

Prepared for:

Cascade Corporation

2201 NE 201st Avenue
Fairview, Oregon 97024

The Boeing Company

P.O. Box 2207, M/S 7A-XA
Seattle, Washington 98124

**ANNUAL PERFORMANCE REPORT
1 JANUARY 2023 – 31 DECEMBER 2023
FIVE YEAR REMEDY PERFORMANCE
EVALUATION
EAST MULTNOMAH COUNTY,
TROUTDALE SANDSTONE AQUIFER REMEDY
ECSI 1479**

Prepared by:



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



Landau Associates, Inc.
155 NE 100th Street, Suite 302
Seattle, Washington 98125



S.S. Papadopoulos & Associates, Inc.
1801 Rockville Pike, Suite 220
Rockville, Maryland 20852

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/m ³	micrograms per cubic meter
µg/L	micrograms per liter
BGal	Billions of gallons
BLA	Blue Lake Aquifer
Boeing	The Boeing Company
Cascade	Cascade Corporation
cNFA	Conditional NFA
CU1	Confining Unit 1
CSSWF	Columbia South Shore Well Field
CTS	Central Treatment System
DCE	cis-1,2-dichloroethene
DEQ	Oregon Department of Environmental Quality
EMC	East Multnomah County
EPA	United States Environmental Protection Agency
EW	extraction well
ft	foot, feet
ft bgs	feet below ground surface
GETs	groundwater extraction treatment systems
gpm	gallons per minute
LAI	Landau Associates, Inc.
lbs	pounds
MCL	maximum contaminant level
msl	mean sea level
NFA	No Further Action
NOAA	National Oceanic and Atmospheric Administration
PCE	tetrachloroethene
PID	photoionization detector
PLC	programmable logistics controller
ppm	parts per million
PVC	polyvinyl chloride
PWB	Portland Water Bureau
ROD	Record of Decision

scfm	standard cubic feet per minute
SGA	Sand and Gravel Aquifer
SSPA	S.S. Papadopoulos & 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 2023 – 31 December 2023**

East Multnomah County Troutdale Sandstone Aquifer Remedy

Prepared by:



Cindy Bartlett, R.G. (OR)
Geosyntec Consultants

Date 07/31/24

Christine Kimmel, L.G.
Landau Associates

Date 07/31/24

Reviewed by:

Brent Miller, P.E.
Geosyntec Consultants

Date 07/31/24

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

Date 07/31/24

Erin Waibel, R.G.
Landau Associates

Date 07/31/24

1.0 INTRODUCTION

This report is submitted on behalf of Cascade Corporation (Cascade) and The Boeing Company (Boeing) and summarizes performance and monitoring data for the East Multnomah County (EMC) Troutdale Sandstone Aquifer (TSA) Remedy project (Site). Data presented in this report were collected during the period of 1 January 2023 through 31 December 2023 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. The 1996 ROD and the Consent Order specify the following remedial action objectives:

- Restore the TSA to protective concentrations in a reasonable time, if feasible. If not feasible, minimize the extent of the TSA containing VOCs above maximum containment levels (MCLs), or 1×10^{-6} excess cancer risk levels, whichever is more stringent and provide long-term containment of areas where concentrations are above the MCLs;
- Prevent ingestion of TSA groundwater that contains trichloroethene (TCE), tetrachloroethene (PCE), cis-1,2-dichloroethene (DCE), and 1,1-dichloroethane at concentrations above their respective MCLs;
- Protect environmental receptors by preventing surface water discharge of TSA groundwater with VOC concentrations that exceed surface water ambient water-quality criteria;
- Prevent the further spread of contamination in the TSA to the extent practicable;
- Protect groundwater quality in the Sand and Gravel Aquifer (SGA) and the Blue Lake Aquifer (BLA); and
- Allow existing uses of groundwater resources in eastern Multnomah County, or if not feasible, minimize the type and duration of groundwater use restrictions.

EMC Site discovery and groundwater investigations of the TSA (also referred as the Upper TSA) and the Troutdale Conglomerate Aquifer (also referred as the Lower TSA) and underlying SGA began in 1986, and initial groundwater extraction using pump and treat methods commenced in 1993. The results of early investigations indicated the presence of VOCs in groundwater at concentrations above United States Environmental Protection Agency (EPA) MCLs for TCE, PCE, 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. 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 and monitoring wells screened across Confining Unit 1 (CU1) between the TGA and the TSA). 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 of the TSA 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 (voluntary remedy technique added after the Consent Order) with the goal of removing VOC mass from the unsaturated zone within the mound area, located along the eastern portion of the Site. The EMC TSA Remedy project background and historical remedial actions are summarized in the following Section 1.2.

Low-level VOC contamination was also discovered in the SGA, underlying the TSA. The SGA was successfully remediated by 2007, and the associated post-remedy groundwater monitoring ceased in 2013. In 2022, DEQ approved No Further Action (NFA) for the SGA and a Conditional NFA (cNFA) for EMC TSA Zone A, the area north of Sandy Boulevard (DEQ 2022a). Three TSA wells (BOP-44(ds), BOP-44(dg), and EMC-2(dg)) and one SGA well (BOP-44(usg)) remain in Zone A, and well decommissioning plans for will be prepared in the future. As part of the Zone A cNFA, DEQ required five years of annual groundwater monitoring (2024 through 2028) at two wells, PWB-1(uts) and PWB-1(lts), which are located in Zone A and managed by the Portland Water Bureau (PWB) as part of the South Columbia South Shore Well Field (CSSWF).

1.1 Purpose of Report

The reporting period for the EMC TSA remedy Annual Performance Report presents data through calendar year 2023. This Annual Performance Report provides an evaluation of the EMC TSA remedy performance, including:

- A summary of the remediation systems (GETs and SVE) operation, maintenance, and performance monitoring data;
- An assessment of the aquifer restoration progress;
- Recommendations and future planned activities; and
- An evaluation of the remedy over the last five years from 2019 through 2023.

The EMC TSA Remedy project area is shown in Figure 1-1.

1.2 Background

The original study area for the EMC Site was approximately 2,300 acres with a dissolved VOC plume impacting approximately 400 acres. The study area 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 TSA remedy project is located in Sections 19, 20, 28, and 29 in Township 1 North, Range 3 East. The ground surface elevation at the EMC TSA remedy project is highest to the south and descends in a series of river/flood cut terraces northward to the Columbia River.

Four TSA remedial areas or zones (Zones A, B, C, and D) were described in the ROD and subsequently assigned letters (DEQ 1996). The TSA remedial zones, the EMC TSA remedy network of extraction wells and monitoring wells, and the current EMC TSA remedy extraction

system layouts are shown in Figure 1-2. A summary of the TSA remedial zones and status are given below:

TSA Remedial Zone	Zone Location	Zone Status
Zone A	Area north of Northeast Sandy Boulevard	cNFA closure certification received by DEQ in 2022. Well decommissioning pending.
Zone B	Area south of Sandy Boulevard in the western portion of the Boeing facility	cNFA recommendation approved by DEQ in 2022. Next step includes DEQ Staff Letter and public comment period before issuance of the closure certificate.
Zone C	Area south of Sandy Boulevard, directly east of Zone B and west of Northeast 205th Avenue	Ongoing remedy
Zone D	Area south of Sandy Boulevard, directly east of Zone C and area east of Northeast 205th Avenue	cNFA recommendation approved by DEQ in 2022. Next step includes DEQ Staff Letter and public comment period before issuance of the closure certificate.

The EMC Site discovery and groundwater investigations of the TSA and SGA began in 1986. Between 1994 and 1996, remedial investigations and a feasibility study were conducted that indicated groundwater VOC concentrations above EPA 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). TCE was determined to be the predominant contaminant and continues to be utilized to evaluate the progress of the EMC TSA remedy.

Initial groundwater extraction, using pump and treat methods, commenced in 1993. Between 1993 and 2000, six GETs were installed to provide long-term containment of the dissolved VOC plume and remove VOC mass. The GETs have been successful at reducing VOC concentrations and shrinking the size of the dissolved plume from 400 acres to about 18 acres consisting of overlapping Upper TSA and Lower TSA plumes. GETs were sequentially shut down in areas of the Site once cleanup levels were achieved. With DEQ approval, the systems were decommissioned, except for the Central Treatment System (CTS),¹ which captures groundwater in the TSA mound area in Zone C and started operation in 1997. The approximate locations of the

¹ The GETs located in Zone B historically treated both Upper TSA and Lower TSA; however, in 2013, TSA extraction operation was no longer required to meet cleanup levels, and the system currently operates for remediation of the TGA for Boeing.

five former (decommissioned) GETs and the remaining GETs are shown in Figure 3-1. A total of 12 Lower TSA extraction wells (EW-1, -2, -4, -5, -8, -11, -12, -14, -15, -16, -18, and -23) routed groundwater to the CTS at system startup. Currently, EW-2 and EW-14 are actively operated, and the CTS continues to operate to provide long-term containment of the dissolved VOC plume (concentrations above MCL). Wells EW-1 and EW-23 are in pilot shutdown mode, and along with EW-3, EW-5 [now CMW-24(dg)], EW-11, EW-12, EW-13, and EW-16, are used for groundwater monitoring purposes only. Wells EW-4, EW-8, EW-15, and EW-18 were decommissioned with DEQ approval.

In 2014, an SVE pilot study commenced in the TSA mound area (Zone C) to evaluate enhanced removal of VOCs in the vadose zone. The pilot test was successful in removing VOC mass, and full-scale operation of the system was implemented in 2015 as an additional voluntary corrective measure. The system was expanded in 2016, 2019, and February 2022. Five SVE wells (VW-17D-42.5, VW-17D-75, VMW-A, VMW-B, and VMW-D) were shut down after VOC concentrations reached asymptotic levels. Although outside of the reporting period for this report, in May 2024 with DEQ approval, three additional SVE wells (VMW-C, VMW-F, and VMW-H) were shut down (DEQ 2024). 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 EMC 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 6.0), 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 2022 – 31 December 2022 East Multnomah County, Troutdale Sandstone Aquifer Remedy ECSI 1479* (Geosyntec Consultants, Inc. [Geosyntec], Landau Associates, Inc. [LAI], and S.S. Papadopoulos & Associates, Inc. [SSPA], 2023). DEQ approved the modifications listed below on 12 July 2023 (DEQ 2023):

- Continue shutdown of EW-1 (since August 2018) and EW-23 (since April 2021);
- Decrease monitoring frequency from quarterly to semiannually for groundwater elevation and groundwater quality monitoring for Zone C well CMW-10(ds);
- Decrease monitoring frequency from semiannually to annually for groundwater elevation and groundwater quality monitoring for Zone C wells located directly downgradient of the mound area (BOP-13(ds), BOP-13(dg), BOP-31(ds), and BOP-31(dg)); and
- Discontinue the routine groundwater elevation and groundwater quality monitoring at the wells located in Zone B; however, DEQ requested the continued biennial sampling of wells BOP-20(ds) and BOP-20(dg) (located in Zone B) and BOP-23(dg) (located in Zone C) to evaluate EW-23 pilot shutdown rebound and the maintenance of wells EW-23 and BOP-23(dg) for potential future sampling purposes.

DEQ has previously provided approvals for well decommissioning that are still pending, including:

- Zone A: Upper TSA well BOP-44(ds), Lower TSA wells BOP-44(dg) and EMC-2(dg), and SGA well BOP-44(usg);
- Zone B Upper TSA wells BOP-21(ds) and BOP-42(ds) and Lower TSA wells BOP-42(dg) and BOP-60(dg); and
- Zone C: Lower TSA wells CMW-8(dg) and CMW-10(dg).

Since the above wells were approved for pending decommissioning, they have been removed from the monitoring network, and no samples were collected from these wells in 2023.

2.2 Municipal Well Field Operations

The City of Portland utilizes the Bull Run Reservoir as a primary drinking water source. Periodically, the City of Portland augments supply with groundwater from municipal production wells in the CSSWF (shown in Figure 1-1). The CSSWF is operated by the PWB.

During 2023, the CSSWF operated for the one pumping event as listed in the table below (PWB 2024).

Inset Table 2.2: Summary of CSSWF 2023 Pumping.

Reason for CSSWF Pumping	Pumping Start Date	Pumping End Date	Total Volume Pumped (BGal)	Aquifer	Percent of Total Volume Pumped	Aquifer-Specific Pumping (BGal)
Bull Run water supply augmentation	24 August 2023	14 November 2023	3.2	TSA	12%	0.38
				SGA	50%	1.60
				BLA	38%	1.22

Notes:

BGal: Billions of gallons

Due to the close vicinity of the CSSWF to the EMC TSA Remedy project, PWB pumping events are closely monitored, and additional contingency monitoring has been established pursuant to the PWB Contingency Monitoring Plan (LAI 2019) that was approved by DEQ (DEQ 2020). Contingency monitoring is discussed in Sections 4.1 and 4.3. Water levels were collected continuously using pressure transducers with periodic manual checks to confirm data. In 2023, the CSSWF pumping event was 82 days, which triggered short-term response monitoring (pumping events lasting between 30 and 90 days). Short-term response monitoring includes continuous water level monitoring (discussed in Section 4.1) and water quality sampling (discussed in Section 4.3) at selected wells within 30 days of pumping start-up and cessation. PWB Contingency wells were sampled on 25 through 27 September 2023 and 27 November 2023. Water levels and water quality are discussed in Section 4.0.

3.0 EXTRACTION AND TREATMENT SYSTEMS

The CTS operates to remove VOC mass and maintain long-term containment of the remaining existing TSA plume, which consists of two overlapping plumes: 1) the Upper TSA (approximately nine acres); and 2) the Lower TSA (approximately 11 acres). The combined plume footprint is approximately 18 acres in the mound area (Figure 1-2). The locations of the current and former GETs, treated water lines, and extraction and monitoring wells are shown in Figure 3-1. This section also summarizes the mound area SVE system. The SVE piping and well network is shown in Figure 3-2. Well construction and location details for current remedy wells are summarized in Table 3-1.

3.1 CTS Operational Summary

In 2023, the CTS was operated to treat and capture groundwater through the operation of two Lower TSA extraction wells (EW-2 and EW-14). 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 system field checks are conducted weekly. Routine system inspections include manual collection of total flowmeter 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:

- 16 and 17 May 2023: EW-14 was shutdown to complete sonar cleaning. The motor was replaced.
- 31 July 2023: The EW-2 manual flowmeter was jammed and not recording flow. The flowmeter assembly was disassembled, and it was discovered that trace amounts of sand had infiltrated and caused the jam. The sand was removed, and the flowmeter was put back into operation on 7 August 2023. EW-2 was temporarily taken offline to remove the jam and reinstall the flowmeter (offline less than several hours total).
- 14 August 2023: EW-2, EW-14, and the SVE system were shut down as a proactive measure to protect system operation during an extreme heatwave. Systems were brought back online on 18 August 2023.
- 9 September 2023: EW-2 was temporarily taken offline in order to install a steel screen in the y-strainer to prevent further sand intrusion into the flowmeter.
- 27 November 2023: Continued sand intrusion in EW-2 prompted installation of a finer-mesh steel screen in the Y-strainer to prevent sand intrusion. EW-2 was temporarily taken offline in order to install the screen.

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

- 19 January 2023: Final repairs were made to the electrical systems for the CTS, which was damaged by the poplar tree toppling onto the electrical wire on 25 November 2022.

The system was reset and began operation. The CTS was shut down for a total of 55 days and is discussed further in Section 3.1.1.

- 14 August 2023: EW-2 was observed to be offline upon arrival to the Site (cause unknown).

Maintenance and unplanned shutdown events for the operating TSA extraction wells in 2023 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 2022), and water level controls (new water level monitoring equipment in 2019 and 2020).

3.1.1 Winter 2022-2023 Unplanned CTS Shutdown

The main powerline to the CTS and extraction wells was knocked down by a tree on 25 November 2022, and the system was offline until 19 January 2023. During this unplanned shutdown, water level and water quality monitoring were conducted in early January 2023 at select mound area monitoring wells (“sentinel” wells). Additional water level transducers were also deployed in the mound area monitoring well network. This section presents a summary of the water level and water quality trends from before the unplanned shutdown (November 2022 quarterly monitoring event), during the unplanned shutdown (January 2023), and after the system was turned back on (February 2023 semi-annual monitoring event). Additional detailed discussion of observed trends, along with figures and tables, are provided in Appendix B.

Overall, TCE concentrations were similar in the mound area monitoring and extraction wells in early January during the shutdown period to those reported from the monitoring events in early November 2022 prior to the shutdown and in early February 2023 following the restarting of the system. There were only slight TCE concentration increases for a select number of monitoring wells sampled during this period: CMW-17(ds), VMW-D, VMW-M, and VMW-N. TCE concentrations decreased at monitoring well CMW-18(ds) and were stable (including below detection) at the remaining sentinel wells (summarized below and in Table B-1). The TCE results for these wells were within the historic concentration range at each well. This indicates that there was not a notable change in contaminant migration resulting from the unplanned shutdown.

Inset Table 3.1.1: Summary of TCE Results Prior (November 2022), During (January 2023), and After the Unplanned Shutdown 2022 – 2023.

Well	Aquifer Zone	Sample Date	TCE µg/L
CMW-17(ds)	Upper TSA	3 November 2022	4.31
CMW-17(ds)	Upper TSA	4 January 2023	6.69
CMW-17(ds)	Upper TSA	1 February 2023	5.55
CMW-18(ds)	Upper TSA	3 November 2022	98.6
CMW-18(ds)	Upper TSA	4 January 2023	30.3
CMW-18(ds)	Upper TSA	1 February 2023	28.5
VMW-D	Upper TSA	3 November 2022	0.624
VMW-D	Upper TSA	2 February 2023	0.86
VMW-M	Upper TSA	3 November 2022	3.33
VMW-M	Upper TSA	2 February 2023	4.28
VMW-N	Upper TSA	3 November 2022	< 0.500
VMW-N	Upper TSA	2 February 2023	4.74

Groundwater elevations in the mound area Upper TSA wells were variable during the CTS unplanned shutdown with a decrease in groundwater elevation at 13 of the 15 monitoring wells and an increase in elevation at 2 of the 15 monitoring wells (Table B-2). The changes in groundwater elevations during this timeframe were minimal with approximately 1 to 2 feet (ft) (except EW-2, EW-14, VMW-I, and VMW-J2, which are most affected by groundwater pumping). There were no consistent groundwater elevation changes measured in the Lower TSA wells. Notably, the pre-Remedy pumping groundwater elevations and gradients (pre-1997) were not achieved during this 2-month remedy shutdown, which is an indication that longer shutdown periods would be required to achieve pre-pumping groundwater elevations.

3.2 Groundwater Extraction Rates

Target flow rates for the extraction wells have been established to maintain long-term hydraulic containment of the dissolved VOC plume. The minimum target extraction rate for EW-2 is 25 gallons per minute (gpm) and for EW-14 is 20 gpm, and flow rates are set to achieve the maximum drawdown possible for each well.

Flows at EW-2 and EW-14 averaged 33 and 22 gpm, respectively² in 2023. From September 2023 to December 2023, the EW-2 pumping rate steadily declined, but remained above the target flow rate throughout 2023 (Figure A-1). Flow in EW-14 through early 2023 hovered around 21 gpm and was last sonar cleaned on 16 April 2019. Therefore, EW-14 was sonar cleaned on 16 and 17

² Monthly average flows are generated from flowrates during the operation period and excludes shutdown periods.

May 2023 and flows increased in the subsequent months following the sonar cleaning event (Figure A-2).

The 2023 flow rates were sufficient to maintain long-term containment of the dissolved VOC plume in the mound area, as demonstrated by groundwater elevations and gradients (discussed in Section 4.2) and stable TCE concentrations in nearby wells (discussed in Section 4.3). TCE was not detected in monitoring wells located downgradient of the mound area in samples collected in 2023 (samples were collected per the Performance Monitoring Schedule [Table 2-2] and non-routine samples were also collected during the CTS shutdown period in January 2023). Water quality data from this shutdown period is described in Section 3.1.1 and summarized in Appendix B.

Flow rate and water level data for the extraction wells are provided in Appendix A, with average monthly extraction well flow rates over the previous six-year period for EW-2 and EW-14 provided in Figures A-1 and A-2, respectively, and combined average monthly flow for extraction wells in Figure A-3. In general, the combined flow varied between 50 and 59 gpm throughout 2023 and declined in the later months of 2023, which coincides with declines in EW-2 flowrates. 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 EMC 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 was 56 gpm³ (Appendix A, Table A-1). There is no minimum flow rate criterion in the discharge permit.
- Effluent pH ranged from 7.63 to 7.91 standard units (SU) and remained within the discharge permit effluent limits of 6 to 9 SU.
- Effluent temperature ranged from 59 to 62 degrees Fahrenheit. There is no temperature operating limit in the discharge permit.
- VOCs were not detected at concentrations above the respective laboratory reporting limits in 2023 quarterly effluent samples. Discharge permit limits for VOC concentrations are set at the MCLs.

³ This total average flow excludes the shutdown periods.

As shown in Table A-2, performance data for 2023 show compliance with discharge permit limits.

3.4 **Well Decommissioning**

No well decommissioning was completed in 2023.

3.5 **Soil Vapor Extraction**

The SVE system is an additional voluntary corrective measure that was implemented in the TSA mound area where VOC concentrations in the groundwater have not decreased at the same rate as other areas of the Site. 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), again in spring 2019 with the 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. In 2022, VMW-J2 and VMW-K were connected to the SVE system (Geosyntec 2021; DEQ 2021).

In 2018 and 2019, SVE was discontinued at five wells after mass removal reached asymptotic levels and did not rebound during the shutdown testing: VW-17D-42.5 and VW-17D-75 (both decommissioned in 2018), VMW-A, VMW-B, and VMW-D (used for groundwater monitoring, shut off from SVE in 2019).

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 10 SVE wells 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 ft. The SVE system maintained an average flow rate of around 374 standard cubic feet per minute (scfm) in 2023, and average weekly flow rates are shown in Table C-1 and Figure C-2 (Appendix C).

3.5.2 **SVE System Monitoring**

Routine SVE system monitoring was conducted in eight of the 11 SVE wells (VMW-C, VMW-E, VMW-F, VMW-G, VMW-H, VMW-J2, VMW-K, and VW-17D-95.5). The 2023 SVE monitoring schedule⁴ is summarized in the table below:

⁴ NM = not monitored for vapor. Vapor extraction at well is currently shut down, and well is utilized for groundwater monitoring.

Inset Table 3.5.2: SVE Vapor Monitoring Schedule

Well Name	Vapor Sampling (Summa) ⁵	Temperature, Pressure, Flow Rate
VMW-17D-95.5 (soil vapor only)	Quarterly	Weekly
VMW-A	NM	NM
VMW-B	NM	NM
VMW-C	Quarterly	Weekly
VMW-D	NM	NM
VMW-E	Quarterly	Weekly
VMW-F	Quarterly	Weekly
VMW-G	Quarterly	Weekly
VMW-H	Quarterly	Weekly
VMW-J2	Quarterly	Weekly
VMW-K	Quarterly	Weekly
Effluent	Monthly	Weekly

The monitoring for the eight 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;
- Monthly Sampling: collect VOC vapor samples from system effluent; and
- Quarterly Sampling: collect VOC vapor and groundwater samples 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 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) (outlet and wells) are summarized in Tables C-1 and C-2, and the analytical results are shown in Figure C-1.

3.5.3 SVE System Monitoring Results

The 2023 quarterly analytical results for the actively operated SVE wells are shown in Figure 3-3. Of the operating SVE wells, VMW-K had the highest average TCE vapor concentration over the operating year and ranged from 850 to 2,000 $\mu\text{g}/\text{m}^3$. The average TCE vapor concentration for the SVE system effluent was 538 $\mu\text{g}/\text{m}^3$, which is a 212 $\mu\text{g}/\text{m}^3$ decrease relative to the 2022 average (750 $\mu\text{g}/\text{m}^3$). This decrease is thought to be due to the continuous vapor removal reducing overall mass in the well network. For 2023, the majority of the SVE mass was removed from VMW-E, VMW-K, VMW-J2, and VW-17d-95.5. VOC mass removal declined at three wells (VMW-C, VMW-F, and VMW-H) to asymptotic levels, and these wells were shut down in spring 2024 following the scheduled May 2024 sampling event. The vapor extraction operational values and

⁵ Summa canister samples sent to the analytical laboratory for analysis.

manual PID measurements are presented in Table C-1 (outlet), and vapor analytical results are summarized in Table C-2 (outlet and wells).

The SVE well screens extend into the upper portion of the saturated Upper TSA to allow for the collection of groundwater samples. Groundwater samples collected from the SVE wells in 2023 indicated that the highest TCE concentrations were detected at VMW-E and ranged from 15.7 to 22.1 µg/L (groundwater results are discussed in Section 4.3, below). Groundwater analytical results for the SVE wells are summarized in Table E-1.

3.5.4 SVE System Mass Removal

The SVE system removed approximately 7.3 pounds (lbs) of VOCs (6.4 lbs of TCE) in 2023 (based on laboratory analyses) and a total of approximately 100.7 lbs of VOCs (86.9 lbs of TCE) from the TSA mound area since the startup of the SVE Pilot Study in 2014 (Table C-3). The VOC mass removal rate in 2023 (7.3 lbs/year) decreased relative to the previous three operational years (9.2 lbs/year in 2022, 8.2 lbs/year in 2021, and 7.6 lbs/year in 2020), which is believed to be due to reduced VOC mass in the vadose zone near operating SVE wells. 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 monitoring is conducted in accordance with the Performance Monitoring Schedule (Table 2-2). 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, semiannually, annually, or biennially 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 at select wells (Figure D-2). Pressure transducers are utilized in wells selected as part of the PWB contingency monitoring plan (currently seven wells). Water level data are downloaded at least quarterly from the pressure transducers.

Groundwater depths and groundwater elevations are summarized in Appendix D, Table D-1. Groundwater elevation hydrographs 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 2023 12-month reporting period was 36.92 inches; approximately equal to the annual precipitation at the Portland Airport (National Oceanic and Atmospheric Administration [NOAA] 2024).

Since the CSSWF operated for 82 consecutive days in 2023, the short-term response monitoring was triggered and groundwater elevations were measured at the PWB Contingency Monitoring Wells (BOP-20(ds), BOP-62(ds), BOP-65(ds), EW-13, BOP-23(dg), CMW-22(dg), and CMW-36(dg)) in September and November. A general decrease in groundwater elevations ranged from 6 to 8 ft in the Upper TSA contingency monitoring wells and 3 to 6 ft in the Lower TSA contingency monitoring wells was observed during the CSSWF pumping event. A larger groundwater elevation decrease was observed at well BOP-62(ds), which is located closer to the CSSWF.

4.2 Groundwater Flow and Long-Term Containment

As defined in the ROD, the objectives of the TSA-dissolved VOC plume remedy are to restore groundwater quality to the MCLs, if feasible, and if not, maintain long-term containment of the dissolved VOC plume and prevent further vertical and horizontal spread of VOC contaminants to allow existing uses of groundwater resources in the eastern Multnomah County (DEQ 1996). Groundwater elevations near the TSA mound area, located within Zone C, indicate that inward horizontal gradients toward the operating extraction wells continued for most of 2023⁶ due to ongoing remedy pumping. Groundwater contours for the semi-annual water level measurement

⁶ See Appendix B for a discussion of unplanned shutdown from November 2022 through January 2023.

event (February 2023) and the annual event (August 2023) are provided in Figures 4-1a, 4-1b, 4-2a, and 4-2b.

Groundwater flow in the Upper TSA exhibits a radial 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 containment and demonstrate the effectiveness of Lower TSA extraction wells EW-2 and EW-14 in achieving and maintaining capture of the dissolved VOC plume. Groundwater flow directions 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 cleanup levels. Containment of the dissolved VOC plume is also exhibited by spatial VOC concentration trends, as discussed in the following subsections.

The electrical system outage in November 2022 through January 2023 resulted in both extraction wells being shut down for approximately two months (25 November 2022 to 19 January 2023). Additional groundwater and SVE sampling was completed in January 2023 at select mound area wells (CMW-17(ds), CMW-18(ds), CMW-10(ds), VMW-D, VMW-L, VMW M, VMW-N, EW-1, CMW-24(dg), CMW-25(dg), CMW-10(dg), and D-17(ds)) to provide data to monitor VOC concentrations when groundwater extraction was not occurring. In addition, water level data from transducers deployed in most mound area wells were collected to evaluate water level rebound and groundwater flow patterns. A summary of VOC and groundwater elevation data collected during the unplanned shutdown is provided in Appendix B.

4.3 Groundwater Quality

Groundwater quality is evaluated against the MCL for 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 monitoring events are conducted in August of odd number calendar years (e.g., 2021 and 2023); therefore, biennial sampling was conducted in 2023. The Performance Monitoring Schedule is reviewed annually to ensure compliance with the ROD and develop recommendations for the monitoring program for DEQ approval.

PWB contingency monitoring, including groundwater quality sampling, was completed at contingency monitoring wells (BOP-20(ds), BOP-62(ds), BOP-65(ds), EW-13, BOP-23(dg), CMW-22(dg), and CMW-36(dg)) on 25 through 27 September and 27 November 2023. The contingency monitoring wells water quality results were compared to the pre-pumping August 2023 data and indicate the following:

- Upper TSA sentinel well BOP-20(ds) along with Lower TSA sentinel wells CMW-22(dg) and CMW-36(dg) results indicate that TCE concentrations were consistently below the laboratory reporting limit throughout the PWB pumping event.
- Upper TSA sentinel wells BOP-62(ds) and BOP-65(ds), along with Lower TSA EW-13 results, indicate a slight increase in TCE concentrations during the pumping event (0.48 µg/L, 0.45 µg/L, and 0.22 µg/L, respectively); however, concentrations decreased to below the laboratory reporting limit upon the cessation of the pumping event. It should be noted that the temporary increases in the TCE concentrations at the wells were consistently below the MCL.
- Upper TSA sentinel well BOP-23(dg) results indicate a slight increase in TCE concentrations from 0.69 µg/L prior to the pumping event to 1.0 µg/L during the pumping event. Upon cessation of the event, TCE concentrations decreased to 0.86 µg/L. It should be noted that although there was a temporary increase in TCE concentrations, the results were consistently below the MCL.
- Lower TSA sentinel wells CMW-22dg and CMW-36dg results were below the laboratory reporting limits during both the September and November contingency monitoring events.

Analytical results for groundwater samples collected during this reporting period are summarized in Appendix E, Table E-1. Plots of TCE profiles for select mound area wells (monitoring wells and extraction wells) are presented in Appendix E, Figures E-1 through E-7. TCE concentration contours for the routine remedy semiannual sampling events (February and August) are shown in Figures 5-1a, 5-1b, 5-2a, and 5-2b 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 Zone C) during the monitoring period (January through December 2023). TCE concentrations in the Upper TSA wells located outside of the mound area were either non-detect at the laboratory reporting limit or below the MCL. TCE concentration contours for February and August 2023 are shown in Figures 5-1a and 5-2a. The current area of the Upper TSA TCE plume with concentrations over the MCL (5 µg/L) is estimated at 9 acres.

At DEQ's request, additional biennial sampling was conducted at Upper TSA well BOP-20(ds) to record possible rebound effects from the shutdown of extraction well EW-23 (DEQ 2023). Lower extraction well EW-23 was shut down in April 2021 based on TCE concentrations being consistently below the MCL since 2014. Since the extraction well shutdown, water quality samples were collected at Upper TSA well BOP-20(ds) in August 2021 and August 2023 (biennial sampling frequency), and TCE concentrations have been consistently below the laboratory reporting limit (similar to data collected at the well since 2011). Based on these results, no TCE rebound was observed at this well. Groundwater elevations at BOP-20(ds) have only increased by 0.49 ft from elevations recorded during active operation of EW-23 (August 2020) and three years

after shutdown (August 2023) with groundwater elevations at 11.83 and 12.32 ft mean sea level (msl), respectively. In addition, BOP-20(ds) is located approximately 682 ft from Lower TSA extraction well EW-23.

A brief discussion of changes in TCE concentrations during the reporting period for Upper TSA mound area (Zone C) wells that have the highest concentrations is below. TCE concentrations for mound area wells are depicted in Figures E-1 through E-4.

- CMW-17(ds): TCE concentrations fluctuated in 2023 from a maximum of 8.89 J µg/L in May to a minimum of 3.95 µg/L in August (Figure E-1).⁷
- CMW-10(ds): TCE concentrations remained stable in 2023, ranging from a maximum of 6.01 J µg/L in February to a minimum of 4.75 J µg/L in May and below the MCL. TCE concentrations were just over the MCL in August and November 2023 (Figure E-2).
- CMW-18(ds): TCE concentrations dropped significantly from 98.6 µg/L in November 2022 to 30.3 µg/L in January 2023 following the unplanned shutdown and remained relatively stable during the remainder of 2023. TCE concentrations ranging from a maximum of 41.3 µg/L in August 2023 to a minimum of 28.1 µg/L in February 2023 (Figure E-3).
- VMW-I: TCE concentrations remained relatively consistent throughout 2023 with concentrations ranging from a maximum of 38.4 µg/L in May to a minimum of 20.8 µg/L in February.
- SVE wells with partial saturated screens, allow for the co-location sampling for vapor and groundwater.
 - Groundwater TCE concentrations in SVE wells (VMW-A, VMW-C VMW-F, VMW-G, VMW-H, VMW-J2 [Figure E-5], VMW-L, and VMW-M) were generally below the MCL.
 - At VMW-N, TCE concentrations ranged from <1 to 5.7 µg/L.
 - VMW-E and VMW-B were consistently above the MCL during 2023 with TCE concentration ranges of 15.7 to 22.1 µg/L and 7.55 to 12.3 µg/L, respectively.
 - VMW-K TCE concentrations in 2023 were relatively constant, ranging from a maximum of 10.1 µg/L in November to a minimum of 7.6 µg/L in May (Figure E-6).

4.3.2 Lower TSA

Per DEQ's request, additional biennial sampling was conducted at BOP-20(dg) and BOP-23(dg) to record possible rebound effects from the shutdown of extraction well EW-23 (DEQ 2023). DEQ also requested that wells BOP-23(dg) and EW-23 not be decommissioned to allow for potential future monitoring of potential migration of cutting oil released to the 85-120 Building in May 2023

⁷ J is a data qualifier assigned to indicate that the analytical result is detected above the method detection limit but below the reporting limit and is therefore estimated.

(DEQ 2023). Decommissioning BOP-23(dg) or EW-23 is not currently planned, as the wells are located in Zone C and downgradient of the dissolved TSA plume. Water levels and water quality results for these wells were evaluated relative to the EW-23 shutdown and are summarized below.

- In 2020, (prior to the EW-23 shutdown) groundwater elevations at BOP-20(dg) and BOP-23(dg) were 12.02 ft msl and 11.65 ft msl, respectively. After three years following EW-23 shutdown, the 2023 groundwater elevations at BOP-20(dg) and BOP-23(dg) have increased by 0.14 ft at BOP-20(dg) and 0.51 ft at BOP-23(dg) (12.16 ft msl and 11.65 ft msl, respectively).
- In addition, the 2023 groundwater quality results for BOP-20(dg) and BOP-23(dg) indicate that TCE concentrations were either non detect at the laboratory reporting limit (BOP-20(dg)) or below the MCL and are consistent with results since 2019.
- Little to no change in either TCE concentrations or groundwater elevation have been observed at wells BOP-20(dg) or BOP-23(dg) from active operation of EW-23 to almost three years post shutdown. Based on these data, aquifer rebound impacts of the EW-23 shutdown were not observed in these wells.

In 2023, 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.

In the western portion of the mound area (Zone C), well D-17(ds) exhibited the highest TCE concentration in the Lower TSA with concentrations ranging from 24.8 to 34.6 µg/L (Appendix E, Figure E-4) in 2023. TCE concentrations at D-17(ds) were generally stable to decreasing 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 decreased to 13.7 µg/L in August 2022. Since August 2022, TCE concentrations have again trended up to a concentration of 34.6 µg/L in November 2023 but remain variable. Monitoring well D-17(ds) is screened at the top of the Lower TSA across the water table (110 to 120 feet below ground surface [ft bgs]), while well D-17(dg) is screened in the lower portion of the Lower TSA (152 to 172 ft bgs). TCE concentrations at D-17(dg) have been consistently below the MCL since August 2016 except for the August 2022 sampling event when the concentration was 18.2 J µg/L.

In 2023, TCE concentrations at EW-1 (still in pilot shutdown mode) remain below the MCL and were below the laboratory reporting limit (0.5 or 1.0 µg/L) for three of five 2023 sampling events (low-level detections of 0.546 and 0.988 µg/L in January and November 2023, respectively). TCE concentrations at operating extraction wells EW-2 ranged from 7.56 to 8.29 J µg/L and EW-14 ranged from 4.85 J to 5.42 µg/L. EW-2 was consistently above the TCE MCL, while EW-14 was slightly below or slightly above for the four monitoring events completed in 2023 (Figure E-7).

In the eastern portion of the mound area (Zone C/D border), TCE concentrations in the Lower TSA former extraction well EW-11 (currently used for monitoring purposes only), were below the MCL during the annual sampling event and has been below the MCL since 2009.

TCE concentrations for the Lower TSA wells sampled in 2023 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), as shown in the figures, is about 11 acres.

4.4 TCE Mass Removal in Saturated TSA

TCE mass removal estimates are based on groundwater concentrations and groundwater extraction flow rates. In 2023, approximately 1.36 lbs of TCE was removed through the GETs and the two operating extraction wells in the mound area. Since startup of the first system in 1993, the EMC pump and treat remedies (6 GETs with 23 extraction wells) have removed an estimated total of 505 lbs of TCE mass from the saturated zone. Mass removal rates declined markedly after the initial operational peak during the first decade following startup and have continued to decline, although more gradually, year after year (Figures E-8 and E-9). The tailing-off of mass removal is expected and likely due to lower VOC concentrations in the groundwater and the systematic shutdown of the various remedial systems once Consent Order restoration goals were achieved. In 2023, the EMC remedy consisted of one GETs (CTS) and two extraction wells (EW-2 and EW-14) in the mound area.

TCE annual mass removal estimates for the EMC 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 FIVE-YEAR EVALUATION

Previous annual reports on the EMC TSA remedy submitted in 2003, 2008, 2013, and 2018 described remedy progress after 5, 10, 15, and 20 years of remedy operation, respectively (LAI, et. al., 2003; 2008; Geosyntec, LAI, and SSPA, 2013; 2018). This section, which describes remedy progress after 25 years of operation, focuses on remedy progress that has been achieved during the past five years from 2019 through 2023.

5.1 Restoration Goals

The EMC TSA remedy was designed to restore groundwater quality in the Upper TSA and the Lower TSA in the central portion of the original plume (Zone C in Figure 1-2) to MCLs by 2018 and to restore groundwater quality in the remainder of the original plume by 2008. For the most part, restoration has progressed as predicted at the time of remedy design. However, restoration of the mound area, Zone C, is still ongoing.

5.2 TCE Concentrations Relative to the MCL

TCE concentrations in 2023 remain above the MCL in Zone C (the TSA mound area located in the central portion of the original plume), as shown in Figures 5-1a and 5-2b.

In 2022, DEQ granted a cNFA for EMC TSA Zone A and an NFA for the SGA (DEQ 2022a). DEQ also approved the regulatory closure requests for Zones B and D in 2022 (DEQ 2022b). TCE concentrations were consistently below the MCL in Zone B (met remedy goals in 2019) and Zone D, and groundwater sampling was discontinued in 2023. DEQ requested the continued biennial monitoring of the Zone B/C wells (BOP-20(ds), BOP-20(dg), and BOP-23(dg)) to evaluate potential rebound related to the pilot shutdown of EW-23, which was shut down in April 2021 (DEQ 2023). In 2023 (three years post-EW-23 pumping cessation), the TCE concentrations and the groundwater elevations at BOP-20(ds), BOP-20(dg), and BOP-23(dg) are similar to conditions observed during active EW-23 operation, indicating that aquifer rebound has not been observed in this area. A request for a cNFA is being drafted for Zones B and D.

In the TSA mound area (Zone C), TCE concentrations exceed the MCL in an area of approximately 18 acres (consisting of a nine-acre plume in the Upper TSA overlapping an 11-acre plume in the Lower TSA). This remaining plume area is roughly bound by monitoring well D-17(ds) to the west and CMW-18(ds) to the east and extends 600 ft north-south as shown on Figure 6-1. In this area, the maximum TCE concentration continues to be observed at water-table monitoring well CMW-18(ds) at 41.3 µg/L (August 2023) and well D-17(ds) at 34.6 µg/L (November 2023). TCE concentration trends through time are discussed in Section 5.3, below.

The TCE plumes (defined as the estimated area where groundwater concentrations exceed the TCE MCL) in the Upper and Lower TSA have shrunk substantially in area since the onset of remedy pumping in 1998. The combined areal extents of the TCE plumes in the Upper and Lower TSA have decreased from approximately 400 acres in 1994 to about 18 acres in 2023 (Figure 6-1). This represents an over 95% reduction in the size of the plumes. During the past five years, the footprint

of the TSA plume in the mound area has shrunk by approximately 10 acres compared to the 2018 plume size of approximately 28 acres.

Active pumping ceased at extraction wells EW-1 on 31 August 2018 and EW-23 on 5 April 2021. TCE rebound has not been observed in these wells. TCE concentrations at EW-1 have been at or slightly above the TCE reporting limit of 0.500 µg/L since February 2020. TCE concentrations have fluctuated between slightly above the detection limit and a high of 2.5 µg/L (recorded in August 2023) at EW-23 since pilot shutdown in April 2021.

5.3 Concentration Time Trends

In addition to the areal decrease in the plume size, the TCE concentration magnitude has also decreased over time, as shown in Figure 6-1. During the past five-year reviews, the maximum TCE concentration within the plume in 1994 was observed at former well BOP-60(ds) at 340 µg/L, while the maximum TCE concentration in 2008 was observed at well BOP-62(ds) at 210 µg/L. The maximum TCE concentrations in 2013, 2018, and 2023 were observed at well CMW-18(ds) at 210, 98.6, and 41.3 µg/L, respectively. The decrease of TCE maximum concentrations from 1994 to 2023 represent an 88% decrease in concentrations. A comparison of the average TCE concentrations through time in the aquifer remedy zones indicates that groundwater meets the Remedial Action Objectives in the areas with the exception the mound area (Zone C).

Overall, TCE concentrations through time show a steady and decreasing trend over the course of the remedy (Appendix E, Figures E-1 through E-9). Wells in the mound area (Zone C) exhibit more variability and fluctuations in TCE trends than other areas of the Site. In August 2023, eight wells within Zone C exhibited TCE concentrations above 5 µg/L (CMW-10(ds), CMW-18(ds), D-17(ds), EW-2, VMW-B, VMW-E, VMW-I, and VMW-K).

During the previous 2018 five-year review, TCE concentration trends in the TSA mound area wells indicated that ROD remedy goals would not be met by 2023. The SVE system was implemented as a voluntary remedial action to remove mass from the unsaturated zone in the mound area. In 2020, a data gap investigation was completed in Zone C to provide additional data and expand the remedy wells for the portion of the TSA that either was not responding or responding more slowly to the GETs remediation.

The SVE system was implemented to remove VOC mass bound in the unsaturated zone to potentially reduce rebound of VOC concentrations in the groundwater as the water table rises to pre-remedy pumping conditions once operation of extraction wells cease.

For example, groundwater elevations at D-17(ds) increased 8.7 ft (elevation 4.9 to 13.6 ft msl) between 2009 and 2023 and 8.6 ft (elevation 4.8 to 13.4 ft msl) at D-17(dg) during the same timeframe. The increase in elevation indicates a degree of resaturation, as a result of decreased remedy pumping, resulting from the shutdown of nearby extraction well EW-1 in August 2018. Prior to the startup of remedy pumping in 1998, groundwater elevations in the area of paired wells

D-17(ds) and D-17(dg) were approximately 20 ft msl (LAI and EMCON 1994), indicating that there is potentially a further 6 ft of resaturation that could still occur when remedy pumping ceases.

TCE concentrations in the extraction wells have varied from sampling event to sampling event, in part as the result of varying pumping rates. TCE concentrations at the monitoring wells have also varied from sampling event to sampling event. The cause of the highly variable TCE concentrations over the past five years at mound area wells D-17(ds), CMW-17(ds), and CMW-18(ds) are not fully understood. Groundwater elevations in the three mound area wells are variable but are not above peak elevations observed since the resaturation in 2009 except for D-17(ds), which shows a 3-ft elevation gain (in peaks) since nearby extraction well EW-1 was shut down. Potential TCE concentration variability could be related to changes in groundwater flow directions that occurred after extraction well EW-1 was shut down in 2018, changes in preferred pathways, or potential additional mass entering the dissolved plume. The unplanned shutdown in winter 2022/2023 resulted in decreased concentrations at CMW-17(ds) and CMW-18(ds), with minor increases in CMW-10(ds) and D-17(ds), and variable increases/decreases in other mound area wells. The causes for the variability are unknown and additional evaluation is being considered.

5.4 Mass Removal

The total TCE mass removed from the TSA by the GETs, and the SVE system during the past five years was approximately 45 lbs. The total TCE mass removed by the GETs was 9.4 lbs. Three extraction wells operated during portions of the last five years (EW-2, EW-14, and EW-23 [shutdown in April 2021]) compared to up to five extraction wells operated during the prior five-year report. However, most of the mass removed during both of the last five-year review periods has been from the two mound area extraction wells EW-2 and EW-14. Over the last five years, mass removal from these wells was approximately 6.1 lbs at EW-2 and 2.8 lbs at EW-14. Cumulative TCE removal is shown in Appendix E, Table E-2, and Figure E-8, and TCE removal per well is shown in Appendix E, Table E-3 and Figure E-9.

Over the past five years, a total of approximately 41.3 lbs of VOC mass (35.6 lbs of TCE) has been removed in vapor by the SVE system, and a total of 9.4 lbs of TCE from the groundwater by the CTS.

5.5 Restoration Progress

Restoration has been achieved for the SGA and Zone A, and a cNFA and an NFA were issued for the two respective areas by DEQ on 10 November 2022 (DEQ 2022a). Additionally, on 23 November 2022, DEQ approved proceeding with a request for cNFAs for both Zones B and D (DEQ 2022b). A formal zone closure/NFA request is pending and anticipated to be submitted to DEQ for approval in 2024.

Significant progress has been made towards attainment of water-quality restoration in the TSA. The footprint of groundwater in the TSA containing TCE concentrations greater than the MCL has decreased from approximately 400 acres in 1994 to 18 acres in 2023 (Figure 6-1). The remaining

area with TCE concentrations above the MCLs is located in the mound area in Zone C. The maximum TCE concentration has decreased from 340 µg/L in 1994 to 41.3 µg/L in 2023, a decrease of 88%. In addition, approximately 592 lbs of TCE mass has been removed (505 lbs from the TSA saturated zone and 87 lbs from the unsaturated zone) in the TSA. However, TCE concentrations remain above the MCL in the Zone C area (TSA mound area) and have not yet met the ROD goal of aquifer restoration. Continued operation of the EW-2 and EW-14 and the current SVE system, based on past trends, is unlikely to obtain aquifer restoration within the next decade. As stated in the ROD, if aquifer restoration is not feasible, long-term containment will continue. Operation of EW-2 and EW-14 currently provide long-term containment of areas where concentrations are above the MCLs.

Performance data indicate that the existing pump and treat system continues to be effective in containing the groundwater-dissolved VOC plume; however, the lower mass removal rates (less than 2 lbs/year) indicated that the system may require a longer remediation timeframe than preferred. It is anticipated that the operation of the current or modified pump and treat system within Zone C will continue. Potential remedy modifications are currently being considered to optimize mass removal and possibly reduce the remedy timeframe for of the remaining contamination in the mound area, and a work plan will be submitted to DEQ this year (2024).

6.0 PERFORMANCE SUMMARY

The EMC TSA remedy has been effective at reducing VOC plume size and magnitude since implementation in 1994. The VOC plume in the TSA has reduced in size from an approximately 400 acres in the mid-1990s to approximately 11 acres in the Lower TSA, nine acres in the Upper TSA, and a combined extent of 18 acres in 2023. The remaining VOC plume that exceeds the MCL is located in the groundwater mound area in Zone C. The EMC TSA groundwater and SVE systems removed 1.36 lbs and 6.4 lbs of TCE, respectively, in 2023. Since Remedy startup, TCE mass removal is estimated at 505 lbs from the saturated zone (1997 through 2023) and 87 lbs from the unsaturated zone (2014 through 2023). Current mass removal rates in the saturated zone are slow (less than 2 lbs/yr), and the GETs is operated primarily for hydraulic containment of the dissolved VOC plume in the mound area.

Significant remedy performance findings are summarized below.

- TCE concentrations are below the ROD remedy goals for the areas of the remedy with the exception of Zone C mound area, where TCE concentrations are above the MCLs, as follows:
 - Four monitoring wells: CMW-10(ds), CMW-17(ds), CMW-18(ds), and D-17(ds) have TCE concentrations above the MCL. Wells D-17(ds) and CMW-18(ds) have the highest TCE concentrations.
 - Two extraction wells: EW-14 and EW-2; and
 - Five of the 14 vapor/groundwater monitoring wells: VMW-B, VMW-E, VMW-I, VMW-K, and VMW-N.
- The highest TCE concentrations were at CMW-18(ds), VMW-I, and VMW-E.
- ROD remedy objectives for long-term containment were achieved in 2023 based on groundwater flow directions in the Upper and Lower TSA that indicate ongoing inward and downward flow towards the operating extraction wells (Figures 4-1a, 4-1b, 4-2a, and 4-2b) and TCE concentrations that continue to decline or are below laboratory reporting limits in wells outside of the mound area.
- Average flow rates at operational extraction wells continue to operate at or above target levels as follows: EW-2 (33 gpm versus target of 25 gpm) and EW-14 (22 gpm versus target of 20 gpm). Extraction wells EW-1 and EW-23 were shut down in 2019 and 2022, respectively, when remedy performance criteria were met (these wells remain in use for groundwater monitoring). In 2023, the average flow rate from the active pumping wells was 56 gpm versus 91 gpm during the last year (2018) of the previous 5-year reporting period (2014 through 2018). The total flow rate decline was the result of the shutdown of EW-23 and EW-1 during the current five-year reporting period (2019-2023).
- Removal of remaining poplar trees is underway to eliminate the potential for falling trees to impact the EMC TSA Remedy infrastructure. The poplar trees were installed for

phytoremediation of the Cascade TGA Remedy (ECSI #635), which was closed in 2015, and are no longer needed.

- Consistent with 2022 observations, TCE concentrations for Lower TSA extraction wells EW-2 and EW-14 have had a slight downward trend since 2017. TCE concentrations were above the MCL at EW-2 in 2023, but at EW-14, TCE concentrations were below the MCL in two of the four sampling events (Figure E-7).
- In 2023, the GETs removed approximately 1.36 lbs of TCE, which is similar to that removed in 2022. Approximately 505 lbs have been removed from the TSA to date from groundwater extraction (including current and decommissioned GETs).
- In 2023, the SVE system removed approximately 6.4 lbs of TCE. The SVE system has removed a total of approximately 87 lbs of TCE from the unsaturated zone near the mound area since pilot test startup in 2014.

7.0 RECOMMENDATIONS AND FUTURE PLANNED ACTIVITIES

7.1 Recommended Changes for Treatment Systems

The CTS continues to operate and maintain long-term containment of the dissolved VOC plume. Continued operation of wells EW-2 and EW-14 is recommended until a pilot testing work plan for the remedy modification has been submitted for approval by DEQ. Potential remedy modifications continue to be evaluated in the mound area. Data from the two-month unplanned shutdown in winter 2022/2023 are being evaluated as part of the remedy modification process. Results of the shutdown period and rebound data (groundwater elevation and groundwater quality) along with recommended remedy modifications will be described in a report to DEQ in 2024. Pilot shutdown of EW-1 and EW-23 and continued use of these wells for groundwater monitoring, as previously approved by DEQ, will continue through 2024.

The SVE continues to remove VOC mass from the unsaturated interval of the Upper TSA. Three SVE wells have reached asymptotic concentrations: VMW-C (since May 2022); VMW-F (since November 2022); and VMW-H (since May 2022). Since they are no longer removing mass, these three SVE wells were shut off after the May 2024 monitoring event. The mass removal rates at the remaining five SVE wells will continue to be monitored to optimize performance.

7.2 Recommend Changes to Monitoring Program and Schedule Modifications

The following monitoring program and sampling schedule modifications are for wells that meet EMC TSA Remedy Criteria (Table 2-1). The recommendations are summarized in Table 2-2 and include the following:

- Decrease monitoring frequency for groundwater elevation and groundwater quality monitoring for Zone C well CMW-10(ds) from quarterly to semiannually. VOC concentrations in this well have been steadily declining since 2010 and are now only slightly above the MCL. Thus, semiannual sampling frequency is sufficient to monitor low-level VOC concentrations.
- Discontinue groundwater elevation and groundwater quality monitoring at Zone B and Zone D wells, with the exception of sentinel wells identified for sampling as part of the PWB Contingency Plan. Following the 2022 Annual Report, DEQ requested the continued sampling of wells BOP-20(ds), BOP-20(dg), and BOP-23(dg) to monitor for potential rebound at extraction well EW-23. Groundwater elevation data and TCE concentrations at wells (BOP-20(ds), BOP-20(dg), and BOP-23(dg)) indicate no aquifer rebound almost three years after EW-23 shutdown. Based on this information, we request to discontinue sampling of these three wells as part of the routine remedy monitoring program. Wells BOP-20(ds) and BOP-23(dg) are sentinel wells for non-routine monitoring during prolonged PWB operation of the CSSWF, as identified in the PWB Contingency Plan.

- Following the May 2024 quarterly sampling event, shut off three SVE wells (VMW-H, VMW-C, and VMW-F). Mass removal at these three wells has declined to asymptotic levels. Vapor extraction from the remaining five SVE wells will continue. DEQ approved this change via email in April 2024 (DEQ, 2024), and this request is included herein for completeness.

8.0 REFERENCES

- Geosyntec Consultants (Geosyntec). 2021. *East Multnomah County Groundwater TSA Remedy (ECSI 1479) SVE System Expansion and Hydraulic Testing Work Plan*. 12 November.
- Geosyntec, Landau Associates, and S.S. Papadopoulos & Associates, Inc (SSPA). 2013. *Semi-Annual Performance Report 1 October 2012 – 31 March 2013; Five Year Remedy Evaluation Troutdale Sandstone Aquifer Remedy*. 29 July.
- Geosyntec, LAI, and SSPA. 2018. *Annual Performance Report: 1 January 2018 through 31 December 2018; Five Year Remedy Performance Evaluation, East Multnomah County TSA Groundwater Remedy (ECSI 1479)*. 31 May.
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- DEQ. 1997. TSA Remedy Order on Consent, WMCSR-NWR-96-08, 14 February.
- DEQ. 2020. Email from K. Thiessen, DEQ: DEQ approval of: EMC TSA Remedy, 2019 PWB Contingency Plan (ECSI #1479).
- DEQ. 2021. Email from K. Thiessen, Subject: DEQ approval of EMC Groundwater TSA Remedy SVE System Expansion and Hyd. Testing Work Plan. 24 November.
- DEQ. 2022a. Letter from K. Thiessen, Re: East Multnomah County, Troutdale Sandstone Aquifer (TSA) Remedy Conditional No Further Action Determination for Zone A of the TSA and a No Further Action Declaration for the Site-Related Sand and Gravel Aquifer (SGA). ECSI #1479. 10 November.

- DEQ. 2022b. Letter from K. Thiessen, Re: Annual Performance Report fo1 Jan. – 31 Dec. 2021. East Multnomah County, Troutdale Sandstone Aquifer Remedy. Zones B and D Closure Requests. ECSI #1479. 23 November.
- DEQ. 2023. Letter from K. Thiessen. Re: Annual Performance Report for 1 Jan.–31 Dec. 2022, East Multnomah County, Troutdale Sandstone Aquifer Remedy, Gresham, Oregon. ECSI #1479. 12 July.
- DEQ. 2024. Email from K. Thiessen. Re: Plan for shutoff of SVE Wells WMV-H, VMW-C, and VMW-F. 24 April.
- PWB. 2024. Email from D. Wise, Portland Water Bureau, RE: PWB SSWF 2023 Pumping Dates and Volumes (email provided pumping information for the CSSWF). 28 March.

TABLES

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

This table summarizes Troutdale Sandstone Aquifer (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 report¹ 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: • <i>If Trichloroethylene (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.</i> • <i>If TCE remains below the MCL cleanup level for two years, DEQ will evaluate potential decommissioning of these wells.</i>
2. MONITORING WELL NETWORK MODIFICATION
Wells may be removed from the monitoring program if a well meets one or more of the following criteria: • <i>TCE concentrations have been consistently below detection limits for two or more years.</i> • <i>The well is located outside the limits of the plume and is no longer needed to monitor hydraulic plume control or restoration progress.</i> • <i>The location of a well duplicates another well better suited to evaluate hydraulic control and restoration progress.</i>
3. SAMPLING FREQUENCY MODIFICATIONS
The following criteria serve to standardize current and future monitoring adjustments as restoration progresses over the coming years: <u>Criteria for Increasing Sampling Frequency:</u> • <i>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 two or more years.</i> • <i>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 two or more years.</i> <u>Criteria for Reducing Sampling Frequency:</u> • <i>If TCE has been consistently below detection limits for the prior two years, the sampling frequency may be reduced.</i> • <i>If TCE has been stable to declining for the prior two years, the sampling frequency may be reduced.</i>
4. CRITERIA FOR WELL DECOMMISSIONINGS
Extraction and monitoring well decommissionings will be proposed to the Oregon Department of Environmental Quality (DEQ) if the following criteria are met: • <i>Extraction well decommissioning may be proposed to DEQ if TCE concentrations remain consistently below the MCL in that well for two years following pilot shutdown; two consecutive TCE detections at or above the MCL may prompt resumed operation.</i> • <i>Monitoring well decommissioning will be proposed to DEQ if TCE concentrations remain below the MCL for two consecutive years.</i>

¹Landau 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 2023 through 31 December 2023
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	Annually	Annually	Boeing
BOP-13(dg)	Lower TSA	Annually	Annually	Boeing
BOP-20(ds)	Upper TSA	Biennial to NLM PWB Monitoring	Biennial to NLM PWB Monitoring	Boeing
BOP-20(dg)	Lower TSA	Biennial to NLM	Biennial to NLM	Boeing
BOP-23(dg)	Lower TSA	Biennial to NLM PWB Monitoring	Biennial to NLM PWB Monitoring	Boeing
BOP-31(ds)	Upper TSA	Annually	Annually	Boeing
BOP-31(dg)	Lower TSA	Annually	Annually	Boeing
BOP-62(ds)	Upper TSA	PWB Monitoring	PWB Monitoring	Boeing
BOP-65(ds)	Upper TSA	PWB Monitoring	PWB Monitoring	Boeing
D-17(ds)	Lower TSA	Quarterly	Quarterly	Cascade
D-17(dg)	Lower TSA	Quarterly	Quarterly	Cascade
EW-11 (monitoring only)	Lower TSA	Annually	Biennial	Cascade
EW-12 (monitoring only)	Lower TSA	Semiannually	Semiannually	Cascade
EW-13 (monitoring only)	Lower TSA	PWB Monitoring	PWB Monitoring	Boeing
CMW-10(ds)	Upper TSA	Semiannually	Semiannually	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
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
Portland Water Bureau				
PWB-01lts	Lower TSA	Annually - Feb	Annually - Feb	Cascade
PWB-01uts	Upper TSA	Annually - Feb	Annually - Feb	Cascade

NOTES:

1. Annual monitoring performed in August; semiannual in February and August; quarterly in February, May, August, and November. Next biennial sampling event planned for August 2025.
2. Recommendations for modifications to the Monitoring Schedules are indicated in red text.
3. Blue text indicates additional monitoring requirements. PWB wells will be sampled until 2028 with 2024 as Year 1.
4. PWB Monitoring indicates the selected well is used for PWB Contingency Monitoring during times of PWB pumping.
NLM = No longer monitored

Table 2-3
Significant Remedy Documents – 1 January 2023 through 31 December 2023
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
20 December 2022	Email	Oregon Department of Environmental Quality (DEQ)	EMC mound area GW pumping from EW-2 & EW-14	DEQ does not approve long-term shutdown of EW-2 and EW-14. <i>(Context: After the unplanned shutdown in late November 2022, the EMC TSA team requested that DEQ consider extending the shutdown period to provide additional data during times when groundwater is not being pumped.)</i>
May 2023	Report	Geosyntec, Landau, S. S. Papadopoulos & Associates	Annual Performance Report 1 January 2022 – 31 December 2022 East Multnomah County, Troutdale Sandstone Aquifer Remedy ECSI 1479	In summary, the Annual Report proposes decreasing monitoring frequency at CMW-10ds; discontinue monitoring at the majority of Zone B wells (except for BOP-13(ds), BOP-13(dg), BOP-31(ds), and BOP-31(dg)); and discontinue routine remedy monitoring at the PWB contingency plan wells.
12 July 2023	Letter	DEQ	RE: Annual Performance Report for 1 Jan. – 31 Dec. 2022. East Multnomah County, Troutdale Sandstone Aquifer Remedy. ECSI #1479	2022 Annual Report Approval. Approval of all project changes, except: • DEQ requests continued monitoring of BOP-20(ds), BOP-20(dg), and BOP-23(dg); • EW-23 and BOP-23(dg) might need to be used to monitor for oil resulting from a cutting oil release at the Boeing property. • DEQ asked “are wells BOP-20(ds), BOP-20(dg), and BOP-23(dg) scheduled for sampling during summer 2023?”

Table 2-3
Significant Remedy Documents – 1 January 2023 through 31 December 2023
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
18 August 2023	Letter	Landau Associates	Response to Comment Letter	Response to DEQ recommendations in 2022 Annual Report: • Wells BOP-23(ds), BOP-20(ds) and BOP-20(dg) show no rebound for EW-23 shutdown and request discontinuation of sampling. • Request to discontinue sampling wells BOP-23(ds) and EW-23 located downgradient of 85-120 building as investigation results indicated no release of coolant material to subsurface. • Clarification that BOP-20(ds), BOP-20(dg), and BOP-23(dg) were sampled in summer 2023.

Table 3-1
Well Construction Data - 1 January 2023 through 31 December 2023
TSA Remedy - East Multnomah County

		NAD 1983 State Plane Oregon (ft)		Elevations (ft NGVD29)				
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
Monitoring Wells & Former Extraction Wells Approved for Monitoring Use								
BOP-13(ds)	Upper TSA	7699461.3	689388.4	126.7	128.94	9.0	-1.0	132
BOP-13(dg)	Lower TSA	7699465.9	689375.4	127.5	128.71	-41.0	-61.0	193
BOP-20(ds)	Upper TSA	7698395.4	691041.6	78.2	77.45	9.0	-11.0	97
BOP-20(dg)	Lower TSA	7698381.4	691042.6	78.1	77.32	-105.0	-125.0	209
BOP-21(ds)	Upper TSA	7697591.5	691105.0	77.1	78.02	-88.0	-108.0	192
BOP-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
EW-23	Lower TSA	7698806.9	690524.7	83.8	83.93	-26.2	-66.2	157
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
BOP-44(usg)	SGA	7698996.3	691888.8	24.6	34.25	-181.0	-191.0	219

Table 3-1
Well Construction Data - 1 January 2023 through 31 December 2023
TSA Remedy - East Multnomah County

		NAD 1983 State Plane Oregon (ft)		Elevations (ft NGVD29)				
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
VMW-J2	Upper TSA + Vapor	7700421.0	689306.9	123.8	-----	-25.8	-45.8	121
VMW-K	Upper TSA + Vapor	7700281.1	689359.2	123.5	-----	13.2	3.2	121
Soil Vapor and Groundwater Monitoring Wells								
PWB-01lts	Lower TSA	7700352.3	692604.8	14.0	-----	-98.0	-118.0	134
PWB-01uts	Upper TSA	7700344.1	692612.1	13.9	-----	-51.1	-71.1	86

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.

bgs = below ground surface

ft = feet

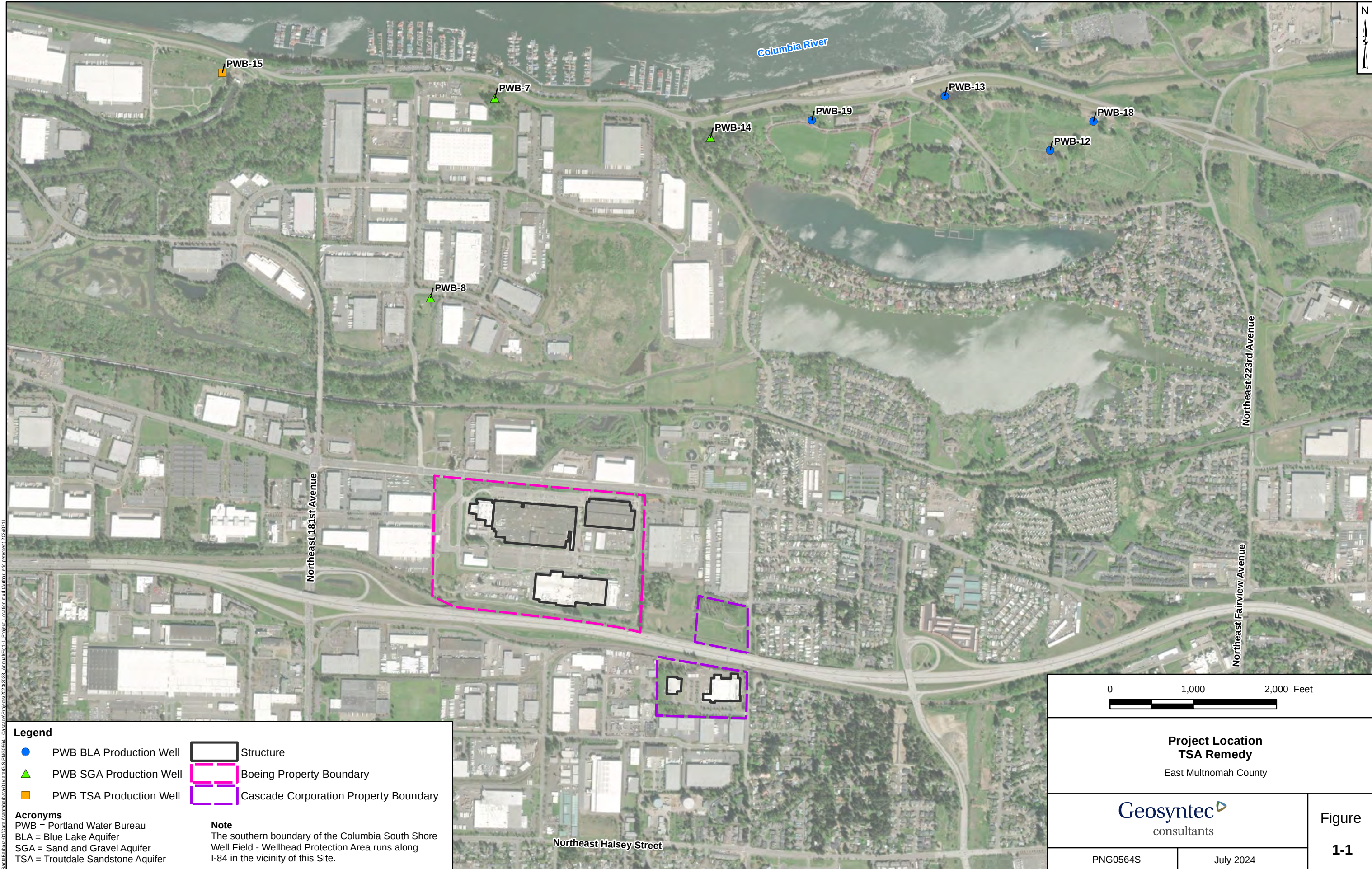
NAD = North American Datum

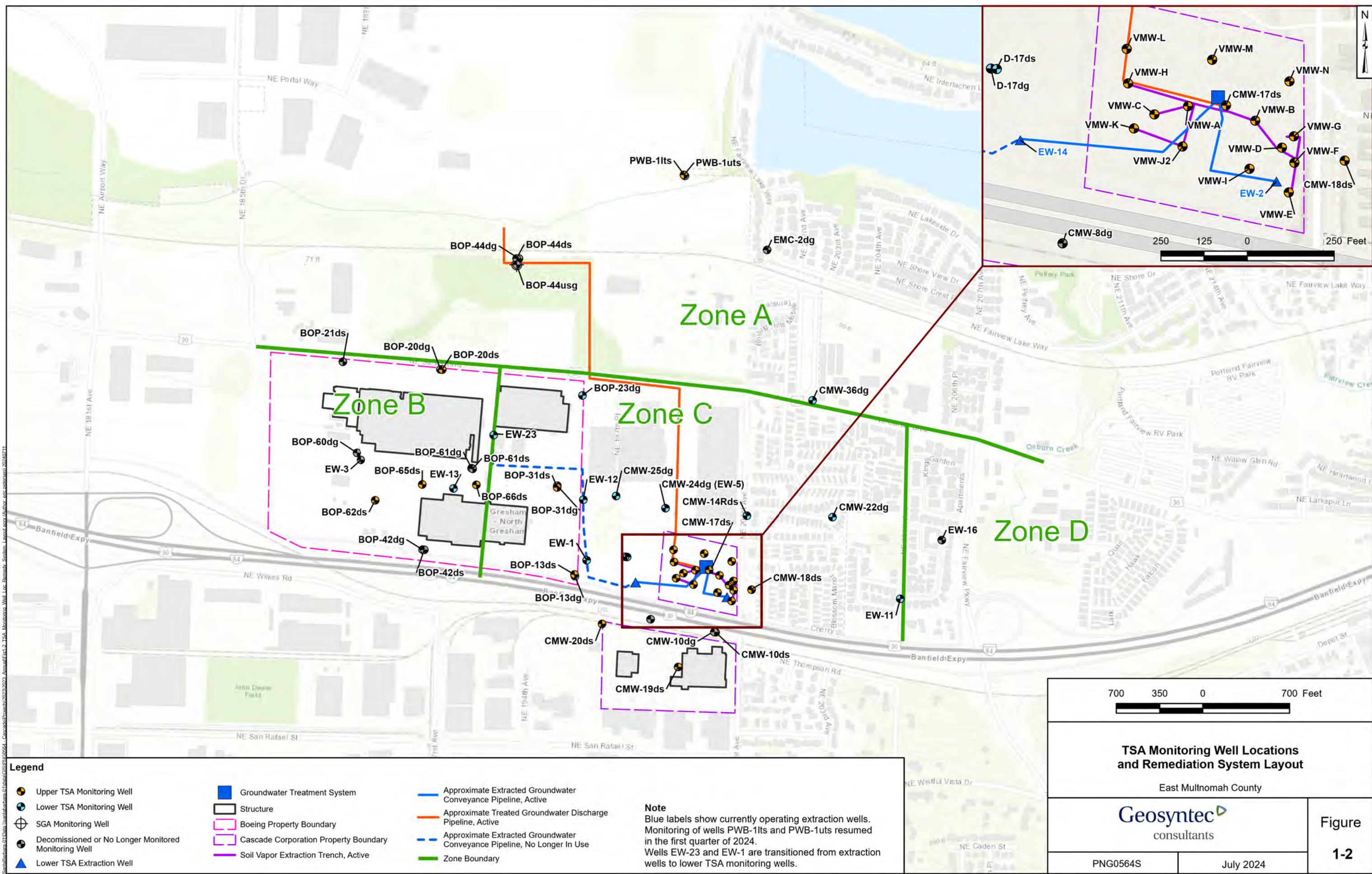
NGVD29 = National Geodetic Vertical Datum of 1929

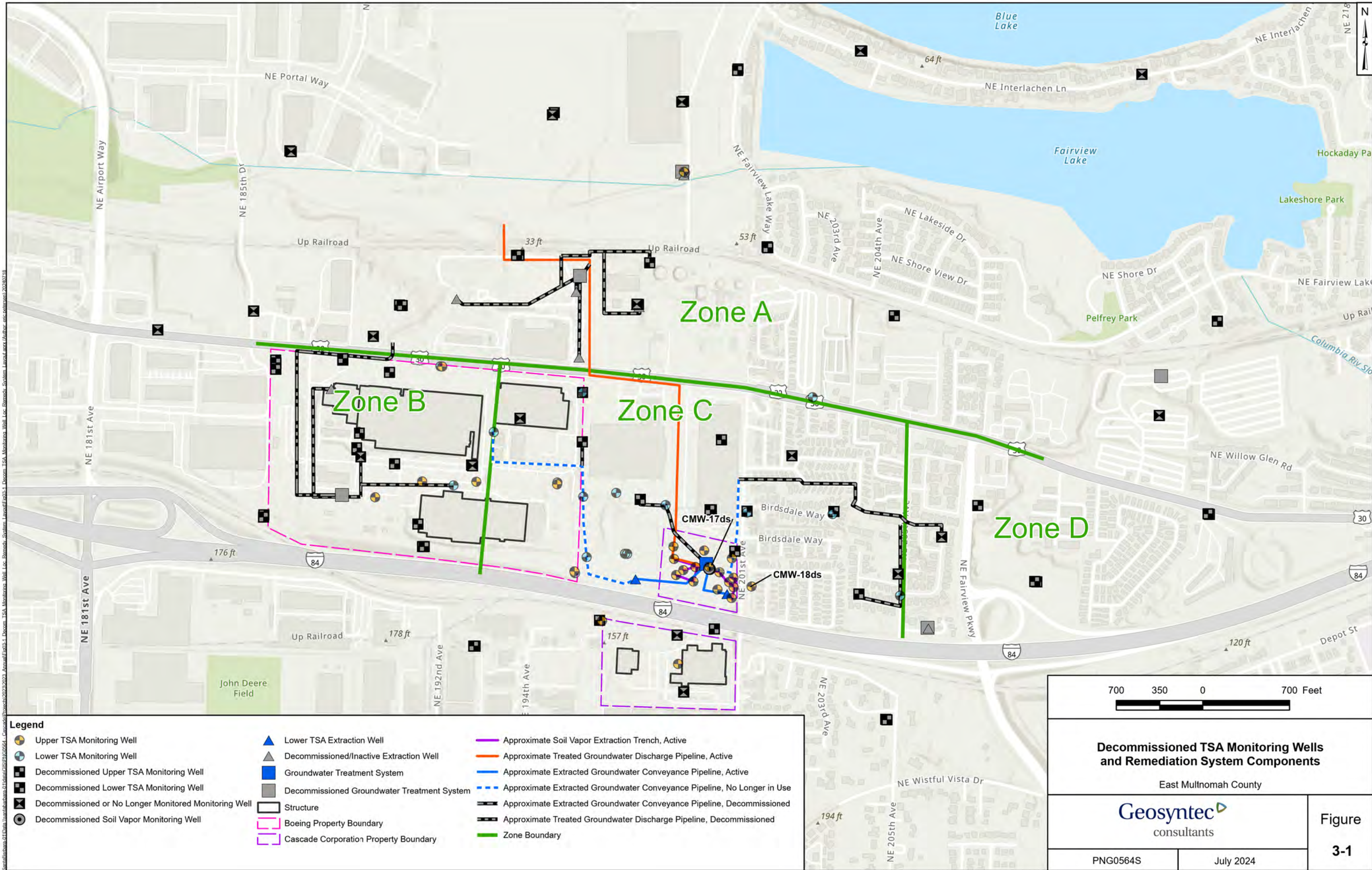
TSA = Troutdale Sandstone Aquifer

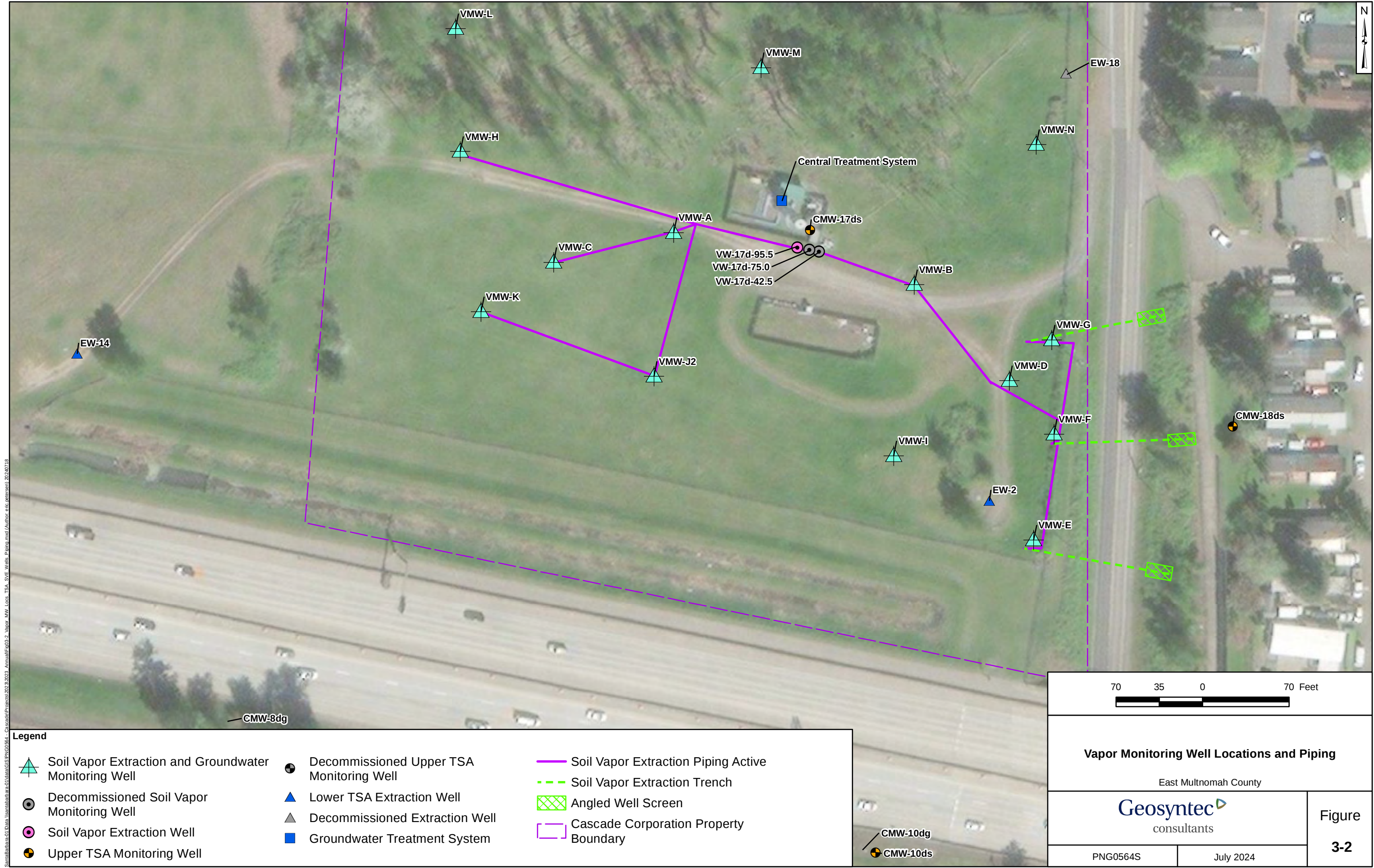
*Angled well

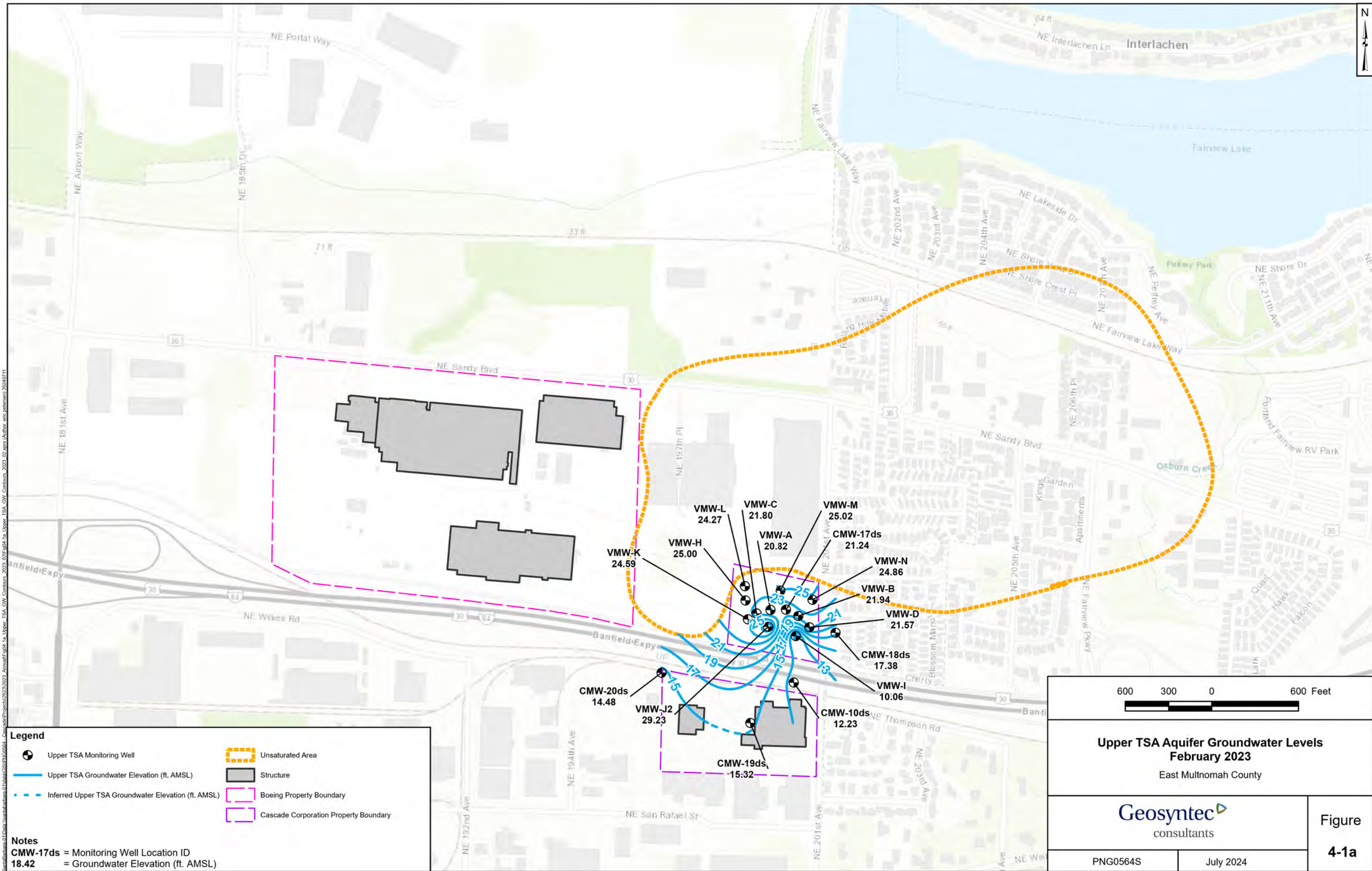
FIGURES

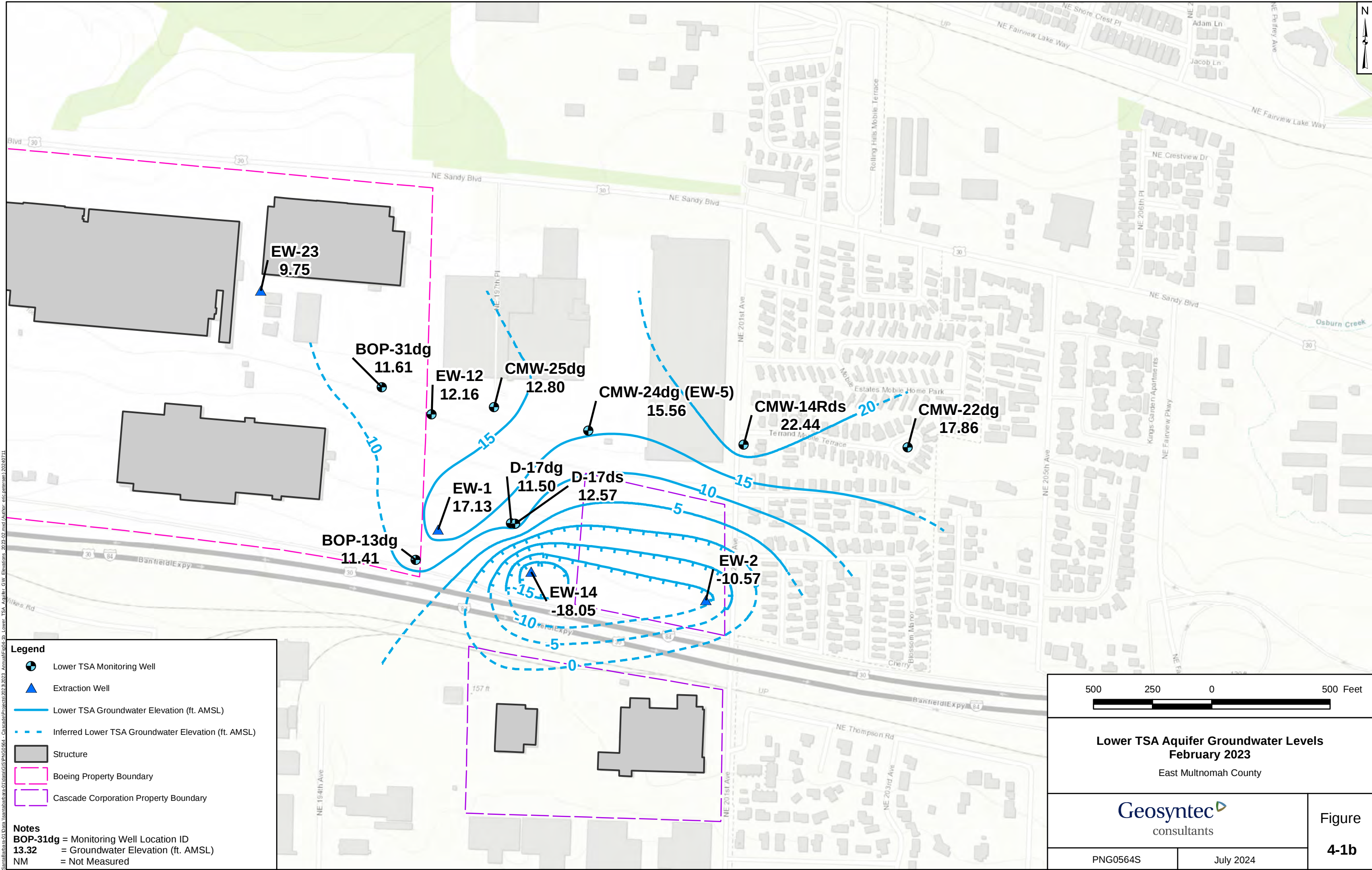


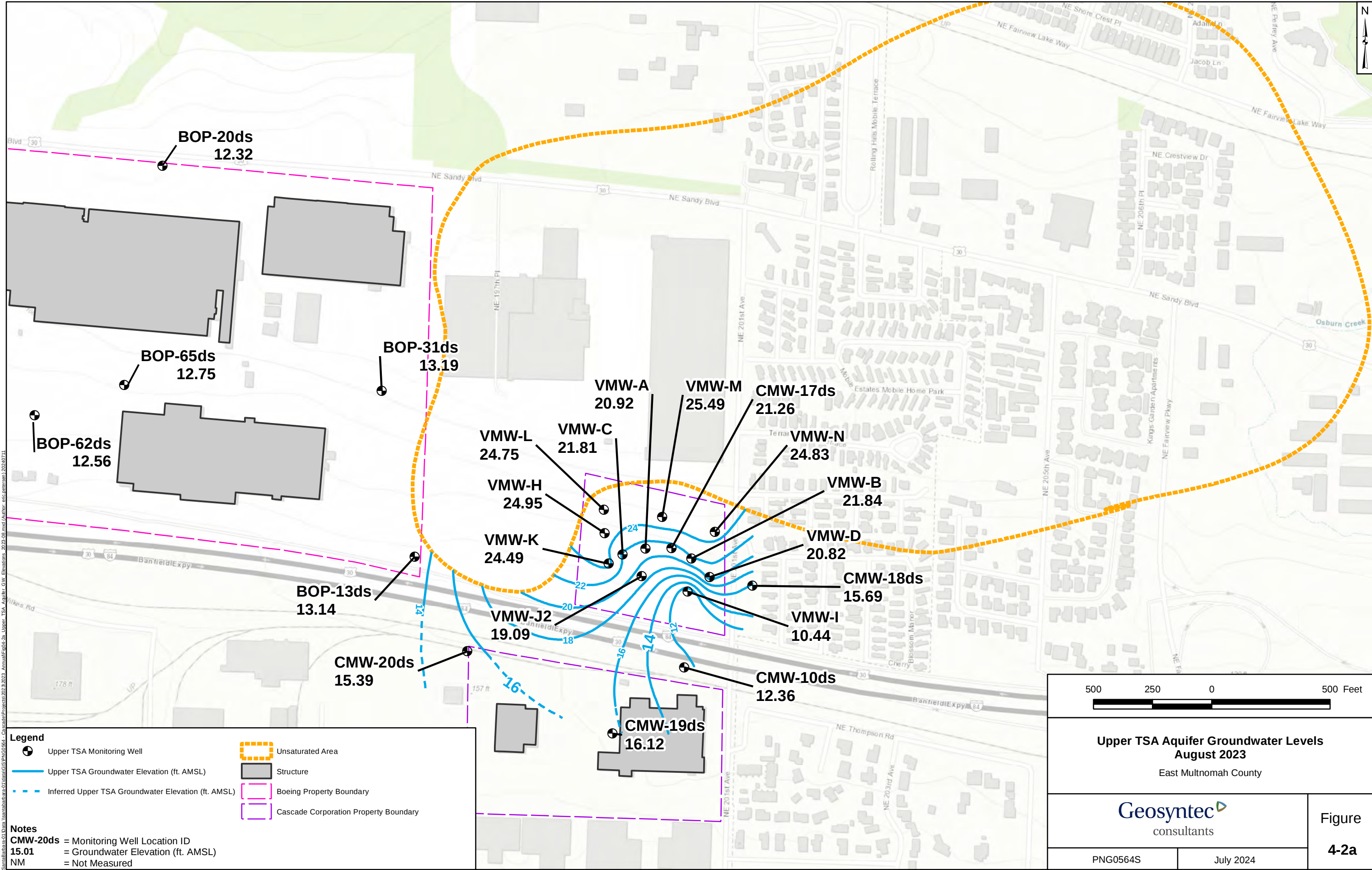


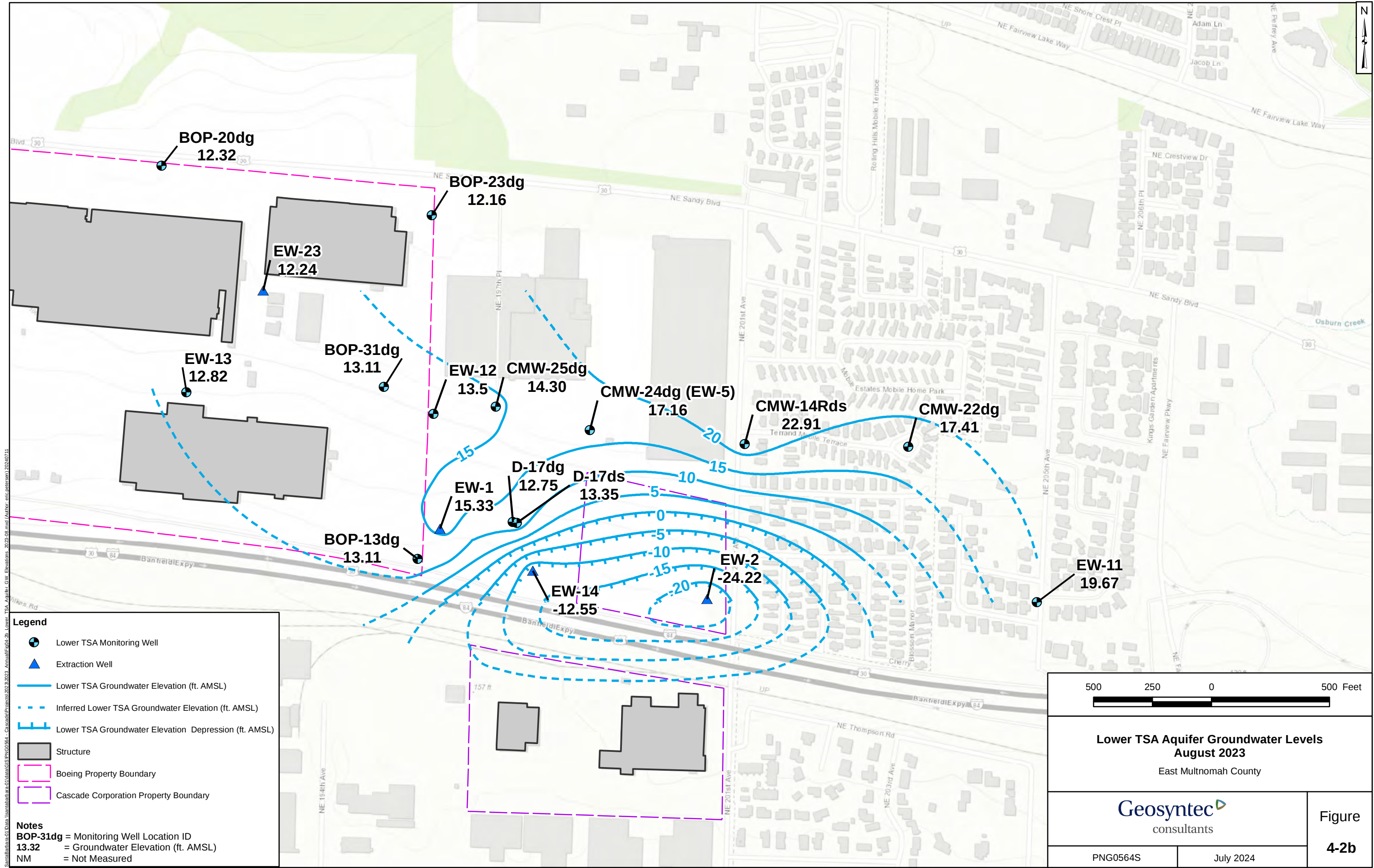


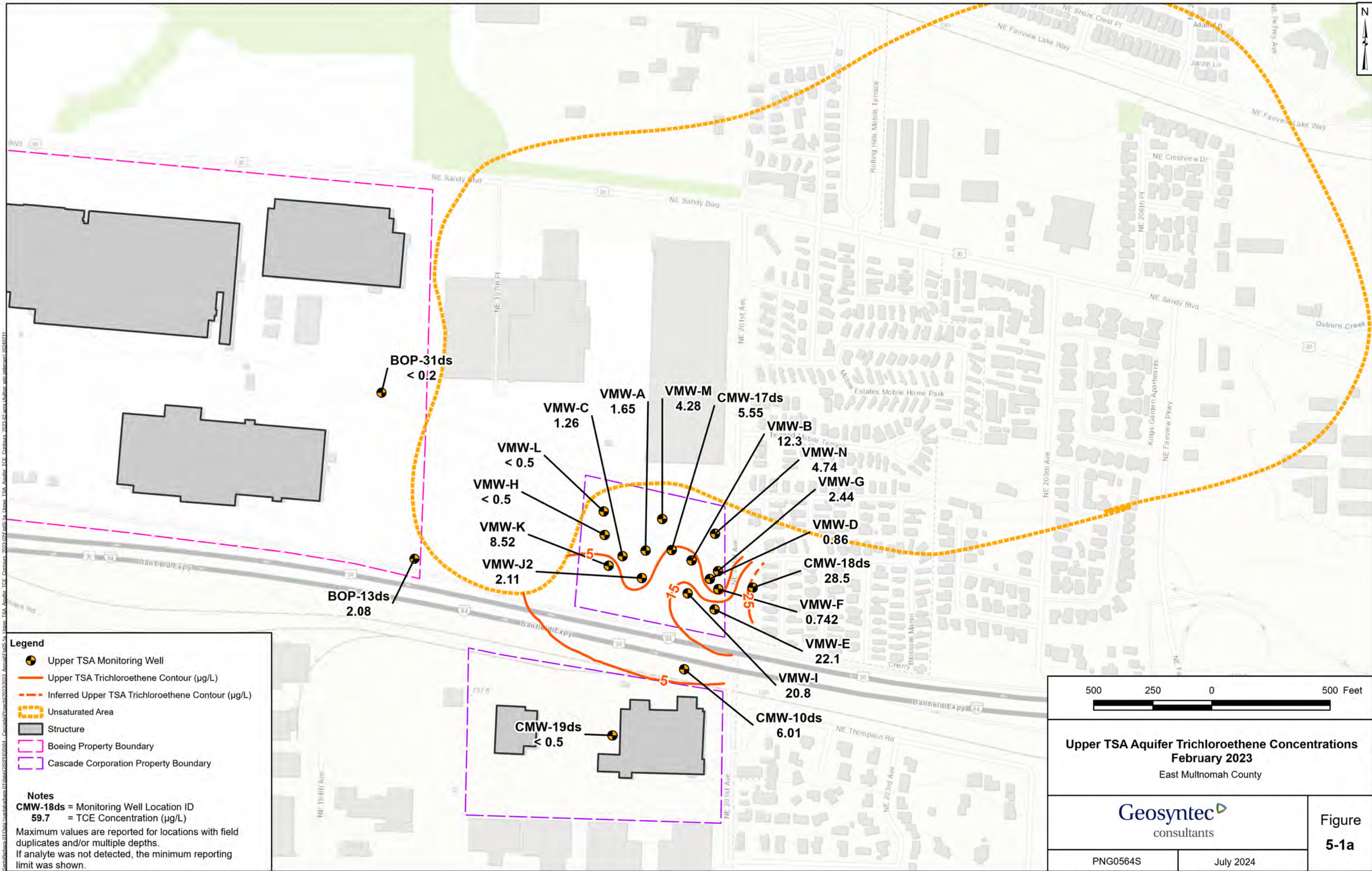


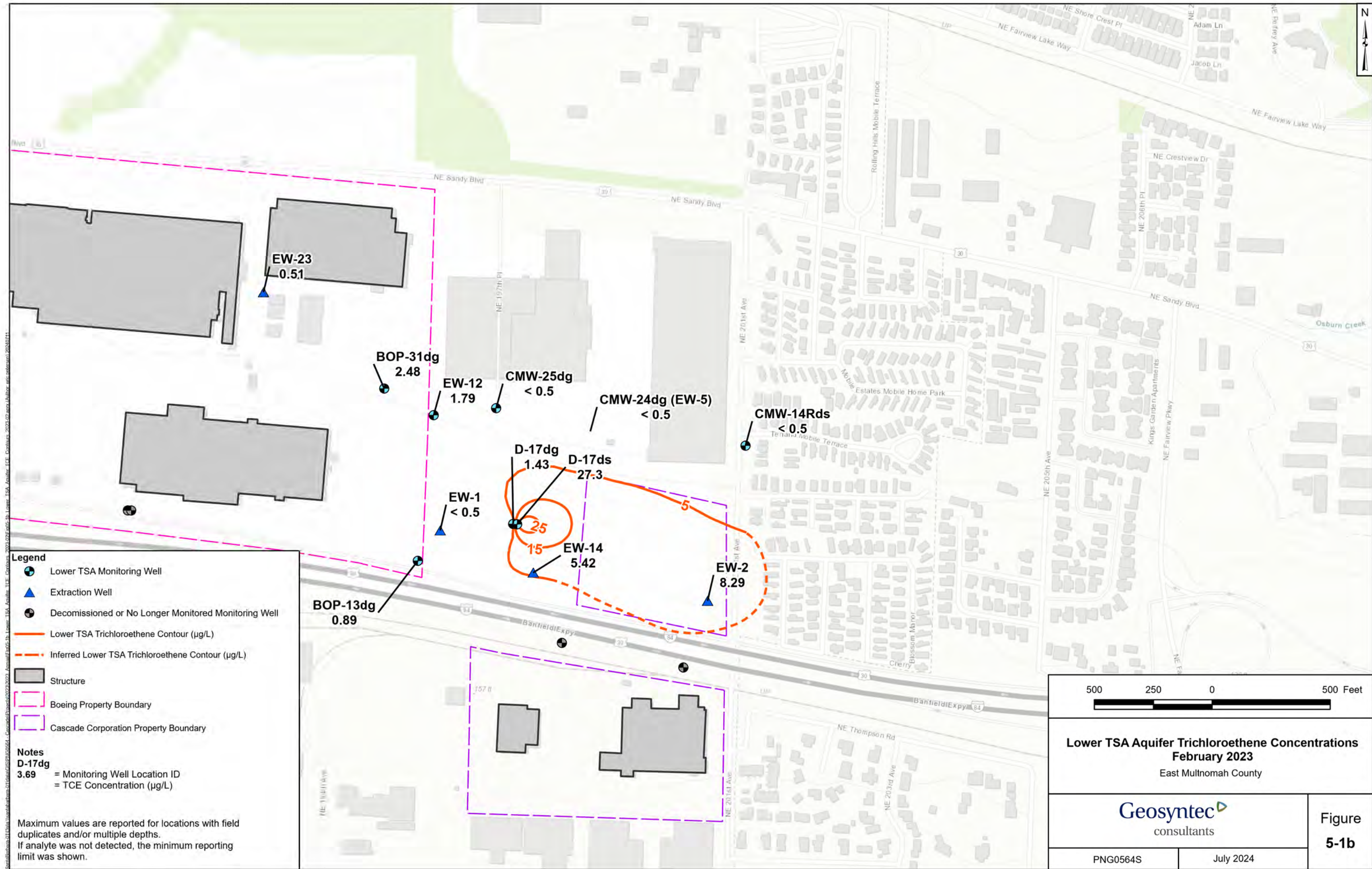


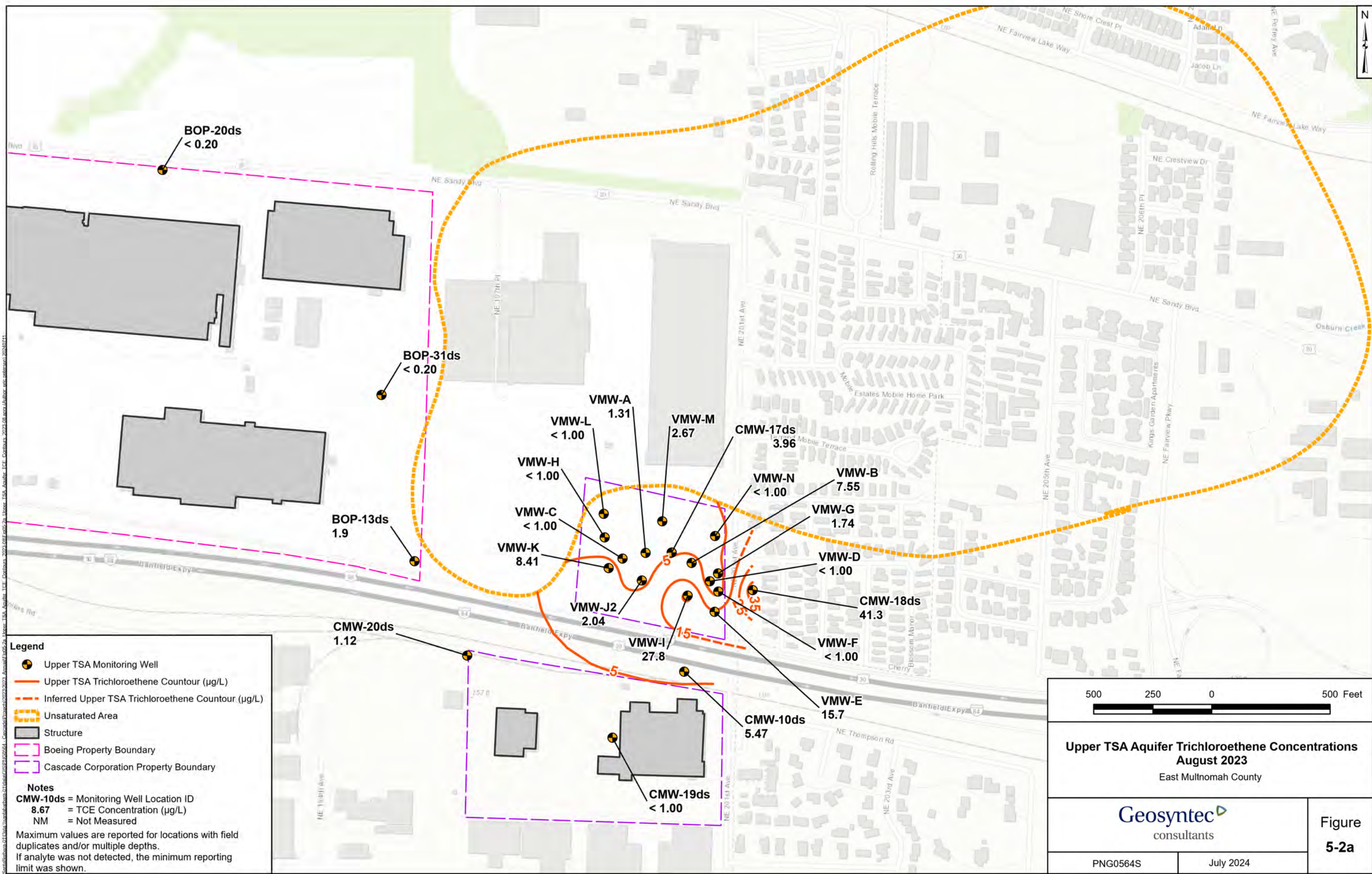


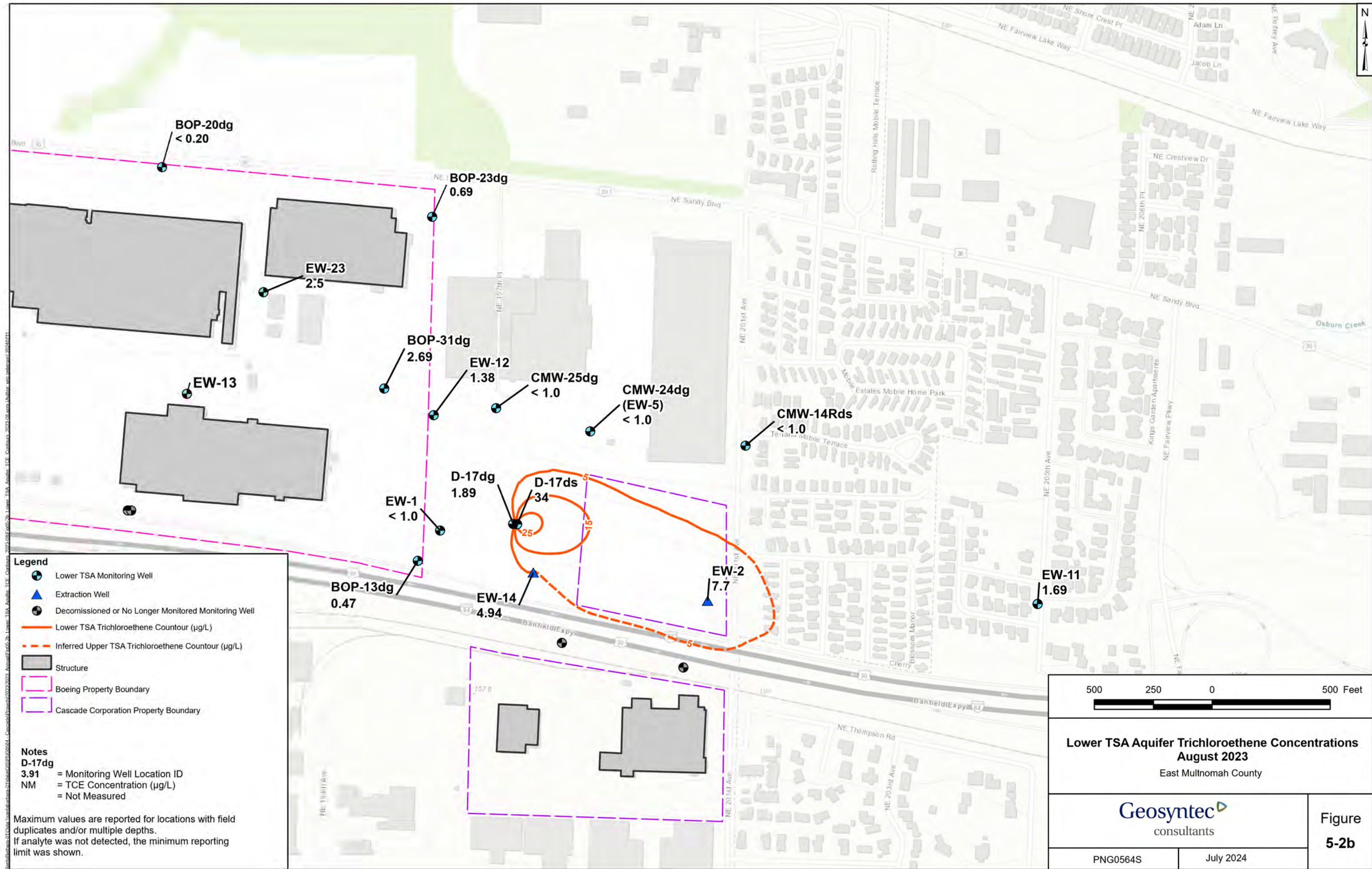


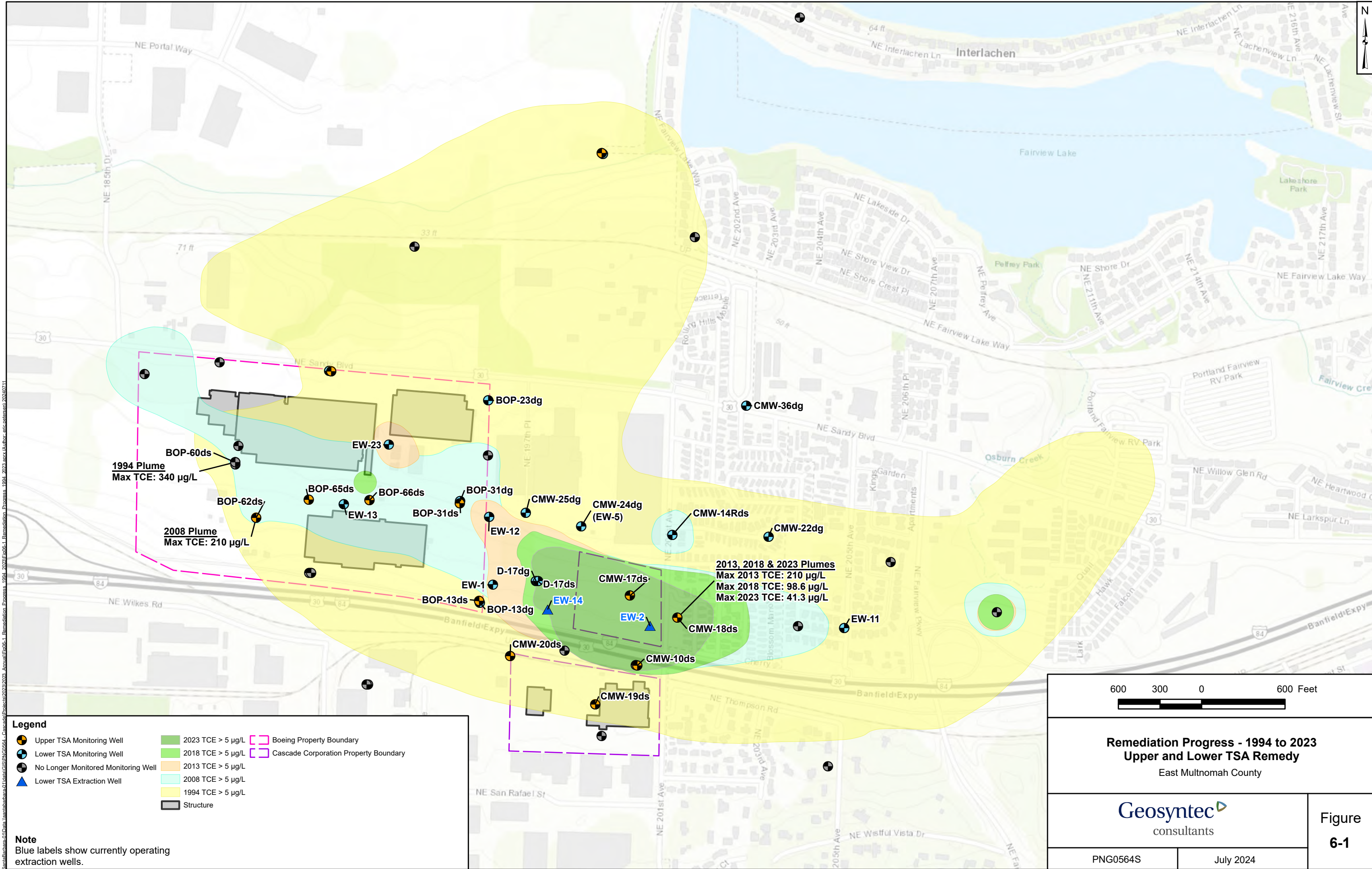












APPENDIX A

Extraction Rates

Table A-1
TSA Extraction Rates 1 January 2023 through 31 December 2023 and
12-Month Averages through 31 December 2023
East Multnomah County TSA Remedy

Zone	12-Mo. Avg.	01/2023²	02/2023	03/2023	04/2023	05/2023	06/2023	07/2023	08/2023	09/2023	10/2023	11/2023	12/2023
<i>EW-2</i>	33	35	37	36	36	36	35	35	31	33	30	28	28
<i>EW-14</i>	22	22	21	20	20	21	24	23	21	25	24	23	22
Total Avg Flow TSA	56	57	57	57	56	57	59	58	52	58	54	52	50

NOTES:

1. Monthly average flow rates are shown in gallons per minute for each well.
2. EW-2 and EW-14 were shutdown on 25 November 2022 due to electrical issues in the system. The wells began pumping again on 19 January 2023, so flowrates reported in January 2023 are biased high as the average is reported only for period that extraction wells were operating and neglects the shutdown period in the flowrate estimates presented. Figures A-1 and A-2 present monthly flowrates including the period that extraction wells were offline.

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2023 through 31 December 2023
East Multnomah County TSA Remedy

Parameter	Discharge Limitations ¹	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
January-23								
pH	6.0 – 9.0	su	—	7.63	7.67	7.70	0	Weekly
Temperature	—	°F	—	59	59	60	—	Weekly
Flow	—	gpm	—	--	56	--	—	Daily
February-23								
Trichloroethene	5.0	µg/L	2/1/2023	--	< 0.500	--	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	2/1/2023	--	< 0.500	--	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	2/1/2023	--	< 0.500	--	0	Quarterly
Tetrachloroethene	5.0	µg/L	2/1/2023	--	< 0.500	--	0	Quarterly
Vinyl Chloride	2.0	µg/L	2/1/2023	--	< 0.500	--	0	Quarterly
pH	6.0 – 9.0	su	—	7.88	7.89	7.89	0	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	57	--	—	Daily
March-23								
pH	6.0 – 9.0	su	—	7.89	7.90	7.91	0	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	57	--	—	Daily
April-23								
pH	6.0 – 9.0	su	—	7.88	7.89	7.90	0	Weekly
Temperature	—	°F	—	60	61	62	—	Weekly
Flow	—	gpm	—	--	56	--	—	Daily
May-23								
Trichloroethene	5.0	µg/L	5/2/2023	--	< 0.500	--	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	5/2/2023	--	< 0.500	--	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	5/3/2023	--	< 0.500	--	0	Quarterly
Tetrachloroethene	5.0	µg/L	5/4/2023	--	< 0.500	--	0	Quarterly
Vinyl Chloride	2.0	µg/L	5/5/2023	--	< 0.500	--	0	Quarterly
pH	6.0 – 9.0	su	—	7.88	7.89	7.89	0	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	57	--	—	Daily
June-23								
pH	6.0 – 9.0	su	—	7.88	7.89	7.89	0	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	59	--	—	Daily
July-23								
pH	6.0 – 9.0	su	—	7.86	7.88	7.90	0	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	58	--	—	Daily
August-23								
Trichloroethene	5.0	µg/L	8/2/2023	--	< 1.00	--	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	8/2/2023	--	< 1.00	--	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	8/3/2023	--	< 1.00	--	0	Quarterly
Tetrachloroethene	5.0	µg/L	8/4/2023	--	< 1.00	--	0	Quarterly
Vinyl Chloride	2.0	µg/L	8/5/2023	--	< 1.00	--	0	Quarterly
pH	6.0 – 9.0	su	—	7.87	7.88	7.89	0	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	52	--	—	Daily

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2023 through 31 December 2023
East Multnomah County TSA Remedy

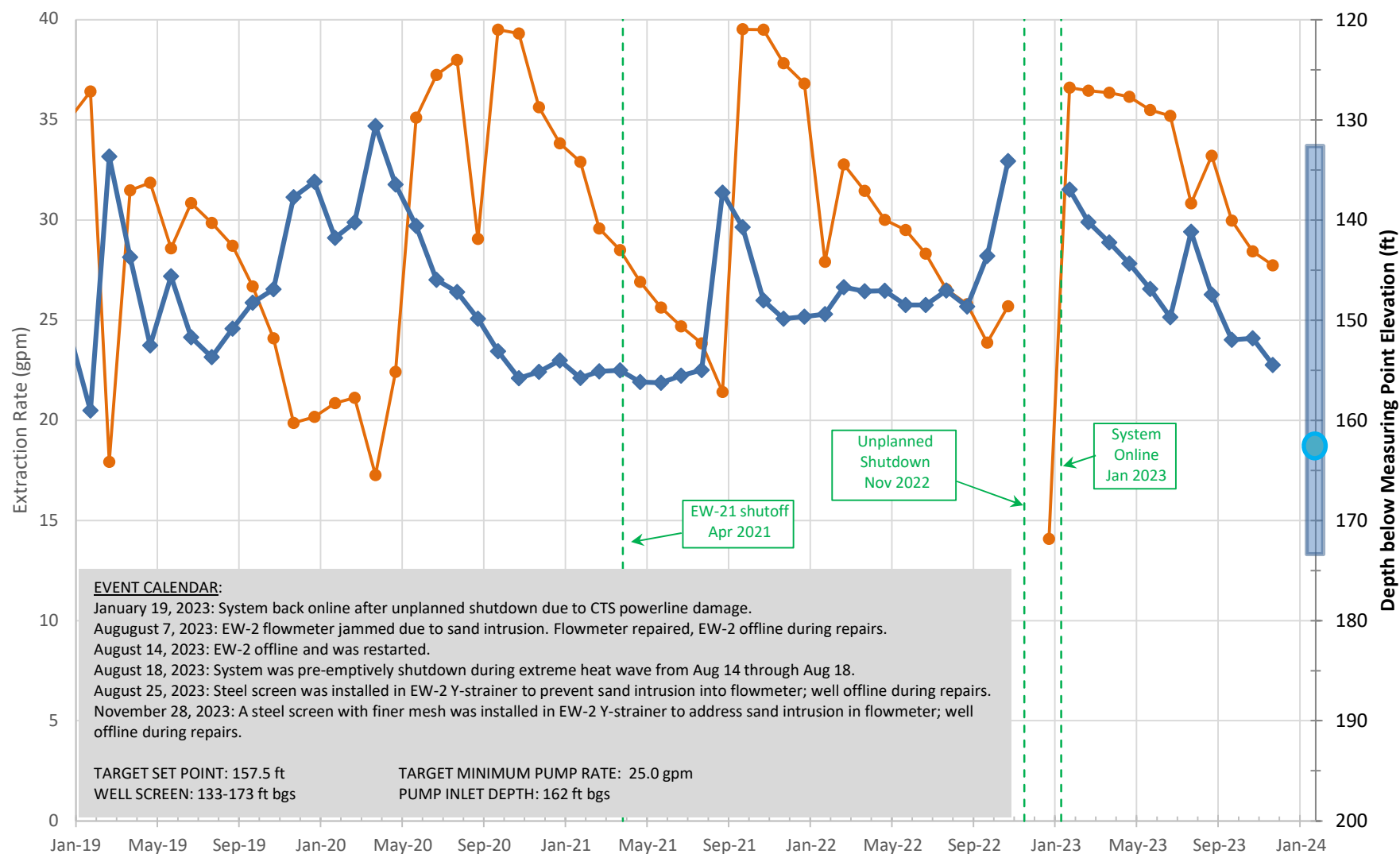
Parameter	Discharge Limitations ¹	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
September-23								
pH	6.0 – 9.0	su	—	7.87	7.88	7.89	0	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	58	--	—	Daily
October-23								
pH	6.0 – 9.0	su	—	7.87	7.88	7.89	0	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	54	--	—	Daily
November-23								
Trichloroethene	5.0	µg/L	11/7/2023	--	< 0.500	--	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	11/7/2023	--	< 0.500	--	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	11/7/2023	--	< 0.500	--	0	Quarterly
Tetrachloroethene	5.0	µg/L	11/7/2023	--	< 0.500	--	0	Quarterly
Vinyl Chloride	2.0	µg/L	11/7/2023	--	< 0.500	--	0	Quarterly
pH	6.0 – 9.0	su	—	7.86	7.87	7.89	0	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	52	--	—	Daily
December-23								
pH	6.0 – 9.0	su	—	7.84	7.86	7.87	—	Weekly
Temperature	—	°F	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	50	--	—	Daily

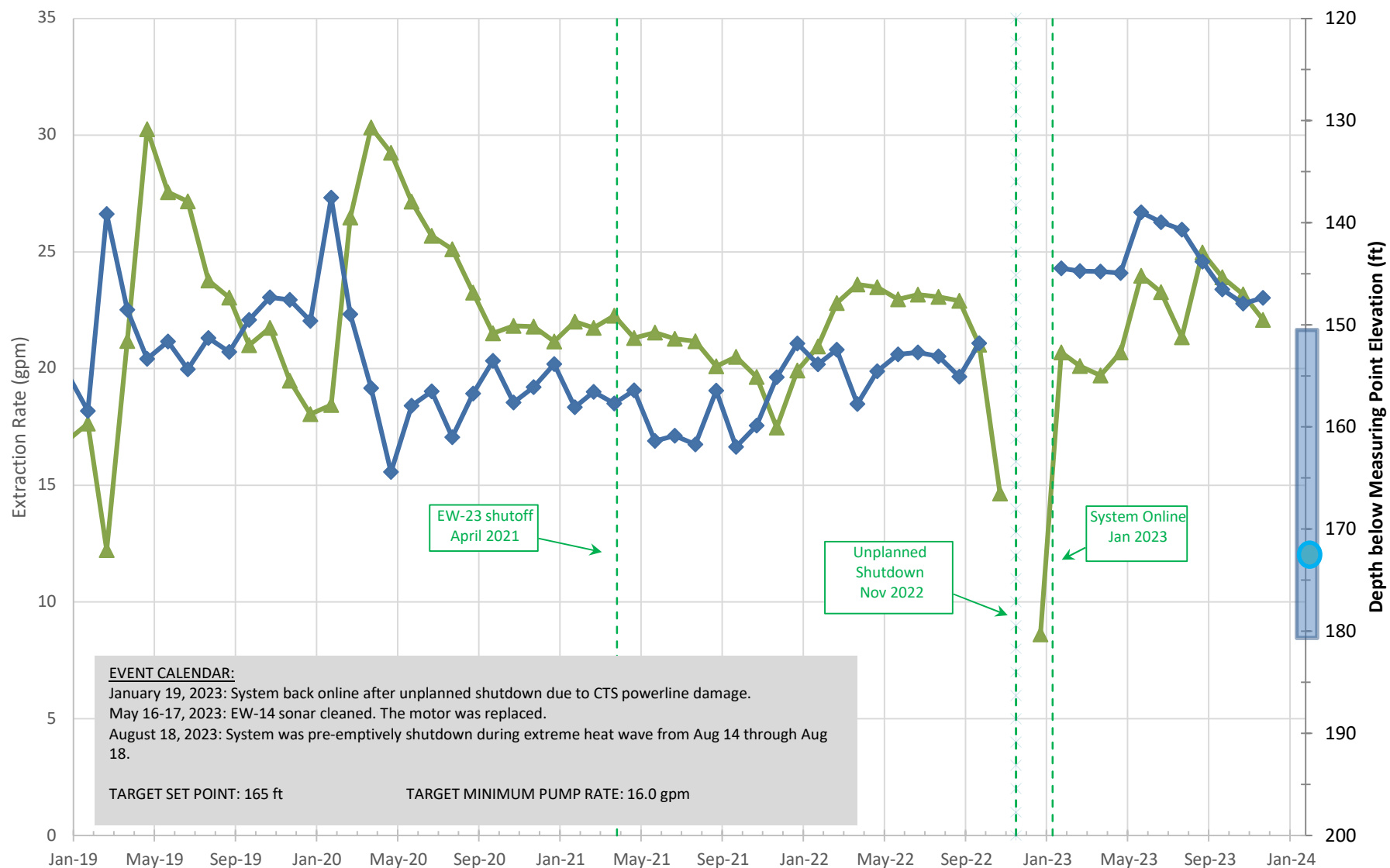
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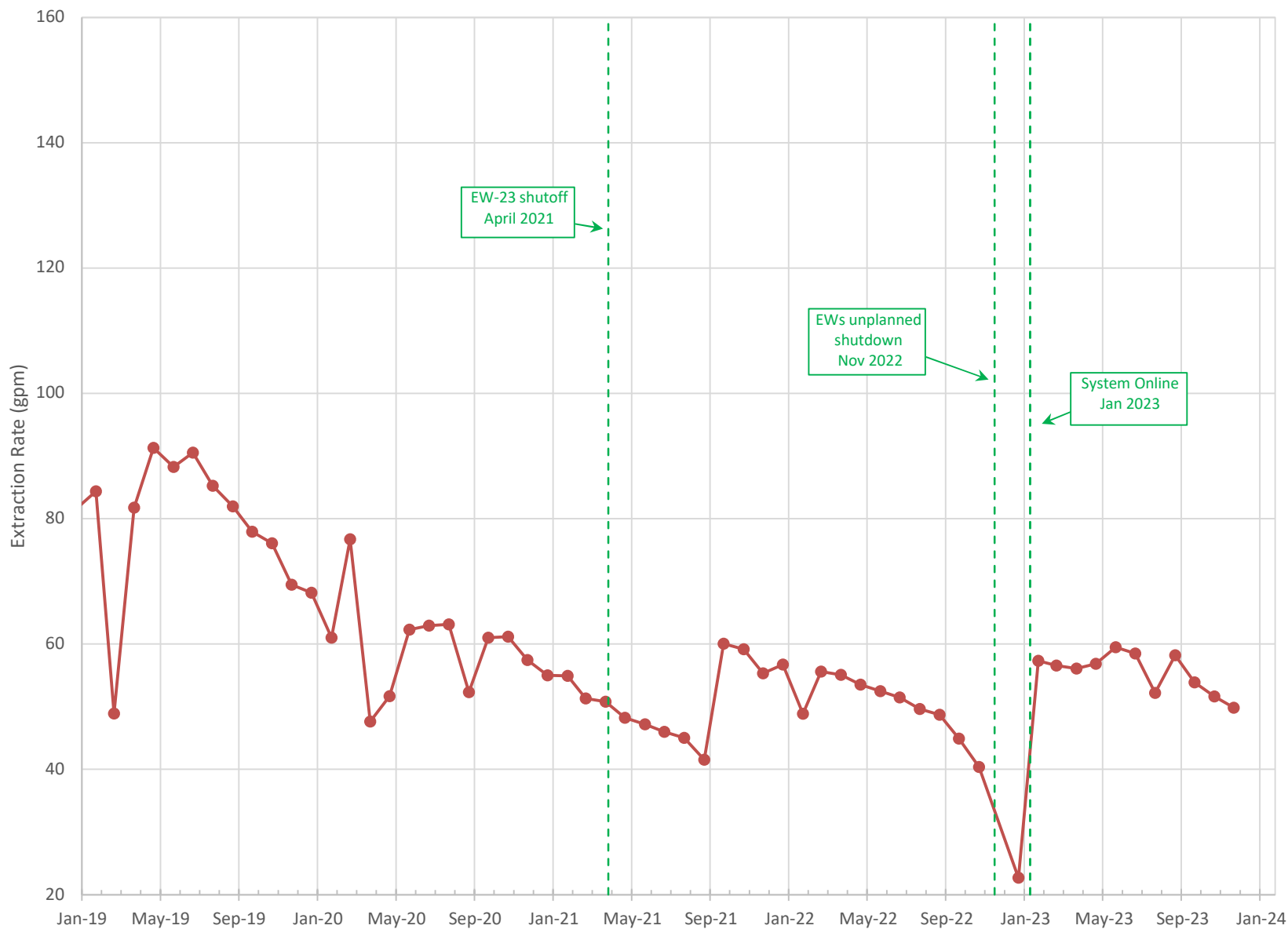
1. Discharge limitations for the CTS are per Attachment C to DEQ Consent Order No. WMCSR-NWR-96-08 dated 14 February 1997.
2. Flow includes EW-2 and EW-14. System was shutdown on 25 November 2022 due to sustained damage to the electrical system and restarted on 16 January 2023 after repairs were made.

ACRONYMS:

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







APPENDIX B

Unplanned Shutdown Trend Discussion

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Appendix B – Winter 2022-2023 Unplanned Shutdown Summary

The Central Treatment System (CTS), located in the mound area in Remedy zone C, experienced an unplanned 2-month shutdown between 25 November 2022 and 19 January 2023 as a result of a poplar tree toppling onto the electrical wires powering the CTS and soil vapor extraction (SVE) system. Three groundwater sampling events were used to evaluate potential changes in groundwater quality and groundwater elevations during this unplanned shutdown. The three sampling events included a routine quarterly event in early November 2022 (prior to system shutdown), a routine semi-annual event in February 2023 (after to system restart), and a non-routine event completed in January 2023 during the shutdown period. The non-routine event included a subset of selected monitoring wells that functioned as sentinel wells during the unplanned shutdown period. The sentinel wells were selected based on the well location and well screen depths to monitor for potential contaminant migration and changes to groundwater flow characteristics while the extraction wells were offline. The sentinel wells included the following:

- **Upper TSA:** CMW-17(ds), CMW-18(ds), CMW-10(ds), VMW-D, VMW-L, VMW-M, and VMW-N.
- **Lower TSA:** EW-1, CMW-24(dg), CMW-25(dg), CMW-10(dg), and D-17(ds).

The analytical and groundwater elevation trends for the Upper and Lower TSA sentinel wells and other monitoring wells with notable trends are described below.

Upper TSA TCE Concentration Trends

- CMW-17(ds): TCE concentrations indicate a slight increase from the pre-shutdown concentrations observed in November 2022 (4.0 µg/L) compared to the shutdown sampling event in January 2023 (6.69 µg/L); however, concentrations slightly decreased in the February 2023 sample (5.55 µg/L) once the system was restarted.
- CMW-18(ds): TCE at CMW-18(ds) exhibited a significant decrease from the pre-shutdown November 2022 (98.6 µg/L) sample result to the shutdown event in January 2023 (30.3 µg/L) and to post-shutdown event February 2023 results (28.5 µg/L).
- CMW-10(ds): TCE concentrations indicated a slight increase from November 2022 (5.87 µg/L) to February 2023 (6.01 µg/L).
- VMW-L: TCE detections for both sampling events were non-detect at 0.5 µg/L.

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- VMW-D and VMW-M: Both wells exhibited slight increases in detected TCE concentrations when comparing sampling results from November 2022 (0.62 µg/L and 3.33 µg/L, respectively) to February 2023 (0.86 µg/L and 4.28 µg/L, respectively).
- VMW-N: TCE results indicated an increase from November 2022 (non-detect at 0.5 µg/L) to February 2023 (4.74 µg/L).

Lower TSA TCE Concentration Trends

- CMW-10(dg), CMW-24(dg), and CMW-25(dg): TCE concentrations remained stable and were non-detect at the reporting limits during this timeframe. VOCs are typically not detected in these wells.
- EW-1: TCE was detected in January 2023 at a concentration just over the detection limit (0.546 µg/L) compared to non-detect results observed in November 2022 and February 2023.
- D-17(ds): TCE concentrations remained relatively stable, with a slight decrease from November 2022 (28.8 µg/L) to January 2023 (24.8 µg/L) and a slight increase in February 2023 (27.3 µg/L).

The results of the evaluation of groundwater quality impacts from the unplanned shutdown of the remedy system indicate that some TCE concentrations remained stable for both the Upper and Lower TSA mound area wells (VMW-L, CMW-10(dg), CMW-24(dg), CMW-25(dg), EW-1) during this timeframe. Five wells reported slight increases in TCE concentrations during the shutdown period (CMW-10(ds), CMW-17(ds), VMW-D, VMW-M, and VMW-N). Two wells (CMW-18ds and D-17(ds)) reported TCE concentration decreases, with well CMW-18(ds) reporting an order of magnitude decrease during this timeframe (98.6 to 28.5 µg/L).—These analytical results are shown on Figure B-1 and in Table B-1.

Groundwater Elevations and Gradients

Groundwater elevations were collected at the wells listed above during the pre-shutdown sampling event in November 2022, during system shutdown in December 2022, January 2023, and during post-shutdown in February 2023. These data were utilized to evaluate rebound when the system was offline. Groundwater elevations are summarized in Table B-2, shown on Figures B-2 and B-3, and are discussed below.

Upper TSA

- Two Upper TSA monitoring wells [CMW-17(ds) and CMW-18(ds)] were included in the non-routine sampling completed in January 2023 and exhibited slight changes in groundwater elevations. There was a slight decrease in groundwater elevations recorded

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for CMW-17(ds) in November 2022 (21.77 feet above mean sea level [ft amsl]) to January 2023 (21.50 ft amsl) and February 2023 (21.24 ft amsl). Alternatively, groundwater levels at CMW-18(ds) were higher in January 2023 (17.32 ft amsl) and February 2023 (17.38 ft amsl) than prior to shutdown in November 2022 (17.04 ft amsl).

- Four sentinel wells (VMW-D, VMW-L, VMW-M, and VMW-N) exhibited decreasing groundwater elevations less than one foot difference. VMW-D did increase slightly based on water level measurements collected in December 2022 (approximately 0.35 ft amsl); however, these trends were not observed in the other VMW wells.
- A significant decrease in groundwater elevation was observed for mound area well VMW-I, recorded in November 2022 (17.83 ft amsl) compared to February 2023 (10.06 ft amsl), likely reflecting enhanced flow and drawdown at EW-2 in February compared to November. EW-2 was sonar cleaned in early November 2022 (prior to the shutdown) to improve well performance, and the extraction well likely had not reach full drawdown after the cleaning event. VMW-I is located adjacent to EW-2 and screened close to the depth of pumping; therefore, water levels in VMW-I closely reflect EW-2 pumping.
- A significant increase in groundwater elevation was observed in mound area well VMW-J2, recorded in November 2022 (20.58 ft amsl) compared to February 2023 (29.23 ft amsl). VMW-J2 is located between the two active mound area extraction wells EW-2 and EW-14 and water levels may have been slow to respond to resumed pumping.

Of the 15 Upper TSA wells with groundwater elevation data collected between November 2022 and February 2023, 13 wells exhibited decreasing groundwater elevations and only two wells exhibited increasing groundwater elevations. Overall, the magnitude of water level changes was less than 1 foot for the majority of wells with the exception of the 7.77 ft decrease observed at VMW-I and the 8.65 ft increase at VMW-J2.

Lower TSA

- There was a slight decrease in groundwater elevations measured at CMW-24(dg) when comparing January 2023 (15.7 ft amsl) to February 2023 (15.56 ft amsl).
- There was a slight increase in groundwater elevations measured at CMW-25(dg) when comparing January 2023 (12.1 ft amsl) to February 2023 (12.8 ft amsl).
- Groundwater elevations in D-17(ds) were variable and fluctuated up and down between November 2022 (13.55 ft amsl) to December 2022 (12.86 ft amsl), January 2023 (13.60 ft

amsl), and February 2023 (12.57 ft amsl). Groundwater elevations decreased in D-17(dg) from November 2022 (12.97 ft amsl) to February 2023 (11.5 ft amsl).

- Groundwater elevation trends in EW-1 indicate an increase in the post-shutdown elevation of approximately 4 feet when comparing November 2022 (13.29 ft amsl) and January 2023 (13.47 ft amsl) measurements against post-shutdown measurements collected in February 2023 (17.13 ft amsl). The reason for the substantial increase in the groundwater elevation at EW-1 is unknown, as active pumping at the well was discontinued in August 2018, which is confounded by the fact that water levels dropped in 14.93 in the measurement collected on 1 May 2023.
- In the two groundwater extraction wells, there were sizable increases in groundwater elevations between November 2022 and February 2023 for EW-2 (-12.13 to -10.57 ft amsl), and EW-14 (-21.28 to -18.05 ft amsl).

Based on this information, the shutdown did not appear to have consistent or significant impacts on the groundwater elevations measured in the surrounding monitoring wells screened in the Lower TSA.

Groundwater elevations and TCE concentrations over time for the sentinel wells and select mound area wells are presented in Table B-1, B-2, and Figures B-1, B-2, and B-3.

Groundwater contours were prepared for the Lower TSA using the groundwater elevation measurements collected in November 2022, December 2022, January 2023, and February 2023. The groundwater gradients appeared to remain relatively stable between November 2022 and February 2023, with some outward expansion of the cone of depression observed in groundwater surrounding EW-14 and very minor changes in the cone of depression surround EW-2. In the Upper TSA, groundwater gradients appeared to remain relatively unchanged throughout this period with groundwater elevations increasing in the southwest direction. The only notable variations were the shift in magnitude between the contours. Groundwater contours for the mound area are presented in Figures B-2 and B-3.

Unplanned Shutdown Trend Conclusions

Overall, TCE concentrations declined or were stable in the mound area monitoring and extraction wells during the unplanned shutdown between November 2022 and February 2023. Based on these results, there was no a notable change in groundwater flow directions and contaminant migration resulting from the unplanned shutdown and water levels are very slow to rebound.

Groundwater elevation changes were variable and within 1-2 feet in 12 of the 15 Upper TSA wells during the 2-month shutdown of the CTS. Notable changes in groundwater elevations were

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observed at VMW-I, VMW-J2, and EW-1. Notable changes in TCE concentrations were observed at CMW-18(ds). The pre-remedy pumping (pre-1997) groundwater gradient did not apparently re-establish in the 2-month timeframe that the system was shutdown.

The groundwater elevation rebound was inconsistent, suggesting insufficient time for water levels and mound/gradients to re-establish to pre-pumping conditions (pre-1997).

ATTACHMENTS

Table B-1: Unplanned Shutdown VOC Data

Table B-2: Unplanned Shutdown Groundwater Elevation Data

Figure B-1: Select Mound Area TCE Well Concentration Profiles and Groundwater Elevations Over Time

Figure B-2: Upper TSA Groundwater Gradients During Unplanned Shutdown

Figure B-3: Lower TSA Groundwater Gradients During Unplanned Shutdown

* * * * *

Table B-1
Unplanned Shutdown VOC Data

Well	Aquifer Zone	Sample Date	Trichloroethene (TCE)	Cis-1,2-Dichloroethene (cis-1,2-DCE)	Vinyl Chloride
CMW-17(ds)	Upper	11/3/2022	4.31	0.604	< 0.500
CMW-17(ds)	Upper	1/4/2023	6.69	0.995	< 0.500
CMW-17(ds)	Upper	2/1/2023	5.55	0.785	< 0.500
CMW-18(ds)	Upper	11/3/2022	98.6	14.7	< 0.500
CMW-18(ds)	Upper	1/4/2023	30.3	3.49	< 0.500
CMW-18(ds)	Upper	2/1/2023	28.5	3.63	< 0.500
CMW-10(ds)	Upper	11/3/2022	5.87	< 0.500	< 0.500
CMW-10(ds)	Upper	2/16/2023	6.01 J	< 0.500	< 0.500
BOP-13(ds)	Upper	2/3/2023	2.1	0.34	< 0.20
VMW-D	Upper	11/3/2022	0.624	< 0.500	< 0.500
VMW-D	Upper	2/2/2023	0.86	< 0.500	< 0.500
VMW-L	Upper	11/3/2022	< 0.500	< 0.500	< 0.500
VMW-L	Upper	2/2/2023	< 0.500	< 0.500	< 0.500
VMW-M	Upper	11/3/2022	3.33	< 0.500	< 0.500
VMW-M	Upper	2/2/2023	4.28	0.534	< 0.500
VMW-N	Upper	11/3/2022	< 0.500	< 0.500	< 0.500
VMW-N	Upper	2/2/2023	4.74	0.738	< 0.500
EW-1	Lower	11/3/2022	< 0.500	< 0.500	< 0.500
EW-1	Lower	1/4/2023	0.546	< 0.500	< 0.500
EW-1	Lower	2/1/2023	< 0.500	< 0.500	< 0.500
CMW-24(dg)	Lower	1/4/2023	< 0.500	< 0.500	< 0.500
CMW-24(dg)	Lower	2/1/2023	< 0.500	< 0.500	< 0.500
CMW-25(dg)	Lower	1/4/2023	< 0.500	< 0.500	< 0.500
CMW-25(dg)	Lower	2/1/2023	< 0.500	< 0.500	< 0.500
CMW-10(dg)	Lower	1/4/2023	< 0.500	< 0.500	< 0.500
D-17(ds)	Lower	11/3/2022	28.8	8.72	< 0.500
D-17(ds)	Lower	1/4/2023	24.8	7.12	< 0.500
D-17(ds)	Lower	2/1/2023	27.3	7.41	< 0.500

Notes:

1. Units are expressed as micrograms per liter (µg/L)
2. J flag indicates that the analytical result is above method detection limit but below the reporting limit and is therefore estimated.

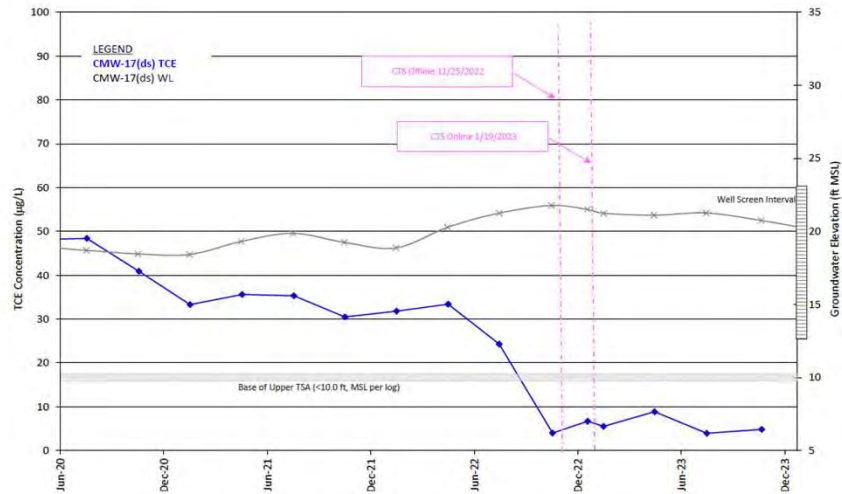
Table B-2
Unplanned Shutdown Groundwater Elevation Data

Well	Aquifer Zone	Sample Date	GWE (ft amsl)
CMW-17(ds)	Upper	11/3/2022	21.77
CMW-17(ds)	Upper	12/21/2022	20.93
CMW-17(ds)	Upper	1/4/2023	21.5
CMW-17(ds)	Upper	2/1/2023	21.24
CMW-18(ds)	Upper	11/3/2022	17.04
CMW-18(ds)	Upper	12/21/2022	16.45
CMW-18(ds)	Upper	1/4/2023	17.32
CMW-18(ds)	Upper	2/1/2023	17.38
CMW-10(ds)	Upper	11/1/2022	13.9
CMW-10(ds)	Upper	2/1/2023	12.23
VMW-D	Upper	11/3/2022	21.97
VMW-D	Upper	12/21/2022	22.31
VMW-D	Upper	2/1/2023	21.57
VMW-I	Upper	11/1/2022	17.83
VMW-I	Upper	12/21/2022	18.81
VMW-I	Upper	2/1/2023	10.06
VMW-J2	Upper	11/1/2022	20.58
VMW-J2	Upper	12/21/2022	19.9
VMW-J2	Upper	2/1/2023	29.23
VMW-L	Upper	11/3/2022	24.89
VMW-L	Upper	12/21/2022	24.04
VMW-L	Upper	2/1/2023	24.27
VMW-M	Upper	11/3/2022	25.7
VMW-M	Upper	12/21/2022	24.69
VMW-M	Upper	2/1/2023	25.02
VMW-N	Upper	11/3/2022	25.25
VMW-N	Upper	12/21/2022	24.81
VMW-N	Upper	2/1/2023	24.86
EW-1	Lower	11/3/2022	13.29
EW-1	Lower	1/4/2023	13.47
EW-1	Lower	2/1/2023	17.13
EW-2	Lower	11/1/2022	-12.13
EW-2	Lower	2/1/2023	-10.57
EW-14	Lower	11/1/2022	-21.28
EW-14	Lower	2/1/2023	-18.05
CMW-24(dg)	Lower	1/4/2023	15.7
CMW-24(dg)	Lower	2/1/2023	15.56
CMW-25(dg)	Lower	1/4/2023	12.1
CMW-25(dg)	Lower	2/1/2023	12.8
CMW-10(dg)	Lower	1/4/2023	14.3
D-17(dg)	Lower	11/1/2022	12.97
D-17(dg)	Lower	2/1/2023	11.5
D-17(ds)	Lower	11/3/2022	13.55
D-17(ds)	Lower	12/21/2022	12.86
D-17(ds)	Lower	1/4/2023	13.6
D-17(ds)	Lower	2/1/2023	12.57

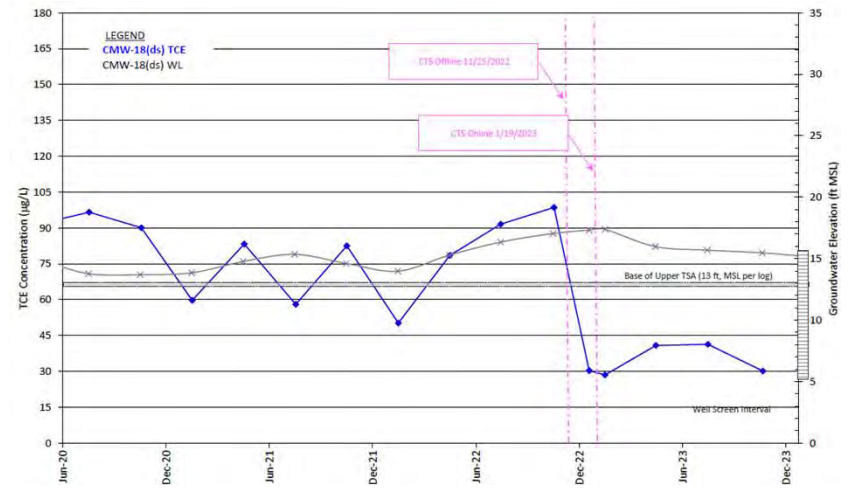
Notes:

1. ft amsl = feet above mean sea level (roughly correlated to the National Geodetic Vertical Datum of 1929 [NGVD 29])

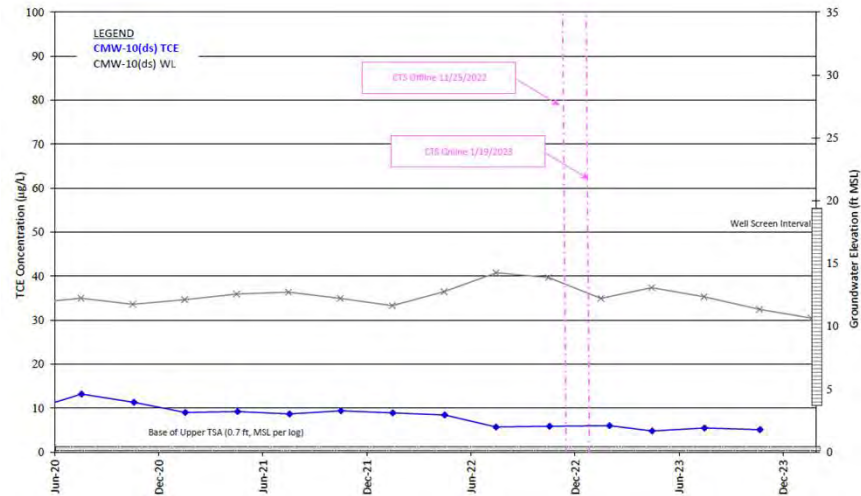
CMW-17(ds)



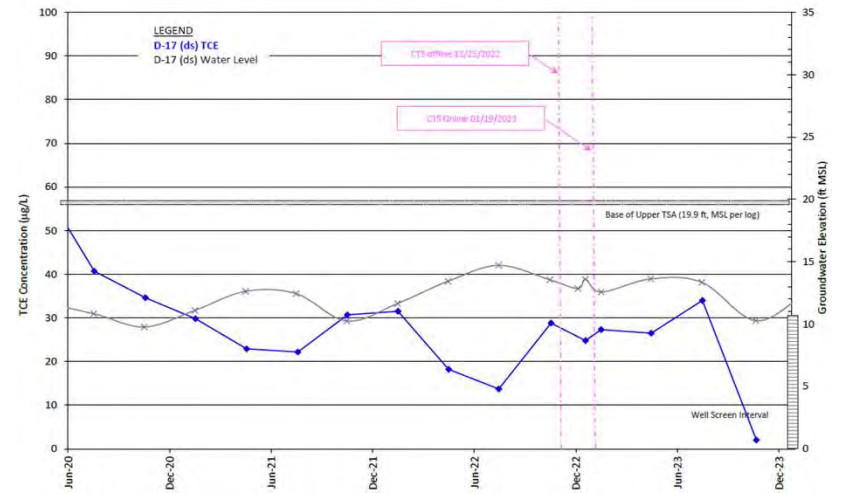
CMW-18(ds)



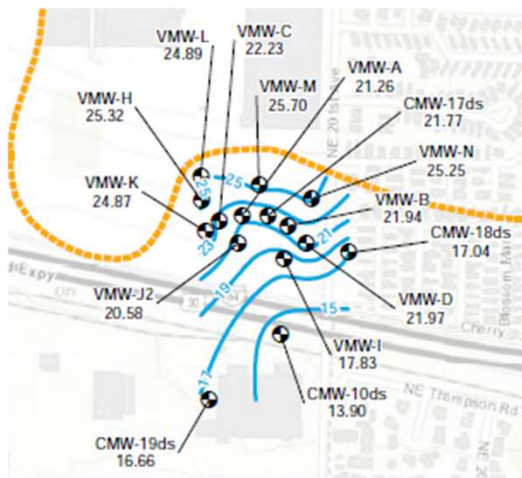
CMW-10(ds)



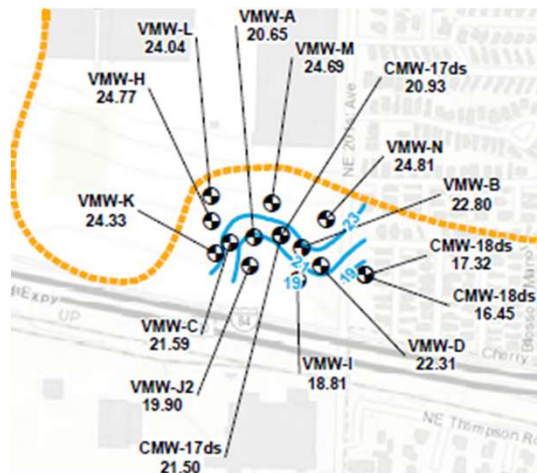
D-17(ds)



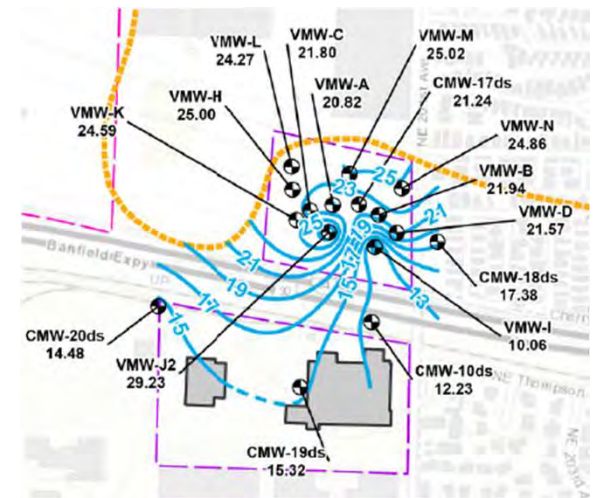
Upper TSA



November 2022



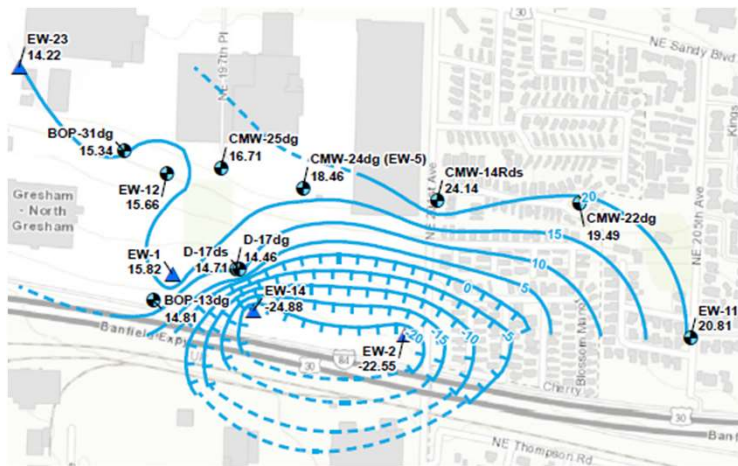
December 2022 / January 2023



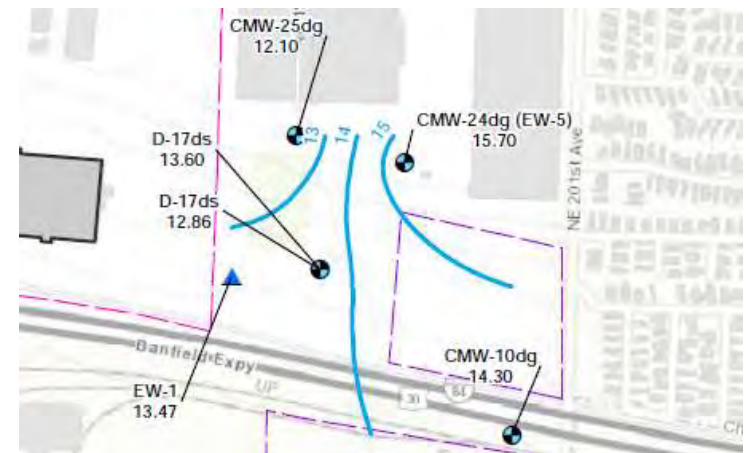
February 2023



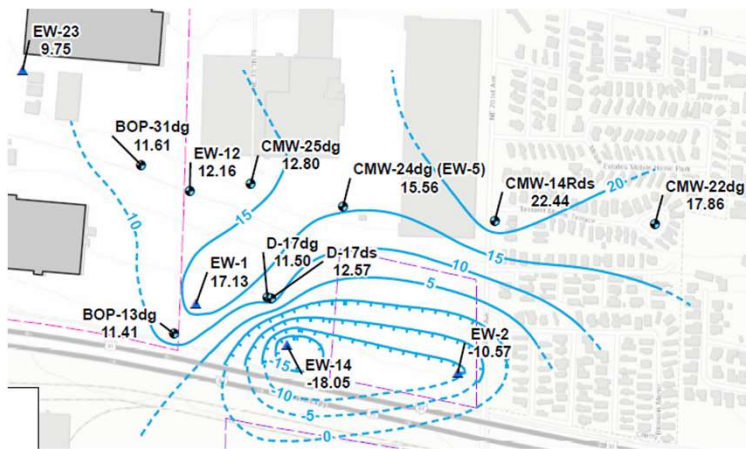
Lower TSA



August 2022



December 2022 & January 2023



February 2023

Notes

There is insufficient groundwater elevation data to prepare groundwater contours for November 2022.

Geosyntec
consultants

July 2024

PNG0564S24

Figure B-3
Lower TSA Groundwater Gradients During Unplanned Shutdown
TSA Remedy

APPENDIX C

SVE Data

Table C-1
Soil Vapor Extraction 1 January 2023 through 31 December 2023
East Multnomah County TSA Remedy

Well ID	Date	Time (hrs)	Temperature ¹ (degrees F)	Flow Rate ² (scfm)	PID Measurement ³ (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet						
SVE System Outlet	1/3/2023	11:50	90	353	--	--
SVE System Outlet	1/10/2023	15:40	90	344	--	--
SVE System Outlet	1/17/2023	9:15	90	378	0.2	1.17
SVE System Outlet	1/24/2023	14:45	90	383	--	--
SVE System Outlet	1/31/2023	15:20	85	328	--	--
SVE System Outlet	2/7/2023	12:40	85	370	--	--
SVE System Outlet	2/14/2023	12:30	90	386	--	--
SVE System Outlet	2/21/2023	11:40	85	357	--	--
SVE System Outlet	2/28/2023	14:10	80	361	--	--
SVE System Outlet	3/7/2023	13:40	90	365	0.1	0.58
SVE System Outlet	3/14/2023	13:20	90	369	0.1	0.58
SVE System Outlet	3/21/2023	14:00	90	375	0.1	0.58
SVE System Outlet	3/28/2023	15:30	85	378	0.1	0.58
SVE System Outlet	4/4/2023	14:50	90	385	0.1	0.58
SVE System Outlet	4/11/2023	13:00	90	389	0.1	0.58
SVE System Outlet	4/17/2023	14:20	90	385	0.1	0.58
SVE System Outlet	4/25/2023	10:40	95	388	0.1	0.58
SVE System Outlet	5/2/2023	10:00	100	388	0.1	0.58
SVE System Outlet	5/9/2023	11:10	110	375	0.1	0.58
SVE System Outlet	5/16/2023	9:15	100	395	0.1	0.58
SVE System Outlet	5/23/2023	14:10	100	341	0.1	0.58
SVE System Outlet	5/30/2023	9:40	95	384	0.1	0.58
SVE System Outlet	6/6/2023	11:00	100	389	0.1	0.58
SVE System Outlet	6/13/2023	10:50	95	395	0.1	0.58
SVE System Outlet	6/20/2023	12:40	90	380	0.1	0.58
SVE System Outlet	6/27/2023	14:20	100	381	0.1	0.58
SVE System Outlet	7/3/2023	13:50	110	365	0.1	0.58
SVE System Outlet	7/11/2023	13:40	100	377	0.1	0.58
SVE System Outlet	7/17/2023	14:40	100	381	0.1	0.58
SVE System Outlet	7/24/2023	9:40	90	391	0.1	0.58
SVE System Outlet	7/31/2023	13:45	115	386	0.1	0.58
SVE System Outlet	8/8/2023	8:50	90	378	0.1	0.58
SVE System Outlet	8/14/2023	10:45	100	363	0.1	0.58
SVE System Outlet	8/22/2023	10:45	95	392	0.1	0.58
SVE System Outlet	8/29/2023	9:50	90	371	0.1	0.58
SVE System Outlet	9/5/2023	13:00	90	376	0.1	0.58

Table C-1
Soil Vapor Extraction 1 January 2023 through 31 December 2023
East Multnomah County TSA Remedy

Well ID	Date	Time (hrs)	Temperature ¹ (degrees F)	Flow Rate ² (scfm)	PID Measurement ³ (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet						
SVE System Outlet	9/12/2023	10:15	90	375	0.1	0.58
SVE System Outlet	9/18/2023	10:40	95	389	0.1	0.58
SVE System Outlet	9/25/2023	10:40	90	363	0.1	0.58
SVE System Outlet	10/3/2023	7:30	90	394	0.1	0.58
SVE System Outlet	10/10/2023	11:45	90	390	0.1	0.58
SVE System Outlet	10/17/2023	12:00	100	368	0.1	0.58
SVE System Outlet	10/24/2023	8:30	90	354	0.1	0.58
SVE System Outlet	10/31/2023	9:50	85	370	0.1	0.58
SVE System Outlet	11/7/2023	15:30	95	373	-	--
SVE System Outlet	11/14/2023	16:15	90	396	-	--
SVE System Outlet	11/21/2023	12:20	85	359	-	--
SVE System Outlet	11/28/2023	12:30	85	374	-	--
SVE System Outlet	12/5/2023	11:00	95	363	-	--
SVE System Outlet	12/12/2023	14:30	95	373	0.1	0.58
SVE System Outlet	12/18/2023	15:00	100	364	0.1	0.58
SVE System Outlet	12/26/2023	11:15	80	361	0.1	0.58

Notes:

ID = identification

hrs = hours

F = Fahrenheit

ppm = parts per million

µg/L = micrograms per liter

VOC = volatile organic compounds

--- = Measurement not available

scfm = standard cubic feet per minute

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

2. The PID was unavailable for use at the Site on 3 January 2023 through 10 January 2023, on 24 January 2023 through 28 February, and on 7 November 2023 through 5 December 2023.

3. The SVE system was temporarily shutdown as a precautionary measure on 14 August 2023 through 18 August 2023 due to an extreme heat wave.

4. Bold text indicates sample for lab analysis was taken on that day or within several days. Those results are shown on Table C-2.

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

Well ID	Date	cis-1,2-dichloroethene (µg/m ³)	Trichloroethene (µg/m ³)	Tetrachloroethene (µg/m ³)	Total VOCs (µg/m ³)	Flow Rate (scfm) ¹
System Outlet	1/4/23	39	630	46	715	353.1
	2/2/23	44	600	44	688	328.1
	3/7/23	46	560	38	644	364.9
	4/11/23	42	430	39	511	388.6
	5/9/23	30	620	42	692	374.8
	6/13/23	38	460	39	537	394.6
	7/11/23	35	520	34	589	376.5
	8/8/23	46	550	41	637	378.3
	9/12/23	44	440	54	538	374.6
	10/10/23	49	540	33	622	389.6
	11/8/23	44	500	36	580	373.4
	12/6/23	38	600	41	679	363.4
Well VW17D-95.5	2/2/23	36	400	32	468	54.1
	5/9/23	0.8	1.1	1.4	3.3	59.3
	8/8/23	33	340	27	400	60.3
	11/8/23	35	330	25	390	59.8
Well VMW-C	2/2/23	4	63	13	80	54.3
	5/9/23	3	71	13	87	50.1
	8/8/23	3.1	47	8.9	59	57.6
	11/8/23	3	43	9.3	55.3	52.1
Well VMW-E	2/2/23	0.74	1	1.3	3.04	57.5
	5/9/23	0.74	5.1	1.3	7.14	70.9
	8/8/23	48	710	59	817	71.8
	11/8/23	44	700	52	796	70.8
Well VMW-F	2/2/23	4.9	31	21	56.9	52.5
	5/9/23	3.3	43	22	68.3	70.1
	8/8/23	0.83	1.1	1.4	3.33	72.3
	11/8/23	3.7	19	17	39.7	71.9
Well VMW-G	2/2/23	0.79	1.1	1.3	3.19	52.5
	5/9/23	10	100	18	128	50.0
	8/8/23	0.83	1.1	1.4	3.33	71.6
	11/8/23	18	120	17	155	71.1
Well VMW-H	2/2/23	0.76	1	1.3	3.06	63.1
	5/9/23	6.7	46	2.5	55.2	66.7
	8/8/23	6	28	1.6	35.6	67.8
	11/8/23	3	43	9.3	55.3	64.3
Well VMW-J2	2/2/23	34	580	46	660	69.8
	5/9/23	21	440	37	498	71.4
	8/8/23	31	430	37	498	72.6
	11/8/23	26	370	29	425	71.6

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

Well ID	Date	cis-1,2-dichloroethene ($\mu\text{g}/\text{m}^3$)	Trichloroethene ($\mu\text{g}/\text{m}^3$)	Tetrachloroethene ($\mu\text{g}/\text{m}^3$)	Total VOCs ($\mu\text{g}/\text{m}^3$)	Flow Rate (scfm) ¹
Well VMW-K	2/2/23	130	1900	99	2129	69.1
	5/9/23	100	2000	100	2200	71.1
	8/8/23	140	1400	85	1625	73.4
	11/8/23	70	850	44	964	72.1

Notes:

ID = identification

scfm = standard cubic feet per minute

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

VOC = volatile organic compounds

Total VOCs are the calculated sum of the three VOCs shown

¹ Flowrates associated with the analytical data on 4 January 2023 were measured on 3 January 2023; on 2 February 2023, flows were measured 7 February 2023; on 18 November 2023, flows were measured 7 November 2023; on 6 December 2023, flows were measured 5 December 2023.

² Blue colored analytical results indicate that the results are non-detect and reported at the detection limit.

Table C-3
Soil Vapor Extraction VOC Mass Removal - April 2015 through December 2023
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 2023
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%
01/06/22	0.61	73.09	0.70	84.90	87%
02/14/22	0.95	74.04	1.08	85.98	88%
03/21/22	0.93	74.97	1.06	87.03	88%
04/05/22	0.42	75.39	0.48	87.52	88%
05/05/22	0.78	76.17	0.88	88.39	89%
06/07/22	0.93	77.10	1.05	89.44	89%
07/06/22	0.64	77.74	0.73	90.17	88%
08/09/22	0.75	78.49	0.85	91.02	88%
09/06/22	0.60	79.08	0.68	91.70	87%
10/03/22	0.49	79.58	0.57	92.27	87%
11/03/22	0.56	80.14	0.64	92.91	87%
12/07/22	0.40	80.54	0.46	93.38	87%

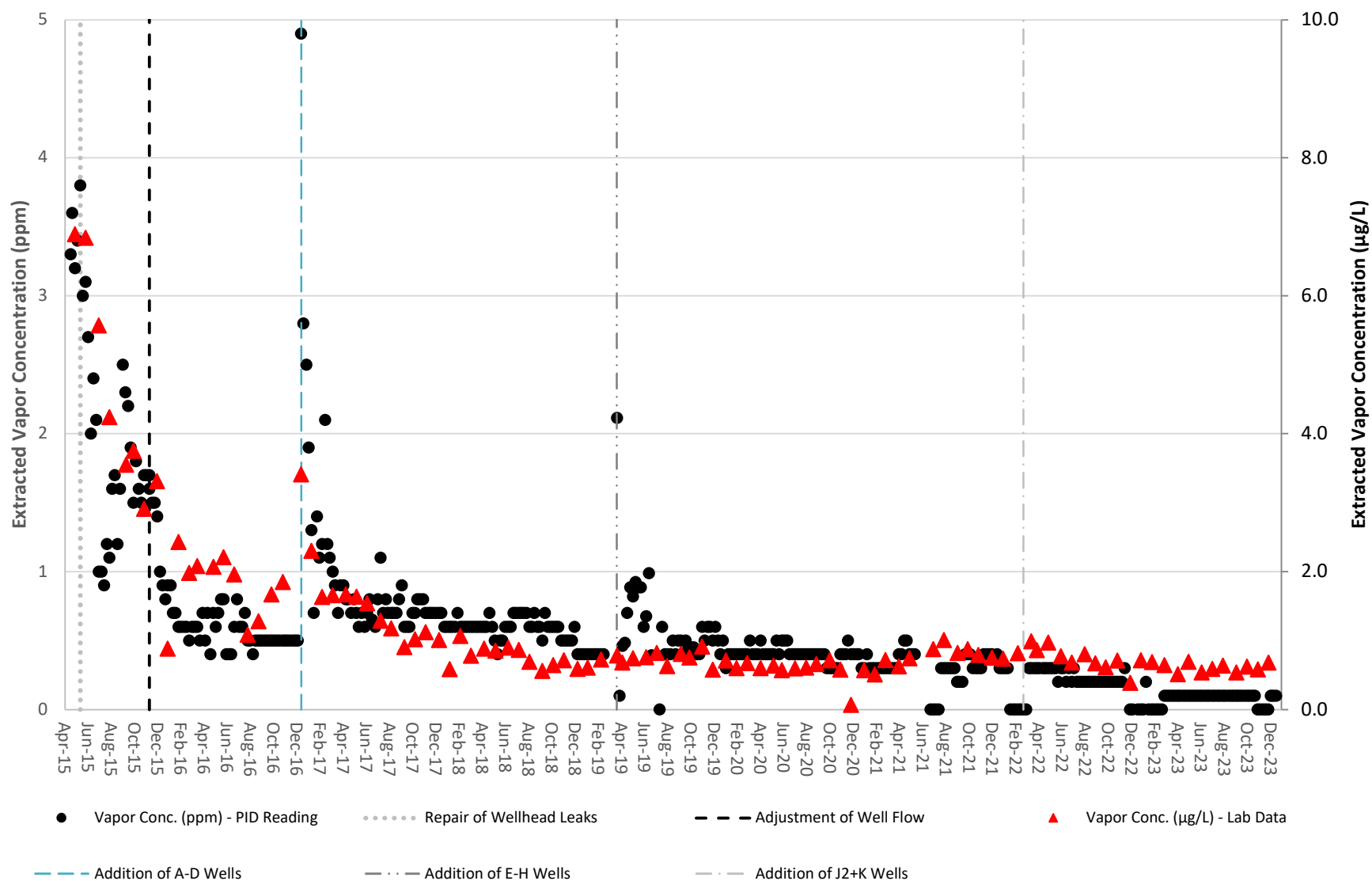
Table C-3
Soil Vapor Extraction VOC Mass Removal - April 2015 through December 2023
East Multnomah County TSA Remedy

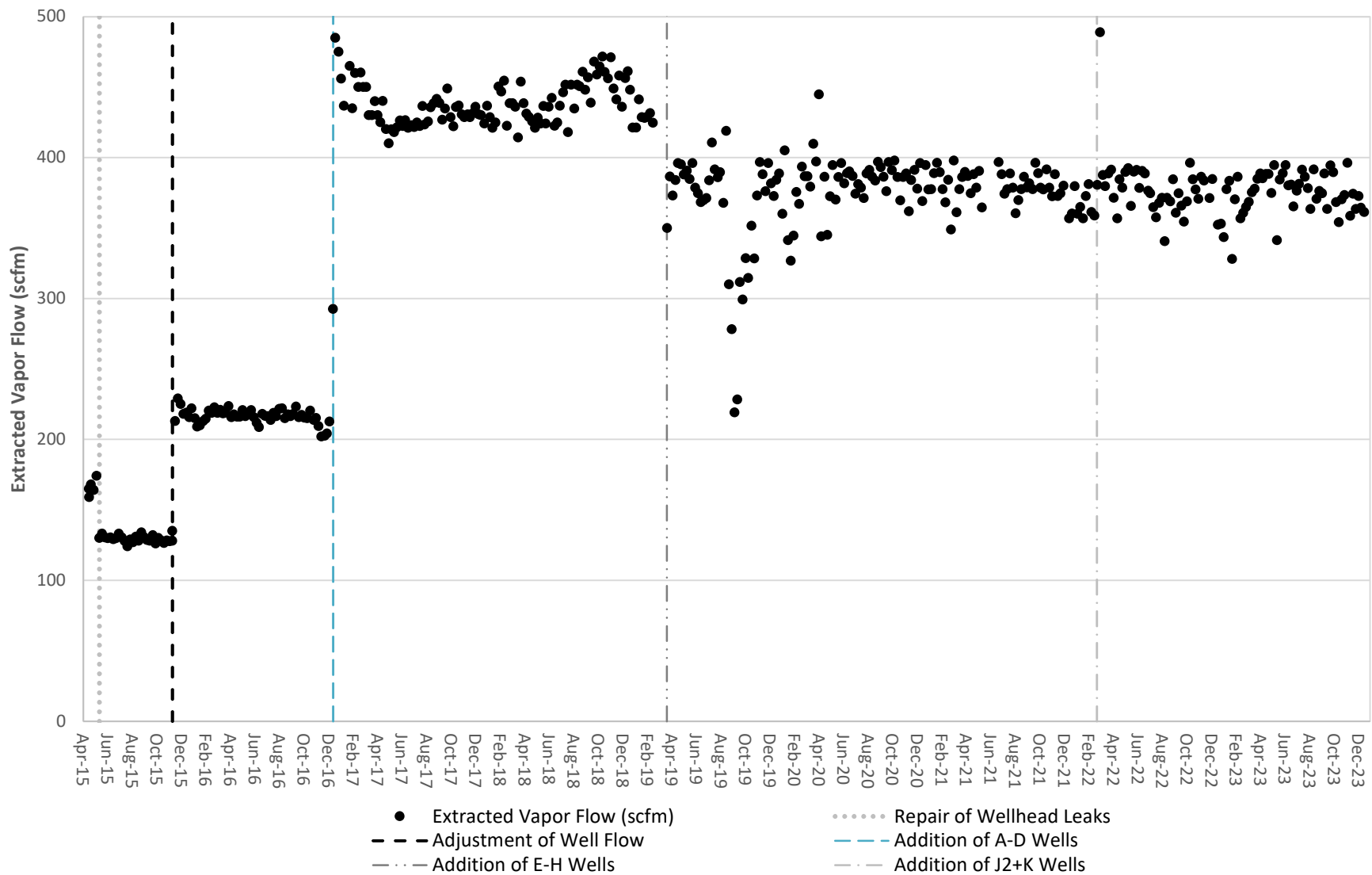
Date	Pounds of TCE Removed Per Sampling Period	Cumulative Pounds of TCE Removed	Pounds of VOCs Removed Per Sampling Period	Cumulative Pounds of VOCs Removed	TCE percentage of mass removal Per Sampling Period
01/04/23	0.44	80.98	0.51	93.89	87%
02/02/23	0.56	81.55	0.64	94.53	88%
03/07/23	0.65	82.20	0.75	95.28	87%
04/11/23	0.57	82.77	0.67	95.95	86%
05/09/23	0.50	83.28	0.58	96.53	87%
06/13/23	0.65	83.93	0.74	97.27	88%
07/11/23	0.47	84.40	0.54	97.81	87%
08/08/23	0.51	84.91	0.58	98.39	87%
09/12/23	0.52	85.43	0.62	99.01	84%
10/10/23	0.47	85.90	0.55	99.57	85%
11/08/23	0.50	86.40	0.57	100.14	87%
12/06/23	0.51	86.91	0.59	100.73	87%

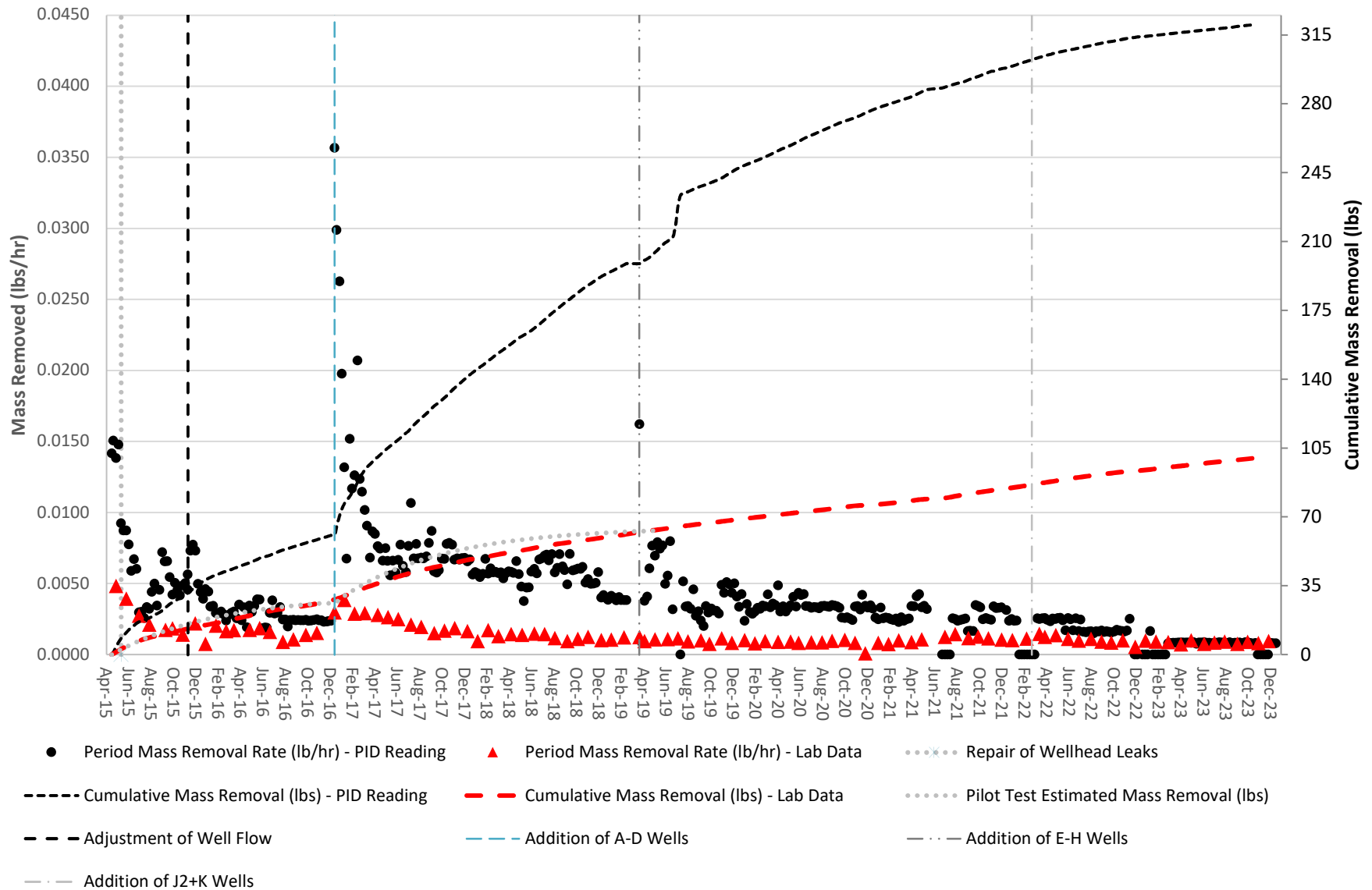
Notes

VOC = Volatile Organic Compound

TCE = Trichloroethylene







APPENDIX D

Groundwater Elevation Data

Table D-1
Groundwater Elevations - 1 January 2023 through 31 December 2023
East Multnomah County Troutdale Sandstone Aquifer (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	2/1/2023	16:08	127.63	145.68	-18.05
Lower	EW-14	5/1/2023	11:24	127.63	145.05	-17.42
Lower	EW-14	8/1/2023	7:15	127.63	140.18	-12.55
Lower	EW-14	11/6/2023	10:16	127.63	147.62	-19.99
Lower	EW-2	2/1/2023	16:15	126.01	136.58	-10.57
Lower	EW-2	5/1/2023	11:17	126.01	143.08	-17.07
Lower	EW-2	8/1/2023	7:05	126.01	150.23	-24.22
Lower	EW-2	11/6/2023	10:00	126.01	151.19	-25.18
Lower	EW-23	2/1/2023	11:22	83.93	74.18	9.75
Lower	EW-23	5/1/2023	13:58	83.93	69.99	13.94
Lower	EW-23	8/1/2023	12:00	83.93	71.69	12.24
Lower	EW-23	11/6/2023	11:41	83.93	77.29	6.64
Monitoring Wells						
Upper	BOP-13ds	2/2/2023	9:21	128.94	117.59	11.35
Upper	BOP-13ds	8/14/2023	7:58	128.94	115.80	13.14
Upper	BOP-20ds	8/14/2023	8:51	77.45	65.13	12.32
Upper	BOP-20ds	9/25/2023	18:53	77.45	70.30	4.15
Upper	BOP-20ds	11/27/2023	14:35	77.45	69.34	8.11
Upper	BOP-31ds	2/2/2023	9:41	99.04	87.50	11.54
Upper	BOP-31ds	8/14/2023	8:16	99.04	85.85	13.19
Upper	BOP-62ds	8/14/2023	9:51	112.29	99.73	12.56
Upper	BOP-62ds	9/25/2023	15:43	112.29	108.53	3.76
Upper	BOP-62ds	11/27/2023	12:24	112.29	104.20	8.90
Upper	BOP-65ds	8/14/2023	10:35	104.22	91.47	12.75
Upper	BOP-65ds	9/25/2023	19:14	104.22	99.68	4.54
Upper	BOP-65ds	11/27/2023	10:15	104.22	95.99	8.23
Upper	CMW-10ds	2/1/2023	13:20	134.54	122.31	12.23
Upper	CMW-10ds	5/1/2023	13:30	134.54	121.46	13.08
Upper	CMW-10ds	8/1/2023	13:55	134.54	122.18	12.36
Upper	CMW-10ds	11/6/2023	12:02	134.54	123.18	11.36
Upper	CMW-17ds	1/4/2023	8:28	121.89	100.39	21.50
Upper	CMW-17ds	2/1/2023	9:58	121.89	100.65	21.24
Upper	CMW-17ds	5/1/2023	12:19	121.89	100.78	21.11
Upper	CMW-17ds	8/1/2023	7:33	121.89	100.63	21.26
Upper	CMW-17ds	11/6/2023	9:50	121.89	101.14	20.75
Upper	CMW-18ds	1/4/2023	10:38	117.66	100.34	17.32
Upper	CMW-18ds	2/1/2023	13:47	117.66	100.28	17.38
Upper	CMW-18ds	5/1/2023	13:08	117.66	101.68	15.98
Upper	CMW-18ds	8/1/2023	10:22	117.66	101.97	15.69
Upper	CMW-18ds	11/6/2023	11:14	117.66	102.19	15.47
Upper	CMW-19ds	2/1/2023	13:00	144.08	128.76	15.32
Upper	CMW-19ds	5/1/2023	13:22	144.08	127.68	16.40
Upper	CMW-19ds	8/1/2023	13:30	144.08	127.96	16.12
Upper	CMW-19ds	11/6/2023	11:54	144.08	129.31	14.77
Upper	CMW-20ds	2/1/2023	12:54	152.72	138.24	14.48
Upper	CMW-20ds	8/1/2023	12:56	152.72	137.33	15.39
Lower	BOP-13dg	2/2/2023	9:30	128.71	117.30	11.41
Lower	BOP-13dg	8/14/2023	8:02	128.71	115.60	13.11
Lower	BOP-20dg	8/14/2023	9:33	77.32	65.00	12.32

Table D-1
Groundwater Elevations - 1 January 2023 through 31 December 2023
East Multnomah County Troutdale Sandstone Aquifer (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-23dg	8/14/2023	8:27	76.96	64.80	12.16
Lower	BOP-23dg	9/25/2023	18:33	76.96	70.40	6.56
Lower	BOP-23dg	11/27/2023	13:42	76.96	66.82	10.14
Lower	BOP-31dg	2/2/2023	9:44	98.51	86.90	11.61
Lower	BOP-31dg	8/14/2023	8:19	98.51	85.40	13.11
Lower	CMW-14Rds	2/1/2023	14:04	83.48	61.04	22.44
Lower	CMW-14Rds	8/1/2023	10:36	83.48	60.57	22.91
Lower	CMW-22dg	2/1/2023	14:17	81.65	63.79	17.86
Lower	CMW-22dg	8/1/2023	10:47	81.65	64.24	17.41
Lower	CMW-22dg	9/27/2023	14:20	81.65	66.26	15.39
Lower	CMW-22dg	11/6/2023	11:16	81.65	66.71	14.94
Lower	CMW-22dg	11/27/2023	13:36	81.65	65.88	15.77
Lower	CMW-24dg (EW-5)	1/4/2023	10:57	77.74	62.04	15.70
Lower	CMW-24dg (EW-5)	2/1/2023	11:42	77.74	62.18	15.56
Lower	CMW-24dg (EW-5)	8/1/2023	8:58	77.74	60.58	17.16
Lower	CMW-25dg	1/4/2023	11:40	75.28	63.18	12.10
Lower	CMW-25dg	2/1/2023	12:00	75.28	62.48	12.80
Lower	CMW-25dg	8/1/2023	12:12	75.28	60.98	14.30
Lower	CMW-36dg	9/27/2023	15:04	78.84	66.98	11.86
Lower	CMW-36dg	11/6/2023	11:23	78.84	66.88	11.96
Lower	CMW-36dg	11/27/2023	13:18	78.84	66.81	12.03
Lower	D-17dg	2/1/2023	15:25	124.61	113.11	11.50
Lower	D-17dg	5/1/2023	11:39	124.61	111.21	13.40
Lower	D-17dg	8/1/2023	8:04	124.61	111.86	12.75
Lower	D-17dg	11/6/2023	10:40	124.61	115.93	8.68
Lower	D-17ds	1/4/2023	9:55	123.28	109.68	13.60
Lower	D-17ds	2/1/2023	15:26	123.28	110.71	12.57
Lower	D-17ds	5/1/2023	11:43	123.28	109.66	13.62
Lower	D-17ds	8/1/2023	8:10	123.28	109.93	13.35
Lower	D-17ds	11/6/2023	10:47	123.28	113.03	10.25
Lower	EW-1	1/4/2023	9:22	124.04	110.57	13.47
Lower	EW-1	2/1/2023	16:03	124.04	106.91	17.13
Lower	EW-1	5/1/2023	11:36	124.04	109.11	14.93
Lower	EW-1	8/1/2023	7:23	124.04	108.71	15.33
Lower	EW-1	11/6/2023	10:52	124.04	114.10	9.94
Lower	EW-11	8/1/2023	11:16	114.73	95.06	19.67
Lower	EW-12	2/1/2023	15:51	94.14	81.98	12.16
Lower	EW-12	8/1/2023	7:50	94.14	80.64	13.50
Lower	EW-13	8/14/2023	10:52	103.59	90.77	12.82
Lower	EW-13	9/25/2023	16:40	103.59	98.20	5.39
Lower	EW-13	11/27/2023	13:14	103.59	95.60	7.99
Vapor Monitoring Wells						
Upper	VMW-A	2/1/2023	16:36	123.34	102.52	20.82
Upper	VMW-A	5/1/2023	12:10	123.34	102.69	20.65
Upper	VMW-A	8/1/2023	9:37	123.34	102.42	20.92
Upper	VMW-A	11/6/2023	13:02	123.34	102.89	20.45
Upper	VMW-B	2/1/2023	16:32	123.25	101.31	21.94
Upper	VMW-B	5/1/2023	12:25	123.25	101.34	21.91
Upper	VMW-B	8/1/2023	10:00	123.25	101.41	21.84
Upper	VMW-B	11/6/2023	13:18	123.25	101.71	21.54
Upper	VMW-C	2/1/2023	16:47	124.17	102.37	21.80

Table D-1
Groundwater Elevations - 1 January 2023 through 31 December 2023
East Multnomah County Troutdale Sandstone Aquifer (TSA) Remedy

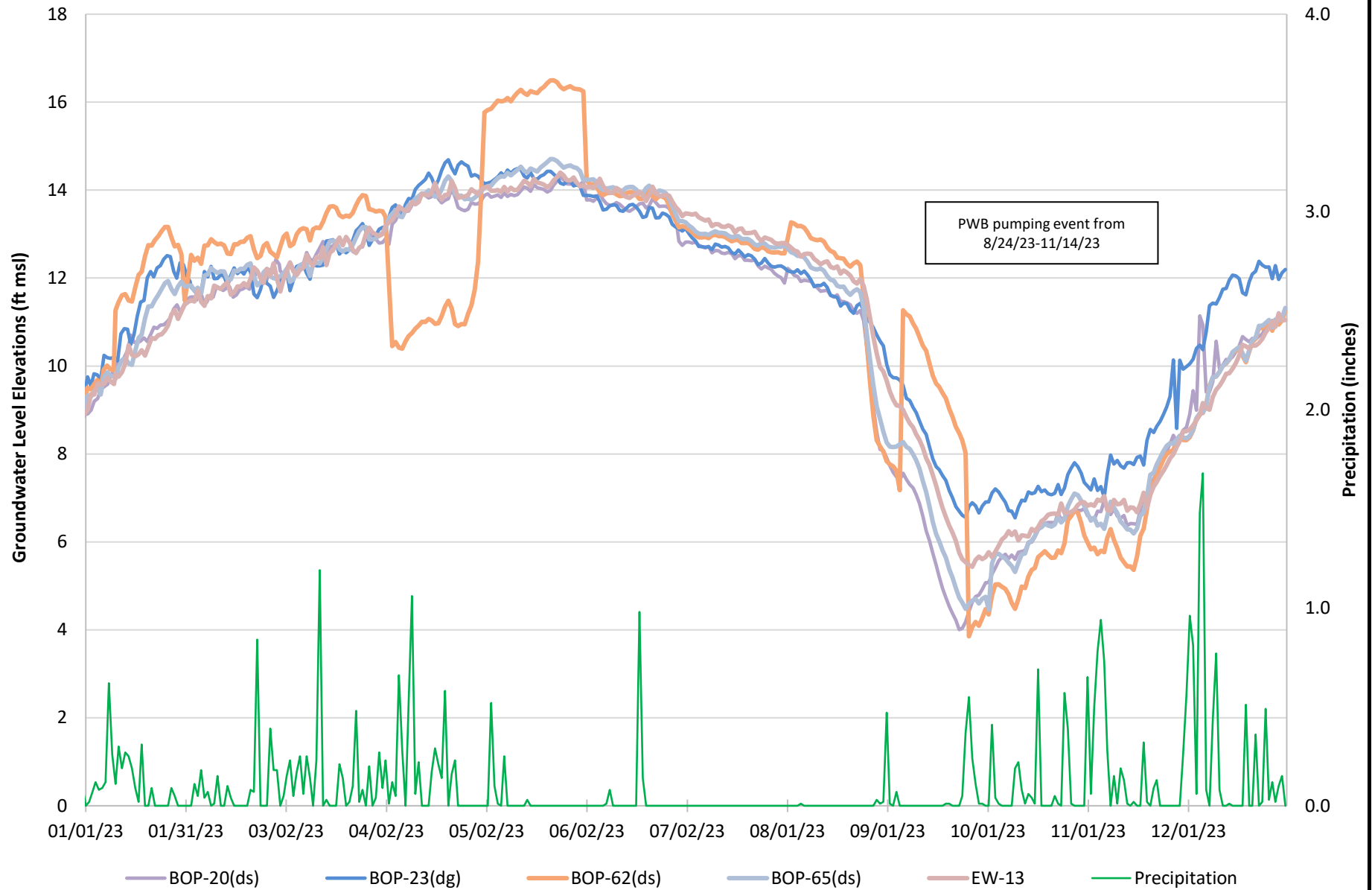
TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Upper	VMW-C	5/1/2023	12:07	124.17	102.33	21.84
Upper	VMW-C	8/1/2023	9:31	124.17	102.36	21.81
Upper	VMW-C	11/6/2023	12:30	124.17	102.61	21.56
Upper	VMW-D	2/1/2023	16:22	126.78	105.21	21.57
Upper	VMW-D	5/1/2023	12:33	126.78	106.18	20.60
Upper	VMW-D	8/1/2023	9:54	126.78	105.96	20.82
Upper	VMW-D	11/6/2023	12:04	126.78	106.51	20.27
Upper	VMW-E	--	--	132.39	--	--
Upper	VMW-F	--	--	127.51	--	--
Upper	VMW-G	--	--	123.14	--	--
Upper	VMW-H	2/1/2023	17:02	126.88	101.88	25.00
Upper	VMW-H	5/1/2023	11:49	126.88	101.48	25.40
Upper	VMW-H	8/1/2023	9:15	126.88	101.93	24.95
Upper	VMW-H	11/6/2023	12:26	126.88	102.91	23.97
Upper	VMW-I	2/1/2023	16:18	131.98	121.92	10.06
Upper	VMW-I	5/1/2023	12:36	131.98	121.13	10.85
Upper	VMW-I	8/1/2023	9:47	131.98	121.54	10.44
Upper	VMW-I	11/6/2023	12:07	131.98	121.81	10.17
Upper	VMW-J2	2/1/2023	16:48	130.12	100.89	29.23
Upper	VMW-J2	5/1/2023	12:40	130.12	111.36	18.76
Upper	VMW-J2	8/1/2023	9:42	130.12	111.03	19.09
Upper	VMW-J2	11/6/2023	12:10	130.12	111.61	18.51
Upper	VMW-K	2/1/2023	16:53	129.80	105.21	24.59
Upper	VMW-K	5/1/2023	12:02	129.80	105.49	24.31
Upper	VMW-K	8/1/2023	9:27	129.80	105.31	24.49
Upper	VMW-K	11/6/2023	12:14	129.80	105.59	24.21
Upper	VMW-L	2/1/2023	16:58	115.23	90.96	24.27
Upper	VMW-L	5/1/2023	11:59	115.23	90.59	24.64
Upper	VMW-L	8/1/2023	9:21	115.23	90.48	24.75
Upper	VMW-L	11/6/2023	12:22	115.23	92.34	22.89
Upper	VMW-M	2/1/2023	16:44	114.72	89.70	25.02
Upper	VMW-M	5/1/2023	12:14	114.72	89.28	25.44
Upper	VMW-M	8/1/2023	9:34	114.72	89.23	25.49
Upper	VMW-M	11/6/2023	13:07	114.72	90.86	23.86
Upper	VMW-N	2/1/2023	16:27	115.77	90.91	24.86
Upper	VMW-N	5/1/2023	12:29	115.77	90.70	25.07
Upper	VMW-N	8/1/2023	10:07	115.77	90.94	24.83
Upper	VMW-N	11/6/2023	13:28	115.77	91.83	23.94

Notes:

ft MSL = feet above mean sea level

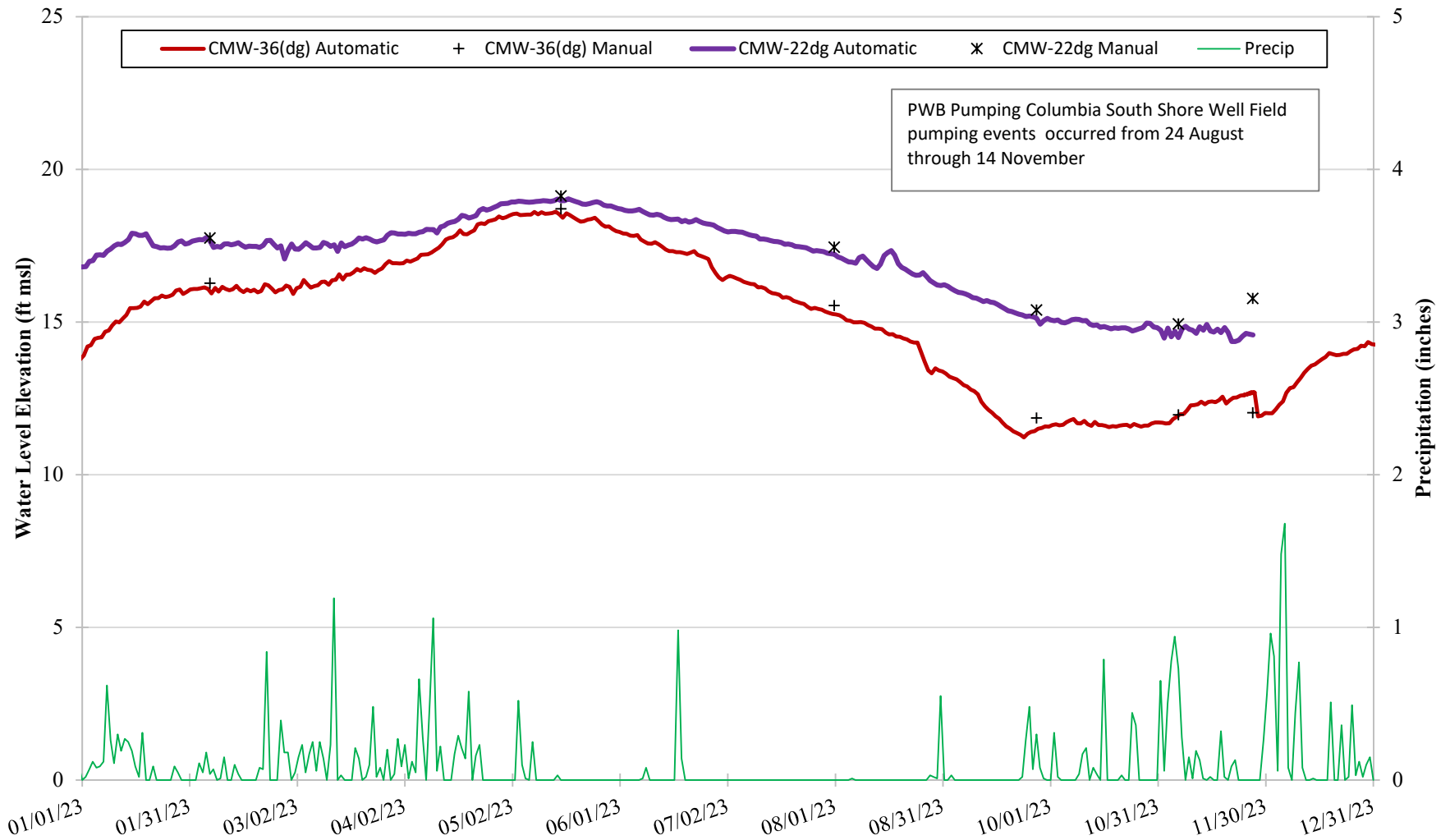
ft TOC =feet below top of casing

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



Note:

Assumed BOP-62(ds) datalogger malfunction from 4/4-6/1 and from 8/24-9/26 based on output. A correction factor was not applied to data shown.



Note: The transducer in CMW-22dg broke during data collection on 27 November 2023. The transducer was repaired and replaced into the well in February 2024.

APPENDIX E

Groundwater Quality Data

Table E-1
Groundwater Analytical Results
1 January 2023 through 31 December 2023
East Multnomah County Troutdale Sandstone Aquifer (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-020123-DUP	2/1/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Eff	TS-C-EFF-020123	2/1/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-050223-DUP	5/2/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Eff	TS-C-EFF-050223	5/2/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-080223	8/2/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	TS-C-Eff	TS-C-EFF-080223-DUP	8/2/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	Yes
Lower	TS-C-Eff	TS-C-EFF-110723-DUP	11/7/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Eff	TS-C-EFF-110723	11/7/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-020123	2/1/2023	4.54	< 0.500	0.511	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-050223	5/2/2023	4.24	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-080223	8/2/2023	4.35	0.413 J	0.483 J	< 1.00	< 1.00	
Lower	TS-C-Inf	TS-C-INF-110723	11/7/2023	6.90	0.500 J	0.703	< 0.500	< 0.500	
Extraction Wells									
Lower	EW-14	EW14-020123	2/1/2023	5.42	< 0.500	0.721	< 0.500	< 0.500	
Lower	EW-14	EW14-050223	5/2/2023	4.85 J	< 0.500	0.690	< 0.500	< 0.500	
Lower	EW-14	EW14-080223	8/2/2023	4.94	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	EW-14	EW14-110723	11/7/2023	5.16	0.329 J	0.692	< 0.500	< 0.500	
Lower	EW-2	EW2-020123	2/1/2023	8.29	0.629	0.887	< 0.500	< 0.500	
Lower	EW-2	EW2-050223	5/2/2023	6.71 J	0.561	0.687	< 0.500	< 0.500	
Lower	EW-2	EW2-080223	8/2/2023	7.70	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	EW-2	EW2-110723	11/7/2023	7.56	0.533	0.765	< 0.500	< 0.500	
Monitoring Wells									
Upper	BOP-13ds	BOP-13DS;BOP-Z-0223;20230203	2/3/2023	2.1	< 0.20	0.34	< 0.20	< 0.20	Yes
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0223;20230203	2/3/2023	2.0	< 0.20	0.33	< 0.20	< 0.20	
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0823;20230803	8/3/2023	1.9	< 0.20	0.27	< 0.20	< 0.20	
Upper	BOP-20ds	BOP-20DS;BOP-20DS-0823;20230803	8/3/2023	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-20ds	BOP-20DS;BOP-20DS-0923;20230925	9/25/2023	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-20ds	BOP-20DS; BOP-20DS-1123; 20231127	11/27/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0223;20230203	2/3/2023	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0823;20230803	8/3/2023	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-62ds	BOP-62DS;BOP-62DS-0923;20230925	9/25/2023	0.48	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-62ds	BOP-62DS; BOP-62DS-1123; 20231127	11/27/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	BOP-65ds	BOP-65DS;BOP-65DS-0923;20230925	9/25/2023	0.45	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-65ds	BOP-65DS; BOP-65DS-1123; 20231128	11/28/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-021623	2/16/2023	6.01 J	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-050223	5/2/2023	4.82 J	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-050223-DUP	5/2/2023	4.75 J	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Upper	CMW-10ds	CMW10DS-080123	8/1/2023	5.47	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	CMW-10ds	CMW10DS-110723-DUP	11/7/2023	5.12	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Upper	CMW-10ds	CMW10DS-110723	11/7/2023	4.93	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-010423	1/4/2023	6.69	< 0.500	0.995	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-010423-DUP	1/4/2023	6.46	< 0.500	0.934	< 0.500	< 0.500	Yes
Upper	CMW-17ds	CMW17DS-020123-DUP	2/1/2023	5.53	< 0.500	0.778	< 0.500	< 0.500	Yes
Upper	CMW-17ds	CMW17DS-020123	2/1/2023	5.55	< 0.500	0.785	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-050223	5/2/2023	8.89 J	0.501	1.24	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-080223	8/2/2023	3.96	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	CMW-17ds	CMW17DS-110723-DUP	11/7/2023	4.95	< 0.500	0.690	< 0.500	< 0.500	Yes
Upper	CMW-17ds	CMW17DS-110723	11/7/2023	4.84	< 0.500	0.678	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-010423	1/4/2023	30.3	1.53	3.49	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-020123-DUP	2/1/2023	28.5	0.614 J	3.63	< 0.500	< 0.500	Yes

Table E-1
Groundwater Analytical Results
1 January 2023 through 31 December 2023
East Multnomah County Troutdale Sandstone Aquifer (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-18ds	CMW18DS-020123	2/1/2023	28.1	0.838 J	3.44	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-050223	5/2/2023	40.8	1.23	6.84	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-080123	8/1/2023	39.5	1.32	6.23	< 1.00	< 1.00	
Upper	CMW-18ds	CMW18DS-080123-DUP	8/1/2023	41.3	1.39	6.43	< 1.00	< 1.00	Yes
Upper	CMW-18ds	CMW18DS-110723	11/7/2023	30.1	1.41	4.63	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-021623	2/16/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-050223	5/2/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-080123	8/1/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	CMW-19ds	CMW19DS-110723	11/7/2023	0.82	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-20ds	CMW20DS-080123	8/1/2023	1.12	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0223;20230203	2/3/2023	0.89	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-13dg	BOP-13DG;BOP-Z-0823;20230803	8/3/2023	0.42	< 0.20	< 0.20	< 0.20	< 0.20	Yes
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0823;20230803	8/3/2023	0.47	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-20dg	BOP-20DG;BOP-20DG-0823;20230803	8/3/2023	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-23dg	BOP-23DG;BOP-23DG-0823;20230803	8/3/2023	0.69	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-23dg	BOP-23DG;BOP-23DG-0923;20230925	9/25/2023	1	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-23dg	BOP-23DG; BOP-23DG-1123; 20231127	11/27/2023	0.86	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0223;20230203	2/3/2023	2.5	0.34	0.22	< 0.20	< 0.20	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0823;20230803	8/3/2023	2.7	0.48	0.20	< 0.20	< 0.20	
Lower	CMW-10dg	CMW10DG-010423	1/4/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-14Rds	CMW14RDS-020123	2/1/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-14Rds	CMW14RDS-080123	8/1/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	CMW-22dg	CMW22DG-080123	8/1/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	CMW-22dg	CMW22DG-092723	9/27/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-22dg	CMW22DG-112723	11/27/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-24dg (EW-5)	CMW24DG-010423	1/4/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-24dg (EW-5)	CMW24DG-020123	2/1/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-24dg (EW-5)	CMW24DG-080123	8/1/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	CMW-25dg	CMW25DG-010423	1/4/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-25dg	CMW25DG-020123	2/1/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-25dg	CMW25DG-080123	8/1/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	CMW-36dg	CMW36DG-092723-DUP	9/27/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	CMW-36dg	CMW36DG-092723	9/27/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-36dg	CMW36DG-112723	11/27/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-020123	2/1/2023	1.43	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-050223	5/2/2023	1.72 J	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-080123	8/1/2023	1.89	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	D-17dg	D17DG-110723	11/7/2023	2.04	< 0.500	0.263 J	< 0.500	< 0.500	
Lower	D-17ds	D17DS-010423	1/4/2023	24.8	0.629	7.12	< 0.500	< 0.500	
Lower	D-17ds	D17DS-020123	2/1/2023	27.3	0.780	7.41	< 0.500	< 0.500	
Lower	D-17ds	D17DS-050223	5/2/2023	26.5 J	0.796	6.01	< 0.500	< 0.500	
Lower	D-17ds	D17DS-080123	8/1/2023	34.0	< 1.00	7.85	< 1.00	< 1.00	
Lower	D-17ds	D17DS-110723	11/7/2023	34.6	0.863	7.32	< 0.500	< 0.500	
Lower	EW-1	EW1-010423	1/4/2023	0.546	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-020123	2/1/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-050223	5/2/2023	< 0.500 J	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-080223	8/2/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	EW-1	EW1-110723	11/7/2023	0.988	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-11	EW11-080123	8/1/2023	1.69	< 1.00	< 1.00	< 1.00	< 1.00	
Lower	EW-12	EW12-020123	2/1/2023	1.79	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-12	EW12-080123	8/1/2023	1.38	< 1.00	< 1.00	< 1.00	< 1.00	

Table E-1
Groundwater Analytical Results
1 January 2023 through 31 December 2023
East Multnomah County Troutdale Sandstone Aquifer (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-13	EW-13;EW-13-0923;20230925	9/25/2023	0.22	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	EW-13	EW-13-1123	11/27/2023	<0.500	<0.500	<0.500	<0.500	<0.500	
Lower	EW-23	EW23-020123	2/1/2023	0.513	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-23	EW23-080823	8/8/2023	2.50 J3	< 0.500	< 0.500	< 0.500	< 0.500	
Vapor Monitoring Wells									
Upper	VMW-A	VMWA-020223	2/2/2023	1.65	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-A	VMWA-050323	5/3/2023	1.88	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-A	VMWA-080223	8/2/2023	1.31	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-A	VMWA-110823	11/8/2023	0.969	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-B	VMWB-020223	2/2/2023	12.3	0.528	2.06	< 0.500	< 0.500	
Upper	VMW-B	VMWB-050323	5/3/2023	11.2	< 0.500	1.78	< 0.500	< 0.500	
Upper	VMW-B	VMWB-080223	8/2/2023	7.55	< 1.00	1.59	< 1.00	< 1.00	
Upper	VMW-B	VMWB-110823-DUP	11/8/2023	8.63	0.380 J	1.60	< 0.500	< 0.500	Yes
Upper	VMW-B	VMWB-110823	11/8/2023	8.58	0.434 J	1.48	< 0.500	< 0.500	
Upper	VMW-C	VMWC-020223	2/2/2023	1.26	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-C	VMWC-050323	5/3/2023	1.28	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-C	VMWC-080223	8/2/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-C	VMWC-110823	11/8/2023	0.971	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-D	VMWD-020223	2/2/2023	0.860	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-D	VMWD-050323	5/3/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-D	VMWD-080223	8/2/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-D	VMWD-110823	11/8/2023	0.579	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-E	VMWE-020223	2/2/2023	22.1	1.64	2.62	< 0.500	< 0.500	
Upper	VMW-E	VMWE-050323	5/3/2023	20.2	1.37	2.75	< 0.500	< 0.500	
Upper	VMW-E	VMWE-080223	8/2/2023	15.7	1.07	2.38	< 1.00	< 1.00	
Upper	VMW-E	VMWE-110823	11/8/2023	17.2	1.13	2.56	< 0.500	< 0.500	
Upper	VMW-F	VMWF-020123	2/2/2023	0.742	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-F	VMWF-050323	5/3/2023	0.701	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-F	VMWF-080223	8/2/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-F	VMWF-110823	11/8/2023	0.477 J	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-G	VMWG-020223	2/2/2023	2.44	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-G	VMWG-050323	5/3/2023	2.78 J	< 0.500 J	< 0.500 J	< 0.500 J	< 0.500 J	
Upper	VMW-G	VMWG-080223	8/2/2023	1.74	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-G	VMWG-110823	11/8/2023	2.29	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-020223	2/2/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-050323	5/3/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-080223	8/2/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-H	VMWH-110823	11/8/2023	0.507	< 0.500	0.177 J	< 0.500	< 0.500	
Upper	VMW-I	VMWI-020223-143.7	2/2/2023	20.8	1.24	1.03	< 0.500	< 0.500	
Upper	VMW-I	VMWI-050323-143.7	5/3/2023	38.4	1.79	2.70	< 0.500	< 0.500	
Upper	VMW-I	VMWI-080223	8/2/2023	27.1	1.29	2.17	< 1.00	< 1.00	
Upper	VMW-I	VMWI-080223-DUP	8/2/2023	27.8	1.32	2.12	< 1.00	< 1.00	Yes
Upper	VMW-I	VMWI-110823-143.7	11/8/2023	37.4	1.72 J	2.74	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-020223-120.25	2/2/2023	2.11	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-050323-120.25-DUP	5/3/2023	2.46	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Upper	VMW-J2	VMWJ2-050323-120.25	5/3/2023	2.31	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-080223	8/2/2023	2.01	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-J2	VMWJ2-080223-DUP	8/2/2023	2.04	< 1.00	< 1.00	< 1.00	< 1.00	Yes
Upper	VMW-J2	VMWJ2-110823-120.25	11/8/2023	2.03	< 0.500	0.327 J	< 0.500	< 0.500	
Upper	VMW-K	VMWK-020223-114.25-DUP	2/2/2023	8.52	< 0.500	1.40	< 0.500	< 0.500	Yes
Upper	VMW-K	VMWK-020223-114.25	2/2/2023	8.42	< 0.500	1.33	< 0.500	< 0.500	

Table E-1
Groundwater Analytical Results
1 January 2023 through 31 December 2023
East Multnomah County Troutdale Sandstone Aquifer (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-K	VMWK-050323-114.25	5/3/2023	7.60	< 0.500	1.32	< 0.500	< 0.500	
Upper	VMW-K	VMWK-080223	8/2/2023	8.41	< 1.00	1.49	< 1.00	< 1.00	
Upper	VMW-K	VMWK-110823-114.25	11/8/2023	10.1	0.500 J	1.89	< 0.500	< 0.500	
Upper	VMW-L	VMWL-020223-103.25	2/2/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-L	VMWL-050323-103.25	5/3/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-L	VMWL-080223	8/2/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-L	VMWL-110823-103.25	11/8/2023	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-M	VMWM-020223-94	2/2/2023	4.28	< 0.500	0.534	< 0.500	< 0.500	
Upper	VMW-M	VMWM-050323-94	5/3/2023	3.47	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-M	VMWM-080223	8/2/2023	2.67	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-M	VMWM-110823-94	11/8/2023	3.33	< 0.500	0.485 J	< 0.500	< 0.500	
Upper	VMW-N	VMWN-020223-110.8	2/2/2023	4.74	< 0.500	0.738	< 0.500	< 0.500	
Upper	VMW-N	VMWN-050323-110.8	5/3/2023	0.597 J	< 0.500 J	< 0.500 J	< 0.500 J	< 0.500 J	
Upper	VMW-N	VMWN-080223	8/2/2023	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	
Upper	VMW-N	VMWN-110823-110.8	11/8/2023	5.71	0.500 J	0.951	< 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

ID = Identification

Table E-2
Trichloroethylene (TCE) Mass Removal - January 1998 through December 2023
Troutdale Sandstone Aquifer (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
Dec-22	1.43	503.31
Dec-23	1.36	504.67

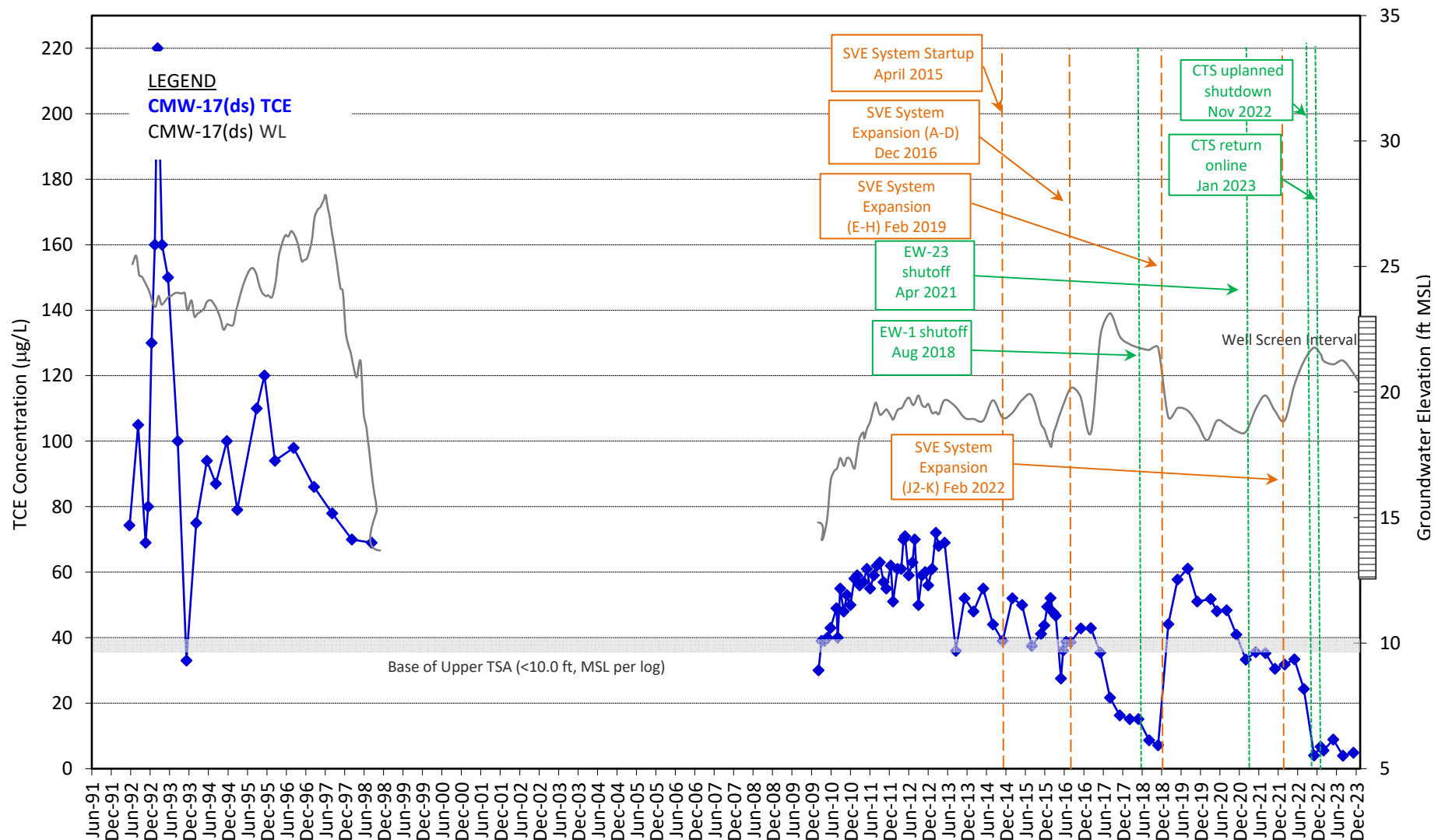
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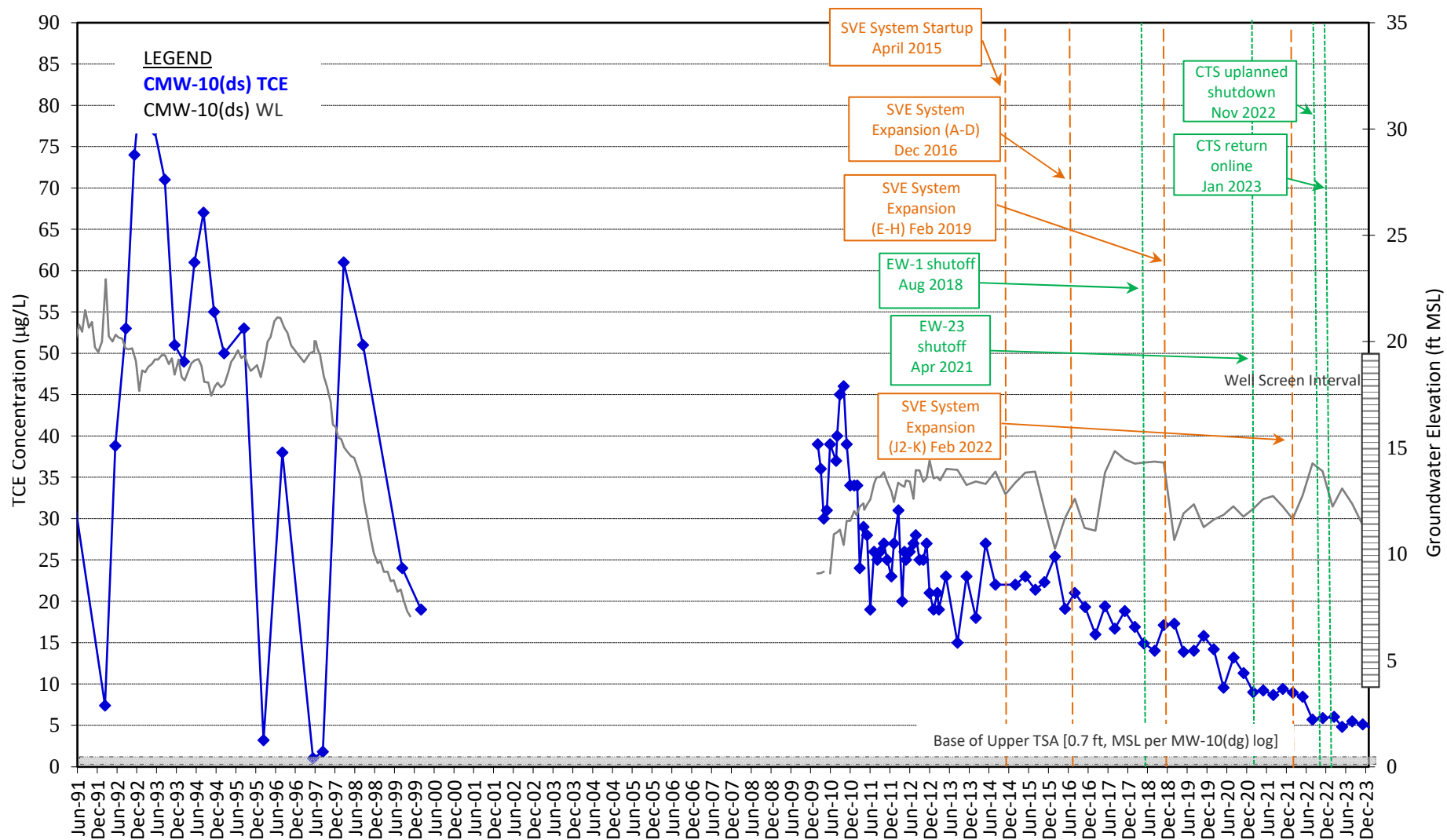
Table E-3
Trichloroethylene (TCE) Mass Removal Per Extraction Well
Troutdale Sandstone Aquifer (TSA) Remedy - East Multnomah County

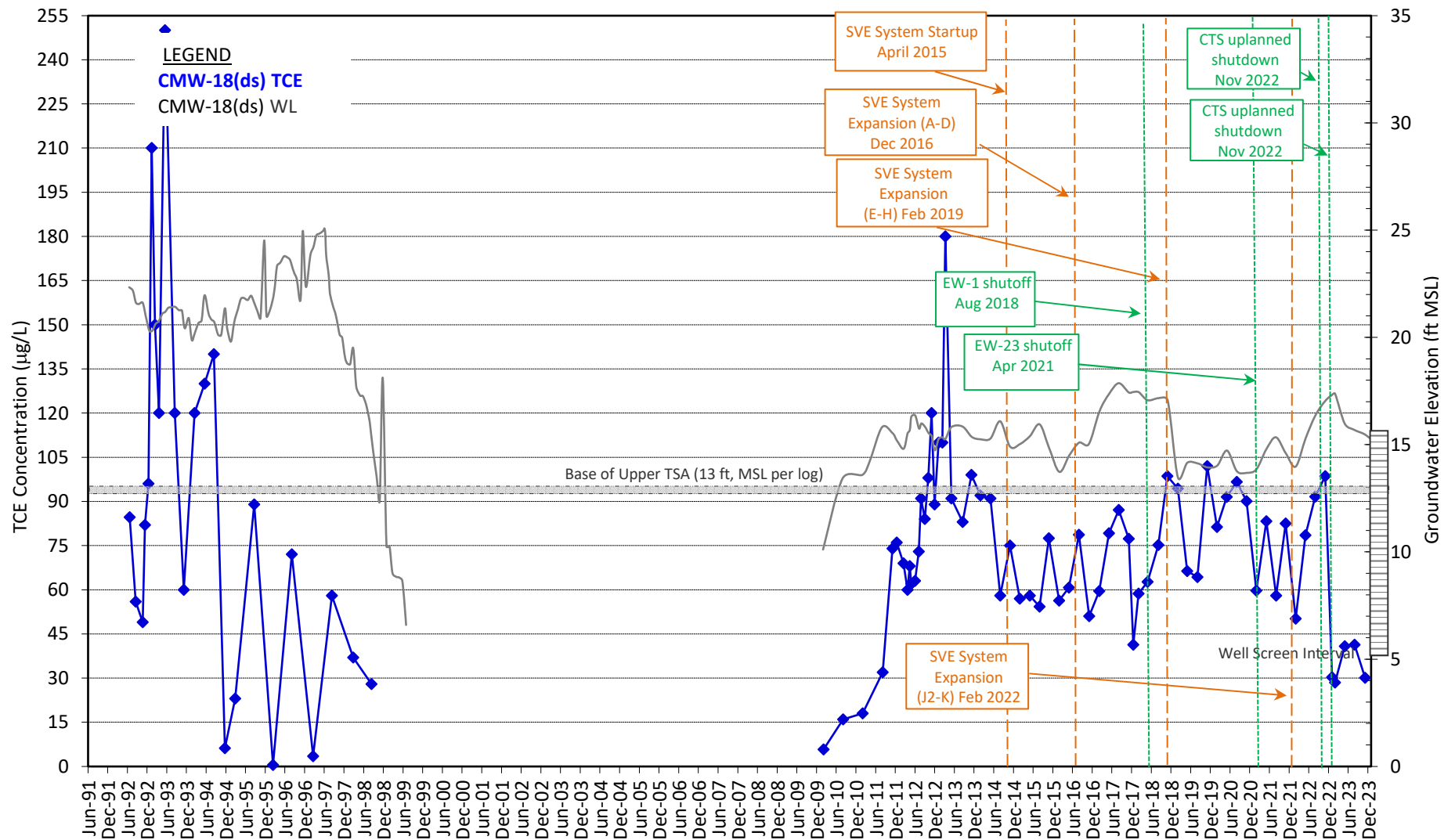
Date	Pounds of TCE Removed Per Well										
	EW-1	EW-2	EW-3	EW-13	EW-14	EW-15	EW-16	EW-18	EW-22	EW-23	Total
Mar 2008-Feb 2009	1.02	2.03	1.54	0.47	1.69	0.60	0.08	0.13	0.12	0.43	8.10
Mar 2009-Feb 2010	0.68	1.93	1.07	0.20	1.52	0.21	0.04	0.08	0.00	0.38	6.11
Mar 2010-Feb 2011	0.79	1.70			1.41	0.03	0.05			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
2022		0.95			0.48						1.43
2023		0.93			0.43						1.36
Total (5 years)	0.00	6.12	0.00	0.00	2.80	0.00	0.00	0.00	0.00	0.52	9.44
Total (10 years)	3.14	12.60	0.00	0.00	6.31	0.00	0.10	0.00	0.00	2.17	24.32

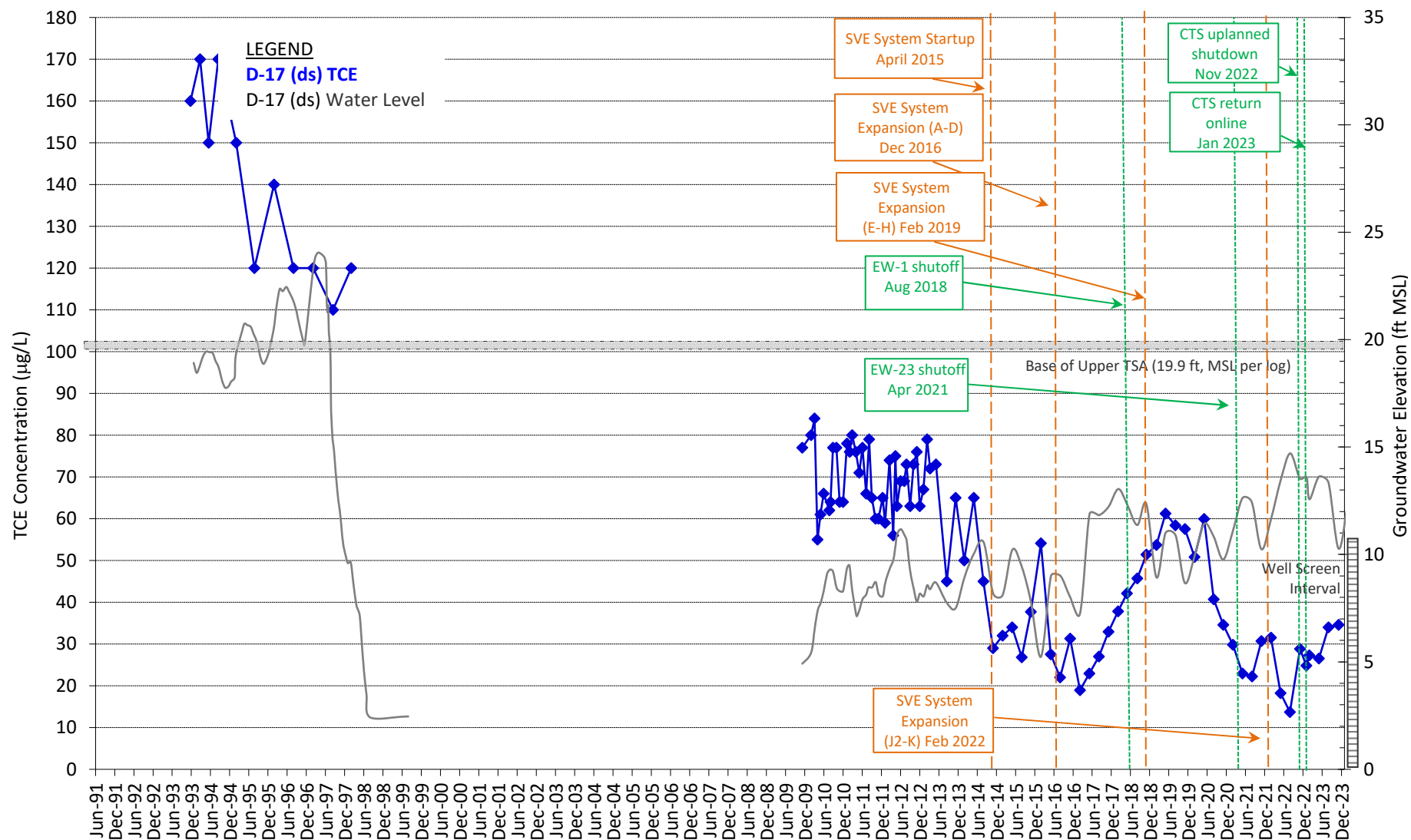
Notes

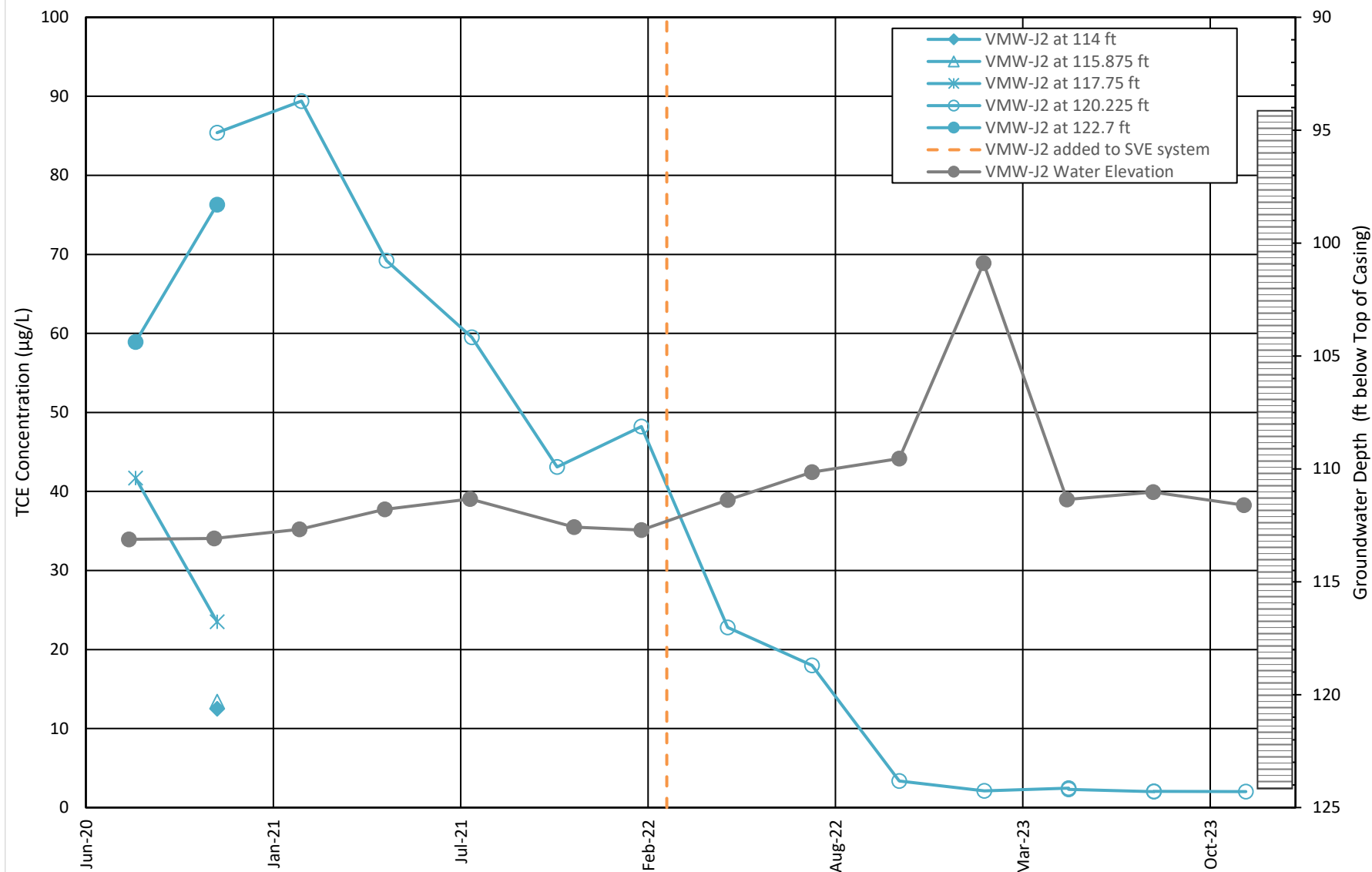
The amount of TCE removed by the extraction wells in the remedial systems was calculated using the average quarterly flow rates at each extraction well and the TCE concentration from samples collected on a quarterly basis. Note that the mass removal for 2018 was incorrectly reported as 1.28 pounds (lbs)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

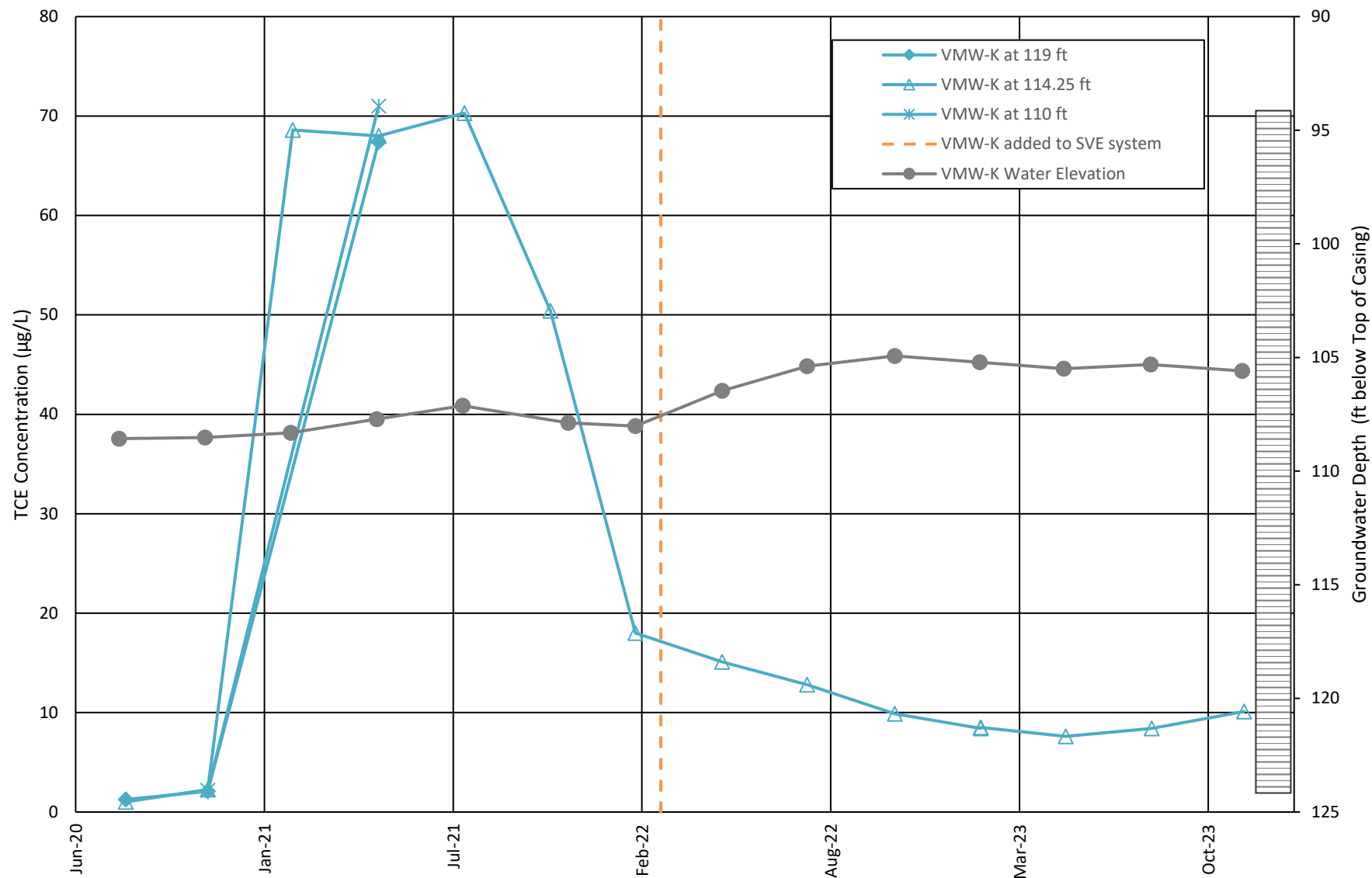


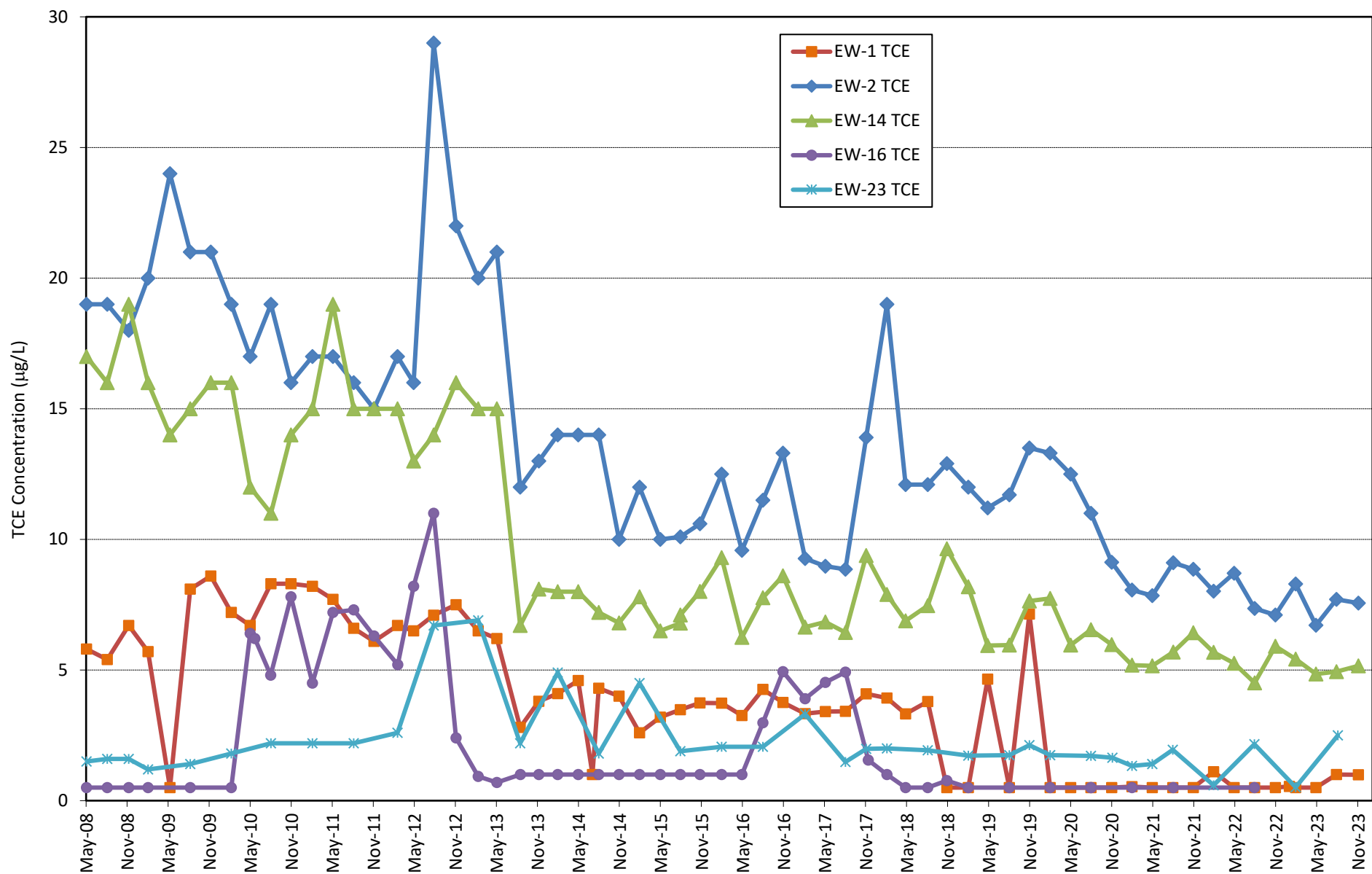


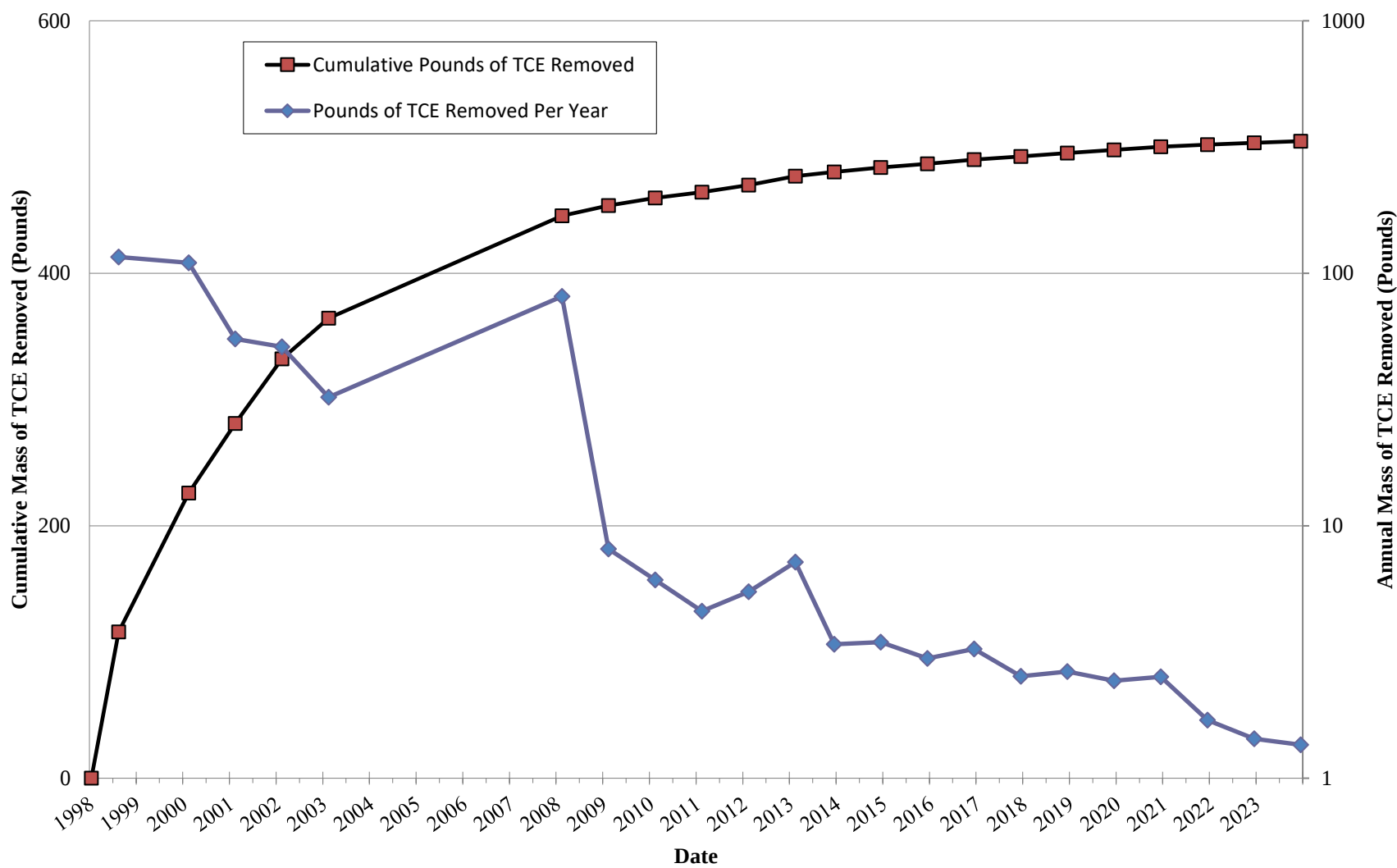


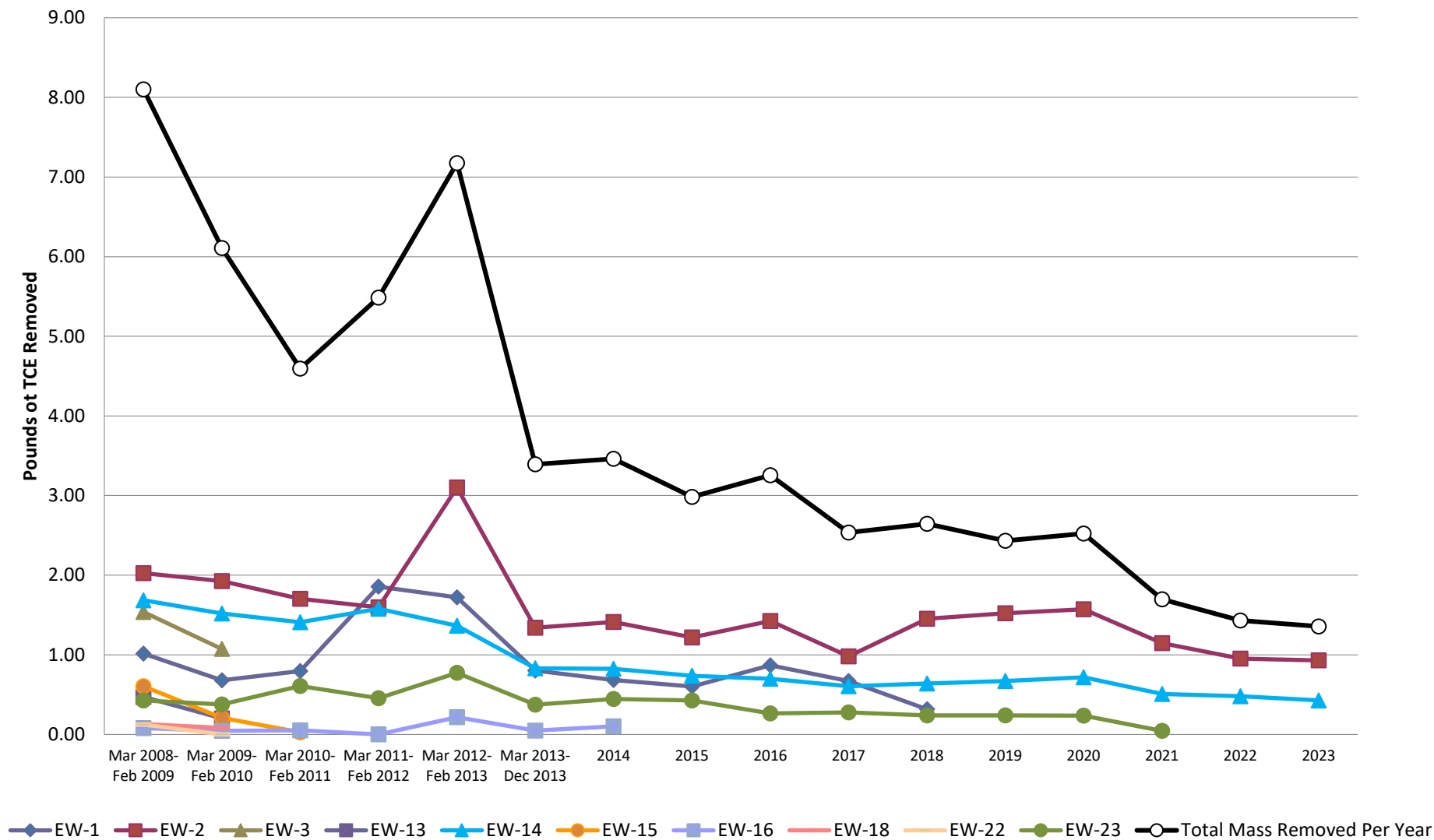












APPENDIX F

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: April 1, 2023
RE: Boeing Portland (TSA)
First Quarter 2023 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 5 groundwater samples and 1 trip blank collected during the first quarter 2023 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 410-114379-1. 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 2020). Landau Associates performed an EPA-equivalent Level IIa verification and validation check on each laboratory data package, which included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).
- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below. All data was found to be acceptable with no qualifications.

Chain-of-Custody Records

A signed chain-of-custody (COC) record was attached to the data package. 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 $\leq 6^{\circ}\text{C}$. 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-0223 / BOP-13ds-0223) was submitted for analysis with data package 410-114379-1.

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 for high for vinyl acetate associated with batch 410-344751. The affected compound was not detected in the associated samples at concentrations greater than the laboratory reporting limit; therefore, no qualification of the data was necessary.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.



Kristi Schultz
Senior Data Specialist



Danille Jorgensen
Environmental Data Manager

DRJ/kes
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References

EPA. 2020. National Functional Guidelines for Organic Superfund Methods Data Review. OLEM 9240.0-51; EPA-540-R-20-005. US Environmental Protection Agency. November.
https://www.epa.gov/sites/default/files/2021-03/documents/nfg_for_organic_superfund_methods_data_review_november_2020.pdf.



TECHNICAL MEMORANDUM

TO: Chris Kimmel, Project Manager
FROM: Kristi Schultz and Danille Jorgensen
DATE: September 1, 2023
RE: Boeing Portland (TSA)
Third Quarter 2023 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 third quarter 2023 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 410-137617-1. 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 2020). Landau Associates performed an EPA-equivalent Level IIa verification and validation check on each laboratory data package, which included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).
- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below. All data was found to be acceptable with no qualifications.

Chain-of-Custody Records

A signed chain-of-custody (COC) record was attached to the data package. 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 $\leq 6^{\circ}\text{C}$. 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-0823 / BOP-13dg-0823) was submitted for analysis with data package 410-114379-1.

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, with the following exception:

- The RPD for acetone was greater than the project-specified control limit. The associated sample results were qualified as estimated (J), as indicated in Table 1.

Quantitation Limits

Project-specified quantitation limits were met for all samples except for instances where high concentrations required dilution of the sample extracts.

Audit/Corrective Action Records

No audits were performed or required. No corrective action records were generated for this sample batch. Based on the laboratory's case narratives, continuing calibration verification (CCV) recovery results were within laboratory-specified control limits. No qualification of the data was necessary.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.



Kristi Schultz
Senior Data Specialist



Danille Jorgensen
Environmental Data Manager

DRJ/kes
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References

EPA. 2020. National Functional Guidelines for Organic Superfund Methods Data Review. OLEM 9240.0-51; EPA-540-R-20-005. US Environmental Protection Agency. November.
https://www.epa.gov/sites/default/files/2021-03/documents/nfg_for_organic_superfund_methods_data_review_november_2020.pdf.

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Sample Number	Analyte	Result	Lab Qualifier	Data Qualifier	Reason
410-137617-1	BOP-13dg-0823	Acetone	40.4		J	High field duplicate RPD
410-137617-1	BOP-Z-0823	Acetone	50.0		J	High field duplicate RPD

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.



TECHNICAL MEMORANDUM

TO: Chris Kimmel, Project Manager
FROM: Kristi Schultz and Danille Jorgensen
DATE: March 1, 2024
RE: Boeing Portland (TSA)
Fourth Quarter 2023 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 5 groundwater samples and 1 trip blank collected during the fourth quarter 2023 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 410-152705-1. 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 2020). 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 package. 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 $\leq 6^{\circ}\text{C}$. 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 for analytical batch 410-449952 were low for chloromethane. Associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.
- The CCV recoveries for batch 410-450419 were high for 2-hexanone and 4-methyl-2-pentanone. The affected compounds were not detected in the associated samples at concentrations greater than the laboratory reporting limit. No qualification of the data was necessary.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.



Kristi Schultz
Senior Data Specialist



Danille Jorgensen
Environmental Data Manager

DRJ/kes

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References

EPA. 2020. National Functional Guidelines for Organic Superfund Methods Data Review. OLEM 9240.0-51; EPA-540-R-20-005. US Environmental Protection Agency. November.
https://www.epa.gov/sites/default/files/2021-03/documents/nfg_for_organic_superfund_methods_data_review_november_2020.pdf.

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Sample Number	Analyte	Result	Lab Qualifier	Data Qualifier	Reason
410-152705-1	BOP-62ds-1123	Chloromethane	0.500	U	UJ	Low continuing calibration recovery
410-152705-1	BOP-65ds-1123	Chloromethane	0.500	U	UJ	Low continuing calibration recovery
410-152705-1	EW-13-1123	Chloromethane	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 analyzed for but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

Memorandum

Date: 02 June 2023
To: Cindy Bartlett, RG, LG
Geosyntec Consultants, Portland, Oregon
From: Anya Epstein
CC: K. Henderson
Subject: **Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1573136, L1582426, L1582434, and L1586976 and Eurofins Air Toxics Work Orders # 2301082, 2302203 and 2303234**

SITE: Cascade

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-seven groundwater samples, five field duplicates, and four trip blanks, collected 4 January 2023, 1-2 February 2023, and 16 February 2023, as well as fourteen soil vapor samples, collected on 4 January 2023, 2 February 2023 and 7 March 2023, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

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

- 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 Modified 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 are usable for supporting project objectives.

The data were reviewed based on the following document, 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 ID	Client ID
2301082-01A	SVE-EFF-010423
2301082-02A	VMWE-010423
2301082-03A	VMWJ2-010423
2301082-04A	VMWK-010423
2302203-01A	SVE-EFF-020223
2302203-02A	VW-17d-95.5-020223
2302203-03A	VMWC-020223-SV
2302203-04A	VMWE-020223-SV
2302203-05A	VMWF-020223
2302203-06A	VMWG-020223-SV
2302203-07A	VMWH-020223-SV
2302203-08A	VMWJ2-020223
2302203-09A	VMWK-020223
2303234-01A	SVE-EFF-030723
L1573136-01	CMW17DS-020123
L1573136-02	CMW17DS-020123-DUP
L1573136-03	EW1-010423
L1573136-04	D17DS-020123
L1573136-05	CMW18DS-010423
L1573136-06	CMW24DG-010423
L1573136-07	CMW25DG-010423
L1573136-08	CMW10DG-010423
L1573136-09	TRIPBLANK1-010423
L1582426-01	EW1-020123
L1582426-02	EW2-020123
L1582426-03	EW14-020123
L1582426-04	EW23-020123
L1582426-05	D17DG-020123
L1582426-06	D17DS-010423
L1582426-07	EW12-020123

Laboratory ID	Client ID
L1582426-08	CMW14RDS-020123
L1582426-09	CMW17DS-010423
L1582426-10	CMW17DS-010423-DUP
L1582426-11	CMW18DS-020123
L1582426-12	CMW18DS-020123-DUP
L1582426-14	CMW24DG-020123
L1582426-15	CMW25DG-020123
L1582426-16	VMWA-020223
L1582426-17	VMWB-020223
L1582426-18	VMWC-020223
L1582426-19	VMWD-020223
L1582426-20	VMWE-020223
L1582426-21	VMWG-020223
L1582426-22	VMWH-020223
L1582426-23	VMWI-020223-143.7
L1582426-24	VMWJ2-020223-120.25
L1582426-25	VMWK-020223-114.25
L1582426-26	VMWK-020223-114.25-DUP
L1582426-27	VMWL-020223-103.25
L1582426-28	VMWM-020223-94
L1582426-29	VMWN-020223-110.8
L1582426-30	TRIPBLANK2-020123
L1582426-31	VMWF-020123
L1582434-01	TS-C-EFF-020123
L1582434-02	TS-C-EFF-020123-DUP
L1582434-03	TS-C-INF-020123
L1582434-04	TRIPBLANK1-020123
L1586976-01	CMW19DS-021623
L1586976-02	CMW10DS-021623
L1586976-03	TRIPBLANK1-021623

The samples were received at the laboratory at 0.3 degrees Celsius (°C), 0.8 °C, and 3.5 °C, within the temperature criteria of 0-6 °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.

- L1582426, L1582434 and 2302203: Incorrect error corrections were observed on the COCs instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.
- L1573136: The sample relinquishing time was not noted on the COC.
- 2301082, 2302203, and 2303234: The sample relinquishing organization was not noted on the COCs.
- L1582426: Matrix and requested analyses were not recorded on the COC for sample TRIPBLANK2-020123, as the sample was recorded in the remarks section. The requested analysis was clarified via email.
- L1582426: Sample VMWF-020123 was not listed on COC. Sample information and requested analyses were confirmed with the Geosyntec project team via email.
- L1582426: Results for CMW-19ds were not reported. The Geosyntec project team confirmed via email that the requested analysis was cancelled due to issues with the field container labeling.

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

L1573136: The percent differences (%Ds) for hexachlorobutadiene (34.9%), 1,2,4-trichlorobenzene (36.1%), and naphthalene (28.7%) in the continuing calibration verification (CCV) in batch WG1984838 were biased low and outside the method specified acceptance criteria. Since validation criteria is not listed for hexachlorobutadiene and naphthalene, the %Ds were less than 40%, and based on professional and technical judgment, no qualifications were applied to the hexachlorobutadiene and naphthalene data. Since the %D for 1,2,4-trichlorobenzene was within the validation specified acceptance criteria of 40%D, and based on professional and technical judgment, no qualifications were applied to the 1,2,4-trichlorobenzene data.

L1573136: The relative response factor (RRF) for 1,2,3-trichlorobenzene (0.362) in the CCV in batch WG1984838 was low and outside the method specified acceptance criteria. Since the RRF was above the minimum validation specified acceptance criteria of 0.200, and based on professional and technical judgment, no qualifications were applied to the 1,2,3-trichlorobenzene data.

L1582426: The %Ds for acetone (35.6%), acrolein (51.6%), naphthalene (25.9%), and styrene (21.4%) in the CCV in batch WG2001210 were biased low and outside the method specified acceptance criteria. Since the %Ds for acetone and styrene were within the validation specified acceptance criteria of 40% and 25%, respectively, and based on professional and technical judgment, no qualifications were applied to the acetone and styrene data. Since validation criteria is not listed for naphthalene, the %D was less than 40%, and based on professional and technical judgment, no qualifications were applied to the naphthalene data. Since validation criteria is not listed for acrolein, the %D was greater than 40%, and based on professional and technical judgment, the non-detect acrolein results were UJ qualified as estimated less than the reported detection limit (RDL).

L1582426: The %Ds for acrolein (42.7%), naphthalene (37.2%), and 1,2,3-trichlorobenzene (21.7%) in the CCV in batch WG2001211 were biased low and outside the method specified acceptance criteria. Since validation criteria is not listed for naphthalene, the %D was less than 40%, and based on professional and technical judgment, no qualifications were applied to the

naphthalene data. Since the %D for 1,2,3-trichlorobenzene was within the validation specified acceptance criteria of 40%, and based on professional and technical judgment, no qualifications were applied to the 1,2,3-trichlorobenzene data. Since validation criteria is not listed for acrolein, the %D was greater than 40%, and based on professional and technical judgment, the non-detect acrolein results were UJ qualified as estimated less than the RDL.

L1582426: The %Ds for acetone (37%) and 2-butanone (26%) in the CCV in batch WG2001211 were biased high and outside the method specified acceptance criteria. Since the %D for acetone was within the validation specified acceptance criteria of 40%, and based on professional and technical judgment, no qualifications were applied to the acetone data. Since the %D for 2-butanone was within the validation specified acceptance criteria of 40%, and based on professional and technical judgment, no qualifications were applied to the 2-butanone data.

L1582426 and L1582434: The %Ds for bromomethane (methyl bromide) (44.8%) and naphthalene (20.7%) in the CCV in batch WG2001504 were biased low and outside the method specified acceptance criteria. Since validation criteria is not listed for naphthalene, the %D was less than 40%, and based on professional and technical judgment, no qualifications were applied to the naphthalene data. Since the %D for methyl bromide was outside the validation specified acceptance criteria of 40%, and based on professional and technical judgment, the non-detect methyl bromide results were UJ qualified as estimated less than the RDL.

L1586976: The %Ds for acrolein (24.6%), n-butylbenzene (25.5%), 1,2-dibromo-3-chloropropane (24.6%), naphthalene (34.1%), n-propylbenzene (22.3%), and 1,2,4-trimethylbenzene (21.1%) in the CCV in batch WG2009553 were biased low and outside the method specified acceptance criteria. Since validation criteria is not listed for acrolein, n-butylbenzene, naphthalene, and n-propylbenzene, the %Ds were less than 40%, and based on professional and technical judgment, no qualifications were applied to the acrolein, n-butylbenzene, naphthalene, and n-propylbenzene data. Since the %Ds for 1,2-dibromo-3-chloropropane and 1,2,4-trimethylbenzene were within the validation specified acceptance criteria of 40% and 30%, respectively, and based on professional and technical judgment, no qualifications were applied to the 1,2-dibromo-3-chloropropane and 1,2,4-trimethylbenzene data.

L1586976: The %D for trichloroethene (TCE) (24%) in batch WG2009553 was biased high and outside the method specified acceptance criteria. Since the %D for TCE was outside the validation specified acceptance criteria of 20%, and based on professional and technical judgment, the TCE concentration in sample CMW10DS-021623 was J qualified as estimated. Since TCE was not detected in the remainder of the associated samples, and based on professional and technical judgement, no qualifications were applied to the non-detect TCE results.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
CMW14RDS-020123	Acrolein	2.54	U,C3	2.54	UJ	9

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
CMW17DS-020123	Acrolein	2.54	U,C3	2.54	UJ	9
CMW25DG-020123	Acrolein	2.54	U,C3	2.54	UJ	9
D17DG-020123	Acrolein	2.54	U,C3	2.54	UJ	9
D17DS-020123	Acrolein	2.54	U,C3	2.54	UJ	9
EW1-020123	Acrolein	2.54	U,C3	2.54	UJ	9
EW12-020123	Acrolein	2.54	U,C3	2.54	UJ	9
EW14-020123	Acrolein	2.54	U,C3	2.54	UJ	9
EW2-020123	Acrolein	2.54	U,C3	2.54	UJ	9
EW23-020123	Acrolein	2.54	U,C3	2.54	UJ	9
TRIPBLANK2-020123	Acrolein	2.54	U,C3	2.54	UJ	9
VMWA-020223	Acrolein	2.54	U,C3	2.54	UJ	9
VMWB-020223	Acrolein	2.54	U,C3	2.54	UJ	9
VMWC-020223	Acrolein	2.54	U,C3	2.54	UJ	9
VMWD-020223	Acrolein	2.54	U,C3	2.54	UJ	9
VMWE-020223	Acrolein	2.54	U,C3	2.54	UJ	9
VMWG-020223	Acrolein	2.54	U,C3	2.54	UJ	9
VMWH-020223	Acrolein	2.54	U,C3	2.54	UJ	9
VMWI-020223-143.7	Acrolein	2.54	U,C3	2.54	UJ	9
VMWJ2-020223-120.25	Acrolein	2.54	U,C3	2.54	UJ	9
VMWK-020223-114.25	Acrolein	2.54	U,C3	2.54	UJ	9
VMWK-020223-114.25-DUP	Acrolein	2.54	U,C3	2.54	UJ	9
VMWL-020223-103.25	Acrolein	2.54	U,C3	2.54	UJ	9
VMWM-020223-94	Acrolein	2.54	U,C3	2.54	UJ	9
VMWN-020223-110.8	Acrolein	2.54	U,C3	2.54	UJ	9
CMW17DS-020123-DUP	Methyl Bromide	0.605	U,C3	0.605	UJ	9
CMW18DS-020123	Methyl Bromide	0.605	U,C3	0.605	UJ	9
CMW18DS-020123-DUP	Methyl Bromide	0.605	U,C3	0.605	UJ	9
CMW24DG-020123	Methyl Bromide	0.605	U,C3	0.605	UJ	9
TRIPBLANK1-020123	Methyl Bromide	0.605	U,C3	0.605	UJ	9
TS-C-EFF-020123	Methyl Bromide	0.605	U,C3	0.605	UJ	9
TS-C-EFF-020123-DUP	Methyl Bromide	0.605	U,C3	0.605	UJ	9
TS-C-INF-020123	Methyl Bromide	0.605	U,C3	0.605	UJ	9
CMW10DS-021623	Trichloroethene (TCE)	6.01	C5	6.01	J	9

µg/L - Microgram per liter

C3- Laboratory flag indicating the continuing calibration standard associated with this data responded low.

C5- Laboratory flag indicating the continuing calibration standard associated with this data responded high. Data is likely to show a high bias concerning the result.

U- The analyte was analyzed for, but was not detected at or above the reported sample quantitation limit

* - 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 WG1984838, WG2001210, WG2001211, WG2001504, WG2003073, and WG2009553). VOCs were not detected in the method blanks above the RDLs, with the following exception.

Naphthalene was detected at an estimated concentration greater than the method detection limit (MDL) and less than the RDL in the method blank in batch WG2001211. Since naphthalene was not detected in the associated samples, no qualifications were applied to the naphthalene data.

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

MS/MSD pairs were not reported. Precision and accuracy were assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pairs, with the following exception.

An LCS was analyzed for batch WG2001504, and batch-specific precision was not assessed.

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). One LCS and five 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 LCS/LCSD RPD for acetone, acrylonitrile, and 2-butanone (methyl ethyl ketone) in batch WG1984838 were high and outside of the laboratory specified acceptance criteria. Therefore, the acetone concentrations in the associated samples were J qualified as estimated; since acrylonitrile and methyl ethyl ketone were not detected in the associated samples, no qualifications were applied to the acrylonitrile and methyl ethyl ketone data.

One or both the recoveries of acrolein and diisopropyl ether in the LCS/LCSD in batch WG2003073 were high and outside of the laboratory specified acceptance criteria. Since acrolein and diisopropyl ether were not detected in the associated sample, no qualifications were applied to the data.

The LCS/LCSD RPD for dichlorodifluoromethane (Freon 12) in batch WG2009553 was high and outside of the laboratory specified acceptance criteria. Since Freon 12 was not detected in the associated samples, no qualifications were applied to the data.

The recovery of n-propylbenzene in the LCSD in batch WG2009553 was low and outside of the laboratory specified acceptance criteria. Therefore, the non-detect n-propylbenzene results in the associated samples were UJ qualified as estimated less than the RDL.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
CMW10DG-010423	Acetone	28	J3	28	J	5
CMW17DS-010423	Acetone	46	J3	46	J	5
CMW17DS-010423-DUP	Acetone	49.7	J3	49.7	J	5
CMW18DS-010423	Acetone	56.5	J3	56.5	J	5
CMW24DG-010423	Acetone	103	J3	103	J	5
CMW10DS-021623	n-Propylbenzene	0.5	U,C3 J4	0.5	UJ	5
CMW19DS-021623	n-Propylbenzene	0.5	U,C3 J4	0.5	UJ	5
TRIPBLANK1-021623	n-Propylbenzene	0.5	U,C3 J4	0.5	UJ	5

µg/L - Microgram per liter

C3- Laboratory flag indicating the continuing calibration standard associated with this data responded low.

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.

U- The analyte was analyzed for, but was not detected at or above the reported sample quantitation limit

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses with the following exception.

The recovery of surrogate 4-bromofluorobenzene was low and outside laboratory specified acceptance criteria in sample VMWH-020223. Since the recoveries of the other two surrogates were acceptable in the sample, and based on professional and technical judgment, no qualifications were applied to the data.

1.7 Trip Blank

Four trip blanks, identified as TRIPBLANK1-010423, TRIPBLANK1-020123, TRIPBLANK2-020123, and TRIPBLANK1-021623, were submitted with the sample sets. VOCs were not detected in the trip blanks above the RDLs.

1.8 Field Duplicate

Five field duplicates, CMW17DS-020123-DUP, CMW17DS-010423-DUP, CMW18DS-020123-DUP, VMWK-020223-114.25-DUP, and TS-C-EFF-020123-DUP were collected with the sample sets. Acceptable precision ($RPD \leq 30\%$) was demonstrated between the field duplicates and the original samples CMW17DS-020123, CMW17DS-010423, CMW18DS-020123, VMWK-020223-114.25, and TS-C-EFF-020123, respectively, with the following exception.

The RPD for tetrachloroethene (PCE) for field duplicate pair CMW18DS-020123/ CMW18DS-020123-DUP was greater than 30%. Therefore, the PCE concentrations in field duplicate pair CMW18DS-020123/ CMW18DS-020123-DUP were J qualified as estimated.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	RPD (%)	Validation Result (µg/L)	Validation Qualifier	Reason Code
CMW18DS-020123	Tetrachloroethene (PCE)	0.838	NA	31%	0.838	J	7
CMW18DS-020123-DUP	Tetrachloroethene (PCE)	0.614	NA		0.614	J	7

µg/L - Microgram per liter

NA-not applicable

1.9 Sensitivity

The 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 in the level II reports; both the RDLs and the method detection limits (MDLs) were listed in the EDDs. No other discrepancies were identified between the level II reports and the EDDs.

2.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA modified Method TO-15 using full scan mode.

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
- ✓ 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). Three method blanks were reported (batches 2301082-05A, 2302203-10A, and 2303234-02A). VOCs were not detected in the method blanks above the reporting limits (RLs).

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). Three 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.

The laboratory also reported CCV standards. The CCV recoveries were within the method 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 RLs. Elevated non-detect results were reported due to the sample 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. 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

Memorandum

Date: 26 September 2023
To: Cindy Bartlett, RG, LG
Geosyntec Consultants, Portland, Oregon
From: Ashley Wilson
CC: K. Henderson
Subject: **Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1612657 and L1612658 and Eurofins Air Toxics Work Orders #2304349, 2305366 and 2306413**

SITE: Cascade

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of twenty-five groundwater samples, three field duplicates and two trip blanks, collected 2-3 May 2023, as well as eleven soil vapor samples, collected on 11 April 2023, 9 May 2023 and 13 June 2023, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

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

- 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 Modified 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. If there are results with two or more different qualifications due to multiple QC failures, the final qualification is reconciled in the electronic data deliverable (EDD) with qualifications. The data

were reviewed based on the following document, 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
2304349-01A	SVE-EFF-041123
2305366-01A	SVE-EFF-050923
2305366-02A	VW-17d-95.5-050923
2305366-03A	VMWC-050923
2305366-04A	VMWE-050923
2305366-05A	VMWF-050923
2305366-06A	VMWG-050923
2305366-07A	VMWH-050923
2305366-08A	VMWJ2-050923
2305366-09A	VMWK-050923
2306413-01A	SVE-EFF-061323
L1612657-01	EW1-050223
L1612657-02	EW2-050223
L1612657-03	EW14-050223
L1612657-04	D17DG-050223
L1612657-05	D17DS-050223
L1612657-06	CMW10DS-050223
L1612657-07	CMW10DS-050223-DUP
L1612657-08	CMW17DS-050223
L1612657-09	CMW18DS-050223
L1612657-10	CMW19DS-050223

Laboratory IDs	Client IDs
L1612657-11	VMWA-050323
L1612657-12	VMWB-050323
L1612657-13	VMWC-050323
L1612657-14	VMWD-050323
L1612657-15	VMWE-050323
L1612657-16	VMWF-050323
L1612657-17	VMWG-050323
L1612657-18	VMWH-050323
L1612657-19	VMWI-050323-143.7
L1612657-20	VMWJ2-050323-120.25
L1612657-21	VMWJ2-050323-120.25-DUP
L1612657-22	VMWK-050323-114.25
L1612657-23	VMWL-050323-103.25
L1612657-24	VMWM-050323-94
L1612657-25	VMWN-050323-110.8
L1612657-26	TRIP1-050223
L1612658-01	TS-C-EFF-050223
L1612658-02	TS-C-EFF-050223-DUP
L1612658-03	TS-C-INF-050223
L1612658-04	TRIP1-050223

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

The laboratory reported results for the analytical method(s) requested for each sample on the chain of custody (COC). The following issues were noted on the COC. No qualifications were applied to the data based on the issues discussed below.

- L1612657: The laboratory noted that samples VMWG-050323 and VMWN-050323-110.8 were analyzed from headspace vials.

- L1612658: The laboratory noted that sample TRIP1-050223 was analyzed from a headspace vial.
- L1612657 and L1612658: Incorrect error corrections were observed on the COCs instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.
- L1612657 and L1612658: Trip blank, TRIP1-050223, was recorded on both COCs and reported in the two laboratory reports with different laboratory IDs.
- L1612657 and L1612658: A sample collection date and time for the trip blank were not documented on the COCs. The trip blank was logged by the laboratory with a sample collection time of 00:00.
- 2305366: The laboratory noted that the COC information for sample VW-17D-95.5-050923 did not match the entry on the sample tag with regard to sample identification. The information on the COC was used to process and report the sample.

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

L1612657: The percent differences (%Ds) for 1,1-dichloroethene (-21.1%), acetone (-27.7%), bromoform (-22.3%), methylene chloride (DCM) (-21.4%), carbon disulfide (-30.4%) +/-25.0%, naphthalene (-23.4%) +/-20.0%, trans-1,2-dichloroethene (-22.6%) +/-20.0%, trichloroethene (TCE) (-21.7%) +/-20.0% and butylbenzene (-29.2%) in the continuing calibration verification (CCV) in batch WG2055792 were low and outside the method specified acceptance criteria. Since the %Ds for 1,1-dichloroethene +/-25.0%D, acetone +/-40.0%D, bromoform +/-25.0%D and DCM +/-30.0%D were within the validation specified acceptance criteria, no qualifications were applied to the 1,1-dichloroethene, acetone, bromoform and DCM data. Since validation criteria is not listed for butylbenzene (-29.2%), the %D was less than 40% and based on professional and technical judgment, no qualifications were applied to the butylbenzene data. The %Ds for carbon disulfide +/-25.0%D, naphthalene +/-20.0%D, trans-1,2-dichloroethene +/-20.0%D and TCE +/-20.0%D were outside of the validation criteria. Therefore, the TCE concentrations in the associated samples were J qualified as estimated and the nondetect results for carbon disulfide, naphthalene and trans-1,2-dichloroethene were UJ qualified as estimated below the reported detection limit (RDL).

L1612657 and L1612658: The %D for 1,2-dibromo-3-chloropropane (-25.5%) in the CCV for batch WG2056127 was low and outside of the method specified acceptance criteria. Since the %D for 1,2-dibromo-3-chloropropane +/-30.0%D was within the validation specified acceptance criteria, no qualifications were applied to the 1,2-dibromo-3-chloropropane data.

L1612658: The %Ds for methyl bromide (24.5%) and butylbenzene (-26.1%) in the CCV for batch WG2059188 were low and outside of the method specified acceptance criteria. Since the %D for methyl bromide +/-40.0% was within the validation specified acceptance criteria, no qualifications were applied to the methyl bromide data. Since validation criteria is not listed for butylbenzene, the %D was less than 40% and based on professional and technical judgment, no qualifications were applied to the butylbenzene data.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
CMW10DS-050223	Carbon Disulfide	0.50	U,C3	0.50	UJ	9
CMW10DS-050223	Naphthalene	2.50	U,C3	2.50	UJ	9
CMW10DS-050223	trans-1,2-Dichloroethene	0.50	U,C3	0.50	UJ	9
CMW10DS-050223	Trichloroethene (TCE)	4.82	C3	4.82	J	9

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
CMW10DS-050223-DUP	Carbon Disulfide	0.50	U,C3	0.50	UJ	9
CMW10DS-050223-DUP	Naphthalene	2.50	U,C3	2.50	UJ	9
CMW10DS-050223-DUP	trans-1,2-Dichloroethene	0.50	U,C3	0.50	UJ	9
CMW10DS-050223-DUP	Trichloroethene (TCE)	4.75	C3	4.75	J	9
CMW17DS-050223	Carbon Disulfide	0.50	U,C3	0.50	UJ	9
CMW17DS-050223	Naphthalene	2.50	U,C3	2.50	UJ	9
CMW17DS-050223	trans-1,2-Dichloroethene	0.50	U,C3	0.50	UJ	9
CMW17DS-050223	Trichloroethene (TCE)	8.89	C3	8.89	J	9
D17DG-050223	Carbon Disulfide	0.50	U,C3	0.50	UJ	9
D17DG-050223	Naphthalene	2.50	U,C3	2.50	UJ	9
D17DG-050223	trans-1,2-Dichloroethene	0.50	U,C3	0.50	UJ	9
D17DG-050223	Trichloroethene (TCE)	1.72	C3	1.72	J	9
D17DS-050223	Carbon Disulfide	0.50	U,C3	0.50	UJ	9
D17DS-050223	Naphthalene	2.50	U,C3	2.50	UJ	9
D17DS-050223	trans-1,2-Dichloroethene	0.50	U,C3	0.50	UJ	9
D17DS-050223	Trichloroethene (TCE)	26.50	C3	26.50	J	9
EW1-050223	Carbon Disulfide	0.50	U,C3	0.50	UJ	9
EW1-050223	Naphthalene	2.50	U,C3	2.50	UJ	9
EW1-050223	trans-1,2-Dichloroethene	0.50	U,C3	0.50	UJ	9
EW1-050223	Trichloroethene (TCE)	0.50	U,C3	0.50	UJ	9
EW14-050223	Carbon Disulfide	0.50	U,C3	0.50	UJ	9
EW14-050223	Naphthalene	2.50	U,C3	2.50	UJ	9
EW14-050223	trans-1,2-Dichloroethene	0.50	U,C3	0.50	UJ	9
EW14-050223	Trichloroethene (TCE)	4.85	C3	4.85	J	9
EW2-050223	Carbon Disulfide	0.50	U,C3	0.50	UJ	9
EW2-050223	Naphthalene	2.50	U,C3	2.50	UJ	9
EW2-050223	trans-1,2-Dichloroethene	0.50	U,C3	0.50	UJ	9
EW2-050223	Trichloroethene (TCE)	6.71	C3	6.71	J	9

µg/l-microgram per liter

U-not detected at or above the RDL

C3-reported concentration is an estimate due to low response of the associated CCV standard

* 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 & Preservation

The holding time for the VOC analysis of a preserved groundwater sample is 14 days from collection to analysis void of headspace in the vial. The holding times and preservations were met for the sample analyses, with the following exceptions.

L1612657: The laboratory noted that samples VMWG-050323 and VMWN-050323-110.8 were analyzed from headspace vials. Therefore, the detected concentrations of VOCs in the associated were J qualified as estimated and the nondetect results were UJ qualified as estimated below the RDL. Qualifications table can be found in Appendix 1 at the end of this data validation report (DVR).

L1612658: The laboratory noted that sample TRIP1-050223 was analyzed from a headspace vial. Therefore, the nondetect results for the associated sample were UJ qualified as estimated below the RDL. Qualifications table can be found in Appendix 1 at the end of this DVR.

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 WG2055792, WG2056127, WG2057785 and WG2059188). VOCs were not detected in the method blanks at or above the RDLs, with the following exceptions.

Benzene and toluene were detected at estimated concentrations greater than the method detection limits (MDLs) and less than the RDLs in the method blank in batch WG2059188. Since these analytes were not detected in the associated sample, no qualifications were applied to the data.

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

MS/MSD pairs were not reported. Precision and accuracy were assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pair for batches WG2055792, WG2056127 and WG2059188. Precision data was not reported for batch WG2057785, based on professional and technical judgment, no qualifications were applied to the data.

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). One LCS and three 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 LCS recovery of butylbenzene in the LCS in batch WG2055792 was low and outside of the laboratory specified acceptance criteria. Therefore, the nondetect results for butylbenzene in the associated samples were UJ qualified as estimated below the RDL.

The recoveries of dichlorodifluoromethane and vinyl chloride in the LCS/LCSD pair in batch WG2056127 were high and outside of the laboratory specified acceptance criteria. Since dichlorodifluoromethane and vinyl 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
CMW10DS-050223	Butylbenzene	0.50	U,C3 J4	0.50	UJ	5
CMW10DS-050223-DUP	Butylbenzene	0.50	U,C3 J4	0.50	UJ	5
CMW17DS-050223	Butylbenzene	0.50	U,C3 J4	0.50	UJ	5
D17DG-050223	Butylbenzene	0.50	U,C3 J4	0.50	UJ	5
D17DS-050223	Butylbenzene	0.50	U,C3 J4	0.50	UJ	5
EW1-050223	Butylbenzene	0.50	U,C3 J4	0.50	UJ	5
EW14-050223	Butylbenzene	0.50	U,C3 J4	0.50	UJ	5
EW2-050223	Butylbenzene	0.50	U,C3 J4	0.50	UJ	5

µg/l-microgram per liter

U-not detected at or above the RDL

C3-reported concentration is an estimate due to low response of the associated CCV standard

J4-associated batch QC was outside the established quality control range for accuracy

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses, with the following exception.

The recovery of toluene-d8 was high and outside laboratory specified acceptance criteria in sample D17DS-050223. Since the recoveries of the other two surrogates were within laboratory limits in this sample, no qualifications were applied to the data, based on professional and technical judgment

1.7 Trip Blank

Two trip blanks, TRIP1-050223, were submitted with the sample sets using the same name. TRIP1-050223 was assigned two different laboratory identification numbers, L1612657-26 and L1612658-04. VOCs were not detected in the trip blanks above the RDLs.

1.8 Field Duplicate

Two field duplicates, CMW10DS-050223-DUP and TS-C-EFF-050223-DUP were collected with the sample sets. Acceptable precision ($RPD \leq 30\%$) was demonstrated between the field duplicates and the original samples CMW10DS-050223 and TS-C-EFF-050223, respectively.

1.9 Sensitivity

The 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 in the level II reports; both the RDLs and the MDLs were listed in the EDDs. No other discrepancies were identified between the level II reports and the EDDs.

2.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA modified Method TO-15 using full scan mode.

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
- ✓ 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). Three method blanks were reported (file names

22042506a, v052308a and 22062306e). VOCs were not detected in the method blanks at or above the reporting limits (RLs).

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). Three 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.

The laboratory also reported CCV standards. The CCV recoveries were within the method 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 RLs. Elevated non-detect results were reported due to the sample 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. No discrepancies were identified between the level II reports and the EDDs.

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

DATA QUALIFIER DEFINITIONS

- U The analyte was analyzed for, but was not detected above the reported sample quantitation limit. 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

APPENDIX 1

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
VMWG-050323	1,2,3-Trichloropropane	2.50	U	2.50	UJ	1
VMWG-050323	1,2,3-Trimethylbenzene	0.50	U	0.50	UJ	1
VMWG-050323	Acrolein	50.00	U	50.00	UJ	1
VMWG-050323	acrylonitrile	5.00	U	5.00	UJ	1
VMWG-050323	cis-1,3-Dichloropropene	0.50	U	0.50	UJ	1
VMWG-050323	Isopropylbenzene	0.50	U	0.50	UJ	1
VMWG-050323	1,1,1-Trichloroethane	0.50	U	0.50	UJ	1
VMWG-050323	1,1,2-Trichloroethane	0.50	U	0.50	UJ	1
VMWG-050323	1,1-dichloro-1-Propene	0.50	U	0.50	UJ	1
VMWG-050323	1,2,3-Trichlorobenzene	0.50	U	0.50	UJ	1
VMWG-050323	Acetone	25.00	U	25.00	UJ	1
VMWG-050323	Dibromomethane	0.50	U	0.50	UJ	1
VMWG-050323	1,1,1,2-Tetrachloroethane	0.50	U	0.50	UJ	1
VMWG-050323	1,1,2,2-Tetrachloroethane	0.50	U	0.50	UJ	1
VMWG-050323	1,2,4-Trichlorobenzene	1.00	U	1.00	UJ	1
VMWG-050323	1,2,4-Trimethylbenzene	0.50	U	0.50	UJ	1
VMWG-050323	1,2-Dibromo-3-Chloropropane	2.50	U,C3	2.50	UJ	1
VMWG-050323	1,2-Dibromoethane	0.50	U	0.50	UJ	1
VMWG-050323	1,2-Dichloroethane	0.50	U	0.50	UJ	1
VMWG-050323	1,2-Dichlorobenzene	0.50	U	0.50	UJ	1
VMWG-050323	1,2-Dichloropropane	0.50	U	0.50	UJ	1
VMWG-050323	1,3,5-Trimethylbenzene	0.50	U	0.50	UJ	1
VMWG-050323	1,3-Dichlorobenzene	0.50	U	0.50	UJ	1
VMWG-050323	1,3-Dichloropropane	1.00	U	1.00	UJ	1
VMWG-050323	1,4-Dichlorobenzene	0.50	U	0.50	UJ	1
VMWG-050323	2,2-Dichloropropane	0.50	U	0.50	UJ	1
VMWG-050323	Benzene	0.50	U	0.50	UJ	1
VMWG-050323	bromobenzene	0.50	U	0.50	UJ	1
VMWG-050323	Bromoform	0.50	U	0.50	UJ	1
VMWG-050323	Carbon Disulfide	0.50	U	0.50	UJ	1
VMWG-050323	Carbon Tetrachloride	0.50	U	0.50	UJ	1
VMWG-050323	Chlorobenzene	0.50	U	0.50	UJ	1
VMWG-050323	Chlorodibromomethane	0.50	U	0.50	UJ	1
VMWG-050323	Chloroform	0.50	U	0.50	UJ	1
VMWG-050323	cis-1,2-Dichloroethene	0.50	U	0.50	UJ	1
VMWG-050323	Dichlorobromomethane	0.50	U	0.50	UJ	1
VMWG-050323	1,1-Dichloroethane	0.50	U	0.50	UJ	1
VMWG-050323	1,1-Dichloroethene	0.50	U	0.50	UJ	1
VMWG-050323	Diisopropyl Ether	0.50	U	0.50	UJ	1
VMWG-050323	Ethylbenzene	0.50	U	0.50	UJ	1
VMWG-050323	Ethyl Chloride	2.50	U	2.50	UJ	1

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
VMWG-050323	Freon 11	2.50	U	2.50	UJ	1
VMWG-050323	Freon 113	0.50	U	0.50	UJ	1
VMWG-050323	Freon 12	2.50	U,J4	2.50	UJ	1
VMWG-050323	Hexachlorobutadiene (HCBd)	1.00	U	1.00	UJ	1
VMWG-050323	Methyl Bromide	2.50	U	2.50	UJ	1
VMWG-050323	Chloromethane	1.25	U	1.25	UJ	1
VMWG-050323	Methyl ethyl ketone	5.00	U	5.00	UJ	1
VMWG-050323	Methyl Isobutyl Ketone (MIBK)	5.00	U	5.00	UJ	1
VMWG-050323	Methyl tert-Butyl Ether (MTBE)	0.50	U	0.50	UJ	1
VMWG-050323	Methylene Chloride (DCM)	2.50	U	2.50	UJ	1
VMWG-050323	Naphthalene	2.50	U	2.50	UJ	1
VMWG-050323	Butylbenzene	0.50	U	0.50	UJ	1
VMWG-050323	n-Propylbenzene	0.50	U	0.50	UJ	1
VMWG-050323	o-Chlorotoluene	0.50	U	0.50	UJ	1
VMWG-050323	p-Chlorotoluene	0.50	U	0.50	UJ	1
VMWG-050323	p-Cymene	0.50	U	0.50	UJ	1
VMWG-050323	sec-Butylbenzene	0.50	U	0.50	UJ	1
VMWG-050323	Styrene	0.50	U	0.50	UJ	1
VMWG-050323	tert-Butylbenzene	0.50	U	0.50	UJ	1
VMWG-050323	Tetrachloroethene (PCE)	0.50	U	0.50	UJ	1
VMWG-050323	Toluene	0.50	U	0.50	UJ	1
VMWG-050323	trans-1,2-Dichloroethene	0.50	U	0.50	UJ	1
VMWG-050323	trans-1,3-Dichloropropene	0.50	U	0.50	UJ	1
VMWG-050323	Trichloroethene (TCE)	2.78	NA	2.78	J	1
VMWG-050323	Vinyl Chloride	0.50	U,J4	0.50	UJ	1
VMWG-050323	Xylenes, Total	1.50	U	1.50	UJ	1
VMWN-050323-110.8	1,1,1,2-Tetrachloroethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,2,3-Trichloropropane	2.50	U	2.50	UJ	1
VMWN-050323-110.8	1,2,3-Trimethylbenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Acetone	225.00	NA	225.00	J	1
VMWN-050323-110.8	Acrolein	50.00	U	50.00	UJ	1
VMWN-050323-110.8	cis-1,3-Dichloropropene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Isopropylbenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,1,1-Trichloroethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,1,2,2-Tetrachloroethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,1,2-Trichloroethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,1-dichloro-1-Propene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,2,3-Trichlorobenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,2,4-Trichlorobenzene	1.00	U	1.00	UJ	1
VMWN-050323-110.8	Dibromomethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,2,4-Trimethylbenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,2-Dibromo-3-Chloropropane	2.50	U,C3	2.50	UJ	1

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
VMWN-050323-110.8	1,2-Dibromoethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,2-Dichloroethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,2-Dichlorobenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,2-Dichloropropane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,3,5-Trimethylbenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,3-Dichlorobenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,3-Dichloropropane	1.00	U	1.00	UJ	1
VMWN-050323-110.8	1,4-Dichlorobenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	2,2-Dichloropropane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	acrylonitrile	5.00	U	5.00	UJ	1
VMWN-050323-110.8	Benzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	bromobenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Bromoform	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Carbon Disulfide	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Carbon Tetrachloride	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Chlorobenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Chlorodibromomethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Chloroform	0.69	NA	0.69	J	1
VMWN-050323-110.8	cis-1,2-Dichloroethene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Dichlorobromomethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,1-Dichloroethane	0.50	U	0.50	UJ	1
VMWN-050323-110.8	1,1-Dichloroethene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Diisopropyl Ether	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Ethylbenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Ethyl Chloride	2.50	U	2.50	UJ	1
VMWN-050323-110.8	Freon 11	2.50	U	2.50	UJ	1
VMWN-050323-110.8	Freon 113	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Freon 12	2.50	U,J4	2.50	UJ	1
VMWN-050323-110.8	Hexachlorobutadiene (HCBd)	1.00	U	1.00	UJ	1
VMWN-050323-110.8	Methyl Bromide	2.50	U	2.50	UJ	1
VMWN-050323-110.8	Chloromethane	1.25	U	1.25	UJ	1
VMWN-050323-110.8	Methyl ethyl ketone	5.00	U	5.00	UJ	1
VMWN-050323-110.8	Methyl Isobutyl Ketone (MIBK)	5.00	U	5.00	UJ	1
VMWN-050323-110.8	Methyl tert-Butyl Ether (MTBE)	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Methylene Chloride (DCM)	2.50	U	2.50	UJ	1
VMWN-050323-110.8	Naphthalene	2.50	U	2.50	UJ	1
VMWN-050323-110.8	Butylbenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	n-Propylbenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	o-Chlorotoluene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	p-Chlorotoluene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	p-Cymene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	sec-Butylbenzene	0.50	U	0.50	UJ	1

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
VMWN-050323-110.8	Styrene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	tert-Butylbenzene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Tetrachloroethene (PCE)	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Toluene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	trans-1,2-Dichloroethene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	trans-1,3-Dichloropropene	0.50	U	0.50	UJ	1
VMWN-050323-110.8	Trichloroethene (TCE)	0.60	NA	0.60	J	1
VMWN-050323-110.8	Vinyl Chloride	0.50	U,J4	0.50	UJ	1
VMWN-050323-110.8	Xylenes, Total	1.50	U	1.50	UJ	1
TRIP1-050223	Acetone	25.00	U	25.00	UJ	1
TRIP1-050223	Acrolein	50.00	U	50.00	UJ	1
TRIP1-050223	acrylonitrile	5.00	U	5.00	UJ	1
TRIP1-050223	Benzene	0.50	U	0.50	UJ	1
TRIP1-050223	bromobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Dichlorobromomethane	0.50	U	0.50	UJ	1
TRIP1-050223	Bromoform	0.50	U	0.50	UJ	1
TRIP1-050223	Methyl Bromide	2.50	U	2.50	UJ	1
TRIP1-050223	Butylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	sec-Butylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	tert-Butylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Carbon Disulfide	0.50	U	0.50	UJ	1
TRIP1-050223	Carbon Tetrachloride	0.50	U	0.50	UJ	1
TRIP1-050223	Chlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Chlorodibromomethane	0.50	U	0.50	UJ	1
TRIP1-050223	Ethyl Chloride	2.50	U	2.50	UJ	1
TRIP1-050223	Chloroform	0.50	U	0.50	UJ	1
TRIP1-050223	Chloromethane	1.25	U	1.25	UJ	1
TRIP1-050223	o-Chlorotoluene	0.50	U	0.50	UJ	1
TRIP1-050223	p-Chlorotoluene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2-Dibromo-3-Chloropropane	2.50	U,C3	2.50	UJ	1
TRIP1-050223	1,2-Dibromoethane	0.50	U	0.50	UJ	1
TRIP1-050223	Dibromomethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,2-Dichlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,3-Dichlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,4-Dichlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Freon 12	2.50	U,J4	2.50	UJ	1
TRIP1-050223	1,1-Dichloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,2-Dichloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,1-Dichloroethene	0.50	U	0.50	UJ	1
TRIP1-050223	cis-1,2-Dichloroethene	0.50	U	0.50	UJ	1
TRIP1-050223	trans-1,2-Dichloroethene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2-Dichloropropane	0.50	U	0.50	UJ	1
TRIP1-050223	1,1-dichloro-1-Propene	0.50	U	0.50	UJ	1
TRIP1-050223	1,3-Dichloropropane	1.00	U	1.00	UJ	1

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
TRIP1-050223	cis-1,3-Dichloropropene	0.50	U	0.50	UJ	1
TRIP1-050223	trans-1,3-Dichloropropene	0.50	U	0.50	UJ	1
TRIP1-050223	2,2-Dichloropropane	0.50	U	0.50	UJ	1
TRIP1-050223	Diisopropyl Ether	0.50	U	0.50	UJ	1
TRIP1-050223	Ethylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Hexachlorobutadiene (HCBD)	1.00	U	1.00	UJ	1
TRIP1-050223	Isopropylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	p-Cymene	0.50	U	0.50	UJ	1
TRIP1-050223	Methyl ethyl ketone	5.00	U	5.00	UJ	1
TRIP1-050223	Methylene Chloride (DCM)	2.50	U	2.50	UJ	1
TRIP1-050223	Methyl Isobutyl Ketone (MIBK)	5.00	U	5.00	UJ	1
TRIP1-050223	Methyl tert-Butyl Ether (MTBE)	0.50	U	0.50	UJ	1
TRIP1-050223	Naphthalene	2.50	U	2.50	UJ	1
TRIP1-050223	n-Propylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Styrene	0.50	U	0.50	UJ	1
TRIP1-050223	1,1,1,2-Tetrachloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,1,2,2-Tetrachloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	Freon 113	0.50	U	0.50	UJ	1
TRIP1-050223	Tetrachloroethene (PCE)	0.50	U	0.50	UJ	1
TRIP1-050223	Toluene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2,3-Trichlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2,4-Trichlorobenzene	1.00	U	1.00	UJ	1
TRIP1-050223	1,1,1-Trichloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,1,2-Trichloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	Trichloroethene (TCE)	0.50	U	0.50	UJ	1
TRIP1-050223	Freon 11	2.50	U	2.50	UJ	1
TRIP1-050223	1,2,3-Trichloropropane	2.50	U	2.50	UJ	1
TRIP1-050223	1,2,4-Trimethylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2,3-Trimethylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,3,5-Trimethylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Vinyl Chloride	0.50	U,J4	0.50	UJ	1
TRIP1-050223	Xylenes, Total	1.50	U	1.50	UJ	1
TRIP1-050223	Acetone	25.00	U	25.00	UJ	1
TRIP1-050223	Acrolein	50.00	U	50.00	UJ	1
TRIP1-050223	acrylonitrile	5.00	U	5.00	UJ	1
TRIP1-050223	Benzene	0.50	U	0.50	UJ	1
TRIP1-050223	bromobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Dichlorobromomethane	0.50	U	0.50	UJ	1
TRIP1-050223	Bromoform	0.50	U	0.50	UJ	1
TRIP1-050223	Methyl Bromide	2.50	U	2.50	UJ	1
TRIP1-050223	Butylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	sec-Butylbenzene	0.50	U	0.50	UJ	1

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
TRIP1-050223	tert-Butylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Carbon Disulfide	0.50	U	0.50	UJ	1
TRIP1-050223	Carbon Tetrachloride	0.50	U	0.50	UJ	1
TRIP1-050223	Chlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Chlorodibromomethane	0.50	U	0.50	UJ	1
TRIP1-050223	Ethyl Chloride	2.50	U	2.50	UJ	1
TRIP1-050223	Chloroform	0.50	U	0.50	UJ	1
TRIP1-050223	Chloromethane	1.25	U	1.25	UJ	1
TRIP1-050223	o-Chlorotoluene	0.50	U	0.50	UJ	1
TRIP1-050223	p-Chlorotoluene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2-Dibromo-3-Chloropropane	2.50	U,C3	2.50	UJ	1
TRIP1-050223	1,2-Dibromoethane	0.50	U	0.50	UJ	1
TRIP1-050223	Dibromomethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,2-Dichlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,3-Dichlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,4-Dichlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Freon 12	2.50	U,J4	2.50	UJ	1
TRIP1-050223	1,1-Dichloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,2-Dichloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,1-Dichloroethene	0.50	U	0.50	UJ	1
TRIP1-050223	cis-1,2-Dichloroethene	0.50	U	0.50	UJ	1
TRIP1-050223	trans-1,2-Dichloroethene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2-Dichloropropane	0.50	U	0.50	UJ	1
TRIP1-050223	1,1-dichloro-1-Propene	0.50	U	0.50	UJ	1
TRIP1-050223	1,3-Dichloropropane	1.00	U	1.00	UJ	1
TRIP1-050223	cis-1,3-Dichloropropene	0.50	U	0.50	UJ	1
TRIP1-050223	trans-1,3-Dichloropropene	0.50	U	0.50	UJ	1
TRIP1-050223	2,2-Dichloropropane	0.50	U	0.50	UJ	1
TRIP1-050223	Diisopropyl Ether	0.50	U	0.50	UJ	1
TRIP1-050223	Ethylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Hexachlorobutadiene (HCBD)	1.00	U	1.00	UJ	1
TRIP1-050223	Isopropylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	p-Cymene	0.50	U	0.50	UJ	1
TRIP1-050223	Methyl ethyl ketone	5.00	U	5.00	UJ	1
TRIP1-050223	Methylene Chloride (DCM)	2.50	U	2.50	UJ	1
TRIP1-050223	Methyl Isobutyl Ketone (MIBK)	5.00	U	5.00	UJ	1
TRIP1-050223	Methyl tert-Butyl Ether (MTBE)	0.50	U	0.50	UJ	1
TRIP1-050223	Naphthalene	2.50	U	2.50	UJ	1
TRIP1-050223	n-Propylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Styrene	0.50	U	0.50	UJ	1
TRIP1-050223	1,1,1,2-Tetrachloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,1,2,2-Tetrachloroethane	0.50	U	0.50	UJ	1

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
TRIP1-050223	Freon 113	0.50	U	0.50	UJ	1
TRIP1-050223	Tetrachloroethene (PCE)	0.50	U	0.50	UJ	1
TRIP1-050223	Toluene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2,3-Trichlorobenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2,4-Trichlorobenzene	1.00	U	1.00	UJ	1
TRIP1-050223	1,1,1-Trichloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	1,1,2-Trichloroethane	0.50	U	0.50	UJ	1
TRIP1-050223	Trichloroethene (TCE)	0.50	U	0.50	UJ	1
TRIP1-050223	Freon 11	2.50	U	2.50	UJ	1
TRIP1-050223	1,2,3-Trichloropropane	2.50	U	2.50	UJ	1
TRIP1-050223	1,2,4-Trimethylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,2,3-Trimethylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	1,3,5-Trimethylbenzene	0.50	U	0.50	UJ	1
TRIP1-050223	Vinyl Chloride	0.50	U,J4	0.50	UJ	1
TRIP1-050223	Xylenes, Total	1.50	U	1.50	UJ	1

µg/l-microgram per liter

U-not detected at or above the RDL

C3-reported concentration is an estimate due to low response of the associated CCV standard

J4-associated batch QC was outside the established quality control range for accuracy

NA-not applicable

Memorandum

Date: 27 October 2023
To: Cindy Bartlett, RG, LG
Geosyntec Consultants, Portland, Oregon
From: Derek Yeadon
CC: K. Henderson
Subject: **Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1642307, 1642328, and L1644259, and Eurofins Air Toxics Work Orders #2307203, 2308236, and 2309294**

SITE: Cascade

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-three groundwater samples, four field duplicates and two trip blanks, collected 1-2 August 2023 and 8 August 2023, as well as eleven soil vapor samples, collected on 11 July 2023, 8 August 2023, and 12 September 2023, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

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

- 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 Modified 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. If there are results with two or more different qualifications due to multiple QC failures, the final

qualification is reconciled in the electronic data deliverable (EDD) with qualifications. The data were reviewed based on the following document, 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
2307203-01A	SVE-EFF-071123
2308236-01A	SVE-EFF-080823
2308236-02A	VW-17d95.5-080823
2308236-03A	VMWJ2-080823
2308236-04A	VMWK-080823
2308236-05A	VMWH-080823
2308236-06A	VMWC-080823
2308236-07A	VMWG-080823
2308236-08A	VMWF-080823
2308236-09A	VMWE-080823
2309294-01A	SVE-EFF-091223
L1642307-01	EW1-080223
L1642307-02	EW2-080223
L1642307-03	EW14-080223
L1642307-04	D17DG-080123
L1642307-05	D17DS-080123
L1642307-06	EW11-080123
L1642307-07	EW12-080123
L1642307-08	CMW10DS-080123
L1642307-09	CMW14RDS-080123
L1642307-10	CMW17DS-080223
L1642307-11	CMW18DS-080123
L1642307-12	CMW18DS-080123-DUP
L1642307-13	CMW19DS-080123
L1642307-14	CMW20DS-080123

Laboratory IDs	Client IDs
L1642307-15	CMW22DG-080123
L1642307-16	CMW24DG-080123
L1642307-17	CMW25DG-080123
L1642307-18	VMWA-080223
L1642307-19	VMWB-080223
L1642307-20	VMWC-080223
L1642307-21	VMWD-080223
L1642307-22	VMWE-080223
L1642307-23	VMWF-080223
L1642307-24	VMWG-080223
L1642307-25	VMWH-080223
L1642307-26	VMWI-080223
L1642307-27	VMWI-080223-DUP
L1642307-28	VMWJ2-080223
L1642307-29	VMWJ2-080223-DUP
L1642307-30	VMWK-080223
L1642307-31	VMWL-080223
L1642307-32	VMWM-080223
L1642307-33	VMWN-080223
L1642307-34	TRIP BLANK LOT#504
L1642328-01	TS-C-EFF-080223
L1642328-02	TS-C-EFF-080223-DUP
L1642328-03	TS-C-INF-080223
L1644259-01	EW23-080823
L1644259-02	TRIP BLANK #489

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

The laboratory reported results for the analytical method(s) requested for each sample on the chain of custody (COC). The following issues were noted on the COC. No qualifications were applied to the data based on the issues discussed below.

- L1642307 and L1642328: Incorrect error corrections were observed on the COCs instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.
- L1642307: Number of containers for samples CMW10DS-080123 and CMW14RDS-080123 were not circled on COC.
- L1642307 and L1642328: Trip blank, TRIP BLANK LOT#504, was recorded on both COCs but results were not included in the report for L1642328.
- L1642307, L1642328, and L1644259: Sample collection time for the trip blanks were not documented on the COCs. The trip blanks were each logged by the laboratory with a sample collection time of 00:00.

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 and Preservation
- ✓ 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

L1642307: The percent difference (%D) (20.8%) for naphthalene in the continuing calibration verification (CCV) in batch WG2108372 was outside the method specified acceptance criteria. Since validation criteria is not listed for naphthalene, and the %D was within the criteria of $\pm 40\%$ and based on professional and technical judgment, no qualifications were applied to the data.

L1642307: The %Ds for bromoform (23.0%), bromomethane (32.5%), 1,2-dibromo-3-chloropropane (23.9%), and methylene chloride (17.4%) in the CCV in batch WG2108561 were outside the method specified acceptance criteria. The validation specified criteria for bromoform bromomethane, 1,2-dibromo-3-chloropropane are $\pm 25.0\%$, $\pm 40.0\%$ and $\pm 30.0\%$, respectively. Since the %Ds of bromoform, bromomethane and methylene chloride were within the validation specified acceptance criteria and based on professional and technical judgment, no qualifications were applied to the data.

L1642307 and L1642328: The %Ds for acrylonitrile (21.8%) and naphthalene (31.8%) in the CCV in batch WG2108712 were outside the method specified acceptance criteria. Since validation criteria is not listed for acrolein and naphthalene, and the %Ds were less than 40% and based on professional and technical judgment, no qualifications were applied to the data.

L1644259: The %D for acrolein (40.5%) in the CCV in batch WG2112324 was outside the method specified acceptance criteria. Since validation criteria is not listed for acrolein, the %D was less than 40% and based on professional and technical judgment, no qualifications were applied to the data.

1.2 Holding Time & Preservation

The holding time for the VOC analysis of a preserved groundwater sample is 14 days from collection to analysis void of headspace in the vial. The holding times and preservations 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 WG2108372,

WG2108561, WG2108712 and WG2112324). VOCs were not detected in the method blanks at or above the reported detection limits (RDLs).

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

MS/MSD pairs were not reported. Precision and accuracy were assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pair for batches WG2108372, WG2108561, WG2108712 and WG2112324. No qualifications were applied to the data.

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/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 for trans-1,2-dichloroethene and 1,1,2-trichlorofluoroethane in the LCSD in batch WG2108372 were high and outside of the laboratory specified acceptance criteria. Since trans-1,2-dichloroethene and 1,1,2-trichlorofluoroethane were not detected in the associated samples, no qualifications were applied to the data.

The RPDs of acrolein, 1,1,2,2-tetrachloroethene, and trichloroethene in the LCS/LCSD pair in batch WG2112324 were high and outside of the laboratory specified acceptance criteria. Since acrolein and 1,1,2,2-tetrachloroethene were not detected in the associated samples, no qualifications were applied to the acrolein and 1,1,2,2-tetrachloroethene data. Since trichloroethene was detected in sample EW23-080823, the trichloroethene result was J qualified as estimated.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
EW23-080823	Trichloroethene	2.50	U,C3 J4	0.50	UJ	5

µg/l-microgram per liter

U-not detected at or above the RDL

C3-laboratory flag is an estimate due to low response of the associated CCV standard

J4-associated batch QC was outside the established quality control range for accuracy

* Validation qualifiers are defined in Attachment 1 at the end of this report

**Reason codes are defined in Attachment 2 at the end of this report

1.6 **Surrogates**

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

Two trip blanks, TRIP BLANK LOT#504 and TRIP BLANK #489, were submitted with the sample sets using the same name. TRIP BLANK LOT#504 and TRIP BLANK #489 were assigned the laboratory identification numbers L1642307-34 and L1644259-02, respectively. VOCs were not detected in the trip blanks above the RDLs.

1.8 Field Duplicate

Four field duplicates (CMW18DS-080123-DUP, VMWI-080223-DUP, VMWJ2-080223-DUP, and TS-C-EFF-080223-DUP) were collected with the sample sets. Acceptable precision ($RPD \leq 30\%$) was demonstrated between the field duplicates and the original samples CMW18DS-080123, VMWI-080223, VMWJ2-080223, and TS-C-EFF-080223, respectively.

1.9 Sensitivity

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

1.10 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the RDLs in the level II reports; both the RDLs and the MDLs were listed in the EDDs. No other discrepancies were identified between the level II reports and the EDDs.

2.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA modified Method TO-15 using full scan mode.

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
- ✓ 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 (file names v072409d, 60081507c, 20081707c, and 21092506c). VOCs were not detected in the method blanks at or above the reporting limits (RLs).

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). Three 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.

The laboratory also reported CCV standards. The CCV recoveries were within the method 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 RLs. Elevated non-detect results were reported due to the sample 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. 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

Memorandum

Date: 16 February 2024
To: Cindy Bartlett, RG, LG
Geosyntec Consultants, Portland, Oregon
From: Ashley Wilson
CC: K. Henderson
Subject: **Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1660621, L1676610, L1676633 and L1681900, and Eurofins Air Toxics Work Orders #2310217, 2311231 and 2312182**

SITE: Cascade

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of twenty-nine groundwater samples, five field duplicates and three trip blanks, collected 27 September 2023 and 7-8 and 27 November 2023, as well as eleven soil vapor samples, collected on 10 October 2023, 8 November 2023, and 6 December 2023, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

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

- 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 Modified 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. If there are results with two or more different qualifications due to multiple QC failures, the final

qualification is reconciled in the electronic data deliverable (EDD) with qualifications. The data were reviewed based on the following document, 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
2310217-01A	SVE-EFF-101023
2311231-01A	SVE-EFF-110823
2311231-02A	VW-17d-95.5-110823
2311231-03A	VMWE-110823
2311231-04A	VMWF-110823
2311231-05A	VMWG-110823
2311231-06A	VMWC-110823
2311231-07A	VMWH-110823
2311231-08A	VMWK-110823
2311231-09A	VMWJ2-110823
2312182-01A	SVE-EFF-120623
L1660621-01	MW22DG-092723
L1660621-02	MW36DG-092723
L1660621-03	MW36DG-092723-DUP
L1660621-04	TRIP BLANK LOT 406
L1676610-01	EW1-110723
L1676610-02	EW2-110723
L1676610-03	EW14-110723
L1676610-04	CMW17DS-110723
L1676610-05	CMW17DS-110723-DUP
L1676610-06	CMW18DS-110723
L1676610-07	CMW19DS-110723
L1676610-08	D17DS-110723
L1676610-09	D17DG-110723

Laboratory IDs	Client IDs
L1676610-10	CMW10DS-110723
L1676610-11	CMW10DS-110723-DUP
L1676610-12	VMWB-110823
L1676610-13	VMWB-110823-DUP
L1676610-14	VMWG-110823
L1676610-15	VMWF-110823
L1676610-16	VMWE-110823
L1676610-17	VMWD-110823
L1676610-18	VMWC-110823
L1676610-19	VMWA-110823
L1676610-20	VMWH-110823
L1676610-21	VMWI-110823-143.7
L1676610-22	VMWJ2-110823-120.25
L1676610-23	VMWK-110823-114.25
L1676610-24	VMWL-110823-103.25
L1676610-25	VMWM-110823-94
L1676610-26	VMWN-110823-110.8
L1676633-01	TS-C-EFF-110723
L1676633-02	TS-C-EFF-110723-DUP
L1676633-03	TS-C-INF-110723
L1676633-04	TRIP BLANK LOT #510
L1681900-01	CMW22DG-112723
L1681900-02	CMW36DG-112723
L1681900-03	TRIP BLANK

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

The laboratory reported results for the analytical method(s) requested for each sample on the chain of custody (COC). The following issue was noted on the COCs. No qualifications were applied to the data based on the issue discussed below.

- L1660621, L1676610, L1676633 and L1681900: Sample collection times for the trip blanks were not documented on the COCs. The trip blanks were each logged by the laboratory with the sample collection time of 00:00.

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 and Preservation
- ✓ 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

L1660621: The percent differences (%Ds) for acetone (31.0%) and acrolein (42.8%) in the continuing calibration verification (CCV) in batch WG2143346 were outside the method specified acceptance criteria. The validation criteria for acetone is $\pm 40.0\%$. Since the %D for acetone was within the validation specified criteria and based on professional and technical judgment, no

qualifications were applied to the data. Validation criteria is not listed for acrolein. Therefore, a %D of $\pm 40\%$ was used based on professional and technical judgment. Since the %D was greater than 40% with low bias, the nondetect results in the associated samples were UJ qualified as estimated below the MDL.

L1676610: The %Ds for acrolein (78.9.1%), 2,2-dichloropropane (24.9%), naphthalene (32.2%), 1,2,3-trichlorobenzene (27.6%), 1,2,4-trichlorobenzene (22.1%) and vinyl chloride (22.0%) in the CCV in batch WG2170371 were outside the method specified acceptance criteria. The validation specified criteria for 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and vinyl chloride are $\pm 30.0\%$, $\pm 30.0\%$ and $\pm 25.0\%$, respectively. Since the %Ds of 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and vinyl chloride were within the validation specified acceptance criteria and based on professional and technical judgment, no qualifications were applied to the data. Validation criteria is not listed for acrolein, 2,2-dichloropropane and naphthalene, and the %Ds for 2,2-dichloropropane and naphthalene were less than 40% and based on professional and technical judgment, no qualifications were applied to the 2,2-dichloropropane and naphthalene data. However, since the %D for acrolein was greater than 40% with low bias, the nondetect results in the associated samples UJ qualified as estimated below the MDL.

L1676610: The %Ds for acetone (85.0%), acrolein (63.9%), naphthalene (30.5%) and vinyl chloride (23.3%) in the CCV in batch WG2170510 were outside the method specified acceptance criteria. The validation criteria for acetone and vinyl chloride are $\pm 40.0\%$ and $\pm 25.0\%$, respectively. Since the %D for vinyl chloride was within the validation specified acceptance criteria and based on professional and technical judgment, no qualifications were applied to the vinyl chloride data. The %Ds for acetone was outside of validation specified criteria with a high bias. Therefore, based on professional and technical judgment, the concentrations of acetone in the associated samples were J qualified as estimated. Validation criteria is not listed for acrolein and naphthalene. Therefore, a %D of $\pm 40\%$ was used based on professional and technical judgment. Since the %D for acrolein was greater than 40% with low bias, the nondetect results in the associated samples UJ qualified as estimated below the MDL.

L1676633: The %Ds for acrolein (63.9%), naphthalene (30.4%) and vinyl chloride (23.3%) in the CCV in batch WG2170510 were outside the method specified acceptance criteria. The validation criteria for vinyl chloride is $\pm 25.0\%$. Since the %D for vinyl chloride was within the validation specified criteria and based on professional and technical judgment, no qualifications were applied to the vinyl chloride data. Validation criteria is not listed for acrolein and naphthalene. Therefore, a %D of $\pm 40\%$ was used based on professional and technical judgment. Since the %D for naphthalene was $< 40\%$ and based on professional and technical judgment, no qualifications were applied to the naphthalene data. Since the %D for acrolein was greater than 40% with low bias, the nondetect results in the associated samples UJ qualified as estimated below the MDL.

L1676633: The %Ds for 1,2-dibromo-3-chloropropane (30.6%), naphthalene (44.9%), 1,2,3-trichlorobenzene (30.7%) and 1,2,4-trichlorobenzene (22.0%) in the CCV in batch WG2173624

were outside the method specified acceptance criteria. The validation criteria for 1,2-dibromo-3-chloropropane, 1,2,3-trichlorobenzene and 1,2,4-trichlorobenzene are all $\pm 30.0\%$. Since the %D for 1,2,4-trichlorobenzene was within the validation specified acceptance criteria and based on professional and technical judgment, no qualifications were applied to the 1,2,4-trichlorobenzene data. The %Ds for 1,2-dibromo-3-chloropropane and 1,2,3-trichlorobenzene were outside of validation specified criteria with low bias. Validation criteria is not listed for naphthalene. Therefore, a %D of $\pm 40\%$ was used based on professional and technical judgment. The %D for naphthalene was greater than 40% with low bias. Therefore, based on professional and technical judgment, the nondetect results of 1,2-dibromo-3-chloropropane, 1,2,3-trichlorobenzene and naphthalene in the associated sample were UJ qualified as estimated below the MDL.

L1681900: The %D for acrolein (21.0%) in the CCV in batch WG2181956 were outside the method specified acceptance criteria. Since validation criteria is not listed for acrolein, the %D was less than 40% and based on professional and technical judgment, no qualifications were applied to the data.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
MW22DG-092723	Acrolein	2.54	U,C3	2.54	UJ	9
MW36DG-092723	Acrolein	2.54	U,C3	2.54	UJ	9
MW36DG-092723-DUP	Acrolein	2.54	U,C3	2.54	UJ	9
TRIP BLANK LOT 406	Acrolein	2.54	U,C3	2.54	UJ	9
TS-C-EFF-110723	Acrolein	2.54	U,C3	2.54	UJ	9
TS-C-EFF-110723-DUP	Acrolein	2.54	U,C3	2.54	UJ	9
TS-C-INF-110723	Acrolein	2.54	U,C3	2.54	UJ	9
CMW10DS-110723	Acrolein	2.54	U,C3	2.54	UJ	9
CMW10DS-110723-DUP	Acrolein	2.54	U,C3	2.54	UJ	9
CMW17DS-110723	Acrolein	2.54	U,C3	2.54	UJ	9
CMW17DS-110723-DUP	Acrolein	2.54	U,C3	2.54	UJ	9
CMW18DS-110723	Acrolein	2.54	U,C3	2.54	UJ	9
CMW19DS-110723	Acrolein	2.54	U,C3	2.54	UJ	9
D17DG-110723	Acrolein	2.54	U,C3	2.54	UJ	9
D17DS-110723	Acrolein	2.54	U,C3	2.54	UJ	9
EW1-110723	Acrolein	2.54	U,C3	2.54	UJ	9
EW14-110723	Acrolein	2.54	U,C3	2.54	UJ	9
EW2-110723	Acrolein	2.54	U,C3	2.54	UJ	9
TRIP BLANK LOT #510	1,2,3-Trichlorobenzene	0.164	U,C3	0.164	UJ	9
TRIP BLANK LOT #510	1,2-Dibromo-3-Chloropropane	0.276	U,C3	0.276	UJ	9
TRIP BLANK LOT #510	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWA-110823	Acrolein	50.0	U,C3	50.0	UJ	9
VMWB-110823	Acrolein	50.0	U,C3	50.0	UJ	9
VMWB-110823-DUP	Acrolein	50.0	U,C3	50.0	UJ	9

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWC-110823	Acrolein	2.54	U,C3	2.54	UJ	9
VMWD-110823	Acrolein	2.54	U,C3	2.54	UJ	9
VMWE-110823	Acrolein	2.54	U,C3	2.54	UJ	9
VMWF-110823	Acrolein	2.54	U,C3	2.54	UJ	9
VMWG-110823	Acrolein	2.54	U,C3	2.54	UJ	9
VMWH-110823	Acrolein	2.54	U,C3	2.54	UJ	9
VMWI-110823-143.7	Acetone	70.2	C5 J4	70.2	J	9
VMWI-110823-143.7	Acrolein	2.54	U,C3	2.54	UJ	9
VMWJ2-110823-120.25	Acetone	65.6	C5 J4	65.6	J	9
VMWJ2-110823-120.25	Acrolein	2.54	U,C3	2.54	UJ	9
VMWK-110823-114.25	Acetone	47.7	C5 J4	47.7	J	9
VMWK-110823-114.25	Acrolein	2.54	U,C3	2.54	UJ	9
VMWL-110823-103.25	Acetone	20.6	J J4	20.6	J	9
VMWL-110823-103.25	Acrolein	2.54	U,C3	2.54	UJ	9
VMWM-110823-94	Acetone	61.2	C5 J4	61.2	J	9
VMWM-110823-94	Acrolein	2.54	U,C3	2.54	UJ	9
VMWN-110823-110.8	Acetone	83.3	C5 J4	83.3	J	9
VMWN-110823-110.8	Acrolein	2.54	U,C3	2.54	UJ	9

µg/l-microgram per liter

U-not detected at or above the RDL

C3-The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.

C5-The reported concentration is an estimate. The continuing calibration standard associated with this data responded high. Method sensitivity check is acceptable.

J4-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 & Preservation

The holding time for the VOC analysis of a preserved groundwater sample is 14 days from collection to analysis void of headspace in the vial. The holding times and preservations 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). Five method blanks were reported (batches WG2143346, WG2170371, WG2170510, WG2173216, WG2173624 and WG2181956). VOCs were not detected in the method blanks at or above the reported detection limits (RDLs), with the following exception.

L1660621

WG2143346: Benzene (0.118 µg/L) was detected at an estimated concentration greater than the MDL and less than the RDL. Since benzene was not detected in the associated samples, no qualifications were applied to the data.

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

MS/MSD pairs were not reported. Precision and accuracy were assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pair for batches WG2143346, WG2170371, WG2170510, WG2173624 and WG2181956. No qualifications were applied to the data.

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

L1660621

WG2143346

The LCS recovery of chloromethane in the LCS/LCSD pair in batch WG2143346 was high and outside of laboratory specified acceptance criteria. Since chloromethane was not detected in the associated samples, no qualifications were applied to the data.

L1676610

WG2170371

The recoveries for acetone in the LCS/LCSD pair in batch WG2170371 were high and outside of the laboratory specified acceptance criteria. Therefore, the concentrations of acetone in the associated samples were qualified as estimated.

The RPD of 1,2,3-trichlorobenzene in the LCS/LCSD pair in batch WG2170371 was high and outside of the laboratory specified acceptance criteria. Since 1,2,3-trichlorobenzene was not detected in the associated samples, no qualifications were applied to the 1,2,3-trichlorobenzene data.

WG2170510

The LCS recovery of acetone in the LCS/LCSD pair in batch WG2170510 was high and outside of laboratory specified acceptance criteria. Therefore, the concentrations of acetone in the associated samples were J qualified as estimated.

The RPDs of acrylonitrile, bromoform, n-butylbenzene, 1,2-dibromo-3-chloropropane, ethylbenzene, isopropylbenzene, naphthalene, tetrachloroethene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and total xylenes in the LCS/LCSD pair in batch WG2170510 were high and outside of the laboratory specified acceptance criteria. Therefore, the concentrations of tetrachloroethene in samples VMWI-110823-143.7, VMWK-110823-114.25 and VMWN-110823-110.8 were J qualified as estimated. Since acrylonitrile, bromomethane, n-butylbenzene, 1,2-dibromo-3-chloropropane, ethylbenzene, isopropylbenzene, naphthalene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and total xylenes were not detected in the associated samples, no qualifications were applied to the acrylonitrile, bromomethane, n-butylbenzene, 1,2-dibromo-3-chloropropane, ethylbenzene, isopropylbenzene, naphthalene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and total xylenes data.

L1676633

WG2170510

The LCS recovery of acetone in the LCS/LCSD pair in batch WG2170510 was high and outside of laboratory specified acceptance criteria. Therefore, the concentration of acetone in the associated sample was J qualified as estimated.

The RPDs of acrylonitrile, bromoform, n-butylbenzene, 1,2-dibromo-3-chloropropane, ethylbenzene, isopropylbenzene, naphthalene, tetrachloroethene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and total xylenes in the LCS/LCSD pair in batch WG2170510 were high and outside of the laboratory specified acceptance criteria. Therefore, the concentration of tetrachloroethene in sample TS-C-INF-110723 was J qualified as estimated. Since acrylonitrile, bromomethane, n-butylbenzene, 1,2-dibromo-3-chloropropane, ethylbenzene, isopropylbenzene, naphthalene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and total xylenes were not detected in the associated samples, no qualifications were applied to the acrylonitrile, bromomethane, n-butylbenzene, 1,2-dibromo-3-chloropropane, ethylbenzene, isopropylbenzene, naphthalene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene and total xylenes data.

WG2173624

The recoveries for acetone in the LCS/LCSD pair in batch WG2173624 were high and outside of the laboratory specified acceptance criteria. Since acetone was not detected in the associated samples, no qualifications were applied to the data.

L1681900

WG2181956

The RPDs of acetone, acrolein, acrylonitrile, carbon tetrachloride and chloroethane in the LCS/LCSD pair in batch WG2181956 were high and outside of the laboratory specified acceptance criteria. Since acetone, acrolein, acrylonitrile, carbon tetrachloride and chloroethane were not detected in the associated samples, no qualifications were applied to the acetone, acrolein, acrylonitrile, carbon tetrachloride and chloroethane data.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
VMWI-110823-143.7	Acetone	70.2	C5 J4	70.2	J	5
VMWJ2-110823-120.25	Acetone	65.6	C5 J4	65.6	J	5
VMWK-110823-114.25	Acetone	47.7	C5 J4	47.7	J	5
VMWL-110823-103.25	Acetone	20.6	J J4	20.6	J	5
VMWM-110823-94	Acetone	61.2	C5 J4	61.2	J	5
VMWN-110823-110.8	Acetone	83.3	C5 J4	83.3	J	5
VMWI-110823-143.7	Tetrachloroethene (PCE)	1.72	J3	1.72	J	5
VMWK-110823-114.25	Tetrachloroethene (PCE)	0.408	J J3	0.408	J	5
VMWN-110823-110.8	Tetrachloroethene (PCE)	0.318	J J3	0.318	J	5
TS-C-INF-110723	Tetrachloroethene (PCE)	0.492	J J3	0.492	J	5

µg/l-microgram per liter

C5-The reported concentration is an estimate. The continuing calibration standard associated with this data responded high. Method sensitivity check is acceptable.

J3-associated batch QC was outside the established quality control range for precision

J4-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, TRIP BLANK LOT 406, TRIP BLANK LOT #510 and TRIP BLANK, were submitted with the sample sets. VOCs were not detected in the trip blanks above the RDLs.

1.8 Field Duplicate

Five field duplicates (CMW10DS-110723-DUP, CMW17DS-110723-DUP, MW36DG-092723-DUP, TS-C-EFF-110723-DUP and VMWB-110823-DUP) were collected with the sample sets. Acceptable precision ($RPD \leq 30\%$) was demonstrated between the field duplicates and the original samples CMW10DS-110723, CMW17DS-110723, MW36DG-092723, TS-C-EFF-110723 and VMWB-110823, respectively.

1.9 Sensitivity

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

1.10 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

2.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA modified Method TO-15 using full scan mode.

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
- ✓ 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 (file names 60102007, 20111406d, 20111507c, and 20121506e). VOCs were not detected in the method blanks at or above the reporting limits (RLs).

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). Three 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.

The laboratory also reported CCV standards. The CCV recoveries were within the method 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 RLs. Elevated non-detect results were reported due to the sample 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. No discrepancies were identified between the level II reports and the EDDs.

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

DATA QUALIFIER DEFINITIONS

- U The analyte was analyzed for, but was not detected above the reported sample quantitation limit. 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