichloroethene in the LCSD in batch WG1769740 were high and outside of the laboratory specified acceptance criteria. Therefore, the concentrations of trichloroethene in the associated samples were J qualified as estimated.

One or both the recoveries of 1,1,1,2-tetrachloroethane, 1,2-dichloroethane, bromoform and carbon tetrachloride in the LCS/LCSD pair in batch WG1770432 were high and outside the laboratory specified acceptance criteria. Since 1,1,1,2-tetrachloroethane, 1,2-dichloroethane, bromoform and carbon tetrachloride were not detected in the associated samples, no qualifications were applied to the data.

One or both the recoveries of acrolein and n-propylbenzene in the LCS/LCSD pair in batch WG1770998 were high and outside the laboratory specified acceptance criteria. Since acrolein and n-propylbenzene were not detected in the associated samples, no qualifications were applied to the data.

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier*	Reason Code**
D17DG-110221	Trichloroethene	4.47	J3 J4	4.47	J	5
D17DS-110221	Trichloroethene	30.7	J3 J4	30.7	J	5
EW12-110221	Trichloroethene	1.95	J3 J4	1.95	J	5
CMW10DS-110221	Trichloroethene	9.25	J3 J4	9.25	J	5
CMW10DS-110221-DUP	Trichloroethene	9.38	J3 J4	9.38	J	5
CMW18DS-110221	Trichloroethene	82.5	J3 J4	82.5	J	5
CMW17DS-110221	Trichloroethene	30.5	J3 J4	30.5	J	5
CMW19DS-110221	Trichloroethene	0.864	J3 J4	0.864	J	5

µg/l-micrograms per liter
J3- laboratory flag indicating the associated batch QC was outside the established quality control range for precision
J4-laboratory flag indicating the associated batch QC was outside the established quality control range for accuracy

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

Three trip blanks were submitted with the sample sets, all were labeled TRIP BLANK LOT#472 with one being associated with each of the following reports, L1426442, L1426444 and L1427184. VOCs were not detected in the trip blanks greater than the MDLs.

1.8 Field Duplicate

Three field duplicates were collected with the sample set, TS-C-EFF-110221-DUP, CMW10DS-110221-DUP and VMWJ2-110321-120.25-DUP. Acceptable precision (RPD ≤ 30%) was demonstrated between the field duplicates and the original samples TS-C-EFF-110221-DUP, CMW10DS-110221-DUP and VMWJ2-110321-120.25-DUP, respectively, with the following exceptions.

Tetrachloroethene was not detected in sample CMW10DS-110221 and detected in CMW10DS-110221-DUP, resulting in a noncalculable RPD. Therefore, based on professional and technical judgment, the tetrachloroethene concentration in CMW10DS-110221-DUP was J qualified as estimated and the non-detect result in sample CMW10DS-110221 was UJ qualified as estimated less than the MDL.

Carbon disulfide was detected at an estimated concentration greater than the MDL and less than the RDL in the method blank in batch WG1769441. Carbon disulfide was detected in the associated sample TS-C-EFF-110221-DUP. The concentration of carbon disulfide in the associated sample was U qualified as not detected at or above the reported result due to blank contamination. Therefore, no qualifications were applied for the non-detect carbon disulfide results in the associated samples.

Sample ID	Compound	Laboratory Result (µg/l)	Laboratory Flag	Validation Result (µg/l)	Validation Qualifier	Reason Code
CMW10DS-110221	Tetrachloroethene	0	NA	0	UJ	7
CMW10DS-110221-DUP	Tetrachloroethene	0.355	J	0.355	J	7

µg/l-micrograms per liter
B-the same analyte is found in the associated blank
J-the result is less than RDL but greater than the MDL and the concentration is an approximate value

1.9 Sensitivity

The sample results were reported to the MDLs. Elevated non-detect results were not 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. No discrepancies were identified between the level II report and the EDD.

2.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA Method TO-15.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable or not applicable. 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
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these laboratory reports are considered usable for supporting project objectives. The results are considered valid; 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 data set is 100%.

2.2 Holding Time

The holding time for the TO-15 analysis of an air sample collected in a 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 20101506c,

21111207a, 21111307c and 60122206). 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 LCS/LCSD pairs were reported. The RPDs were not reported by the laboratory; therefore, the RPDs were calculated by the validator based on the reported recovery results. The recovery and RPD results were within the laboratory specified acceptance criteria.

2.5 Surrogates

The surrogate recoveries were within the laboratory specified acceptance criteria.

2.6 Sensitivity

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

2.7 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. The results were reported in both parts per billion by volume (ppbv) and micrograms per cubic meter ($\mu g/m^3$) in the laboratory reports; the results were reported in $\mu g/m^3$ in the EDDs. No other discrepancies were identified between the level II reports and the EDDs.

---

* * * * *

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	Extraction or 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
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
14	Lab flag removed or modified: no validation qualification required

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample duplicate
RPD - Relative percent difference

Geosyntec consultants

180A Marketplace Blvd
Knoxville, TN 37922
PH 865.330.0037
www.geosyntec.com

Memorandum

Date:	18 February 2022
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Jennifer Pinion
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables –Eurofins Air Toxics Work Order # 2105457, 2106089, 2106638 and 2109191**

SITE: Cascade TSA Data Gaps; Job No: PNG0564S21

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of fifteen air samples, collected on May 20, 2021, June 1, 2021, June 24, 2021, and September 8, 2021, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event. The air samples were analyzed by Eurofins Air Toxics, Folsom, California for the following analytical test:

- United States (US) Environmental Protection Agency (EPA) Method TO-15 - Selected Volatile Organic Compounds (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 supporting project objectives.

The data were reviewed based on the following documents, the pertinent methods referenced by the data package and professional and technical judgment:

- US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005)

The following samples were analyzed in the data sets:

Laboratory IDs	Client IDs
2105457-01A	VMWI-052021
2105457-02A	VMWJ2-052021
2105457-03A	VMWK-052021

Laboratory IDs	Client IDs
2105457-04A	VMWL-052021
2105457-05A	VMWM-052021
2105457-06A	VMWN-052021

Laboratory IDs	Client IDs
2106089-01A	VMWI-060121
2106089-02A	VMWJ2-060121
2106089-03A	VMWK-060121
2106089-04A	VMWL-060121
2106089-05A	VMWM-060121

Laboratory IDs	Client IDs
2106089-06A	VMWN-060121
2106638-01A	VMWJ2-062421
2106638-02A	VMWK-062421
2109191-01A	SVE-EFF-090821

The following issues were noted on the chain of custody (COC) forms. No qualifications were applied to the data based on the issues discussed below.

- Incorrect error corrections were observed on the COCs in laboratory reports 2105457 instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

- The second relinquished by signatures, dates and times were not documented on the COCs for laboratory reports 2105457, 2106089, 2106638 and 2109191.

- Sample identification was not listed on the canister for sample VMWK-062421 in laboratory report 2106638. The sample was logged using the sample ID on the COC.

1.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA Method TO-15.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable or not applicable. 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
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

The VOC data reported in these laboratory reports are considered usable for supporting project objectives. The results are considered valid; 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 data set is 100%.

1.2 Holding Time

The holding time for the TO-15 analysis of an air sample collected in a canister is 30 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). Eight method blanks were reported (file names 20052706, a060114, 21061107a, 21061406a, a061407d, v062906, a070606, 20091506e). VOCs were not detected in the method blanks above the reporting limits (RLs).

1.4 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). Eight LCS/LCS duplicate (LCSD) pairs were reported. The relative percent difference (RPD) results were not reported by the laboratory; therefore, the RPDs were calculated by the validator based on the reported recovery results. The recovery and RPD results were within the laboratory specified acceptance criteria.

Continuing calibration verifications (CCVs) were also reported with the data. The CCV recoveries were within the method specified acceptance criteria.

1.5 Surrogates

The surrogate recoveries were within the laboratory specified acceptance criteria.

1.6 Sensitivity

The samples were reported to the RLs. Elevated non-detect results were reported due to the dilutions analyzed.

1.7 Electronic Data Deliverable Review (EDD)

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. No discrepancies were identified between the level II reports and the EDDs.

---

* * * * *

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	Extraction or 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
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
14	Lab flag removed or modified: no validation qualification required

LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample duplicate
RPD - Relative percent difference