2024 Annual Groundwater Monitoring Report

Northwest Pipe Company
12005 North Lombard Street
Portland, Oregon 97203
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Executive Summary

This report presents the results of groundwater monitoring conducted in 2024 at the Northwest Pipe Company (Northwest Pipe) facility (the Site) at 12005 North Lombard Street, Portland, Oregon. Shallow groundwater in a portion of the southeast area of Northwest Pipe's property (the Southeast Area) contains volatile organic compounds (VOCs) at concentrations that exceed the U.S. Environmental Protection Agency (EPA) Record of Decision (ROD) Table 17 cleanup levels (CULs) for groundwater at the Portland Harbor Superfund site. Northwest Pipe has conducted investigations and focused remedial actions to address environmental conditions at the Site since it began operations at the property in 1982. As established in the *Remedial Investigation and Source Control Evaluation*, finalized in 2021, monitored natural attenuation (MNA) is the remedy and source control measure selected for VOCs in groundwater at the Site. Groundwater monitoring is intended to confirm that natural attenuation of VOCs in the shallow groundwater continues to be an effective remedy and source control measure.

In accordance with the MNA Work Plan (Jacobs 2022) approved by the Oregon Department of Environmental Quality on September 20, 2022, groundwater monitoring was conducted annually for the MNA network on May 13 through 16, 2024Data obtained were used to evaluate MNA at the Site following the protocol outlined in the EPA guidance document *Performance Monitoring of MNA Remedies for VOCs in Ground Water* (2004). Prior sampling at the Site established the Southeast Area conceptual site model that groundwater contamination is limited to the shallow aquifer and VOCs do not extend below the confining layer. Groundwater in the shallow aquifer discharges toward Terminal 4 Slip 1 of the Willamette River, approximately 1,000 feet downgradient from the Southeast Area. Groundwater monitoring performed since 2016 shows that concentrations in groundwater samples from wells closest to the river are consistently below ROD CULs.

Groundwater monitoring conducted in 2024 at the Site continues to confirm that natural attenuation of VOCs in the shallow groundwater at the Southeast Area is occurring, is effective, and is protective (that is, there are no adverse effects in the form of VOCs at concentrations above the Portland Harbor ROD CULs reaching the river). The most recent groundwater data confirm the long-standing conceptual site model by way of the following:

- The Northwest Pipe groundwater source area has been remediated.
- Groundwater monitoring at the Site indicates that the groundwater plume is stable and decreasing, consistent with EPA guidance.
- Potential human health and ecological risks are addressed by MNA.
- Groundwater flow observations in 2024 continue to show a low hydraulic gradient, and corresponding long travel time, across the Southeast Area and the Port property allowing for contaminant concentrations to be reduced by reductive dechlorination.
- Analysis for geochemical indicators of natural attenuation demonstrates the geochemical environment continues to be favorable to degradation of Site-related VOCs by reductive dechlorination to maintain plume stability and decrease plume extent.
- New wells installed in 2022 on the Port property provide additional information on the lateral extent of the plume and increase the area monitored under the MNA program. The addition of three monitoring wells further allows for an early warning of the potential migration of VOCs toward the Willamette River, in the unlikely event that it would occur.
- Groundwater quality analysis demonstrates the plume is not migrating beyond previously determined boundaries.

- Concentrations of VOCs remaining in groundwater are relatively low, and there is consistent evidence in monitoring data collected since 2016 that groundwater containing VOCs does not reach the Willamette River above protective levels established in the ROD.

The groundwater monitoring work completed in 2024 confirms that MNA is satisfying the source control objective for the Site. Accordingly, groundwater monitoring will continue annually as scheduled in the approved MNA Work Plan.

Contents

Acronyms and Abbreviations

°C	degree(s) Celsius
µg/L	microgram(s) per liter
µmol/L	micromole(s) per liter
A	annually
bgs	below ground surface
CUL	cleanup level
DCE	dichloroethene
DEQ	Oregon Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
ft/day	foot per day
ft/ft	foot per foot
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
MNA	monitored natural attenuation
Northwest Pipe	Northwest Pipe Company
OAR	Oregon Administrative Rule
PCE	tetrachloroethene
Port	Port of Portland
Q	quarterly
RBC	risk-based concentration
RI	Remedial Investigation
ROD	Record of Decision
SA	semiannually
SAP	Sampling and Analysis Plan
SCE	Source Control Evaluation
Site	Northwest Pipe Company Portland property including the locality of the facility
TCE	trichloroethene
TOC	total organic carbon
USGS	U.S. Geological Survey
VOC	volatile organic compound

1. Introduction

Jacobs has prepared this report presenting the results of groundwater monitoring conducted in 2024 at the Northwest Pipe Company (Northwest Pipe) facility (the Site) at 12005 North Lombard Street, Portland, Oregon. Shallow groundwater in a portion of the Southeast Area (Figure 1-1) of the Northwest Pipe Portland property contains volatile organic compounds (VOCs) at concentrations that exceed the U.S. Environmental Protection Agency (EPA) Record of Decision (ROD) Table 17 cleanup levels (CULs) for groundwater at the Portland Harbor Superfund site. This report presents the results of groundwater monitoring associated with the Southeast Area completed in 2024 in accordance with the *Monitored Natural Attenuation Work Plan* (Jacobs 2022) approved by the Oregon Department of Environmental Quality (DEQ) on September 20, 2022. This report presents an evaluation of the data and discussion regarding the ability of natural attenuation to prevent adverse effects from VOCs to the Willamette River at concentrations above the Portland Harbor ROD CULs. This report was prepared following the guidance for evaluating monitored natural attenuation (MNA) provided in the EPA document *Performance Monitoring of MNA Remedies for VOCs in Ground Water* (2004).

Northwest Pipe has conducted investigations and focused remedial actions to address environmental conditions at the Site since it began operations at the property in 1982. The investigations and remedial actions conducted have provided environmental data defining the nature and extent of constituents at the Site and documented the effectiveness of the targeted remedial actions taken by Northwest Pipe. A Remedial Investigation (RI) and Source Control Evaluation (SCE) were conducted under the 2004 *Voluntary Agreement for Remedial Investigation and Source Control Evaluation* (DEQ agreement LQDVC-NWR-04-01). The RI/SCE, finalized in 2021, documented the environmental investigations and remedial actions conducted at the Site over more than 30 years (Jacobs 2021b). As established in the RI/SCE, MNA is the remedy and source control measure selected for VOCs in groundwater at the Site. Groundwater monitoring is intended to confirm that natural attenuation of VOCs in the shallow groundwater continues to be an effective remedy under DEQ's Hazardous Substance Remedial Action Rules (Oregon Administrative Rule [OAR] 340-122-0040) and source control measure under the EPA and DEQ Joint Source Control Strategy (DEQ and EPA 2005).

This annual groundwater monitoring report focuses on the 2024 monitoring of VOCs in the Southeast Area shallow groundwater in accordance with the MNA Work Plan (Jacobs 2022). This report is organized as follows:

- Section 1—Introduction
- Section 2—Groundwater Monitoring Network and Function
- Section 3—2024 Groundwater Monitoring Summary
- Section 4—Review of Southeast Area Conceptual Site Model
- Section 5— MNA Data Evaluation
- Section 6—Conclusions
- Section 7—References

2. Groundwater Monitoring Network and Function

The VOCs of concern include tetrachloroethene (PCE) and its breakdown products trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride. The purpose of the groundwater monitoring at Northwest Pipe is to confirm that natural attenuation of VOCs in the shallow groundwater at the Southeast Area is occurring, is effective, and is protective (that is, there are no adverse effects in the form of VOCs at concentrations above the Portland Harbor ROD CULs reaching the river). This section describes how the groundwater monitoring network and sampling frequency were enhanced as outlined in the approved MNA Work Plan (Jacobs 2022) to facilitate this goal.

2.1 Monitoring Network

Monitoring well locations were selected using criteria presented in EPA's *Performance Monitoring MNA Remedies for VOCs in Ground Water* (EPA 2004). Three new monitoring wells (MW-10, MW-11, and MW-12) were installed at the Site in March 2022 after DEQ email approval on January 26, 2022. The well network for long-term MNA monitoring is depicted on Figure 2-1. The network includes the three new wells and previously existing wells, and is based on the following rationale to fulfill the criteria in EPA guidance (2004):

- Upgradient uncontaminated groundwater relative to the zone of contamination – Well MW-02 is in the upgradient portion of the Site and meets the requirement for an uncontaminated area because over its monitoring history it has had low or non-detectable VOC concentrations. MW-02 data also are used as representing background concentrations, leading to a conservative evaluation of geochemical changes across the Site.
- Source area/main plume core – Well MW-06 is in the general area of a former aboveground storage tank, a suspected source area. Well MW-06 has historically had higher levels of VOC concentrations compared to other wells and likely represents conditions in the plume core. Well MW-03 is in the plume core closer to the Northwest Pipe property boundary.
- Cross-gradient – Well MW-01 and MW-04 monitor VOC concentrations along the eastern margin of the plume in the plume core area. The proposed network also includes Well T4S1MW-22 and T4S1MW-23, both wells are on Port of Portland (Port) property and monitor the lateral extent of VOC concentrations on both the eastern and western margins of the plume.
- Uncontaminated downgradient parts of the aquifer – Wells T4S1MW-03S and T4S1MW-09 on Port property are uncontaminated and show groundwater quality prior to discharge to the Willamette River Terminal 4 Slip 1.
- Distinct geochemical zones – The geochemistry of groundwater on the Site differs from that on the Port's site, as described in Section 4.2. The network includes wells in the Southeast Area (MW-01 through MW-06), some of which have elevated VOC concentrations. Wells on the Port property (MW-10, MW-11, MW-12, T4S1MW-22, T4S1MW-23, T4S1MW-09, and T4S1MW-03S) have lower- to nondetectable VOC concentrations. These wells are used to monitor three geochemical zones: one for the Southeast Area, one with low VOC concentrations on the Port property, and one with nondetectable concentrations on the Port property.
- Groundwater flow characterization – Groundwater-level monitoring includes three more wells in addition to those targeted for sampling (Tables 2-1 and 3-1). This network of monitoring wells provides a sufficient basis to confirm that the already well-documented flow direction remains consistent with past observations.
- High-permeability zones – No high-permeability zones have been identified within the plume area other than the area monitored by MW-05, where slug testing and water level response during purging

and sampling have identified a localized pocket of higher permeability in the shallow aquifer than encountered in other nearby wells.

The construction information for the monitoring wells selected for the MNA program are summarized in the Sampling and Analysis Plan (SAP) included in the MNA Work Plan (Jacobs 2022). Figure 2-1 shows the MNA monitoring well network.

Table 2-1. Well Construction Details for MNA Program

Well	Coordinates		Screened Interval (feet bgs)		Total Depth (feet bgs)	Well Use in MNA Network
	Northing (feet)	Easting (feet)	Screen Top	Screen Bottom		
MW-01	7621115.44	715674.70	14	24	25	Water Quality and Water Level
MW-02	7620821.90	715683.93	10.5	20.5	22	Water Quality and Water Level
MW-03	7620850.03	715487.66	14.5	24.5	26	Water Quality and Water Level
MW-04	7621087.85	715497.29	16.5	26.5	27	Water Quality and Water Level
MW-05	7621060.97	715816.63	17.5	27.5	28	Water Quality and Water Level
MW-06	7621020.40	715649.12	18.5	28.5	29	Water Quality and Water Level
MW-10	715211.03	7620361.85	9.0	29.0	29	Water Quality and Water Level
MW-11	715191.86	7620738.32	15.0	35.0	35	Water Quality and Water Level
MW-12	715222.46	7621019.27	15.0	30.0	30	Water Quality and Water Level
T4S1MW-02S	7621214.97	714998.33	20	30	30	Water Level Only
T4S1MW-03S	7620492.60	714732.19	20	30	30	Water Quality and Water Level
T4S1MW-09	7620519.44	714609.19	20	30	30	Water Quality and Water Level
T4S1MW-10	7620514.97	714448.17	10	20	20	Water Level Only
T4S1MW-22	7621091.96	715327.08	13	23	30	Water Quality and Water Level
T4S1MW-23	7620347.24	715358.39	15	25	30	Water Quality and Water Level
T4S1MW-25	7620880.20	714518.94	10	20	20	Water Level Only

Note:

Coordinate System: North American Datum 1983 State Plane Oregon North (U.S. feet)

bgs = below ground surface

2.2 Groundwater Monitoring Frequency

In accordance with EPA guidance (2004), the sampling frequency of the monitoring program is designed to accomplish the following:

- Provide timely warning of impacts on receptors.
- Detect VOC releases to groundwater that warn of possible plume expansion.
- Detect changes in plume size and concentration.
- Determine temporal variability of data.
- Detect changes in geochemistry that warn of changes in attenuation.
- Yield data necessary to reliably evaluate progress toward VOC reduction objectives.

In accordance with EPA guidance, quarterly monitoring was conducted for the three new monitoring wells in 2022 and 2023 to establish baseline conditions, observe seasonal trends including response to recharge, and estimate attenuation rates for key constituents (EPA 2004). Quarterly monitoring for the three new wells, and semiannual monitoring for the other wells in the MNA network, was conducted for 2 years in accordance with the approved MNA Work Plan (Jacobs 2022). In 2024, the monitoring frequency transitioned to annual sampling for all wells in accordance with the approved MNA Work Plan (Jacobs 2022). Groundwater depth-to-water measurements are performed on all wells in the monitoring program (Table 2-1) prior to purging and sample collection. The approved monitoring schedule is presented in Table 2-2.

Table 2-2. Sampling Frequency by Well

Well	2022	2023	2024	2025	2026
MW-01	SA	SA	A	A	A
MW-02	SA	SA	A	A	A
MW-03	SA	SA	A	A	A
MW-04	SA	SA	A	A	A
MW-05	SA	SA	A	A	A
MW-06	SA	SA	A	A	A
MW-10	Q;. ,	Q	A	A	A
MW-11	Q	Q	A	A	A
MW-12	Q	Q	A	A	A
T4S1MW-03S	SA	SA	A	A	A
T4S1MW-09	SA	SA	A	A	A
T4S1MW-22	SA	SA	A	A	A
T4S1MW-23	SA	SA	A	A	A

A = annually

Q = quarterly

SA = semiannually

3. 2024 Groundwater Monitoring Summary

In accordance with the approved MNA Work Plan, groundwater monitoring was conducted annually for all wells in the MNA network. The annual monitoring event was conducted May 13 through 16, 2024. Groundwater monitoring parameters for long-term monitoring included VOCs and natural attenuation parameters. Time-sensitive parameters (that is, pH, temperature, specific conductance, dissolved oxygen, oxidation-reduction potential, and turbidity) were measured in the field at the time of sample collection. Field notes and groundwater sampling logs are included in Appendix A.

3.1 Groundwater-level Measurements

Groundwater level measurements were made at each well listed in Table 3-1 prior to purging and sampling. A potentiometric contour map for May 13, 2024, is presented on Figure 3-1.

3.2 Water Quality Sampling Summary

Groundwater samples were collected using EPA low-flow sampling techniques. Parameters measured in the field at the time of sample collection are reported on Table 3-2. Collected samples were submitted for analysis to EMAX Laboratories, Inc. in Torrance, California. Groundwater laboratory analysis was performed for selected VOCs (PCE, TCE, cis-1,2-DCE, and vinyl chloride) to provide the agency-requested updated information on plume stability and to evaluate fate and transport. Analysis for geochemical indicators of natural attenuation (chloride, nitrate as nitrite, sulfate, total organic carbon [TOC], ferrous iron, carbon dioxide, and methane) was conducted to provide further evidence of site conditions favorable for natural enhanced reductive dechlorination. Copies of the analytical laboratory reports for groundwater samples are provided in Appendix B. In 2024, all monitoring wells were sampled in accordance with the SAP (Table 2-2). All wells were functional and accessible for water quality sampling. One field duplicate was collected at MW-12. No deviations from the SAP were noted.

3.3 Data Quality Review

A data quality evaluation was prepared for each monitoring event in 2024 (Appendix C). The completed data quality review procedure for each event included the following activities:

- Reviewing the case narrative, when available, from the laboratory report, noting any issues that were identified by the laboratory.
- Calculating hold times and comparing them with EPA's recommended maximum hold times. For the measured analytes, the hold times were calculated from information presented in the analytical laboratory reports.
- Reviewing the notes and definitions from the laboratory report, which are at the end of each report. Notes were reviewed to determine whether any sample results needed to be qualified. If results were qualified, the note and analyte were listed in the associated technical memoranda included as Appendix C.

For 2024 analytical reports received from the laboratory, the data quality evaluations present the number and type of samples per event, the sampling dates, qualified data (listed by the issue encountered), the parameter, and the sample locations and dates affected (Appendix C). The data sets were determined to be usable with the addition of selected flags. The precision and accuracy of the data, as measured by field and laboratory quality control indicators, demonstrate that the SAP goals for project use were met. Natural

attenuation parameters are presented in Table 3-3, and VOC data are presented in Table 3-4. VOC data are screened against ROD CULs selected from Table 17 of the *Portland Harbor ROD* (EPA 2017) (Table 3-4). CULs were selected from Remedial Action Objectives 4 and 8 associated with migration of contaminated groundwater. CULs reflect changes from the *Errata for Portland Harbor ROD* (EPA 2018) and Errata #2 for *Portland Harbor ROD* (EPA 2020).

4. Review of Southeast Area Conceptual Site Model

The Southeast Area of the Site has been the subject of environmental investigation and monitoring since the late 1980s. Contamination in shallow soil at a localized area within what is now referred to as the Southeast Area was discovered in 1989, evidently associated with a former aboveground tank that had been located near current monitoring well MW-06 (Dames & Moore 1989). The tank and associated contaminated soil were subsequently removed in coordination with DEQ oversight (Crosby & Overton 1989). Follow-up investigations in the Southeast Area identified VOCs in shallow groundwater. The VOCs of concern in the Southeast Area are PCE and its breakdown products TCE, cis-1,2-DCE, and vinyl chloride. Although TCE is a breakdown product of PCE, it was also used as a commercially available solvent; its presence may be attributable, in part, to the historical use of products containing TCE. Groundwater contamination is limited to the shallow aquifer, and Geoprobe sampling at the Site determined that VOCs do not extend below the confining layer, the top of which is situated at approximately 28 feet bgs (Jacobs 2021b). Groundwater in the shallow aquifer discharges to Terminal 4 Slip 1 of the Willamette River, approximately 1,000 feet downgradient from the Southeast Area. Groundwater monitoring has shown that concentrations in groundwater samples from wells closest to the river are below ROD CULs.

4.1 Hydrologic Setting

The Site occupies a former alluvial floodplain of the Willamette River, as shown in an 1897 U.S. Geological Survey (USGS) map of the area (USGS 1897) (selected hydrographic features from which are depicted on Figure 4-1). The historical location of a former alluvial channel, identified by the USGS as Gatton Creek, was offsite to the east of the Site and flowed south to the area now occupied by Terminal 4 Slip 1. Dredged material consisting of silty sand was used to fill and level the area in early 1941 (OSC 1945). The Linnton USGS 7.5-minute topographic map indicates that the current topography of the Site is relatively flat (USGS 1961). Surface elevations range from 30 to 35 feet above mean sea level, with elevations in the northern part of the Site slightly lower than in the southern part. Native surface soil at the Site has been covered by fill, modified by re-grading and construction, and capped by pavement or structures. Fill and fluvial/lacustrine deposits extend from the ground surface to at least 258 feet bgs and are composed of interbedded silt, sand, and gravel layers, consisting of the following distinct zones:

- A shallow zone of fine sand and silty sand fill material (0 to 28 feet bgs), saturated in its lower half under unconfined conditions and underlain by a low-permeability confining layer. Elevated VOC concentrations have been determined to be limited to this shallow unconfined aquifer (Jacobs 2021b).
- An upper confining layer of low-permeability silt with sparsely interbedded sand from approximately 28 feet to 161 feet bgs. The top of this confining layer represents the historical ground surface prior to site filling and development. Principal sandy horizons within the upper confining layer are from 98 to 118 feet bgs and from 129 to 133 feet bgs.
- A deep, confined, water-bearing zone of sand and gravel from 161 feet to 221 feet bgs, in which the Site's production well is screened.
- A deep confining layer from 221 to at least 258 feet bgs (maximum depth of the Site's production well).

Following the guidance presented by EPA (2004), cross sections through the monitoring network in the general direction of groundwater flow and perpendicular to groundwater flow were developed and are presented on Figure 4-2. The subsurface information gained from the new wells installed in 2022 served to supplement the understanding of the subsurface geology along the flow path on the Port property. Figure 4-2 shows that somewhat greater variability in subsurface conditions was identified on the

Northwest Pipe property compared to that identified on the Port property, particularly in wells MW-05 and MW-06. The lower hydraulic conductivity associated with the finer grained material present in the subsurface slows groundwater movement on the Northwest Pipe property. The elevation of the bottom of the shallow aquifer was similar in all the borings along and perpendicular to the flow path and is observed at approximately 5 to 8 feet elevation (North American Vertical Datum of 1988).

In 2024, the depth to groundwater in the shallow aquifer ranged from 8.36 feet to 11.25 feet bgs on the Northwest Pipe property and from 7.29 feet to 18.23 feet bgs on the Port property (Table 3-1). These depths are consistent with the historical range for the Northwest Pipe property of 6 to 14 feet bgs (Jacobs 2021b). The depth to groundwater is shallower in the central part of the Site. A groundwater divide occurs between the IT Slip north–northwest of the Site and the Terminal 4 Slip 1 southwest of the Site, with groundwater occurring deeper on the northern and southern edges of the Site. The groundwater flow direction in the southeastern portion of the Site is consistently south–southwest toward Slip 1; though the gradient is generally flat and localized, temporal flow directions between wells can vary. Groundwater levels in the shallow aquifer are influenced by the Willamette River stage closer to the slip and recharge from precipitation closer to the Site. Groundwater depth measurements and water quality sampling performed in 2024 captures wet season conditions. The seasonality of groundwater VOC concentrations was evaluated in 2023, and the wet season was selected for monitoring as groundwater was observed to have consistently higher VOC concentrations than other times of the year (Jacobs, 2024).

The hydraulic gradient across the Site is low but increases approaching Slip 1. In May 2024, the hydraulic gradient across the Southeast Area had a transient northerly component, measured between MW-01 and MW-05, of 0.0004 foot per foot (ft/ft) and a transient westerly component, measured between MW-04 and MW-03, of 0.002 ft/ft. The gradient leaving the Southeast Area and across approximately a third of the flow path on the Port property was calculated between wells MW-03 and MW-11 at 0.002 ft/ft. Between wells MW-11 and T4S1MW-03S, gradient further increased to 0.007 ft/ft . These gradients are consistent with those previously observed across the Southeast Area and Port property (Jacobs 2021b, Jacobs 2023, and Jacobs 2024). The addition of well MW-11 served to better refine the conceptual site model by supporting that the gradient increases gradually along the flow path and more quickly closer to Slip 1. This low hydraulic gradient, and corresponding long travel time, across the Southeast Area and the Port property allows contaminant concentrations to be reduced by reductive dechlorination. Short duration periods of hydraulic gradient reversal or stagnation localized to the Southeast Area further slow groundwater movement toward Slip 1 and serve to prolong the exposure of contaminant concentrations to optimal reducing conditions as discussed in Section 4.2. The effect of localized horizonal hydraulic gradients on VOC transport is discussed in Section 5.2.2.

4.2 Geochemical Environment

Reductive dechlorination is most effective in the range corresponding to sulfate reduction and methanogenesis (which occurs through the reduction of carbon dioxide) (EPA 1998, 2004). Groundwater chemistry that indicates sulfate-reducing or methanogenic conditions in the Southeast Area include the following:

- Low dissolved oxygen concentrations, typically less than 0.5 milligram per liter (mg/L)
- Low oxidation-reduction potential, typically less than 50 millivolts and preferably below -100 millivolts
- Low concentrations of nitrate, typically less than 1 mg/L
- Presence of ferrous iron (Fe^{2+}), which results from the reduction of ferric iron (Fe^{3+}), at concentrations greater than 1 mg/L

Natural attenuation parameters were measured in 2005 and from 2016 through 2024 to evaluate the potential for reductive dechlorination based on geochemical conditions at the Site (Table 3-3). The dissolved oxygen and oxidation-reduction potential levels measured at Site monitoring wells typically meet the criteria for sulfate-reducing or methanogenic conditions listed previously. Additionally, the pH of groundwater measured at the Site is within the range amenable to microorganism survival, and the alkalinity is sufficient for buffering the pH against acids naturally produced by bacteria during biodegradation.

The natural attenuation data also were evaluated using EPA's screening worksheet to assess the potential for reductive dechlorination based on geochemical conditions (EPA 1998). The evaluation was performed using data from MW-02 for background conditions for both the 2005 and 2016 through 2024 data sets. For data representing the plume core of VOCs, wells MW-01, MW-04, and MW-06 were selected for 2005, and wells MW-05 and MW-06 were selected for 2016 through 2024. Although the evaluation and determinations about the presence of ongoing biodegradation are intended for use with data from the plume core (EPA 1998), the potential for reductive dechlorination on the Port property outside of the zone of highest contaminants was also evaluated for the upgradient portion of the Port property. Wells MW-10, MW-11, and MW-12 were evaluated to represent the upgradient portion of the Port property using 2022 and 2024 data.

The points awarded during the screening performed in the worksheet are interpreted as presented in Table 4-1 (EPA 1998).

Table 4-1. Interpretation of Points Awarded during Screening

Score	Interpretation
0 to 5	Inadequate evidence for anaerobic biodegradation of chlorinated organics
6 to 14	Limited evidence for anaerobic biodegradation of chlorinated organics
15 to 20	Adequate evidence for anaerobic biodegradation of chlorinated organics
>20	**Strong evidence for anaerobic biodegradation of chlorinated organics**

Note:

biodegradation = reductive dechlorination

Table 4-2 contains the worksheet along with scores assigned to the Northwest Pipe property and the upgradient portions of the Port property for 2016 through 2024. The total score of 21 for the Northwest Pipe data falls within the "strong evidence" category identified by EPA for VOC degradation via reductive dechlorination (EPA 1998) (Table 4-1), indicating that geochemical conditions at the Site are well-suited to reductive dechlorination and consistent with the observed limited migration of VOCs. The upgradient portion of the Port property receives a total score of 17, falling within the category of "adequate evidence" category identified by EPA for VOC degradation via reductive dechlorination (EPA 1998) (Table 4-1), indicating that geochemical conditions are still conducive to reductive dechlorination. Data provided by the new wells installed in 2022 provide the evidence that reductive dechlorination is continuing on the Port property. This evaluation shows MNA is an effective and protective remedy for the groundwater in the Southeast Area and that the geochemical environment supports VOC degradation via reductive dechlorination.

Table 4-2. Analytical Parameters and Weighting for Preliminary Screening for Anaerobic Biodegradation Processes

Analysis	Concentration in Most Contaminated Zone[a]	Interpretation	Value	Northwest Pipe 2016 to 2024	Port of Portland Upgradient 2022 to 2024
Dissolved Oxygen	< 0.5 mg/L	Tolerated; suppresses the reductive pathway at higher concentrations	3	3	0
Nitrate	< 1 mg/L	At higher concentrations, may compete with reductive pathway	2	2	2
Iron II	> 1 mg/L	Reductive pathway possible	3	3	3
Sulfate	< 20 mg/L	At higher concentrations, may compete with reductive pathway	2	2	2
Sulfide	> 1 mg/L	Reductive pathway possible	3	ND	ND
Methane	> 0.5 mg/L	Ultimate reductive Breakdown product	3	3	3
Oxidation-reduction Potential	< 50 millivolts	Reductive pathway likely	2	1	1
pH	5 < pH < 9	Optimal range for reductive pathway	0	0	0
TOC	> 20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2	0	0
Temperature	>20°C	At T > 20°C, biochemical process is accelerated	1	0	0
Carbon Dioxide	> 2x background[a]	Ultimate oxidative breakdown product	1	1	0
Alkalinity	> 2x background[a]	Results from interaction between carbon dioxide and aquifer minerals	1	ND	ND
Chloride	> 2x background[a]	Breakdown product of organic chlorine	2	0	0
Hydrogen	> 1 nM	Reductive pathway possible	3	ND	ND
TCE	–	Breakdown product of PCE	2[b]	2	2
DCE	–	Breakdown product of TCE	2[b]	2	2
Vinyl Chloride	–	Breakdown product of DCE	2[b]	2	2
		Total Score		**21**	**17**

Table 4-2. Analytical Parameters and Weighting for Preliminary Screening for Anaerobic Biodegradation Processes

Notes:

[a] Data from MW-02 are used to indicate background conditions. MW-05 and MW-06 are used for 2016 to 2024. Wells MW-10, MW-11, and MW-12 were evaluated to represent the upgradient portion of the Port property using 2022 and 2024 data.

[b] Points awarded only if it can be shown that the compound is a breakdown product (that is, not a constituent of the source material). The presence of TCE and further breakdown products, combined with the limited migration distance away from the area of highest concentration, indicate that TCE, DCE, and vinyl chloride are breakdown products.

Notes:

ND = Not determined. Assigned a value of zero; the actual value, if data were available, may be higher.
°C = degree(s) Celsius
nM = nanomoles per liter
Source Area Remediation

Soil associated with a former aboveground tank located near current monitoring well MW-06 (Dames & Moore 1989) was remediated in 1989. Following excavation, confirmation sampling was performed, and low levels of PCE were detected in soil. Confirmation soil sample results ranged from below the reporting limit of 0.005 milligram per kilogram (mg/kg) in two samples to a maximum of 0.17 mg/kg PCE from the eastern wall of the excavation. This work was done in communication with DEQ, which considered the site a low-priority project (DEQ 1989). Although it was done several years before DEQ issued its risk-based decision-making guidance, the post-remedial action confirmation samples showed PCE levels in soil after remediation were well below potentially applicable risk-based decision-making values. Because this potential source area has been remediated in the past, the source area was capped in 2009/2010, and no other on-site potential source area has been identified in more than 25 years of investigation at the Site, the source control element of an on-site MNA remedy (EPA 2004) has been met.

5. Monitored Natural Attenuation Data Evaluation

This annual groundwater report was developed in accordance with MNA guidance (EPA 2004) and the MNA Work Plan (Jacobs 2022). This report presents groundwater data collected in 2024 which, including data collected before that, provide evidence in support of the MNA decision for VOCs in Southeast Area groundwater.

5.1 VOC Concentrations in the Southeast Area

Low-level VOC concentrations in the Southeast Area have decreased substantially since monitoring began in the early 2000s, and recent concentrations demonstrate that MNA is an effective source control measure and remedial action for groundwater. Samples in the Southeast Area were collected from six wells in the area from 2001 through 2005, 2007, and 2016 through 2024. Groundwater sampling using Geoprobes was conducted in 2001, 2002, and 2004. Four Port wells were included in the monitoring program from 2016 through 2021, and an additional three wells located on the Port property have been monitored since their installation in 2022.

Historical VOC concentrations in groundwater in the Southeast Area collected from 2001 through 2005 are shown on Figure 5-1. The highest historical concentrations of PCE occurred near MW-06 and MW-01 close to the location of the former aboveground tank, with lower concentrations detected both upgradient (MW-05) and downgradient (MW-03 and MW-04) of these wells. Groundwater monitoring resumed in 2016.

VOC concentrations in monitoring wells for both the Northwest Pipe property and Port property from 2016 through 2024 are shown on Figures 5-2 and 5-3, respectively. Trend plots for this time period are presented on Figures 5-4, 5-5, and 5-6. These data show the wells with the highest VOC concentrations are consistently wells MW-05 and MW-06. By comparison, MW-01, MW-03, and MW-04 have shown consistently moderate concentrations, and MW-02 and the Port property wells have concentrations near or less than the laboratory reporting limits for VOCs.

In September 2022, MW-02 exhibited values of cis-1,2-DCE and vinyl chloride approximately 1 order of magnitude greater than those usually observed. Concentrations of cis-1,2-DCE and vinyl chloride were conversely an order of magnitude lower than usual at well MW-06, approximately 200 feet to the east of MW-02. This trend continued through 2023 and 2024 and also included increases in PCE and TCE at MW-02 and reciprocal decreases in PCE and TCE at MW-06. These observations suggest the core of the plume may have moved slightly west of its usual location closer to MW-06. To assess what may have caused this condition, Willamette River stage height measurements were compared for 2022, 2023, and 2024 to average conditions between 2007 and 2024. The data for 2022 show a month-and-a-half period of unusually high river stage, from early June to mid-July, and a similar elevated high river stage occurred in May 2023 (Figure 5-7). Both periods of high river stage ended in a steep decline (steeper than typical). In 2023, the steep decline is followed by lower-than-typical river stages until September. In 2024, the spring river level was lower than normal, similar to 2021 levels. In a review of Site water levels, groundwater elevations were found to be elevated to a range of 20 to 21 ft for both 2022 and 2023 measurements versus the more typical 17 to 18 ft elevations measured from 2019 through 2021 (Figure 5-7). Despite the lower-than-normal river stage levels in spring 2024, the groundwater elevations of site wells continued to be elevated in May 2024 around 22.5 ft. The unusual high river stages would cause a general rise in water levels both in Willamette River tributaries as well as in aquifers hydraulically connected to the river. Then, when the river stage underwent its unusually steep decline, that would have caused a stronger-than-normal westerly gradient in the aquifer underlying the site. Although not

definitive, this sequence of events and the resulting higher than normal water levels across the Site could have caused the plume core to be pulled slightly west.

Wells MW-10, MW-11, and MW-12 on the Port property were installed approximately perpendicular to the groundwater flow path at the downgradient edge of the plume. The VOC concentrations observed in 2022 and 2024 support that these wells are near the leading edge of the plume just prior to where reductive dechlorination is anticipated to have degraded concentrations below laboratory reporting limits. The data obtained from these wells suggest the centerline of the plume is in the area monitored by MW-11 and MW-12. These wells improve the confidence in the assessment of the lateral extent of the plume and increases the lateral area monitored as requested by DEQ (DEQ 2021). The addition of three monitoring wells further allows for an early warning of potential changes in groundwater quality that may have relevance to the evaluation of protectiveness of the MNA remedy with respect to the Willamette River.

Data collected from 2016 through 2024 exhibit normal and expected temporal variability in concentrations. However, the maximum value of the most highly concentrated VOC identified in data (PCE in MW-05; 4,400 micrograms per liter [µg/L] measured in May 2019) is less than half the maximum concentration previously detected in groundwater at the site (PCE in GP-1; 9,800 µg/L measured in 2001). This reduction in the concentration of PCE is consistent with a stable or decreasing plume that is controlled by the natural attenuation processes.

5.2 Evidence of Plume Stability

Jacobs reviewed EPA documents and other supporting information on plume stability in the context of MNA decision-making to evaluate the stability of the Southeast Area VOC plume.

5.2.1 Evaluation of Plume Stability Using EPA Criteria (1999)

As stated in *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, "sites where the contaminant plumes are no longer increasing in extent, or are shrinking, would be the most appropriate candidates for MNA remedies" (EPA 1999). The factors that characterize plume stability outlined by EPA (1999) are as follows:

- The plume area is not expanding.
- The geochemical environment is favorable to degradation of site-related constituents.

When defining the plume area, EPA (1999) states that a plume boundary is more realistically defined by a zone rather than a line, and concentration fluctuations occurring within this zone likely result from factors such as analytical, seasonal, or spatial variations, and may or may not be indicative of a trend in plume migration. One way to counter this variability is presented in later EPA guidance (2004), which states that data from downgradient limits of a plume should be considered in a group of wells to determine stable or decreasing trends compared to previous sampling rounds (EPA 2004).

The Southeast Area plume meets the metrics for stability presented in these documents as evidenced by VOC concentrations in the plume's margin, in downgradient wells, and in the soil gas investigation performed in 2021 (Jacobs 2021a). The results of the soil gas sampling indicate that the downgradient migration of VOCs in groundwater is limited because nearly all the passive soil gas sampler results on Port property showed no detectable chlorinated ethenes. Furthermore, wells at the plume margins (such as MW-03 and T4S1MW-22) have shown clearly decreasing trends in the concentrations of parent VOCs. The wells closest to Terminal 4 Slip 1 (T4S1MW-03S and T4S1MW-09) have not had detectable VOCs since Northwest Pipe began consistent groundwater monitoring in 2016.

As described in Section 4.2, trends in concentrations in wells within the plume interior exhibit temporal variability. According to EPA (2004), contaminant concentrations at individual sampling points may exhibit fluctuations, including small-scale expansion and shrinkage in response to groundwater flow mechanics and biological degradation rates throughout the year. In addition, VOC concentrations in individual wells may fluctuate with changes in plume configuration caused by oscillations in groundwater flow (EPA 2004). Concentrations in MW-03 are a good example of this characteristic. Although some concentrations were higher in 2016 than previously measured in 2005, concentrations of PCE and TCE have been consistently decreasing since monitoring resumed in 2016. Likewise, cross-gradient wells T4S1MW-22 and T4S1MW-23 both show much lower concentrations in recent monitoring than were found in historical samples, as do wells closer to the source area, MW-01 and MW-04. Minor variations in concentration in the plume interior are expected, commonly observed, and are consistent with a stable to decreasing condition as long as the areal extent of the plume does not expand.

After eliminating the effect of the molecular weights of the different constituents by converting concentration data to micromoles per liter, the downward trends of PCE and TCE to their breakdown products (cis-1,2-DCE and vinyl chloride) are illustrated in wells MW-06 and MW-03 (Figure 5-8). PCE is a definitive parent compound, while TCE may be a parent compound or a breakdown product of PCE. The presence and increasing magnitude of the breakdown products of PCE and TCE are evidence that reductive dechlorination is active in the Southeast Area.

Figure 5-9 presents the molar concentrations for May 2024 parallel to groundwater flow along the centerline of the plume. This plot includes the three highest-concentration wells in the Southeast Area (MW-05, MW-06, and MW-03), new well MW-11 on the Port property, and a Port well closest to Terminal 4 Slip 1 (T4S1MW-03S). Molar concentrations of PCE and TCE are highest in MW-05 and decrease progressively from MW-06 to MW-03 to MW-11 and are nondetect, or estimated in the case of PCE, at the well closest to the slip at T4S1MW-03S. Vinyl chloride and cis-1,2-DCE are also highest in MW-05, but lower in MW-06 than MW-03. VOC concentrations are substantially reduced on the Site, and all average VOC molar concentrations are less than 0.05 micromole per liter beyond MW-11, over 700 feet from Slip 1. VOCs are below detection limits and ROD CULs in Port well T4S1MW-03S (and neighboring well T4S1MW-09), over 100 feet distant from the slip. This pattern shows effective and protective degradation of the plume of VOCs by natural attenuation processes.

5.2.2 Evaluation of Plume Stability Using Criteria in EPA (1998)

EPA's *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (1998) states the determination of plume stability should be based on the following:

- Contaminant properties, including volatility, sorptive properties, and biodegradability
- Aquifer properties, including hydraulic gradient, hydraulic conductivity, porosity, and concentrations of native organic material in the aquifer matrix (fractional organic carbon, or f_{oc})
- The location of the plume and contaminant source relative to potential receptor exposure points (that is, the distance between the leading edge of the plume and the potential receptor exposure points)

The first point in support of plume stability is addressed by the screening worksheet described in Section 4.1, also included in EPA (1998), which integrates the contaminant properties, including volatility, sorptive properties, f_{oc} (from the second point), and biodegradability. When screened, site data scored in the "strong evidence" category, indicating that geochemical conditions at the Site support reductive dechlorination and are consistent with the data demonstrating limited migration of VOCs.

Regarding the second point in EPA's (1998) protocol in support of plume stability, aquifer properties were investigated using aquifer testing in November 2016 to provide additional site-specific information on

aquifer hydraulic characteristics and better determine the groundwater flow velocity at the site (Jacobs 2021b). Single-well rising head tests, commonly referred to as slug-withdrawal tests, were performed on three of the six monitoring wells on the Site (MW-05, MW-06, and MW-03) and two Port wells (T4S1MW-22 and T4S1MW-03S). The typical hydraulic conductivity for the shallow aquifer along the flow path ranges from approximately 2 to 25 feet per day (ft/day). The hydraulic conductivity of MW-05 was calculated to be higher than the typical range (130 ft/day), indicating that this well is screened in a localized zone of higher hydraulic conductivity. The higher hydraulic conductivity at this well is reflected in observations of minimal drawdown during sampling; however, this zone of higher hydraulic conductivity is bounded by lower conductivity in the downgradient direction and that lower conductivity will ultimately determine the rate of flow through this area (Jacobs 2021b). The average hydraulic conductivity over the flow path is 12.5 ft/day.

The net groundwater flow direction is consistently south to southwest toward Terminal 4 Slip 1 on the Port property, downgradient of the Southeast Area. The hydraulic gradient increases approaching Terminal 4 Slip 1, from an average of 0.005 ft/ft from the boundary of the Site through the middle of the Port property, transitioning to an average of 0.01 ft/ft near the slip (Jacobs 2021b)[1]. Water levels on the Port property, particularly closer to the Terminal 4 Slip 1, are more susceptible to influence from river stage because of closer proximity to surface water. This effect is most pronounced in wells located closest to the Terminal 4 Slip 1. On the Northwest Pipe property, the hydraulic gradient appears to be nearly flat and more variable than further south, but flow is predominantly southerly as well. The observed variability in hydraulic gradient appears to be caused by a combination of the gradual gradient and short-term aquifer response to changes in river stage or precipitation events. The groundwater flow direction in the area of MW-04, to the east of the high-concentration area, appears to vary seasonally with westerly and, infrequently, northerly flow directions. The decrease in hydraulic gradient (an average of 0.0006 ft/ft) across the Southeast Area compared to the Port property, causes slower groundwater flow compared to the Port property. Groundwater levels farther away from surface water, such as at the Southeast Area, have less sensitivity to changes in river stage. Actual groundwater movement during short periods of hydraulic gradient reversal are minimal because of the combination of low hydraulic gradient, low hydraulic conductivity, and the brief duration of gradient reversal. When considering retardation of VOCs dissolved in groundwater caused by sorption/desorption onto organic carbon in the aquifer matrix, the movement of VOCs would be much less even than that suggested by calculations of groundwater flow.

Using these site-specific parameters, groundwater velocity can be calculated for the Southeast Area using a version of Darcy's Law:

$$v = K * i/n$$

where:

v = groundwater velocity (ft/day)
K = hydraulic conductivity (ft/day)
i = hydraulic gradient (ft/ft)
n = effective porosity (unitless)

The average hydraulic conductivity (12.5 ft/day), hydraulic gradient (0.005 ft/day), and typical effective porosity based on soil type (0.2) results in a groundwater velocity across the Southeast Area and the northern Port property of 0.31 ft/day.

[1] 2024 hydraulic gradient observations were approximately 0.002 ft/ft across the Northwest Pipe property and the middle of the Port property, and 0.007 ft/ft closer to Slip 1. The hydraulic gradient values used in this analysis have been maintained at average levels to be conservative.

Regarding the third point in the EPA (1998) protocol in support of plume stability, the slow rate of groundwater flow and the distance from the Southeast Area to the river (1,370 feet from MW-06 to Terminal 4 Slip 1) provides sufficient distance between the leading edge of the plume and the potential receptor exposure point at the river, thereby addressing the third point in EPA (1998) establishing plume stability. Therefore, data for the Southeast Area support all three points, thus verifying plume stability as described in EPA guidance (1998).

According to the evaluation presented in this work plan by the metrics outlined in EPA guidance on MNA, the VOC plume in the Southeast Area is stable.

5.2.3 Site Specific Attenuation Rate Estimates

Using the data from 2024, bulk attenuation rates were calculated using the method presented in *Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies* (EPA 2002). Bulk attenuation rates are based on concentration versus distance attenuation and "are used for estimating if a plume is expanding, showing relatively little change, or shrinking due to the combined effects of dispersion, biodegradation, and other attenuation processes" (EPA 2002). The rate constants for each VOC were derived by plotting the natural log of the 2024 concentration versus the distance along the centerline of the groundwater plume for wells MW-05, MW-06, MW-03, MW-11, and T4S1MW-03S (Appendix D). The negative of the slope of the linear trendline for each constituent was then multiplied by the contaminant velocity. The contaminant velocity is the groundwater velocity divided by the retardation factor. For these calculations, the retardation factor was estimated based on effective porosity (typical value, 0.2), soil bulk density (typical value, 1.7 kilograms per Liter), fraction of organic carbon (average of three shallow aquifer formation samples collected in boring MW-06, 0.000843), and partition coefficients for each constituent (literature values) (see Appendix D for calculation). The resulting attenuation rates are presented in Table 5-1.

Table 5-1. Calculation of Site-Specific Attenuation Rate Estimates

Wells Along Flow Path	Distance Along Flow Path (ft)	2024 Concentrations (µg/L)			
		PCE	**TCE**	**cis-1,2-DCE**	**vinyl chloride**
MW-05	76	240	36	920	130
MW-06	248	150	23	45	0
MW-03	483	4	6	57	4
MW-11	808	0.6	0.5	26.0	7.6
T4S1MW-03S*	1,320	0.0330	0.0300	0.0200	0.0200
Slope of linear trendline (per foot)		-0.0075	-0.006	-0.0075	-0.0048
Groundwater seepage velocity (ft/day)		0.31	0.31	0.31	0.31
Retardation factor		4.05	1.93	1.90	1.21
Contaminant seepage velocity (ft/day)		0.076	0.160	0.164	0.256
Estimated Bulk Attenuation Rate (per day)		0.0007	0.0005	0.0006	0.0004
Estimated Bulk Attenuation Rate (per year)		0.21	0.17	0.21	0.14

Note:
*Concentrations at T4S1MW-03S are below detection limits, with the exception of PCE, which is estimated.

5.3 Protectiveness of MNA Remedy

The possible transport pathways from the source area to potential receptors include the following: (1) shallow groundwater discharge to surface water, (2) contact with shallow groundwater during excavation activities, and (3) volatilization of VOCs from shallow groundwater to indoor and outdoor air.

Conclusions from the human health risk screening for groundwater as presented in the RI/SCE (Jacobs 2021b) are that maximum VOC concentrations in groundwater do not pose an unacceptable risk to human health or the environment, as summarized for each pathway below:

- **Groundwater Discharge to Surface Water** – Groundwater samples collected at wells closest to the river have not exceeded ROD CULs, indicating that there is no unacceptable risk to human health from the groundwater-to-surface-water pathway. Groundwater samples collected at wells closest to the river have not exceeded DEQ Level II screening level values for potential aquatic, bird, or mammalian receptors, indicating that there is no unacceptable risk to ecological receptors from a groundwater-to-surface-water pathway. Furthermore, the soil gas investigation conducted in 2021 indicate that the groundwater-to-surface-water (Willamette River at Terminal 4 Slip 1) transport pathway is incomplete (Jacobs 2021a).
- **Shallow Groundwater in a Potential Excavation** –Data generated since groundwater monitoring resumed in 2016 (and continues to the present) confirm that the risk posed by recent and current concentrations is below the DEQ hazard index target of 1. This data reflects current risk at the Site by accounting for continued and active degradation of VOCs. Contact with groundwater through excavation work is controlled by the Site's Contaminated Media Management Plan (included as an appendix to the RI/SCE [Jacobs 2021b]). The media management plan includes worker notification, health and safety precautions, and proper management and disposal of groundwater encountered during a potential excavation.
- **Volatilization from Shallow Groundwater to Indoor and Outdoor Air** – Maximum detected concentrations for groundwater samples collected from Site monitoring wells and Geoprobe samples were compared to DEQ groundwater vapor intrusion risk-based concentrations (RBCs), groundwater outdoor air RBCs, and groundwater in an excavation RBCs. None of the VOC concentrations, either historical or current, exceeded indoor or outdoor air occupational worker RBCs.

The risk assessment presented in the RI/SCE (Jacobs 2021b) concluded that no excess human health or ecological risk exists from VOCs in the Southeast Area of the Site. In addition, given the ongoing process of reductive dechlorination, VOC concentrations in the Southeast Area of the Site are continuing to attenuate below levels of potential concern before reaching surface water.

6. Conclusions

Groundwater monitoring conducted in 2024 at Northwest Pipe confirms that natural attenuation of VOCs in the shallow groundwater at the Southeast Area is occurring, is effective, and is protective (that is, there are no adverse effects in the form of VOCs at concentrations above the Portland Harbor ROD CULs). The most recent groundwater data confirms the long-standing conceptual site model by way of the following:

- The Northwest Pipe groundwater source area has been remediated.
- Groundwater monitoring at the site indicates that the groundwater plume is stable or decreasing, consistent with EPA guidance.
- Potential human health and ecological risk are addressed by MNA.
- Groundwater flow observations in 2024 continue to show the plume is stable.
- Analysis for geochemical indicators of natural attenuation demonstrates the geochemical environment continues to be favorable to degradation of site-related VOCs by reductive dechlorination to maintain plume stability.
- New wells installed in 2022 on the Port property provide additional information on the lateral extent of the plume and additional insight on groundwater flow conditions in the area. The addition of three monitoring wells further allows for an early warning of the potential migration of contaminants toward the Willamette River, in the unlikely event that this would occur.
- Analysis indicates the plume is not migrating beyond previously-documented boundaries.
- Concentrations of VOCs remaining in Site groundwater are relatively low, and there is consistent evidence in monitoring data collected since 2016 that groundwater containing VOCs above protective levels established in the ROD does not reach the Willamette River.

MNA is currently satisfying the source control objective for the Site and is an effective remedy under DEQ's Hazardous Substance Remedial Action Rules (OAR 340-122-0040) and source control measure under the EPA and DEQ Joint Source Control Strategy (DEQ and EPA 2005). Long-term groundwater monitoring will continue annually as scheduled in the approved MNA Work Plan. Based on the seasonality of the data, the high-water conditions of the second quarter will be targeted for annual monitoring going forward.

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Tables

Table 3-1
Groundwater and Willamette River Elevation Measurements
Northwest Pipe Company Portland Plant

Well ID	Measurement Point Elevation[1] (ft)	Ground Surface Elevation[1] (ft)	Measurement Date	Depth to Water (ft bgs)	Elevation[1] (ft)
MW-01	30.64	30.99	10/25/2016	12.96	17.68
			1/10/2017	11.60	19.04
			1/30/2017	11.23	19.41
			4/25/2017	9.64	21.00
			7/24/2017	11.05	19.59
			12/4/2018	13.89	16.75
			5/7/2019	12.76	17.88
			10/7/2019	13.87	16.77
			4/21/2020	12.88	17.76
			10/20/2020	14.15	16.49
			4/13/2021	12.28	18.36
			10/26/2021	13.89	16.75
	33.82	34.17	4/11/2022	11.97	21.85
			9/12/2022	12.81	21.01
			3/20/2023	11.78	22.04
			8/21/2023	12.94	20.88
			5/13/2024	11.25	22.57
MW-02	27.66	27.97	10/25/2016	10.04	17.62
			1/10/2017	8.70	18.96
			1/30/2017	8.22	19.44
			4/25/2017	6.66	21.00
			7/24/2017	8.16	19.50
			12/4/2018	10.98	16.68
			5/7/2019	9.84	17.82
			10/7/2019	10.92	16.74
			4/21/2020	9.97	17.69
			10/20/2020	11.23	16.43
			4/13/2021	9.36	18.30
			10/26/2021	10.95	16.71
	30.85	31.16	4/11/2022	9.06	21.79
			9/12/2022	9.91	20.94
			3/20/2023	8.85	22.00
			8/21/2023	10.02	20.83
			5/13/2024	8.36	22.49
MW-03	29.15	29.38	10/25/2016	11.63	17.52
			1/10/2017	10.20	18.95
			1/30/2017	9.69	19.46
			4/25/2017	8.09	21.06
			7/24/2017	9.82	19.33
			12/4/2018	12.66	16.49
			5/7/2019	11.42	17.73
			10/7/2019	12.59	16.56
			4/21/2020	11.56	17.59
			10/20/2020	12.89	16.26
			4/13/2021	10.91	18.24
			10/26/2021	12.49	16.66
	32.34	32.57	4/11/2022	NM	NM
			9/12/2022	11.49	20.85
			3/20/2023	10.23	22.11
			8/21/2023	11.62	20.72
			5/13/2024	9.96	22.38
MW-04	30.12	30.77	10/25/2016	12.50	17.62
			1/10/2017	11.07	19.05
			1/30/2017	10.62	19.50
			4/25/2017	9.00	21.12
			7/24/2017	10.64	19.48
			12/4/2018	13.49	16.63
			5/7/2019	12.29	17.83
			10/7/2019	13.46	16.66
			4/21/2020	12.42	17.70
			10/20/2020	13.74	16.38

Table 3-1
Groundwater and Willamette River Elevation Measurements
Northwest Pipe Company Portland Plant

Well ID	Measurement Point Elevation[1] (ft)	Ground Surface Elevation[1] (ft)	Measurement Date	Depth to Water (ft bgs)	Elevation[1] (ft)
MW-04	30.12	30.77	4/13/2021	11.76	18.36
			10/26/2021	13.38	16.74
	33.30	33.95	4/11/2022	11.43	21.87
			9/12/2022	12.34	20.96
			3/20/2023	11.11	22.19
			8/21/2023	12.52	20.78
			5/13/2024	10.75	22.55
MW-05	30.38	30.74	10/25/2016	12.70	17.68
			1/10/2017	11.38	19.00
			1/30/2017	10.98	19.40
			4/25/2017	9.44	20.94
			7/24/2017	10.82	19.56
			12/4/2018	13.60	16.78
			5/7/2019	12.51	17.87
			10/7/2019	13.58	16.80
			4/21/2020	12.64	17.74
			10/20/2020	13.86	16.52
			4/13/2021	12.05	18.33
			10/26/2021	13.62	16.76
	33.57	33.93	4/11/2022	11.78	21.79
			9/12/2022	12.55	21.02
			3/20/2023	11.58	21.99
			8/21/2023	12.70	20.87
			5/13/2024	11.06	22.51
MW-06	29.82	30.06	10/25/2016	12.16	17.66
			1/10/2017	10.80	19.02
			1/30/2017	10.38	19.44
			4/25/2017	8.79	21.03
			7/24/2017	10.27	19.55
			12/4/2018	13.11	16.71
			5/7/2019	11.96	17.86
			10/7/2019	13.06	16.76
			4/21/2020	12.08	17.74
			10/20/2020	13.35	16.47
			4/13/2021	11.47	18.35
			10/26/2021	13.08	16.74
	33.01	33.25	4/11/2022	11.15	21.86
			9/12/2022	12.00	21.01
			3/20/2023	10.95	22.06
			8/21/2023	12.15	20.86
			5/13/2024	10.42	22.59
MW-10[2]	32.17	32.51	4/11/2022	11.00	21.17
			6/29/2022	10.02	22.15
			9/12/2022	11.92	20.25
			12/6/2022	12.12	20.05
			3/20/2023	10.49	21.68
			8/21/2023	11.97	20.20
			5/13/2024	10.41	21.76
MW-11[2]	32.06	32.43	4/11/2022	11.30	20.76
			6/29/2022	10.00	22.06
			9/12/2022	11.78	20.28
			12/6/2022	12.08	19.98
			3/20/2023	10.35	21.71
			8/21/2023	11.92	20.14
			5/13/2024	10.26	21.80
MW-12[2]	35.42	36.30	4/11/2022	13.76	21.66
			6/29/2022	13.25	22.17
			9/12/2022	14.81	20.61
			12/6/2022	15.19	20.23
			3/20/2023	13.41	22.01

Table 3-1
Groundwater and Willamette River Elevation Measurements
Northwest Pipe Company Portland Plant

Well ID	Measurement Point Elevation[1] (ft)	Ground Surface Elevation[1] (ft)	Measurement Date	Depth to Water (ft bgs)	Elevation[1] (ft)
MW-12[2]	35.42	36.30	8/21/2023	14.97	20.45
			5/13/2024	13.17	22.25
T4S1MW-02S	35.27	35.59	10/25/2016	18.35	16.92
			1/10/2017	16.52	18.75
			1/30/2017	16.10	19.17
			4/25/2017	14.15	21.12
			7/24/2017	16.39	18.88
			12/4/2018	19.39	15.88
			5/7/2019	17.89	17.38
			10/7/2019	19.29	15.98
			4/21/2020	17.98	17.29
			10/20/2020	19.51	15.76
			4/13/2021	17.22	18.05
			10/26/2021	19.23	16.04
	38.46	38.78	4/11/2022	16.89	21.57
			9/12/2022	18.00	20.46
			3/20/2023	16.63	21.83
			8/21/2023	18.22	20.24
			5/13/2024	16.36	22.10
T4S1MW-03S	32.91	33.36	10/25/2016	19.04	13.87
			1/10/2017	18.04	14.87
			1/30/2017	17.61	15.30
			4/25/2017	15.65	17.26
			7/24/2017	18.09	14.82
			12/4/2018	19.85	13.06
			5/7/2019	18.75	14.16
			10/7/2019	19.75	13.16
			4/21/2020	18.91	14.00
			10/20/2020	19.85	13.06
			4/13/2021	18.48	14.43
			10/26/2021	19.61	13.30
	36.09	36.54	4/11/2022	22.75	13.34
			9/12/2022	18.94	17.15
			3/20/2023	17.94	18.15
			8/21/2023	18.95	17.14
			5/13/2024	17.85	18.24
T4S1MW-09	33.47	33.75	10/25/2016	19.33	14.14
			1/10/2017	18.47	15.00
			1/30/2017	18.10	15.37
			4/25/2017	16.46	17.01
			7/24/2017	18.51	14.96
			12/4/2018	19.99	13.48
			5/7/2019	19.01	14.46
			10/7/2019	19.88	13.59
			4/21/2020	19.11	14.36
			10/20/2020	19.93	13.54
			4/13/2021	18.68	14.79
			10/26/2021	19.77	13.70
	36.65	36.93	4/11/2022	18.52	18.13
			9/12/2022	19.18	17.47
			3/20/2023	18.26	18.39
			8/21/2023	19.22	17.43
			5/13/2024	18.23	18.42

Table 3-1
Groundwater and Willamette River Elevation Measurements
Northwest Pipe Company Portland Plant

Well ID	Measurement Point Elevation[1] (ft)	Ground Surface Elevation[1] (ft)	Measurement Date	Depth to Water (ft bgs)	Elevation[1] (ft)
T4S1MW-10	22.22	22.53	10/25/2016	8.16	14.06
			1/10/2017	7.44	14.78
			1/30/2017	7.20	15.02
			4/25/2017	5.65	16.57
			7/24/2017	7.57	14.65
			12/4/2018	8.75	13.47
			5/7/2019	8.02	14.20
			10/7/2019	8.67	13.55
			4/21/2020	8.01	14.21
			10/20/2020	8.71	13.51
			4/13/2021	7.61	14.61
			10/26/2021	8.56	13.66
	25.40	25.71	4/11/2022	7.31	18.09
			9/12/2022	8.03	17.37
			3/20/2023	7.23	18.17
			8/21/2023	8.10	17.30
			5/13/2024	7.29	18.11
T4S1MW-17	31.06	31.34	10/25/2016	14.89	16.17
			1/10/2017	13.43	17.63
			1/30/2017	12.87	18.19
			4/25/2017	11.31	19.75
			7/24/2017	13.75	17.31
			12/4/2018	16.68	14.38
			5/7/2019	14.81	16.25
			10/7/2019	16.51	14.55
			4/21/2020	16.44	14.62
			10/20/2020	16.86	14.20
			4/13/2021	15.95	15.11
	34.24	34.52	10/26/2021	16.89	17.35
			Well abandoned		
T4S1MW-22	32.95	33.30	10/25/2016	15.46	17.49
			1/10/2017	13.95	19.00
			1/30/2017	13.44	19.51
			4/25/2017	11.78	21.17
			7/24/2017	13.63	19.32
			12/4/2018	16.50	16.45
			5/7/2019	15.34	17.61
			10/7/2019	16.47	16.48
			4/21/2020	15.34	17.61
			10/20/2020	16.74	16.21
			4/13/2021	14.85	18.10
			10/26/2021	16.39	16.56
	36.14	36.49	4/11/2022	14.31	21.83
			9/12/2022	15.29	20.85
			3/20/2023	14.00	22.14
			8/21/2023	15.47	20.67
			5/13/2024	13.70	22.44
T4S1MW-23	31.21	31.45	10/25/2016	13.72	17.49
			1/10/2017	12.44	18.77
			1/30/2017	11.82	19.39
			4/25/2017	10.45	20.76
			7/24/2017	12.34	18.87

Table 3-1

Groundwater and Willamette River Elevation Measurements

Northwest Pipe Company Portland Plant

Well ID	Measurement Point Elevation[1] (ft)	Ground Surface Elevation[1] (ft)	Measurement Date	Depth to Water (ft bgs)	Elevation[1] (ft)
T4S1MW-23			12/4/2018	14.98	16.23
			5/7/2019	13.72	17.49
			10/7/2019	14.89	16.32
			4/21/2020	13.90	17.31
			10/20/2020	15.20	16.01
			4/13/2021	13.30	17.91
			10/26/2021	14.81	16.40
	34.39	34.63	4/11/2022	12.99	21.40
			9/12/2022	13.90	20.49
			3/20/2023	12.51	21.88
			8/21/2023	13.86	20.53
			5/13/2024	12.40	21.99
T4S1MW-25	30.95	31.38	10/25/2016	15.11	15.84
			1/10/2017	13.46	17.49
			1/30/2017	12.95	18.00
			4/25/2017	11.16	19.79
			7/24/2017	13.54	17.41
			12/4/2018	16.03	14.92
			5/7/2019	14.57	16.38
			10/7/2019	15.88	15.07
			4/21/2020	14.68	16.27
			10/20/2020	16.02	14.93
			4/13/2021	14.00	16.95
			10/26/2021	15.79	15.16
	34.14	34.57	4/11/2022	13.75	20.39
			9/12/2022	14.77	19.37
			3/20/2023	13.45	20.69
			8/21/2023	14.92	19.22
			5/13/2024	13.30	20.84
Willamette River[3]			10/25/2016		5.03
			1/10/2017		6.82
			1/30/2017		6.07
			4/25/2017		14.88
			7/24/2017		4.00
			12/4/2018		2.20
			5/7/2019		6.02
			10/7/2019		-0.01
			4/21/2020		2.97
			10/20/2020		2.42
			4/13/2021		3.20
			10/26/2021		3.67
			4/11/2022		3.86
			6/29/2022		11.24
			9/12/2022		2.56
			12/6/2022		3.19
			3/20/2023		3.65
			8/21/2023		3.46
			5/13/2024		5.94

Notes:

ft bgs = feet below ground surface

NGVD29 = National Geodetic Vertical Datum of 1929

NAVD88 = North American Vertical Datum of 1988

[1]Elevations prior to April 2022 are in NGVD29, after April 2022, elevations are in NAVD88.

[2]MW-10, MW-11, and MW-12 were installed in March 2022. Wells are sampled quarterly.

[3]The Willamette River stage measurement for the second semi-annual event of 2022 was measured at the Morrison Bridge river gauge (USGS 14211720) on 9/12/2022 at 11:50 AM.

Table 3-2
Groundwater Quality Field Parameters
Northwest Pipe Company Portland Plant

Well	Date Sampled	Temperature (°C)	pH	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
Northwest Pipe Company Wells							
MW-01	10/26/2016	15.9	6.42	352	0.26	6	6.8
	2/2/2017	16.0	6.64	385	0.01	-36	3.1
	5/1/2017	15.5	6.56	423	0.12	36	3.0
	7/26/2017	17.2	6.46	513	0.08	66	1.0
	12/6/2018	15.0	6.61	460	0.47	-32	1.0
	5/9/2019	16.4	6.48	889	0.92	93	1.7
	10/9/2019	11.7	6.46	458	0.32	-16	1.9
	4/23/2020	15.5	6.37	401	0.74	97	3.1
	10/22/2020	15.7	6.45	500	0.32	53	3.6
	4/15/2021	15.5	6.53	449	0.16	-9	4.2
	10/28/2021	16.6	6.49	443	0.45	46	0.8
	4/13/2022	11.4	6.85	406	0.34	102	0.1
	9/15/2022	16.9	6.32	496	0.42	45	3.3
	3/22/2023	15.9	6.47	461	0.12	-136	3.8
	8/23/2023	18.3	6.42	62*	0.20	175	3.1
	5/15/2024	17.0	2.61*	519	0.17	288	3.3
MW-02	10/26/2016	16.8	6.90	197	0.24	-138	0.7
	2/1/2017	15.4	6.97	202	0.09	-136	8.2
	4/27/2017	15.0	7.11	240	0.20	-142	8.1
	7/25/2017	20.1	6.74	244	0.07	-141	1.0
	12/5/2018	15.8	7.10	265	0.36	-167	1.6
	5/8/2019	17.1	7.03	501	0.52	-136	4.6
	10/8/2019	13.7	6.87	246	0.26	-106	0.9
	4/22/2020	15.2	6.94	484	0.15	-170	<5[1]
	10/21/2020	17.4	6.96	332	0.52	-139	0.5
	4/14/2021	15.8	6.80	291	0.95	-116	0.5
	10/27/2021	17.7	7.05	281	1.21	-155	0.8
	4/13/2022	11.5	7.31	284	0.23	-129	0.0
	9/14/2022	19.6	7.36	302	0.13	-138	1.9
	3/22/2023	16.4	7.04	246	0.06	-148	4.4
	8/23/2023	19.5	7.04	57*	0.05	-157	1.1
	5/15/2024	17.5	6.84	229	0.00	-99	3.6
MW-03	10/26/2016	16.4	6.61	281	0.32	-88	2.6
	2/2/2017	15.9	6.76	321	0.26	-68	3.2
	5/1/2017	15.5	6.56	334	0.07	-43	3.5
	7/27/2017	17.0	6.55	360	0.08	-69	2.6
	12/7/2018	14.6	6.74	372	1.02	-43	5.8
	5/9/2019	15.8	6.67	691	0.44	-37	6.3
	10/9/2019	12.2	6.49	342	0.80	-33	4.6
	4/23/2020	14.8	6.60	276	0.26	-74	10.6
	10/22/2020	15.3	6.67	345	0.31	-85	3.6
	4/15/2021	15.4	6.65	339	0.23	-19	16.5
	10/28/2021	16.6	6.58	309	0.46	-46	6.7
	4/14/2022	10.3	7.20	333	0.29	-50	11.7
	9/14/2022	16.1	6.85	346	0.25	-59	15.4
	3/22/2023	14.1	6.76	274	0.20	-146	15.5
	8/23/2023	16.9	6.77	58*	0.08	-81	7.4
	5/15/2024	15.6	6.52	253	0.51	387*	1.1
MW-04	10/26/2016	14.8	6.34	323	0.28	-59	4.1
	2/1/2017	14.3	6.39	440	0.32	-45	1.3
	4/27/2017	13.0	6.60	337	0.22	-59	5.0
	7/26/2017	15.1	6.42	374	0.13	-66	8.1
	12/6/2018	14.3	6.53	403	0.53	-48	1.3
	5/8/2019	14.5	6.47	777	0.92	-30	1.4
	10/8/2019	11.7	6.19	418	0.24	-26	0.5

Table 3-2
Groundwater Quality Field Parameters
Northwest Pipe Company Portland Plant

Well	Date Sampled	Temperature (°C)	pH	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
MW-04	4/22/2020	14.4	6.38	673	0.75	-41	1.2
	10/21/2020	15.4	6.33	467	0.39	-32	0.5
	4/14/2021	14.6	6.60	300	0.41	32	0.6
	10/27/2021	16.2	6.28	316	0.54	1	1.0
	4/13/2022	9.8	6.68	267	0.31	60	0.0
	9/15/2022	15.5	6.42	289	0.46	-41	0.8
	3/22/2023	13.8	6.44	212	0.53	-132	0.4
	8/22/2023	15.9	6.51	273	0.19	-69	1.1
	5/16/2024	14.7	6.62	267	0.29	-44	11.1
MW-05	10/26/2016	15.5	6.50	375	0.17	-52	1.2
	2/2/2017	15.7	6.59	426	0.33	77	1.8
	5/1/2017	15.4	6.60	360	0.11	-40	0.5
	7/27/2017	18.0	6.46	390	0.11	19	2.2
	12/7/2018	13.5	6.71	386	0.62	-7	1.0
	5/9/2019	16.7	6.39	748	0.79	97	1.2
	10/9/2019	12.7	6.42	394	0.31	-19	0.3
	4/23/2020	16.0	6.35	354	0.63	-10	0.9
	10/22/2020	16.5	6.48	431	0.25	-36	0.7
	4/15/2021	16.6	6.25	404	0.19	-1	0.4
	10/28/2021	17.0	6.33	386	0.20	-18	0.6
	4/14/2022	11.7	7.15	341	0.24	-78	0.7
	9/15/2022	17.6	6.57	301	0.23	-22	1.7
	3/23/2023	14.9	6.72	295	0.16	-123	0.9
	8/24/2023	17.0	6.59	326	0.09	-66	4.7
	5/16/2024	16.7	6.68	366	0.05	-68	2.3
MW-06	10/26/2016	15.9	6.47	266	0.15	-76	2.7
	2/2/2017	15.5	6.54	299	0.20	-47	2.8
	5/1/2017	15.7	6.35	310	0.13	20	4.4
	7/27/2017	16.6	6.27	322	0.07	-9	10.7
	12/7/2018	14.3	6.61	395	0.66	-49	13.4
	5/9/2019	17.8	6.42	712	0.70	31	36.1
	10/9/2019	12.0	6.38	339	0.14	-36	2.1
	4/23/2020	15.6	6.24	282	0.36	20	5.7
	10/22/2020	15.4	6.47	358	0.21	-46	0.5
	4/15/2021	16.3	6.23	386	0.18	-21	7.7
	10/28/2021	16.1	6.21	379	0.81	-6	2.0
	4/14/2022	11.3	6.93	444	0.42	14	0.4
	9/15/2022	16.6	6.31	426	0.24	-1	0.5
	3/23/2023	14.8	6.41	383	0.27	-130	2.5
	8/24/2023	16.1	6.41	62*	0.05	62	2.7
	5/16/2024	16.0	6.35	296	0.41	81	1.9
Northwest Pipe Company Wells on Port of Portland Property [2]							
MW-10	4/12/2022	11.0	7.17	285	0.27	-109	8.2
	6/29/2022	15.8	6.81	122	1.08	65	48.0
	9/13/2022	15.4	7.28	282	0.11	-111	0.5
	12/6/2022	13.7	6.97	269	0.42	-116	1.0
	3/21/2023	15.0	7.02	275	0.11	-167	10.1
	6/6/2023	16.5	6.21	263	0.22	-114	5.6
	8/23/2023	15.9	7.01	286	0.12	-141	8.5
	11/14/2023	14.1	6.74	256	0.17	-136	3.5
	5/14/2024	16.6	6.96	300	0.00	-152	5.9

Table 3-2
Groundwater Quality Field Parameters
Northwest Pipe Company Portland Plant

Well	Date Sampled	Temperature (°C)	pH	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
MW-11	4/12/2022	9.7	6.85	226	0.24	-7	1.4
	6/29/2022	15.4	6.76	263	0.00	-17	2.9
	9/13/2022	15.2	6.77	268	0.16	-54	1.9
	12/6/2022	13.7	6.83	241	0.88	-83	2.4
	3/21/2023	14.1	6.88	238	0.08	-138	4.9
	6/6/2023	15.3	6.16	211	0.26	-78	4.4
	8/23/2023	15.2	6.79	58*	0.20	-49	18.4
	11/14/2023	13.7	6.48	266	0.30	-72	3.5
	5/14/2024	17.4	6.82	252	0.05	-100	6.4
MW-12	4/12/2022	9.2	6.70	266	0.88	-27	9.4
	6/29/2022	14.9	6.63	203	2.17	18	19.5
	9/13/2022	15.4	6.92	280	1.87	-25	2.8
	12/6/2022	14.2	6.56	295	3.63	-11	1.7
	3/21/2023	12.2	6.58	228	2.36	-132	2.3
	6/6/2023	14.3	6.12	241	1.56	41	5.7
	8/22/2023	15.9	6.49	250	1.81	16	10.8
	11/14/2023	13.8	6.05	269	1.97	11	1.6
	5/15/2024	13.8	6.31	301	0.65	14	6.8
Port of Portland Wells							
T4S1MW-03S	10/25/2016	14.2	6.42	245	0.86	72	0.5
	2/1/2017	14.3	6.65	111	5.19	145	0.8
	4/26/2017	13.2	6.62	87	8.96	167	1.6
	7/25/2017	16.0	6.46	164	4.46	115	0.3
	12/5/2018	13.4	6.53	203	0.63	161	0.2
	5/8/2019	14.5	6.55	338	2.34	145	0.3
	10/7/2019	11.2	6.26	171	0.47	47	0.3
	4/21/2020	14.3	6.32	181	3.11	207	0.5
	10/20/2020	14.6	6.10	151	0.81	125	0.2
	4/13/2021	15.0	6.60	148	5.15	70	0.6
	10/26/2021	14.8	6.35	164	0.73	102	0.3
	4/11/2022	8.5	6.52	181	5.44	146	2.8
	9/14/2022	16.1	6.65	168	2.13	74	0.7
	3/20/2023	11.1	6.66	218	3.10	505	0.5
	8/21/2023	18.3	6.70	50*	1.62	109	1.4
	5/14/2024	15.2	6.49	230	3.69	111	0.7
T4S1MW-09	10/25/2016	14.9	6.51	278	3.27	-53	1.6
	2/1/2017	14.9	6.67	234	2.87	-41	0.9
	4/26/2017	14.3	6.51	200	0.98	-20	4.2
	7/25/2017	16.0	6.45	216	1.77	96	1.8
	12/5/2018	14.8	6.76	176	1.49	187	0.5
	5/8/2019	14.4	6.26	393	5.52	194	1.2
	10/7/2019	12.1	6.46	201	1.42	64	0.5
	4/21/2020	15.5	6.41	200	4.38	182	0.7
	10/20/2020	17.6	6.20	211	1.63	89	0.1
	4/13/2021	16.6	6.50	188	3.15	52	0.3
	10/26/2021	15.4	6.59	225	1.19	151	0.4
	4/11/2022	10.7	6.48	171	4.20	66	0.8
	9/14/2022	16.3	6.72	198	2.86	91	0.7
	3/20/2023	11.5	6.74	201	7.30	434	0.8
	8/22/2023	15.2	6.57	199	2.82	102	2.3
	5/14/2024	15.8	6.66	148	2.56	-30	3.5

Table 3-2
Groundwater Quality Field Parameters
Northwest Pipe Company Portland Plant

Well	Date Sampled	Temperature (°C)	pH	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Turbidity (NTU)
T4S1MW-22	10/25/2016	15.7	6.35	217	0.33	97	4.0
	2/1/2017	14.4	6.40	255	0.30	132	1.2
	4/27/2017	15.0	6.36	232	1.20	169	1.4
	7/26/2017	16.0	6.25	242	0.88	117	0.7
	12/6/2018	15.0	6.47	281	0.63	149	0.3
	5/8/2019	15.8	6.22	651	1.13	123	1.2
	10/8/2019	12.4	6.16	321	0.26	42	1.0
	4/22/2020	15.7	6.26	522	0.85	138	0.6
	10/21/2020	16.1	6.25	290	0.22	104	0.4
	4/14/2021	15.7	6.14	261	1.13	50	0.2
	10/27/2021	16.4	6.20	262	0.28	98	0.3
	4/13/2022	10.1	6.65	254	0.99	120	0.0
	9/13/2022	16.9	6.27	299	0.34	98	1.2
	3/21/2023	15.5	6.46	244	0.24	-202	0.2
	8/22/2023	17.4	6.36	248	0.45	104	0.7
	5/13/2024	17.4	6.31	256	1.52	112	0.6
T4S1MW-23	10/25/2016	15.1	6.49	165	0.90	39	1.2
	2/1/2017	14.2	6.54	177	1.31	51	1.4
	4/27/2017	14.9	6.53	161	1.12	92	1.9
	7/26/2017	18.0	6.57	165	1.47	61	0.6
	12/6/2018	13.8	6.67	182	1.14	80	1.0
	5/9/2019	14.6	6.37	438	1.34	101	1.5
	10/8/2019	12.0	6.31	202	1.79	33	1.0
	4/22/2020	15.1	6.32	469	1.24	123	1.6
	10/21/2020	16.3	6.35	291	1.19	87	1.1
	4/14/2021	15.8	6.51	225	1.39	30	0.8
	10/27/2021	15.7	6.30	236	1.66	88	0.2
	4/12/2022	10.1	6.69	219	2.23	102	0.2
	9/13/2022	16.7	6.57	246	2.44	97	0.8
	3/21/2023	15.6	7.20	300	0.07	-222	8.5
	8/22/2023	16.7	6.63	250	0.70	-26	7.9
	5/15/2024	17.0	6.62	215	0.78	-6	10.7

Notes:

[1]Hach 2100Q was not reading values below 5; cause of this was not determined.

[2]MW-10, MW-11, and MW-12 were installed in March 2022. Wells are sampled quaterly.

pH was analyzed at the laboratory due to field meter malfunction for MW-02, MW-04, T4S1MW-03S, and T4S1MW-09 for the April 2021 event.

*Field probe may have been malfunctioning for selected readings, leading to erroneous values. For future monitoring events, the calibration of the probe will be rechecked, and, if necessary, a functional probe will be obtained, when erroneous measurements are observed.

°C = degrees Celsius
mg/L = milligrams per liter
mV = millivolts
µS/cm = microsiemens per centimeter
NTU = Nephelometric Turbidity Units

Table 3-3

Groundwater Quality Analytical Data for Natural Attenuation Parameters

Northwest Pipe Company Portland Plant

		Natural Attenuation Parameters (mg/L)							
Sample ID	*Sample Date*	**Chloride**	**Nitrate-N**	**Sulfate**	**TOC**	**Iron, dissolved**	**Ferrous Iron[1]**	**Carbon Dioxide[1]**	**Methane**
Northwest Pipe Company Wells									
MW-01	10/26/2016	2.46	0.370 J	10.1	1.00	1.59	--	81.0	1.25
	2/2/2017	3.69	0.061	4.71	0.84	3.01	--	68.2	1.74
	5/1/2017	4.00	0.029	3.57	1.34	1.53	--	82.6	3.12
	7/26/2017	5.29	4.22	29.3	1.28	0.01	--	10.3	0.177
	12/6/2018	2.50	0.20	8.50	1.20	--	4.72	50	0.62
	5/9/2019	2.70	0.50 U	12.0	1.20	--	0.08	95	0.31
	10/9/2019	2.50	0.60	11.0	1.30	--	2.69	80	0.990
	4/23/2020	2.40	1.10 J	12.0	1.20	--	0.00	72	0.220
	10/22/2020	2.00	0.93	14.0	1.30	--	0.18	70	0.420
	4/15/2021	2.50 U	0.63	13.0 J	1.20	--	0.00	90	0.011
	10/28/2021	2.30	0.27	7.60	0.99	--	0.71	85	0.110
	4/13/2022	2.40	0.34	8.90	1.40	--	0.00	60	0.0500
	9/15/2022	2.90	3.30	18.0	1.40	--	0.00	95	0.026
	3/22/2023	3.25	0.178	6.72	1.13	--	0.59	140	2.80
	8/23/2023	3.88	5.59	31.0	1.58	--	0.04	100	0.069
	5/15/2024	4.65	3.17	27.6	1.39	--	0.00	95	0.06
MW-02	10/26/2016	1.98	0.023 J	4.15	1.48	5.45	--	29.6	3.68
	2/1/2017	2.50	0.390	8.09	1.23	5.39	--	17.6	3.30
	4/27/2017	2.47	0.310	5.37	1.60	1.34	--	15.6	3.42
	7/25/2017	3.14	0.270	5.88	1.52	5.91	--	19.3	5.33
	12/5/2018	2.90	0.020 U	2.50	1.60	--	4.94	34	7.30
	5/8/2019	2.90 U	0.044 J	0.92 J	1.30	--	3.64	40	7.20
	10/8/2019	2.90 J	0.020 U	1.50 J	1.40	--	2.52	30	7.70
	4/22/2020	3.60	0.510	0.80 J	1.50	--	2.35	17	4.80
	10/21/2020	2.90	0.024 J	1.40	1.40	--	2.84	40	4.50
	4/14/2021	4.30	0.130 U	1.60	1.50	--	6.00	50	5.30
	10/27/2021	2.70	0.037 J	1.30 J	1.20	--	6.48	30	4.30
	4/13/2022	2.80	0.057 J	1.50	1.70	--	1.85	40	3.50
	9/14/2022	2.70	0.110 J	3.40	1.60	--	5.13	45	1.80
	3/22/2023	2.75	0.0724 J	1.81	1.41	--	2.53	40	8.50
	8/23/2023	3.00	0.124	6.35	1.52	--	4.84	40	6.40
	5/15/2024	3.64	0.106	3.96	1.47	--	3.20	45	7.90
MW-03	10/26/2016	3.61	0.018 J	10.2	1.27	6.14	--	53.6	1.48
	2/2/2017	3.92	0.018	10.4	0.93	4.46	--	44.1	0.734
	5/1/2017	5.47	0.0028 U	12.1	1.27	3.32	--	53.9	0.748
	7/27/2017	5.19	0.011	9.48	1.33	6.31	--	57.6	2.67
	12/7/2018	3.80	0.02 U	10	1.50	--	2.96	45	2.20
	5/9/2019	4.30	0.2 U	9.40	1.30	--	2.72	60	2.30
	10/9/2019	4.20	0.031 J	10	1.60	--	3.12	60	2.60
	4/23/2020	4.10	0.29	7.30	1.40	--	1.27	23	1.70
	10/22/2020	3.10	0.08 J	7.00	1.40	--	5.18	40	1.10
	4/15/2021	4.50	0.13 U	9.10	1.40	--	2.77	55	0.490
	10/28/2021	3.30	0.2	7.70	1.40	--	2.58	50	0.390
	4/14/2022	3.30	0.031 J	12.0	1.40	--	2.32	45	0.190
	9/14/2022	3.30	0.03 U	9.00	1.50	--	5.86	55	0.110
	3/22/2023	3.33	0.0802 J	7.29	1.07	--	4.82	40	0.760
	8/23/2023	8.10	0.05 U	5.34	1.21	--	4.88	40	2.20
	5/15/2024	16.00	0.0519 J	4.28	1.17	--	0.25	55	0.17
MW-04	10/26/2016	3.00	0.043 J	5.70	1.21	12.9	--	104	1.46
	2/1/2017	4.90	0.0028 U	4.42	1.09	9.75	--	98.4	1.86
	4/27/2017	4.52	0.011	2.35	1.40	9.83	--	82.0	1.21
	7/26/2017	4.10	0.023	2.55	0.720	10.0	--	82.9	1.78
	12/6/2018	3.30	0.046 J	4.10	1.70	--	2.96	80	2.90
	5/8/2019	3.40 U	0.058 J	3.70	1.30	--	10.1	85	1.40
	10/8/2019	3.20	0.053 J	3.90	1.50	--	2.95	150	2.70
	4/22/2020	3.70	0.29	3.90	1.40	--	2.00	55	0.620
	10/21/2020	2.70	0.024 J	4.10 N	1.40	--	1.59	95	0.700
	4/14/2021	4.00	0.031 U	3.50	1.20	--	0.39	50	0.100
	10/27/2021	5.30	0.1 J	5.10	1.20	--	3.18	60	0.370
	4/13/2022	10.0	0.03 U	3.50	1.30	--	0.28	25	0.044

Table 3-3
Groundwater Quality Analytical Data for Natural Attenuation Parameters
Northwest Pipe Company Portland Plant

		Natural Attenuation Parameters (mg/L)							
Sample ID	*Sample Date*	**Chloride**	**Nitrate-N**	**Sulfate**	**TOC**	**Iron, dissolved**	**Ferrous Iron[1]**	**Carbon Dioxide[1]**	**Methane**
MW-04	9/15/2022	15.0	0.03 U	3.00	1.40	--	2.22	65	0.110
	3/22/2023	9.36	0.05 U	4.28	1.13	--	0.21	50	0.073
	8/22/2023	14.0	0.05 U	6.13	1.77	--	2.96	60	0.470
	5/16/2024	10.4	0.0588 J	3.75	1.08	--	2.91	40	1.20
MW-05	10/26/2016	5.36	0.34 J	20.5	1.67	4.46	--	75.1	1.16
	2/2/2017	7.03	0.57	29.7	1.50	0.0137 U	--	74.9	0.887
	5/1/2017	4.87	0.0028 U	11.9	1.33	4.17	--	50.5	2.31
	7/27/2017	6.53	1.05	20.9	1.28	2.14	--	63.8	1.19
	12/7/2018	3.50	0.02 U	7.10	1.60	--	1.85	40	1.7
	5/9/2019	4.80	1.0	17.00	1.50	--	0.05	60	0.17
	10/9/2019	5.20	0.15 J	12.0	1.90	--	3.78	65	3.0
	4/23/2020	6.00	2.4	18.0	1.80	--	2.18	42	0.63
	10/22/2020	4.30	0.48	12.0	1.90	--	2.94	75	1.20
	4/15/2021	6.50	0.26 U	22.0	1.70	--	0.33	85	0.28
	10/28/2021	4.10	0.66	13.0	1.70	--	3.62	75	0.94
	4/14/2022	3.80	0.03 U	5.90	1.90	--	1.62	60	1.20
	9/15/2022	5.00	0.9	7.70	1.20	--	0.700	55	0.35
	3/23/2023	4.63	0.05 U	1.66	1.05	--	3.54	55	9.20
	8/24/2023	5.08	0.595	8.61	1.64	--	3.30	55	5.10
	5/16/2024	4.85	0.0548 J	2.1	1.71	--	3.14	60	4.80
MW-06	10/26/2016	5.07	0.016 J	5.17	1.25	7.29	--	57.1	2.28
	2/2/2017	6.12	0.0028 U	9.27	1.15	6.10	--	60.5	0.623
	5/1/2017	6.20	0.0028 U	13.9	1.27	3.53	--	81.8	0.206
	7/27/2017	5.18	0.0084 J	13.7	1.05	3.24	--	78.6	0.214 J
	12/7/2018	5.20	0.02 U	8.70	1.50	--	1.87	55	3.5
	5/9/2019	5.80	0.13 U	17.0	1.50	--	1.41	90	0.37
	10/9/2019	5.50	0.039 J	9.40	1.80	--	4.40	80	3.1
	4/23/2020	6.30	0.23	14.0	1.50	--	1.56	34	0.61
	10/22/2020	5.50	0.021 J	9.50	1.70	--	4.88	95	1.2
	4/15/2021	8.20	0.096 U	15.0	1.50	--	1.71	110	0.28
	10/28/2021	5.40	0.12 J	11.0	1.40	--	3.18	100	0.76
	4/14/2022	4.10	0.03 U	25.0	1.80	--	1.76	100	0.58
	9/15/2022	2.80	0.03 U	22.0	1.60	--	1.46	150	0.036 J
	3/23/2023	2.62	0.05 U	16.4	1.25	--	1.04	90	0.11 J
	8/24/2023	2.55	0.05 U	13.7	1.47	--	0.38	85	0.23
	5/16/2024	2.14	0.0524 J	6.44	0.928 J	--	0.21	75	0.041
MW-06	10/26/2016	5.05	0.017 J	5.36	1.15	7.4	--	59.5	2.04
Duplicate	2/2/2017	5.95	0.003 J	9.09	1.12	6.09	--	62.3	0.666
	5/1/2017	6.21	0.0028 U	14.0	1.40	3.6	--	82.3	0.265
	7/27/2017	5.21	0.01	13.6	1.16	3.22	--	80.0	0.382 J
	12/7/2018	5.20	0.02 U	8.80	1.50	--	1.87	55	4.1
	5/9/2019	5.70	0.14 U	17.0	1.60	--	1.41	90	0.35
	10/9/2019	5.50	0.035 J	9.70	2.10	--	4.40	80	2.9
	4/23/2020	6.30	0.23	13.0	1.40	--	1.56	44	0.59
	10/22/2020	5.40	0.02 U	9.30	1.70	--	4.88	95	1.3
	4/15/2021	8.30	0.093 U	15.0	1.60	--	1.71	110	0.23
	10/28/2021	5.30	0.16 J	11.0	1.40	--	3.18	100	0.8
	4/14/2022	4.10	0.03 U	25.0	1.80	--	1.76	100	0.057
	9/15/2022	2.80	0.03 U	23.0	1.50	--	1.46	150	0.018 J
	3/23/2023	2.60	0.05 U	16.8	1.22	--	1.04	90	0.077 J
Northwest Pipe Company Wells on Port of Portland Property[1]									
MW-10[2]	4/12/2022	2.60	0.03 U	2.00	2.50	--	1.77	35	1.2
	6/29/2022	1.60	0.20	5.40	0.79	--	0	7.4	0.0011
	9/13/2022	1.80	0.03 U	1.80	2.00	--	6.08	40	0.86
	12/6/2022	2.30	0.03 U	2.10	2.50	--	2.02	30	1 J
	3/21/2023	2.72	0.05 U	3.53	2.01	--	4.22	50	2.9
	6/6/2023	2.16	0.05 U	3.79	2.40	--	8.52	45	3.1
	8/23/2023	2.37	0.05 U	4.81	2.28	--	6.32	35	2.6
	11/14/2023	2.63	0.05 U	1.86	2.19	--	2.64	30	4.6
	5/14/2024	2.28	0.05 U	2.02	2.24	--	3.30	30	4.9

Table 3-3
Groundwater Quality Analytical Data for Natural Attenuation Parameters
Northwest Pipe Company Portland Plant

		Natural Attenuation Parameters (mg/L)							
Sample ID	*Sample Date*	**Chloride**	**Nitrate-N**	**Sulfate**	**TOC**	**Iron, dissolved**	**Ferrous Iron[1]**	**Carbon Dioxide[1]**	**Methane**
MW-10[2]	6/29/2022	1.70	0.21	5.40	0.76	--	0	7.3	0.0012
Duplicate	12/6/2022	2.30	0.03 UJ	2.30	2.40	--	2.02	30	0.41 J
	6/6/2023	2.19	0.05 U	4.46	2.40	--	8.52	45	3.3
	11/14/2023	2.68	0.05 U	2.09	2.22	--	2.64	30	6.2
MW-11[2]	4/12/2022	3.30	0.03 U	2.80	1.30	--	0.48	30	1.4
	6/29/2022	4.30	0.03 U	4.50	1.40	--	1.75	18	1.9
	9/13/2002	4.20	0.072 J	4.90	1.50	--	2.27	45	0.95
	12/6/2022	3.50	0.076 J	4.10	1.40	--	3.17	40	1.1
	3/21/2023	4.74	0.16	4.31	1.25	--	3.07	45	2.5
	6/6/2023	4.02	0.13	4.45	1.40	--	2.71	35	2.9
	8/23/2023	6.30	0.22	13.4	1.20	--	0.97	30	0.45
	11/14/2023	15.8	0.24	0.238	1.08	--	2.37	30	1.7
	5/14/2024	13.5	0.06 J	3.12	1.08	--	2.75	45	1.6
MW-12[2]	4/12/2022	2.50	0.09 J	4.00	1.60	--	1.58	35	0.27
	6/29/2022	2.10	0.17 J	3.50	1.20	--	2.41	20	0.21
	9/13/2022	2.60	0.22	3.30	1.30	--	5.90	70	0.41
	12/6/2022	4.60	0.44	7.20	1.40	--	3.09	55	0.33
	3/21/2023	2.66	0.30	4.95	1.07	--	1.82	35	0.59
	6/6/2023	3.25	0.13	4.99	1.40	--	1.71	55	0.68
	8/22/2023	3.99	0.89	5.07	1.43	--	2.93	65	0.52
	11/14/2023	5.81	0.93	0.93	1.13	--	2.02	50	1.50
	5/15/2024	4.44	0.36	4.41	1.13	--	2.16	60	0.57
MW-12[2]	8/22/2023	4.11	0.86	5.79	1.38	--	2.93	65	0.49
Duplicate	5/15/2024	4.9	0.368	5.2	1.16	--	2.16	60	0.57
Port of Portland Wells									
T4S1MW-03S	10/25/2016	5.10 J	5.2 J	24.7 J	0.85 J	0.0304 J	--	26.2 J	0.0291 J
	2/1/2017	0.86	1.2	4.54	0.39 J	0.01 U	--	13.9	0.0101 J
	4/26/2017	0.71	0.44	2.56	0.50	0.01 U	--	9.6	0.00515 U
	7/25/2017	1.90	3.8	12.4	0.56	0.01 U	--	18.1	0.00495 U
	12/5/2018	1.60	1.2	13.000	0.82 J	--	0	37.5	0.1 U
	5/8/2019	1.50 U	1.4	6.90	0.63	--	0.05	24	0.00025 U
	10/7/2019	1.20	1.2	8.60	0.84	--	0.01	24	0.16
	4/21/2020	1.30	4.8 J	15.000	0.72	--	0.55	15	0.00089 J
	10/20/2020	1.20	1.6	11.00	0.73	--	0.09	26	0.1
	4/13/2021	1.30 U	4.6 J	6.90	0.77 U	--	0.00	24	0.0007 J
	10/26/2021	1.50	0.63	7.70	0.67	--	0.07	25	0.08
	4/11/2022	1.10 J	3.0	10.000	0.99	--	0.00	32	0.00011 U
	9/14/2022	1.30 J	1.2	4.80	0.86	--	0.03	40	0.00044
	3/20/2023	1.20	3.1	12.2	0.754 J	--	0.02	30	0.00068 U
	8/21/2023	1.73	1.2	6.90	1.09	--	0.00	30	0.00068 U
	5/14/2024	1.21	2.5	8.96	0.812 J	--	0.02	35	0.00068 U
T4S1MW-09	10/25/2016	2.76 J	1.2 J	5.97 J	1.09 J	7.62	--	49.1 J	2.64 J
	2/1/2017	1.70	2.9	5.66	0.61	4.41	--	29	1.22
	4/26/2017	1.65	1.9	5.95	0.7	2.00	--	27.3	0.0225 J
	7/25/2017	2.34	1.9	7.16	0.69	0.0321 J	--	30.8	0.0225 J
	12/5/2018	1.80	1.2	5.60	0.66 J	--	0	27.5	0.00025 U
	5/8/2019	1.60 U	1.8	7.00	0.53	--	0.08	26	0.0024
	10/7/2019	1.00 J	1.3	6.30 J	0.55	--	0.01	26	0.0036
	4/21/2020	1.30	2.7	7.70	0.55	--	0.02	13	0.0069
	10/20/2020	1.40	1.7	10.0	0.83	--	0.21	30	0.033
	4/13/2021	1.90 U	2.4	11.0	0.90 U	--	0.11	36	0.046
	10/26/2021	1.80	1.9	9.30	0.75	--	0.09	40	0.0025
	4/11/2022	1.60	1.5 J	5.60	0.78	--	0	30	0.0017
	9/14/2022	1.50	1.7	6.50	0.74	--	0	36	0.0031
	3/20/2023	1.33	1.8	7.14	0.715 J	--	0	25	0.003
	8/22/2023	1.67	1.6	6.95	1.46	--	0	30	0.11
	5/14/2024	1.6	1.1	5.89	1.21	--	0.96	25	0.65

Table 3-3

Groundwater Quality Analytical Data for Natural Attenuation Parameters

Northwest Pipe Company Portland Plant

		Natural Attenuation Parameters (mg/L)							
Sample ID	*Sample Date*	**Chloride**	**Nitrate-N**	**Sulfate**	**TOC**	**Iron, dissolved**	**Ferrous Iron[1]**	**Carbon Dioxide[1]**	**Methane**
T4S1MW-22	10/25/2016	2.80 J	0.095 J	5.49 J	1.19 J	0.01 U	--	48.4 J	0.0159 J
	2/1/2017	4.56	0.039	8.90	1.09	0.01 U	--	84.5	0.0334
	4/27/2017	3.38	0.92	10.0	1.18	0.01 U	--	49.1	0.00605 U
	7/26/2017	4.78	0.36	7.90	1.15	0.01 U	--	60	0.0154 J
	12/6/2018	6.10	0.02 U	15.0	1.30	--	0.00	50	0.16
	5/8/2019	7.90	0.11 J	11.0	1.20	--	0.05	85	0.041
	10/8/2019	7.30	0.02 U	16.0	1.60	--	0.01	60	0.016
	4/22/2020	5.00	0.73	7.70	1.30	--	0.00	40	0.023
	10/21/2020	4.40	0.021 J	6.50	1.50	--	0.00	50	0.0096
	4/14/2021	5.40	0.20 U	9.70	1.30	--	0.02	80	0.018
	10/27/2021	4.80	0.034 J	5.30	1.30 J	--	0.11	50	0.0097
	4/13/2022	6.90	0.23	5.70	1.40	--	0.00	40	0.0011
	9/13/2022	6.60	0.26	7.40	1.40	--	0.10	70	0.0038
	3/21/2023	3.87	0.074 J	5.84	1.24	--	0.08	55	0.013
	8/22/2023	7.09	0.25	14.5	1.45	--	0	65	0.016
	5/13/2024	4.71	1.03	10.2	1.26	--	0.05	55	0.0098
T4S1MW-23	10/25/2016	3.92 J	0.27 J	7.67 J	0.65 J	0.221	--	52.9 J	0.00507 J
	2/1/2017	4.24	0.58	8.74	0.68	0.185	--	26.9	0.0379
	4/27/2017	3.36	0.42	7.76	0.78	0.0545 J	--	20.4	0.00712 J
	7/26/2017	4.07	0.36	4.83	1.18	0.11	--	27.5	0.0196 J
	12/6/2018	3.60	0.42	10.0	0.79 J	--	0.02	26	0.068
	5/9/2019	13.0	0.48 U	8.30	0.67	--	0.08	36	0.016
	10/8/2019	8.50	0.40	6.60	0.78	--	0.05	28	0.067
	4/22/2020	28.0	1.20	7.50	0.58	--	0.03	16	0.0087
	10/21/2020	30.0	0.96	8.30	0.82	--	0.00	35	0.0024
	4/14/2021	14.0 J	0.50 J	9.30 J	0.81 U	--	0.00	40	0.0031
	10/27/2021	9.00	0.71	7.70	0.72	--	0.10	32	0.0027
	4/12/2022	6.80	0.75	7.20	0.95	--	0.16	15	0.0029
	9/13/2022	7.80	0.91	6.00	1.1	--	0.00	35	0.0062
	3/21/2023	14.0	0.12	5.35	2.38	--	2.88	30	0.17
	8/22/2023	16.0	0.38	7.75	1.93	--	2.49	40	0.20
	5/15/2024	9.9	0.32	6.15	1.25	--	0.02	30	0.14

Notes:

mg/L = milligrams per Liter

TOC = Total Organic Carbon

[1] Parameter has been measured in the field since 2017. Carbon dioxide was measured using RSK 175 for the April 2020 and June 2022 sampling event.

[2] MW-10, MW-11, and MW-12 were installed in March 2022. Wells are sampled quaterly.

J - the analyte was detected, but the analytical laboratory has flagged the associated numerical value as estimated.

U - the analyte was analyzed for but was not detected above the detection limit.

Table 3-4

Groundwater Quality Analytical Data for Volatile Organic Compounds

Northwest Pipe Company Portland Plant

		Volatile Organic Compounds (µg/L)			
		PCE	TCE	cis-1,2-DCE	VC
Portland Harbor ROD Concentrations (µg/L) [1]		*0.24*	*0.6*	*70*	*0.022*
Northwest Pipe Company Wells					
MW-01	10/26/2016	158	22.8	113	16.7
(1,280 feet to river)	2/2/2017	71.1	14.9	107	29.9
	5/1/2017	61.7	13.0	220	51.6
	7/26/2017	197	26.7	174	8.51
	12/6/2018	98.0	13	160	19.0
	5/9/2019	220	28	100	3.80
	10/9/2019	150	18	140	17.0
	4/23/2020	260	29	110	5.2
	10/22/2020	220	26	160	22.0
	4/15/2021	280	24	58	0.5
	10/28/2021	130	23	120	19.0
	4/13/2022	140	23	60	3.2 J
	9/15/2022	210	21	74	2.9 J
	3/22/2023	52	15	64	15
	8/23/2023	220	21	50	0.58
	5/15/2024	110	13	70	0.76
MW-02	10/26/2016	0.0598	0.15 U	0.15 U	0.0652
(1,140 feet to river)	2/1/2017	0.169	0.15 U	0.200 J	0.0370
	4/27/2017	0.224	0.15 U	0.210 J	0.0115 J
	7/25/2017	0.451	0.15 U	0.410 J	0.0190 J
	12/5/2018	0.1 U	0.1 U	1.40	2.60
	5/8/2019	0.1 U	0.1 U	0.360	1.20
	10/8/2019	0.1 U	0.1 U	0.760	2.90
	4/23/2020	0.1 U	0.1 U	0.290	0.68
	10/21/2020	0.1 U	0.1 U	0.660	2.60
	4/14/2021	0.1 U	0.1 U	0.260	0.60
	10/27/2021	0.1 U	0.1 U	1.5	4.9
	4/13/2022	0.16 J	0.1 J	3.8	3.6 J
	9/14/2022	0.22	0.066 U	43	36 J
	3/22/2023	0.27	1.6	49	26
	8/23/2023	0.85	0.46	160	86
	5/15/2024	2.8	1.2	34	65
MW-03	10/26/2016	630	221	428	22.8
(975 feet to river)	2/2/2017	483	178	502	20.8
	5/1/2017	657	283	847	26.1
	7/27/2017	550	209	670	29.9
	12/7/2018	490	160	850	46.0
	5/9/2019	370	100	860	46.0
	10/9/2019	530	160	990	62.0
	4/23/2020	170	58	730	42.0
	10/22/2020	250	54	360	36.0
	4/15/2021	160	42	510	43.0
	10/28/2021	130	26	300	57.0
	4/14/2022	130	34	410	70.0 J
	9/14/2022	68	16	200	53 J
	3/22/2023	27	11	300	44
	8/23/2023	36	8	140	39
	5/15/2024	4.4	6.2	57	3.8

Table 3-4

Groundwater Quality Analytical Data for Volatile Organic Compounds

Northwest Pipe Company Portland Plant

		Volatile Organic Compounds (µg/L)			
		PCE	TCE	cis-1,2-DCE	VC
Portland Harbor ROD Concentrations (µg/L) [1]		*0.24*	*0.6*	*70*	*0.022*
MW-04	10/26/2016	28.2	38.4	111	4.45
(1,130 feet to river)	2/1/2017	12.4	20.3	119	9.73
	4/27/2017	14.4	29.7	116	16.6
	7/26/2017	18.5	35.4	137	9.43
	12/6/2018	16.0	19.0	190	4.60
	5/8/2019	5.40	8.40	150	6.10
	10/8/2019	10.0	16.0	120	5.60
	4/22/2020	4.9	8.8	170	4.00
	10/21/2020	12.0	12.0	110	3.70 J
	4/14/2021	5.0	10.0	120	1.70
	10/27/2021	13.0	8.2 J	110	2.50
	4/13/2022	6.0	13	110	2.50 J
	9/15/2022	2.8	6.0	44	11 J
	3/22/2023	6.4	7.4	47	2.9
	8/22/2023	1.5	5.6	46	2.6
	5/16/2024	29	7.2	93	23
MW-05	10/26/2016	3,510	195	1,160	40.4
(1,370 feet to river)	2/2/2017	4,150	208	1,240	39.5
	5/1/2017	949	92	634	70.7
	7/27/2017	3,640	170	1,730	7.58 J
	12/7/2018	1,200	85	1,600	77.0
	5/9/2019	4,400	240	1,700	14.0
	10/9/2019	2,300	140	2,200	120
	4/23/2020	3,600	170	1,900	34
	10/22/2020	2,400	150	1,200	87
	4/15/2021	3,700	170	1,800	26
	10/28/2021	2,200	180	760	56
	4/14/2022	1,900	110	960	170 J
	9/15/2022	2,600 J	180	1,200	61
	3/23/2023	850	100	680	72
	8/24/2023	1,900	160	810	94
	5/16/2024	240	36	920	130
MW-06	10/26/2016	287	60.4	1,160	170
(1,200 feet to river)	2/2/2017	805	147	1,590	51.0
	5/1/2017	1,280	225	1,530	21.9
	7/27/2017	810	128	1,080	18.3
	12/7/2018	430	110	1,300	130
	5/9/2019	980	210	1,900	40.0
	10/9/2019	520	110	1,700	110 J
	4/23/2020	920	160	2,000	55
	10/22/2020	560	110	1,700	150
	4/15/2021	810	210	2,100	71
	10/28/2021	590	120	1,500	92
	4/14/2022	360	91	1,100	30 J
	9/15/2022	230	48 J	190 J	0.65 U
	3/23/2023	180	50	180	1.5
	8/24/2023	170	30	68	5
	5/16/2024	150	23	45	0.29

Table 3-4

Groundwater Quality Analytical Data for Volatile Organic Compounds

Northwest Pipe Company Portland Plant

		Volatile Organic Compounds (µg/L)			
		PCE	TCE	cis-1,2-DCE	VC
Portland Harbor ROD Concentrations (µg/L) [1]		*0.24*	*0.6*	*70*	*0.022*
MW-06	10/26/2016	299	70.9	1,130	177
Duplicate	2/2/2017	760	145	1,600	53.9
(1,200 feet to river)	5/1/2017	1,280	228	1,550	20.7
	7/27/2017	728	123	1,080	22.5
	12/7/2018	400	110	1,400	130
	5/9/2019	1,000	220	1,900	44.0
	10/9/2019	600	130	1,800	150 J
	4/23/2020	900	160	2,000	67
	10/22/2020	620	130	1,900	170
	4/15/2021	830	220	2,200	69
	10/28/2021	620	130	1,500	91
	4/14/2022	350	94	980	21 J
	9/15/2022	240 J	68 J	290 J	3.8
	3/23/2023	180	50	180	1.6
Northwest Pipe Company Wells on Port of Portland Property [2]					
MW-10 *(570 feet to river)*	4/12/2022	0.084 U	0.28	4.7	1.1
	6/29/2022	0.54	0.26 U	0.067 J	0.017 J
	9/13/2022	0.084 U	0.19 J	2.0	0.66
	12/6/2022	0.024 J	0.23	4.9	0.26
	3/21/2023	0.03 J	0.5	4.7	0.073
	6/6/2023	0.021 J	0.33	4.6	0.074
	8/23/2023	0.02 U	0.31	2.5	0.13
	11/14/2023	0.02 U	0.18	2.4	0.15
	5/14/2024	0.02 U	0.2	3.3	0.29
MW-10	6/29/2022	0.46	0.23	0.062 J	0.016 J
Duplicate	12/6/2022	0.022 J	0.22	4.9	0.26
	6/6/2023	0.02 J	0.36	4.8	0.082
	11/14/2023	0.02 U	0.19	2.5	0.15
MW-11 *(670 feet to river)*	4/12/2022	1.6	0.8	46	26
	6/29/2022	1.2	1.1 U	64	52
	9/13/2022	2.1	1.1	32	32
	12/6/2022	1.8	0.7	19	19
	3/21/2023	1.1	0.48	31	12
	6/6/2023	0.77	0.44	37	7.7
	8/23/2023	1.8	0.66	19	4.6
	11/14/2023	2.9	0.63	21	36
	5/14/2024	0.6	0.45	26	7.6
MW-12 *(880 feet to river)*	4/12/2022	2.8	3.9	45	7.6
	6/29/2022	1.8	3.3	42	6
	9/13/2022	2.1	3.8	44	8.6
	12/6/2022	2.3	4.4	34	3.8
	3/21/2023	1.6	3.1	25	1.9
	6/6/2023	1.7	3.9	40	2.0
	8/23/2023	1.8	4.0	30	2.3
	11/14/2023	1.8	4.0	29	4.3
	5/15/2024	1.4	2.2	37	4.4
MW-12 *Duplicate*	8/23/2023	1.7	3.9	30	2.2
	5/15/2024	1.6	2.8	33	4.0

Table 3-4

Groundwater Quality Analytical Data for Volatile Organic Compounds

Northwest Pipe Company Portland Plant

		Volatile Organic Compounds (µg/L)			
		PCE	TCE	cis-1,2-DCE	VC
Portland Harbor ROD Concentrations (µg/L) [1]		*0.24*	*0.6*	*70*	*0.022*
Port of Portland Wells (Upgradient to Downgradient)					
T4S1MW-22	10/25/2016	1.46 J	4.60 J	2.77 J	0.0499 J
(1,010 feet to river)	2/1/2017	1.28	4.29	5.36	0.106
	4/27/2017	1.43	3.56	2.11	0.022
	7/26/2017	1.71	3.00	3.78	0.0638
	12/6/2018	1.4	4.6	5.8	0.076 J
	5/8/2019	1.8	4.4	7.5	0.33
	10/8/2019	1.3	3.4	7.4	0.18
	4/22/2020	1.1	3.3	7.0	0.32
	10/21/2020	0.94	2.8	7.9 J	0.17
	4/14/2021	1.7	2.7	5.0	0.14
	10/27/2021	1.1	2.7	4.8	0.20
	4/13/2022	1.5	2.6	3.6	0.20 J
	9/13/2022	1.6	2.2	3.6	0.41
	3/21/2023	1.2	2.5	3.3	0.06
	8/22/2023	1.4	2.1	1.7	0.03 J
	5/13/2024	1.7	1.7	2.4	0.039 J
T4S1MW-23	10/25/2016	1.59 J	0.15 UJ	0.700 J	0.008 UJ
(710 feet to river)	2/1/2017	0.937	0.41 J	0.650	0.0188 J
	4/27/2017	1.07	0.39 J	0.420 J	0.008 U
	7/26/2017	1.21	0.29 J	0.15 U	0.008 U
	12/6/2018	1.8	0.61	1.40	0.023 J
	5/9/2019	1.9	0.50	0.34	0.02 U
	10/8/2019	1.6	0.40	0.58	0.02 U
	4/22/2020	1.6	0.37	0.18 J	0.02 U
	10/21/2020	1.8	0.33	1.50	0.02 U
	4/14/2021	1.3	0.37	0.23	0.02 U
	10/27/2021	1.3	0.47	0.59	0.02 U
	4/12/2022	1.3	0.41	0.89	0.032
	9/13/2022	1.5	0.29	0.17 J	0.013 UJ
	3/21/2023	1.3	0.47	0.41	0.02 U
	8/22/2023	1.2	0.20	0.04 J	0.02 U
	5/15/2024	0.91	0.18	0.054	0.02 U
T4S1MW-03S	10/25/2016	0.112 J	0.15 UJ	0.15 UJ	0.008 UJ
(160 feet to river)	2/1/2017	0.230	0.15 U	0.15 U	0.008 U
	4/26/2017	0.117	0.15 U	0.15 U	0.008 U
	7/25/2017	0.0508	0.15 U	0.15 U	0.008 U
	12/5/2018	0.1 U	0.1 U	0.1 U	0.02 U
	5/8/2019	0.1 U	0.1 U	0.1 U	0.02 U
	10/7/2019	0.1 U	0.1 U	0.1 U	0.02 U
	4/21/2020	0.1 U	0.1 U	0.1 U	0.02 U
	10/20/2020	0.1 U	0.1 U	0.1 U	0.02 U
	4/13/2021	0.1 U	0.1 U	0.1 U	0.02 U
	10/26/2021	0.1 U	0.1 U	0.1 U	0.02 U
	4/11/2022	0.084 U	0.066 U	0.055 U	0.013 U
	9/14/2022	0.084 U	0.066 U	0.055 U	0.013 U
	3/20/2023	0.027 J	0.030 U	0.02 U	0.02 U
	8/21/2023	0.030 J	0.030 U	0.02 U	0.02 U
	5/14/2024	0.033 J	0.030 U	0.02 U	0.02 U

Table 3-4

Groundwater Quality Analytical Data for Volatile Organic Compounds

Northwest Pipe Company Portland Plant

		Volatile Organic Compounds (µg/L)			
		PCE	TCE	cis-1,2-DCE	VC
Portland Harbor ROD Concentrations (µg/L) [1]		*0.24*	*0.6*	*70*	*0.022*
T4S1MW-09	10/25/2016	0.0191 J	0.15 UJ	0.15 UJ	0.0197 J
(145 feet to river)	2/1/2017	0.0177 J	0.15 U	0.15 U	0.0113 J
	4/26/2017	0.005 U	0.15 U	0.15 U	0.008 U
	7/25/2017	0.0139 J	0.15 U	0.15 U	0.008 U
	12/5/2018	0.1 U	0.1 U	0.1 U	0.02 U
	5/8/2019	0.1 U	0.1 U	0.1 U	0.02 U
	10/7/2019	0.1 U	0.1 U	0.1 U	0.02 U
	4/21/2020	0.1 U	0.1 U	0.1 U	0.02 U
	10/20/2020	0.1 U	0.1 U	0.1 U	0.02 U
	4/13/2021	0.1 U	0.1 U	0.1 U	0.02 U
	10/26/2021	0.1 U	0.1 U	0.1 U	0.02 U
	4/11/2022	0.084 U	0.066 U	0.055 U	0.013 U
	9/14/2022	0.084 U	0.066 U	0.055 U	0.013 U
	3/20/2023	0.02 J	0.03 U	0.02 U	0.02 U
	8/22/2023	0.02 U	0.03 U	0.02 U	0.02 U
	5/14/2024	0.02 U	0.03 U	0.02 U	0.02 U

Notes:

µg/L = micrograms per Liter

Shaded values exceed identified ROD concentrations.

[1]ROD concentrations are selected from Table 17 of the Portland Harbor Record of Decision (U.S. Environmental Protection Agency Region 10, 2017). Values were selected from remedial action objectives (RAOs) 4 and 8 associated with migration of contaminated groundwater. Values reflect changes from ROD Errata #1 (EPA 2018) and #2 (EPA 2020).

[2]MW-10, MW-11, and MW-12 were installed in March 2022. Wells are sampled quaterly.

Distances to the river are direct, instead of along flow paths, which can vary.

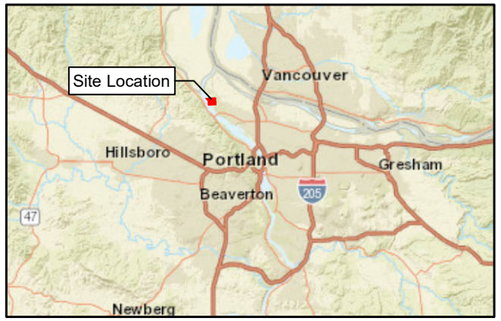
B - Analyte was found in the blank and sample.

J - the analyte was detected, but the analytical laboratory has flagged the associated numerical value as estimated.

U - the analyte was analyzed for but was not detected above the detection limit.

UJ - the analyte was not detected above the detection limit. However, the detection 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.

Figures



LEGEND

- Northwest Pipe Site Boundary
- Burgard Industrial Park
- Felton Property

N

0 250 500 1,000
Feet

Figure 1-1. Vicinity Map
Northwest Pipe Company
Portland, Oregon

Jacobs

\\PDXFPP01\PROJ\NORTHWESTPIPECOMPANY\485880PORTHARBSUP\GIS\MAPFILES\2021\MNA WORK PLAN\FIGURE1-1_VICINITYMAP.MXD GGEE 10/8/2021 2:37:13 PM

LEGEND

MNA Monitoring Network

- Groundwater Quality Monitoring Well
- Monitoring Well for Water Level Monitoring Only
- Northwest Pipe Site Boundary

N

0 70 140 280

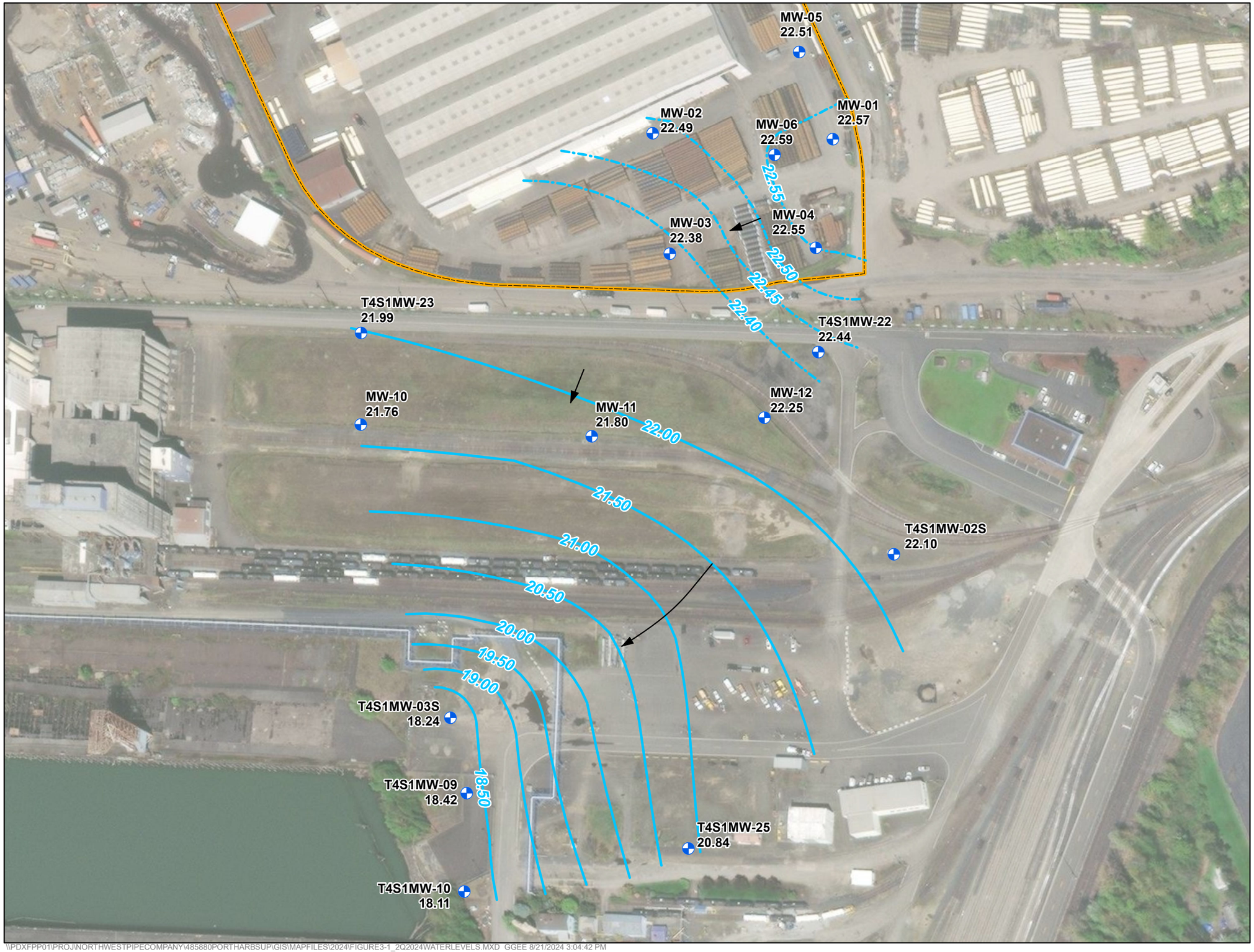
Feet

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 2-1. MNA Monitoring Well Network
Northwest Pipe Company
Portland, Oregon

Jacobs

\\PDXFPP01\PROJ\NORTHWESTPIPECOMPANY\485880PORTHARBSUP\GIS\MAPFILES\2024\FIGURE2-1_MNANETWORK.MXD GGEE 8/21/2024 8:04:19 PM



LEGEND

- Investigation Wells
- Groundwater Elevation Contour (0.5 ft contour interval, ft NAVD88)
- Groundwater Elevation Contour (0.05 ft contour interval, to show detail in the NW Pipe Southeast Area, ft NAVD88)
- Groundwater Flow Direction
- Northwest Pipe Site Boundary

Note: Groundwater levels measured between 10:05 AM and 11:18 AM on May 13, 2024. During this period, the Willamette River stage decreased by 0.25 foot, as measured at the Morrison Bridge river gauge (USGS 14211720).

N

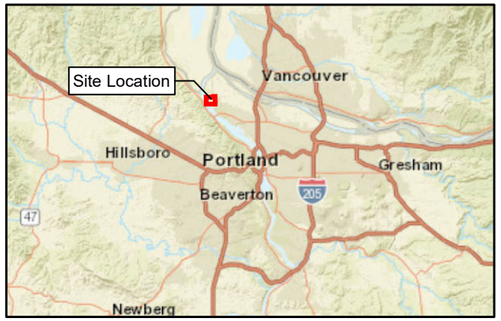
0 75 150 300
Feet

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure 3-1. Groundwater Elevation Contour Map Southeast Area, May 13, 2024
Northwest Pipe Company
Portland, Oregon

Jacobs

\\PDXFPP01\PROJ\NORTHWESTPIPECOMPANY\485880PORTHARBSUP\GIS\MAPFILES\2024\FIGURE3-1_2Q2024WATERLEVELS.MXD GGEE 8/21/2024 3:04:42 PM



LEGEND

1897 Surface Water Features

- Historical Waterbody
- Historical Marsh/Mudflat
- Historical Gatton Creek[1]
- Northwest Pipe Site Boundary

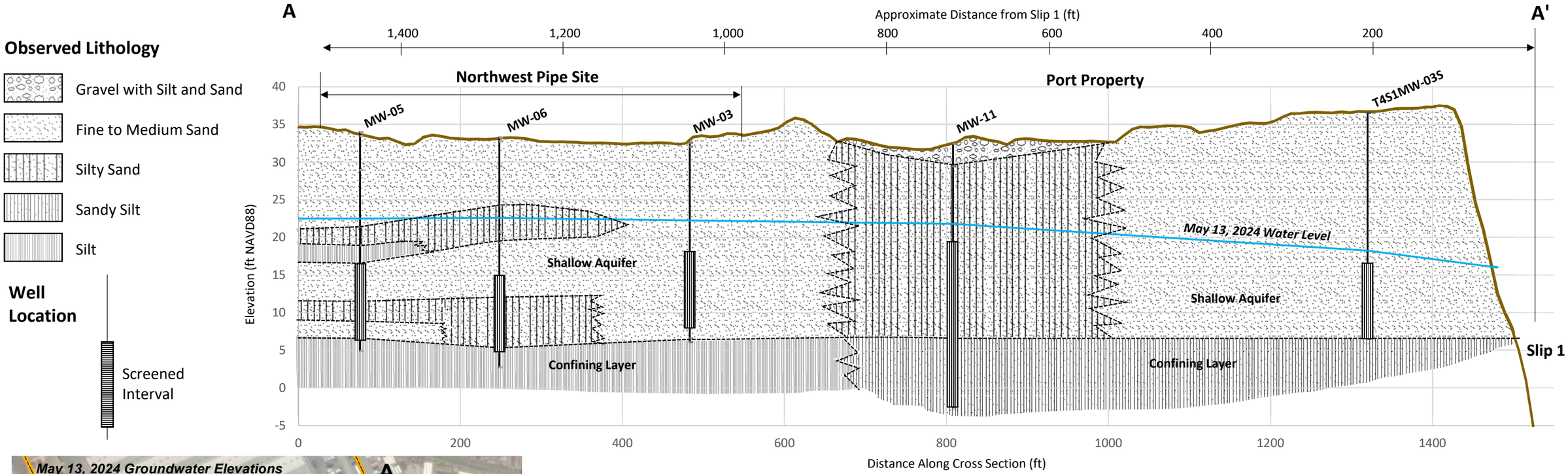
Note:
[1]The depicted location of historical Gatton Creek is based on its mapped location shown by the U.S. Geological Survey in its 1897 topographic map of the area. However, the historical creek channel may have shifted to the east or west over time, as is common for stream channels, before it was buried by fill placed in the area in the early 1940s.

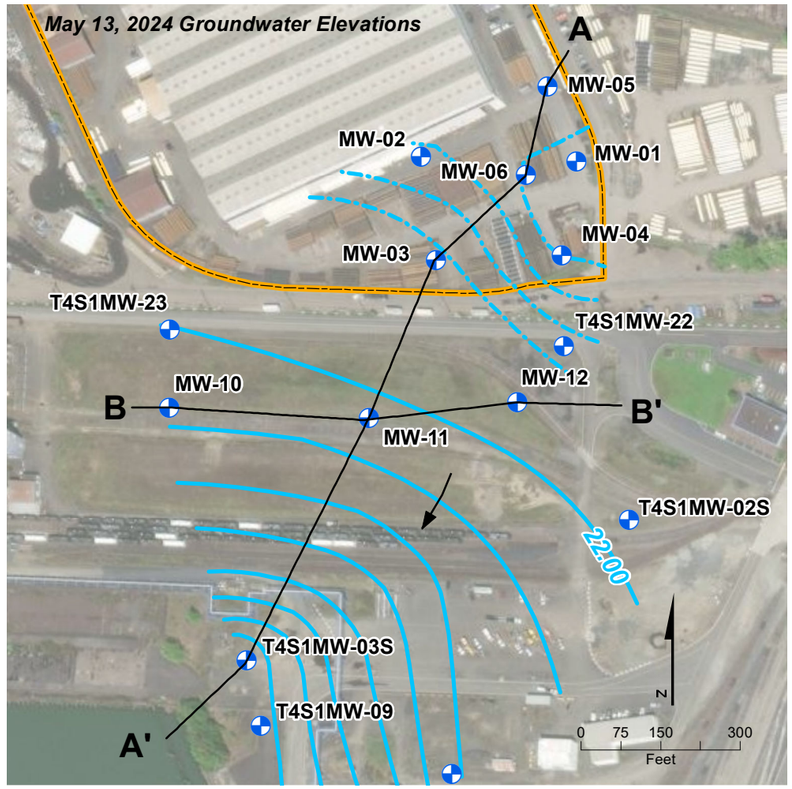
N

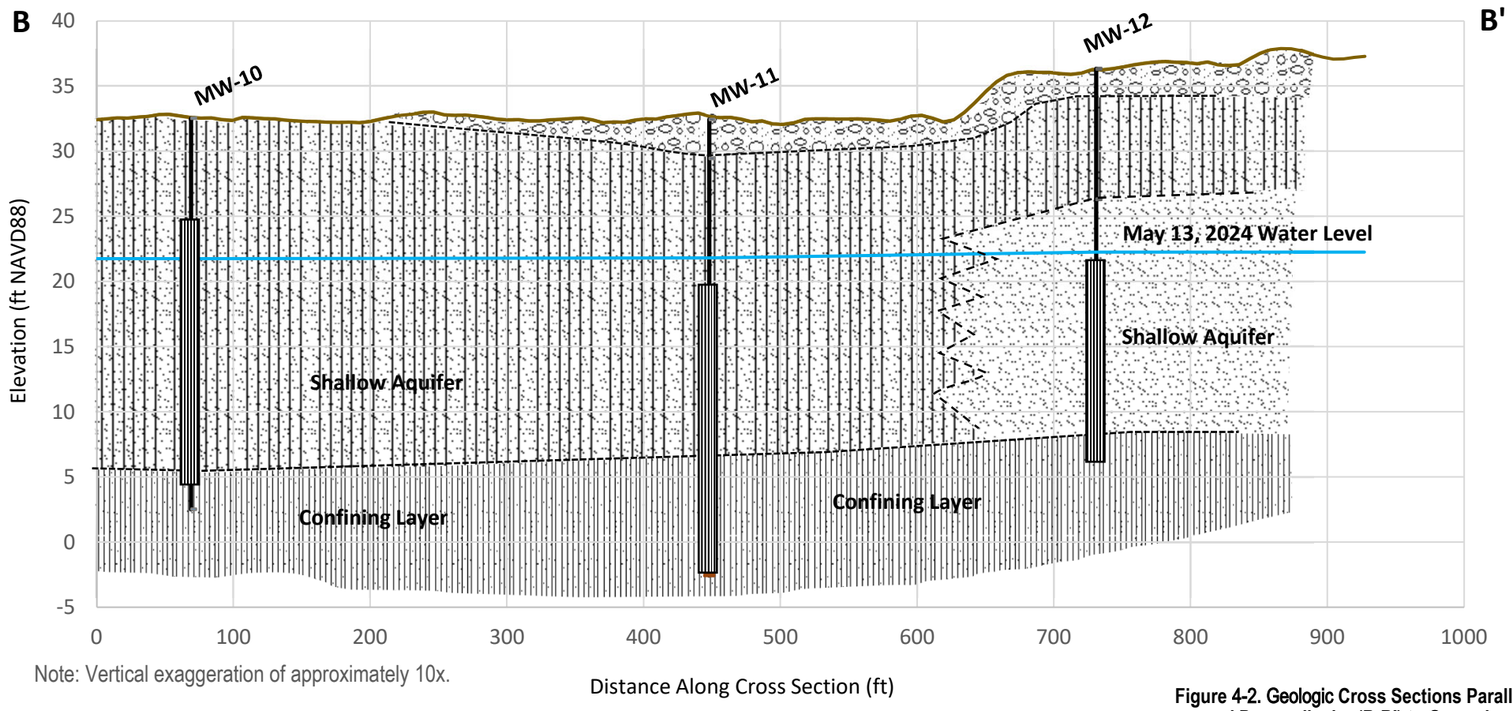
0 200 400 800
Feet

Figure 4-1. Selected Hydrologic Features from 1897 Map Digitized onto Current Aerial
Northwest Pipe Company
Portland, Oregon

Jacobs







Note: Vertical exaggeration of approximately 10x.

LEGEND

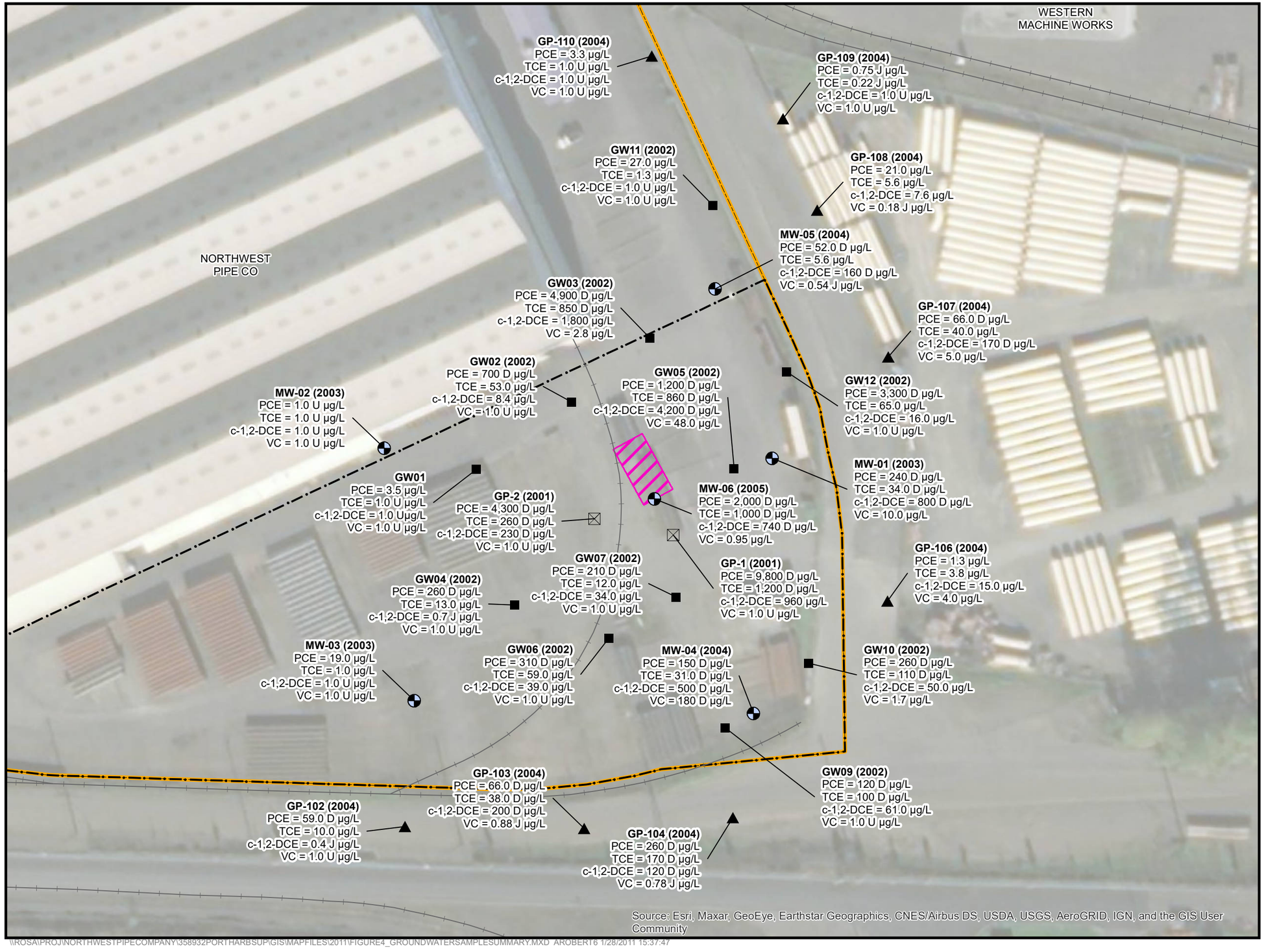
Investigation Wells
Groundwater Flow Direction
Groundwater Elevation Contour
Northwest Pipe Site Boundary

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

\\PDXFPP01\PROJ\NORTHWESTPIPECOMPANY\485880PORTHARBSUP\GIS\MAPFILES\2024\WORKING_CROSSSECTIONS.MXD GGEE 7/19/2024 11:00:16 AM

Figure 4-2. Geologic Cross Sections Parallel (A-A') and Perpendicular (B-B') to Groundwater Flow
Northwest Pipe Company
Portland, Oregon

Jacobs



LEGEND

Groundwater Sample Location

- September, 2001 Geoprobe Sample
- August, 2002 Geoprobe Sample
- 2003 - Present Monitoring Well Location
- July, 2004 Geoprobe Sample
- Approximate Location of Former Waste Oil Tank[1]
- Railroad Line
- Leased Property Boundary
- Northwest Pipe Site Boundary

Notes:
µg/L = micrograms per Liter
PCE = tetrachloroethene
TCE = trichloroethene
c-1,2-DCE = cis-1,2-dichloroethene
VC = vinyl chloride
U = nondetect
J = estimated
D = dilution
[1] Dames & Moore, 1989

N

0 37.5 75 150
Feet

Figure 5-1. VOCs in Groundwater 2001 through 2005
Northwest Pipe Company
Portland, Oregon

Jacobs

\\ROSA\PROJ\NORTHWESTPIPECOMPANY\358932PORTHARBSUP\GIS\MAPFILES\2011\FIGURE4_GROUNDWATERSAMPLESUMMARY.MXD AROBERT6 1/28/2011 15:37:47

MW-06

	PCE	TCE	cis-1,2-DCE	VC
10/26/2016	287 / 299	60.4 / 70.9	1,160 / 1,130	170 / 177
2/1/2017	805 / 760	147 / 145	1,590 / 1,600	51.0 / 53.9
5/1/2017	1,280 / 1,280	225 / 228	1,530 / 1,550	21.9 / 20.7
7/27/2017	810 / 728	128 / 123	1,080 / 1,080	18.3 / 22.5
12/7/2018	430 / 400	110 / 110	1,300 / 1,400	130 / 130
5/9/2019	980 / 1,000	210 / 220	1,900 / 1,900	40 / 44
10/9/2019	520 / 600	110 / 130	1,700 / 1,800	110 J / 150 J
4/23/2020	920 / 900	160 / 160	2,000 / 2,000	55 / 67
10/22/2020	560 / 620	110 / 130	1,700 / 1,900	150 / 170
4/15/2021	810 / 830	210 / 220	2,100 / 2,200	71 / 69
10/28/2021	590 / 620	120 / 130	1,500 / 1,500	92 / 91
4/14/2022	360 /350	91 / 94	1,100 / 980	30 J/ 21 J
9/15/2022	230 / 240 J	48 J / 68 J	190 J / 290 J	0.65 U / 3.8
3/23/2023	180 / 180	50 / 50	180 / 180	1.5 / 1.6
8/24/2023	170	30	68	5
5/16/2024	150	23	45	0.29

MW-05

	PCE	TCE	cis-1,2-DCE	VC
10/26/2016	3,510	195	1,160	40.4
2/2/2017	4,150	208	1,240	39.5
5/1/2017	949	92	634	70.7
7/27/2017	3,640	170	1,730	7.58 J
12/7/2018	1,200	85	1,600	77.0
5/9/2019	4,400	240	1,700	14.0
10/9/2019	2,300	140	2,200	120
4/23/2020	3,600	170	1,900	34.0
10/22/2020	2,400	150	1,200	87.0
4/15/2021	3,700	170	1,800	26
10/28/2021	2,200	180	760	56
4/14/2022	1,900	110	960	170 J
9/15/2022	2,600 J	180	1,200	61
3/23/2023	850	100	680	72
8/24/2023	1,900	160	810	94
5/16/2024	240	36	920	130

MW-02

	PCE	TCE	cis-1,2-DCE	VC
10/26/2016	0.0598	0.15 U	0.15 U	0.0652
2/1/2017	0.169	0.15 U	0.200 J	0.0370
4/27/2017	0.224	0.15 U	0.210 J	0.0115 J
7/25/2017	0.451	0.15 U	0.410 J	0.0190 J
12/5/2018	0.1 U	0.1 U	1.40	2.60
5/8/2019	0.1 U	0.1 U	0.360	1.20
10/8/2019	0.1 U	0.1 U	0.760	2.90
4/23/2020	0.1 U	0.1 U	0.290	0.68
10/21/2020	0.1 U	0.1 U	0.660	2.60
4/14/2021	0.1 U	0.1 U	0.260	0.60
10/27/2021	0.1 U	0.1 U	1.5	4.9
4/13/2022	0.16 J	0.1 J	3.8	3.6 J
9/14/2022	0.22	0.066 U	43.0	36.0 J
3/22/2023	0.27	1.7	49	26
8/23/2023	0.85	0.46	160	86
5/15/2024	2.8	1.2	34	65

MW-01

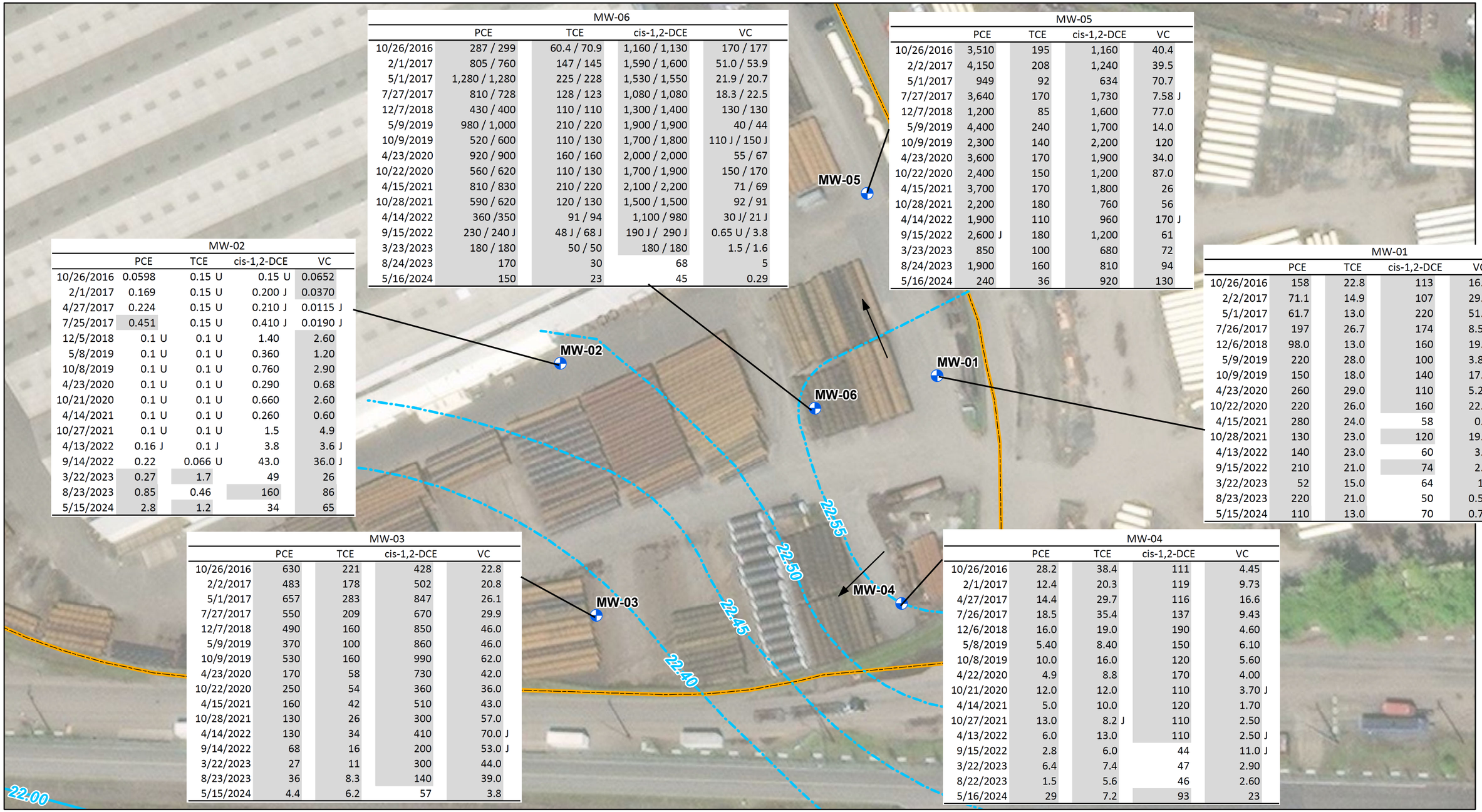
	PCE	TCE	cis-1,2-DCE	VC
10/26/2016	158	22.8	113	16.7
2/2/2017	71.1	14.9	107	29.9
5/1/2017	61.7	13.0	220	51.6
7/26/2017	197	26.7	174	8.51
12/6/2018	98.0	13.0	160	19.0
5/9/2019	220	28.0	100	3.80
10/9/2019	150	18.0	140	17.0
4/23/2020	260	29.0	110	5.20
10/22/2020	220	26.0	160	22.0
4/15/2021	280	24.0	58	0.5
10/28/2021	130	23.0	120	19.0
4/13/2022	140	23.0	60	3.2 J
9/15/2022	210	21.0	74	2.9 J
3/22/2023	52	15.0	64	15
8/23/2023	220	21.0	50	0.58
5/15/2024	110	13.0	70	0.76

MW-03

	PCE	TCE	cis-1,2-DCE	VC
10/26/2016	630	221	428	22.8
2/2/2017	483	178	502	20.8
5/1/2017	657	283	847	26.1
7/27/2017	550	209	670	29.9
12/7/2018	490	160	850	46.0
5/9/2019	370	100	860	46.0
10/9/2019	530	160	990	62.0
4/23/2020	170	58	730	42.0
10/22/2020	250	54	360	36.0
4/15/2021	160	42	510	43.0
10/28/2021	130	26	300	57.0
4/14/2022	130	34	410	70.0 J
9/14/2022	68	16	200	53.0 J
3/22/2023	27	11	300	44.0
8/23/2023	36	8.3	140	39.0
5/15/2024	4.4	6.2	57	3.8

MW-04

	PCE	TCE	cis-1,2-DCE	VC
10/26/2016	28.2	38.4	111	4.45
2/1/2017	12.4	20.3	119	9.73
4/27/2017	14.4	29.7	116	16.6
7/26/2017	18.5	35.4	137	9.43
12/6/2018	16.0	19.0	190	4.60
5/8/2019	5.40	8.40	150	6.10
10/8/2019	10.0	16.0	120	5.60
4/22/2020	4.9	8.8	170	4.00
10/21/2020	12.0	12.0	110	3.70 J
4/14/2021	5.0	10.0	120	1.70
10/27/2021	13.0	8.2 J	110	2.50
4/13/2022	6.0	13.0	110	2.50 J
9/15/2022	2.8	6.0	44	11.0 J
3/22/2023	6.4	7.4	47	2.90
8/22/2023	1.5	5.6	46	2.60
5/16/2024	29	7.2	93	23



LEGEND

- Investigation Wells
- Groundwater Elevation Contour (0.5 ft contour interval, ft NAVD88)
- Groundwater Elevation Contour (0.05 ft contour interval, to show detail in the NW Pipe Southeast Area, ft NAVD88)
- Groundwater Flow Direction
- Northwest Pipe Facility Boundary

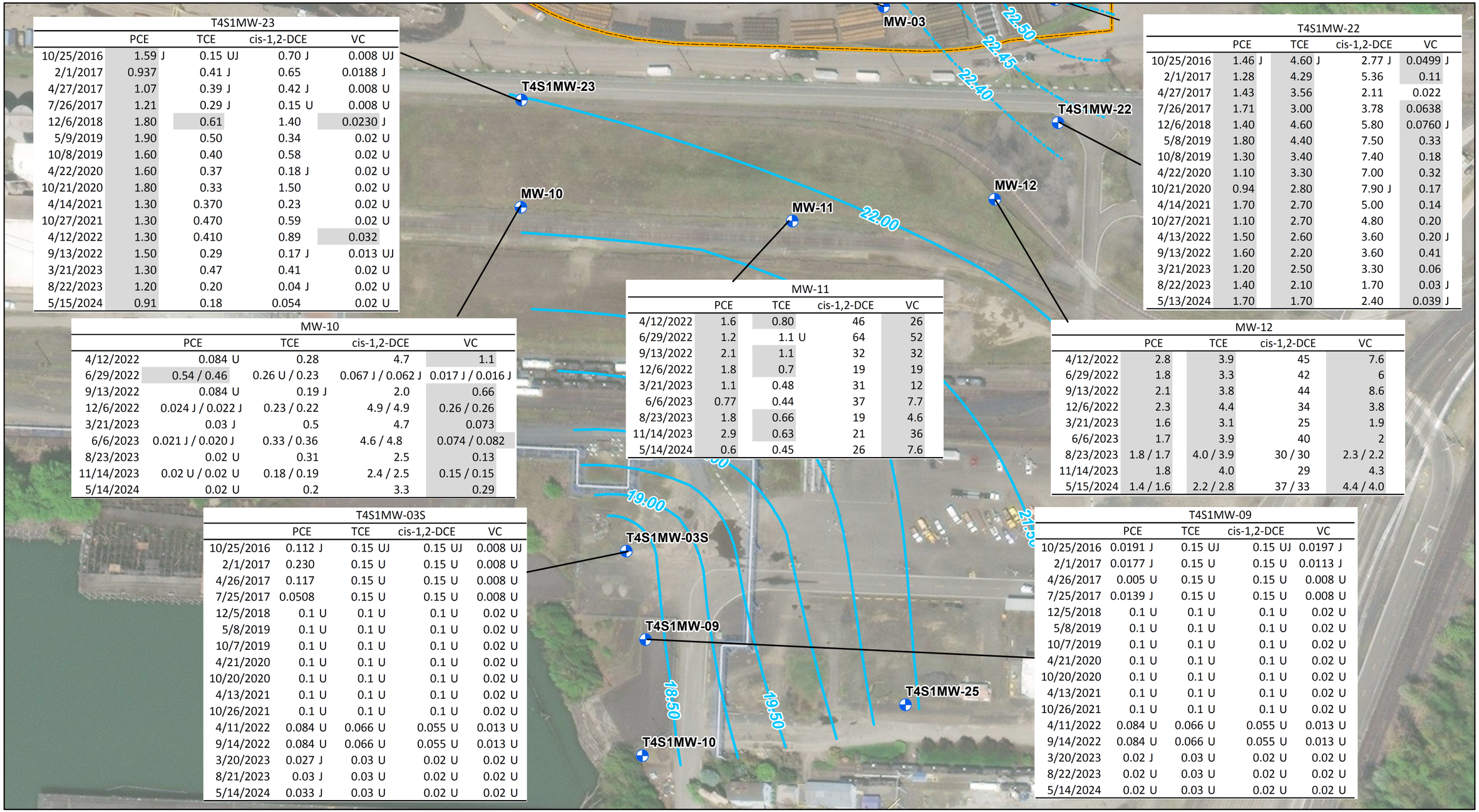
Notes:
All chlorinated volatile organic compound (VOC) concentrations are reported in micrograms per liter (µg/L).
PCE = Tetrachloroethene; TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; VC = Vinyl Chloride
D - the sample was diluted for analysis.
U - the analyte was analyzed for but was not detected above the detection limit.
J - the analyte was detected, but the analytical laboratory has flagged the associated numerical value as estimated.
UJ - the analyte was not detected above the detection limit. However, the detection 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.
Shaded values exceed ROD concentrations selected from Table 17 of the Portland Harbor Record of Decision (U.S. Environmental Protection Agency Region 10, 2017). Values were selected from remedial action objectives (RAOs) 4 and 8 associated with migration of contaminated groundwater. The following values are used: PCE = 0.24, TCE = 0.6, cis-1,2-DCE = 70, and VC = 0.022. All values in µg/L.

N

0 25 50 100
Feet

Figure 5-2. Southeast Area VOC Concentrations October 2016 through May 2024
Northwest Pipe Company
Portland, Oregon

Jacobs



T4S1MW-23

	PCE	TCE	cis-1,2-DCE	VC
10/25/2016	1.59 J	0.15 UJ	0.70 J	0.008 UJ
2/1/2017	0.937	0.41 J	0.65	0.0188 J
4/27/2017	1.07	0.39 J	0.42 J	0.008 U
7/26/2017	1.21	0.29 J	0.15 U	0.008 U
12/6/2018	1.80	0.61	1.40	0.0230 J
5/9/2019	1.90	0.50	0.34	0.02 U
10/8/2019	1.60	0.40	0.58	0.02 U
4/22/2020	1.60	0.37	0.18 J	0.02 U
10/21/2020	1.80	0.33	1.50	0.02 U
4/14/2021	1.30	0.370	0.23	0.02 U
10/27/2021	1.30	0.470	0.59	0.02 U
4/12/2022	1.30	0.410	0.89	0.032
9/13/2022	1.50	0.29	0.17 J	0.013 UJ
3/21/2023	1.30	0.47	0.41	0.02 U
8/22/2023	1.20	0.20	0.04 J	0.02 U
5/15/2024	0.91	0.18	0.054	0.02 U

T4S1MW-22

	PCE	TCE	cis-1,2-DCE	VC
10/25/2016	1.46 J	4.60 J	2.77 J	0.0499 J
2/1/2017	1.28	4.29	5.36	0.11
4/27/2017	1.43	3.56	2.11	0.022
7/26/2017	1.71	3.00	3.78	0.0638
12/6/2018	1.40	4.60	5.80	0.0760 J
5/8/2019	1.80	4.40	7.50	0.33
10/8/2019	1.30	3.40	7.40	0.18
4/22/2020	1.10	3.30	7.00	0.32
10/21/2020	0.94	2.80	7.90 J	0.17
4/14/2021	1.70	2.70	5.00	0.14
10/27/2021	1.10	2.70	4.80	0.20
4/13/2022	1.50	2.60	3.60	0.20 J
9/13/2022	1.60	2.20	3.60	0.41
3/21/2023	1.20	2.50	3.30	0.06
8/22/2023	1.40	2.10	1.70	0.03 J
5/13/2024	1.70	1.70	2.40	0.039 J

MW-10

	PCE	TCE	cis-1,2-DCE	VC
4/12/2022	0.084 U	0.28	4.7	1.1
6/29/2022	0.54 / 0.46	0.26 U / 0.23	0.067 J / 0.062 J	0.017 J / 0.016 J
9/13/2022	0.084 U	0.19 J	2.0	0.66
12/6/2022	0.024 J / 0.022 J	0.23 / 0.22	4.9 / 4.9	0.26 / 0.26
3/21/2023	0.03 J	0.5	4.7	0.073
6/6/2023	0.021 J / 0.020 J	0.33 / 0.36	4.6 / 4.8	0.074 / 0.082
8/23/2023	0.02 U	0.31	2.5	0.13
11/14/2023	0.02 U / 0.02 U	0.18 / 0.19	2.4 / 2.5	0.15 / 0.15
5/14/2024	0.02 U	0.2	3.3	0.29

MW-11

	PCE	TCE	cis-1,2-DCE	VC
4/12/2022	1.6	0.80	46	26
6/29/2022	1.2	1.1 U	64	52
9/13/2022	2.1	1.1	32	32
12/6/2022	1.8	0.7	19	19
3/21/2023	1.1	0.48	31	12
6/6/2023	0.77	0.44	37	7.7
8/23/2023	1.8	0.66	19	4.6
11/14/2023	2.9	0.63	21	36
5/14/2024	0.6	0.45	26	7.6

MW-12

	PCE	TCE	cis-1,2-DCE	VC
4/12/2022	2.8	3.9	45	7.6
6/29/2022	1.8	3.3	42	6
9/13/2022	2.1	3.8	44	8.6
12/6/2022	2.3	4.4	34	3.8
3/21/2023	1.6	3.1	25	1.9
6/6/2023	1.7	3.9	40	2
8/23/2023	1.8 / 1.7	4.0 / 3.9	30 / 30	2.3 / 2.2
11/14/2023	1.8	4.0	29	4.3
5/15/2024	1.4 / 1.6	2.2 / 2.8	37 / 33	4.4 / 4.0

T4S1MW-03S

	PCE	TCE	cis-1,2-DCE	VC
10/25/2016	0.112 J	0.15 UJ	0.15 UJ	0.008 UJ
2/1/2017	0.230	0.15 U	0.15 U	0.008 U
4/26/2017	0.117	0.15 U	0.15 U	0.008 U
7/25/2017	0.0508	0.15 U	0.15 U	0.008 U
12/5/2018	0.1 U	0.1 U	0.1 U	0.02 U
5/8/2019	0.1 U	0.1 U	0.1 U	0.02 U
10/7/2019	0.1 U	0.1 U	0.1 U	0.02 U
4/21/2020	0.1 U	0.1 U	0.1 U	0.02 U
10/20/2020	0.1 U	0.1 U	0.1 U	0.02 U
4/13/2021	0.1 U	0.1 U	0.1 U	0.02 U
10/26/2021	0.1 U	0.1 U	0.1 U	0.02 U
4/11/2022	0.084 U	0.066 U	0.055 U	0.013 U
9/14/2022	0.084 U	0.066 U	0.055 U	0.013 U
3/20/2023	0.027 J	0.03 U	0.02 U	0.02 U
8/21/2023	0.03 J	0.03 U	0.02 U	0.02 U
5/14/2024	0.033 J	0.03 U	0.02 U	0.02 U

T4S1MW-09

	PCE	TCE	cis-1,2-DCE	VC
10/25/2016	0.0191 J	0.15 UJ	0.15 UJ	0.0197 J
2/1/2017	0.0177 J	0.15 U	0.15 U	0.0113 J
4/26/2017	0.005 U	0.15 U	0.15 U	0.008 U
7/25/2017	0.0139 J	0.15 U	0.15 U	0.008 U
12/5/2018	0.1 U	0.1 U	0.1 U	0.02 U
5/8/2019	0.1 U	0.1 U	0.1 U	0.02 U
10/7/2019	0.1 U	0.1 U	0.1 U	0.02 U
4/21/2020	0.1 U	0.1 U	0.1 U	0.02 U
10/20/2020	0.1 U	0.1 U	0.1 U	0.02 U
4/13/2021	0.1 U	0.1 U	0.1 U	0.02 U
10/26/2021	0.1 U	0.1 U	0.1 U	0.02 U
4/11/2022	0.084 U	0.066 U	0.055 U	0.013 U
9/14/2022	0.084 U	0.066 U	0.055 U	0.013 U
3/20/2023	0.02 J	0.03 U	0.02 U	0.02 U
8/22/2023	0.02 U	0.03 U	0.02 U	0.02 U
5/14/2024	0.02 U	0.03 U	0.02 U	0.02 U

LEGEND

- Investigation Wells
- Groundwater Elevation Contour (0.5 ft contour interval, ft NAVD88)
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Notes:
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UJ - the analyte was not detected above the detection limit. However, the detection 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.
Shaded values exceed ROD concentrations selected from Table 17 of the Portland Harbor Record of Decision (U.S. Environmental Protection Agency Region 10, 2017). Values were selected from remedial action objectives (RAOs) 4 and 8 associated with migration of contaminated groundwater. The following values are used: PCE = 0.24, TCE = 0.6, cis-1,2-DCE = 70, and VC = 0.022. All values in µg/L.

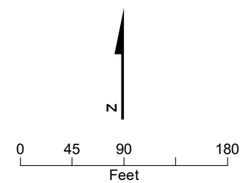


Figure 5-3. Southeast Area VOC Concentrations October 2016 through May 2024
Northwest Pipe Company
Portland, Oregon

Jacobs

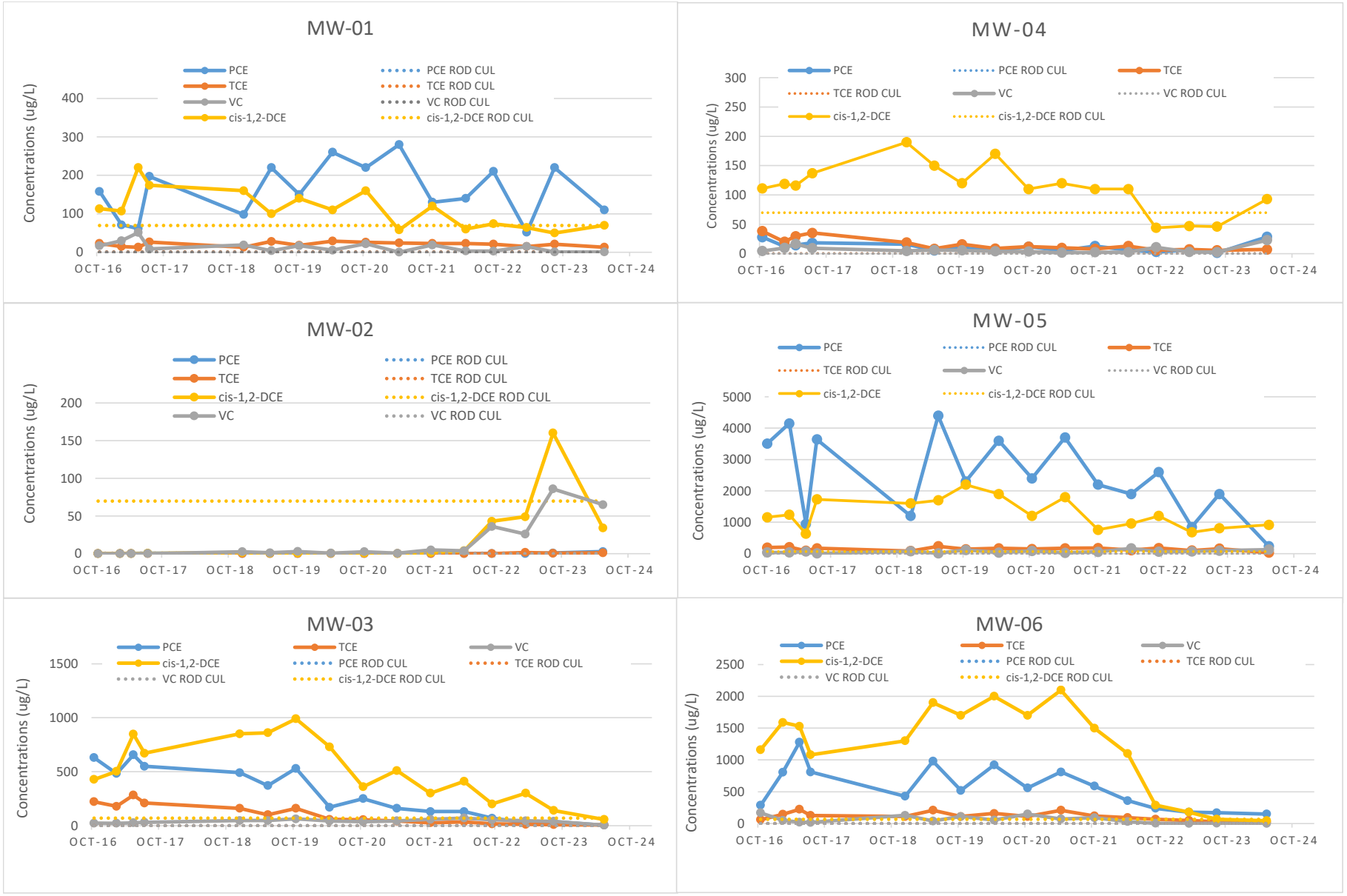
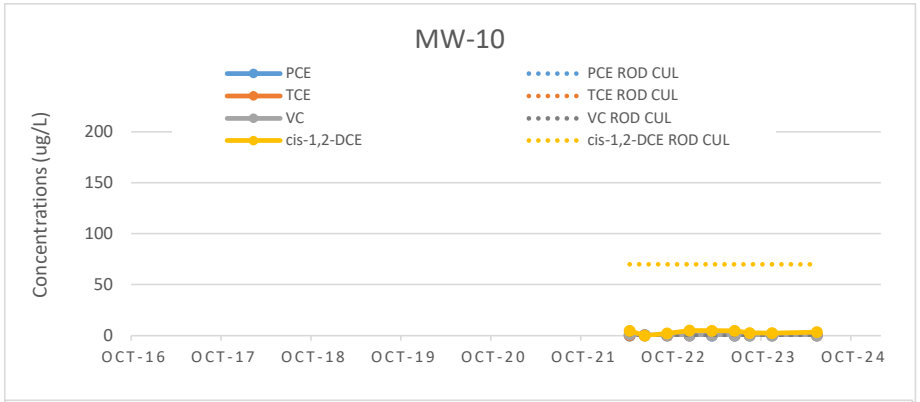
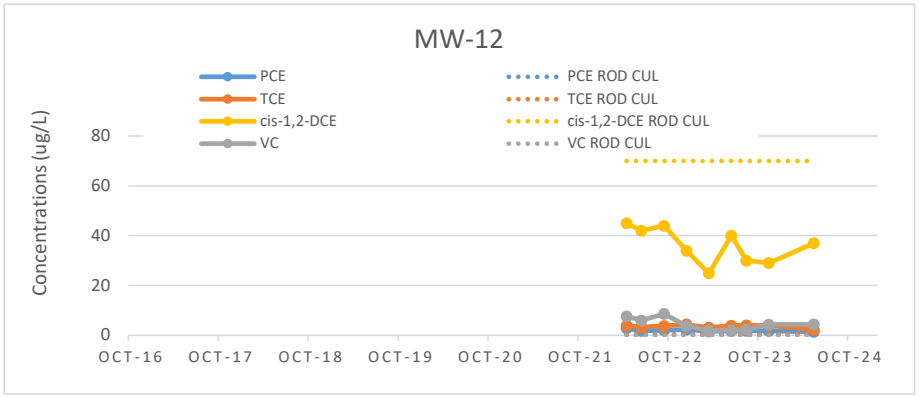


Figure 5-4. VOC Trend Plots in the Southeast Area (2016 - 2024)

Northwest Pipe Company Portland Plant

Portland, Oregon





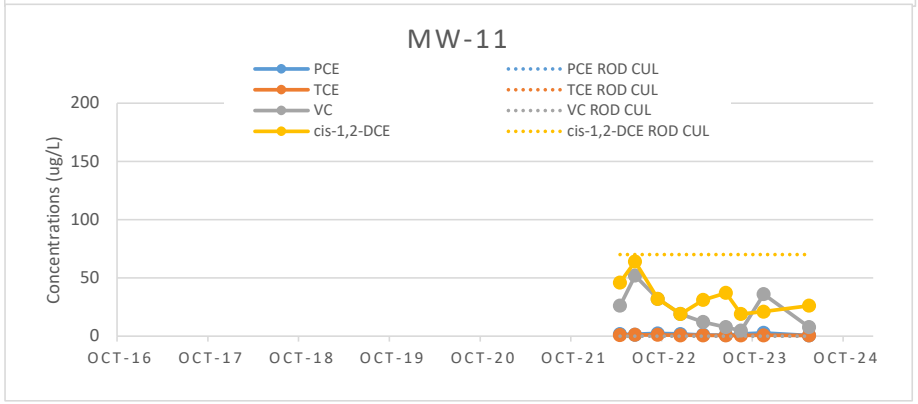


Figure 5-5. VOC Trend Plots in the New Port Wells (2022 - 2024)
Northwest Pipe Company Portland Plant
Portland, Oregon

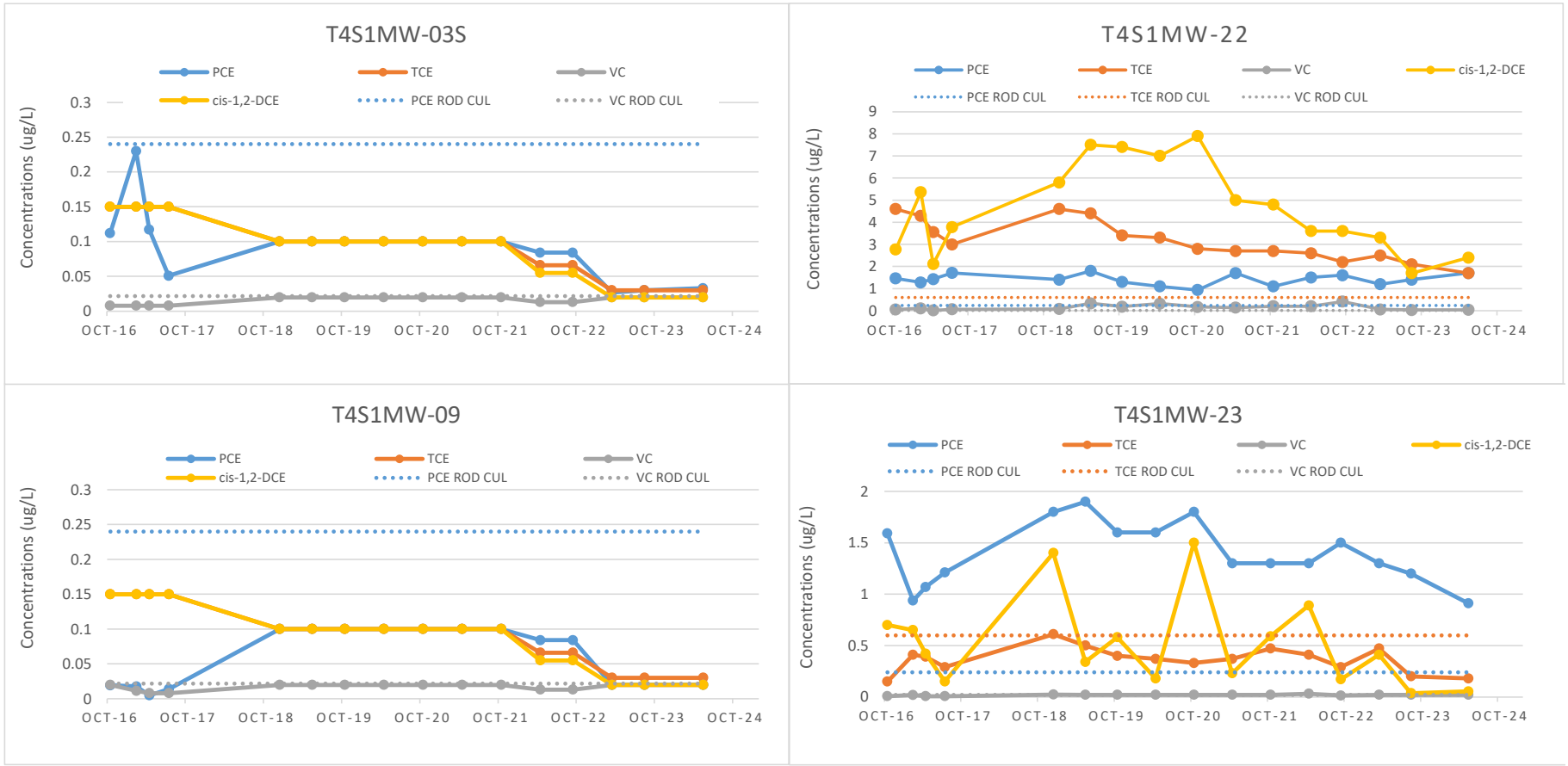


Figure 5-6. VOC Trend Plots in Previously Existing Port Wells (2016 - 2024)

Northwest Pipe Company Portland Plant

Portland, Oregon

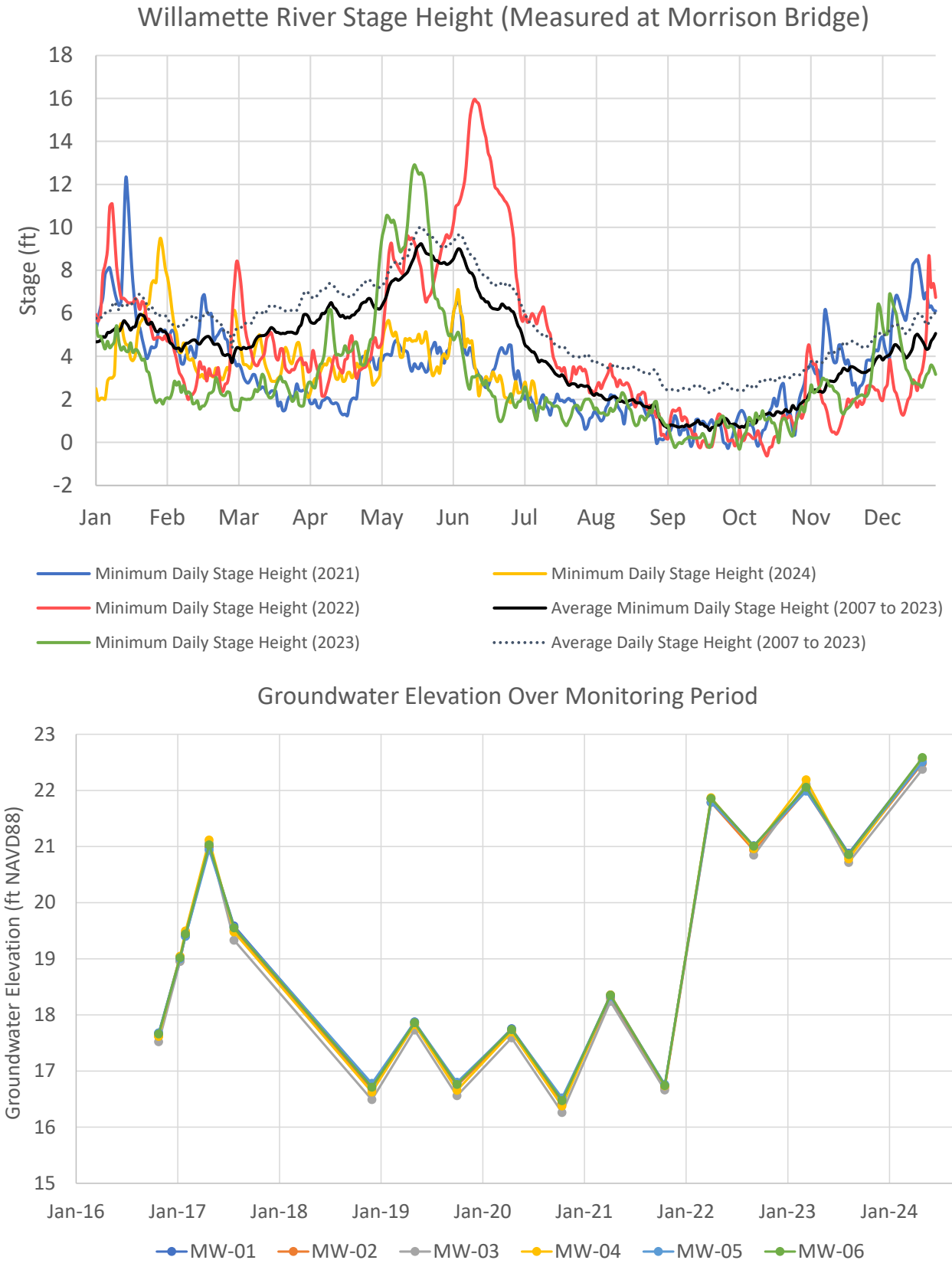
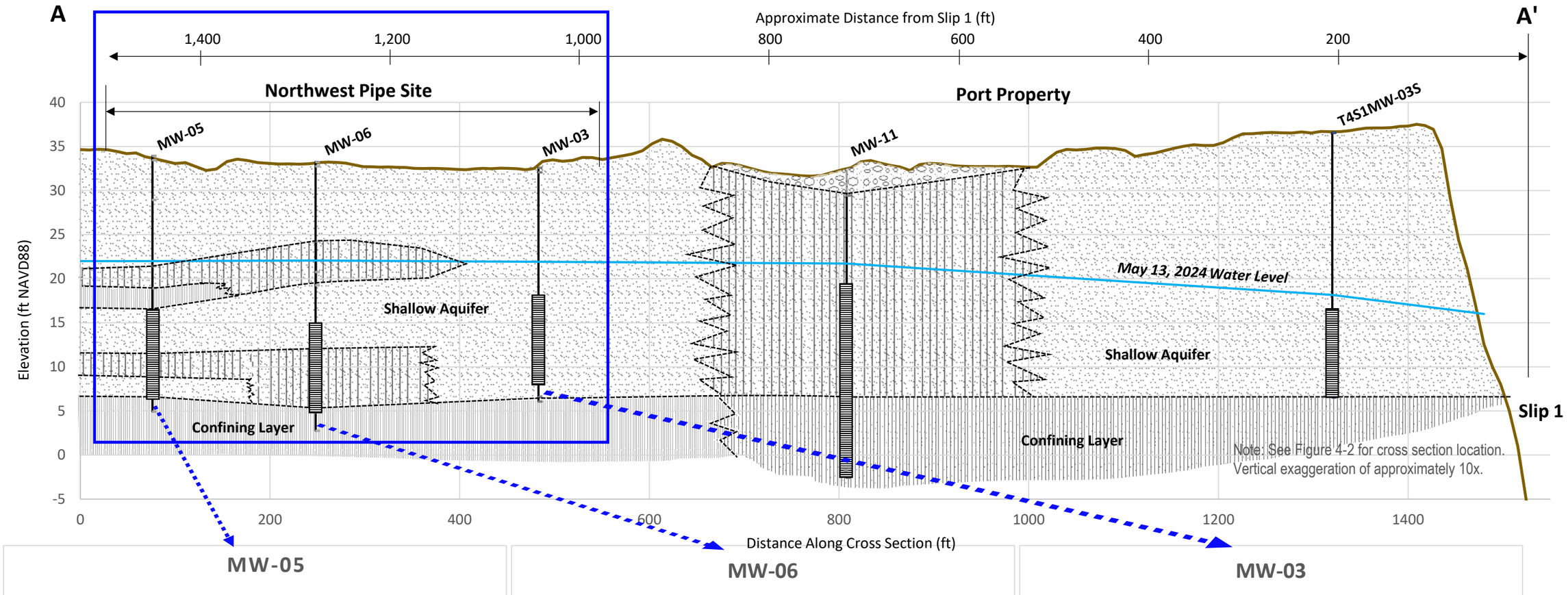


Figure 5-7

Evaluation of Willamette River Stage and Site Groundwater Levels over Time

Northwest Pipe Company

Portland, Oregon



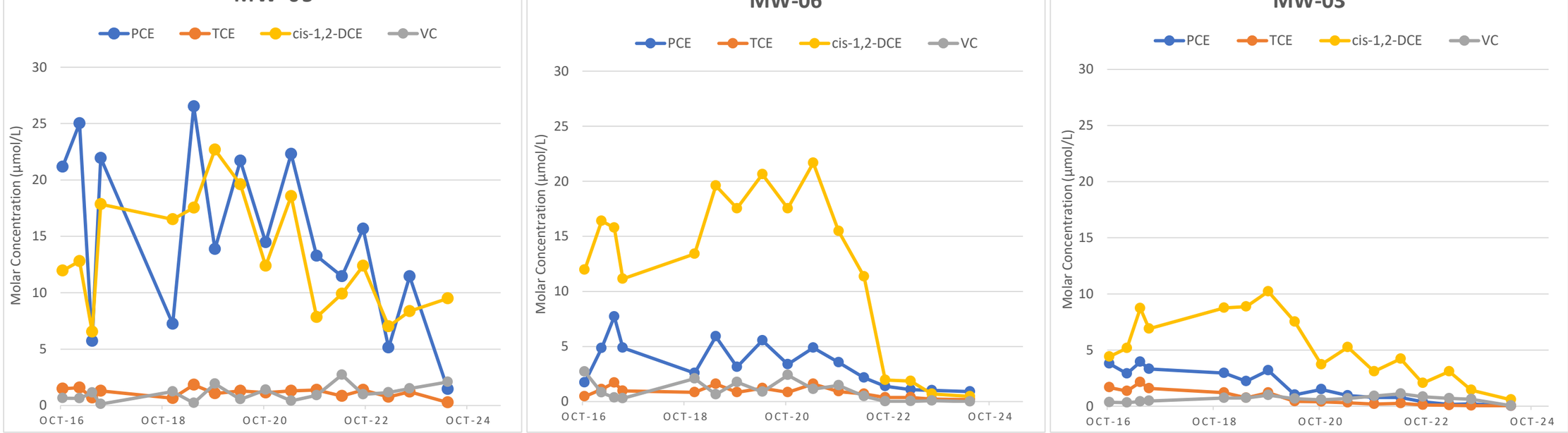
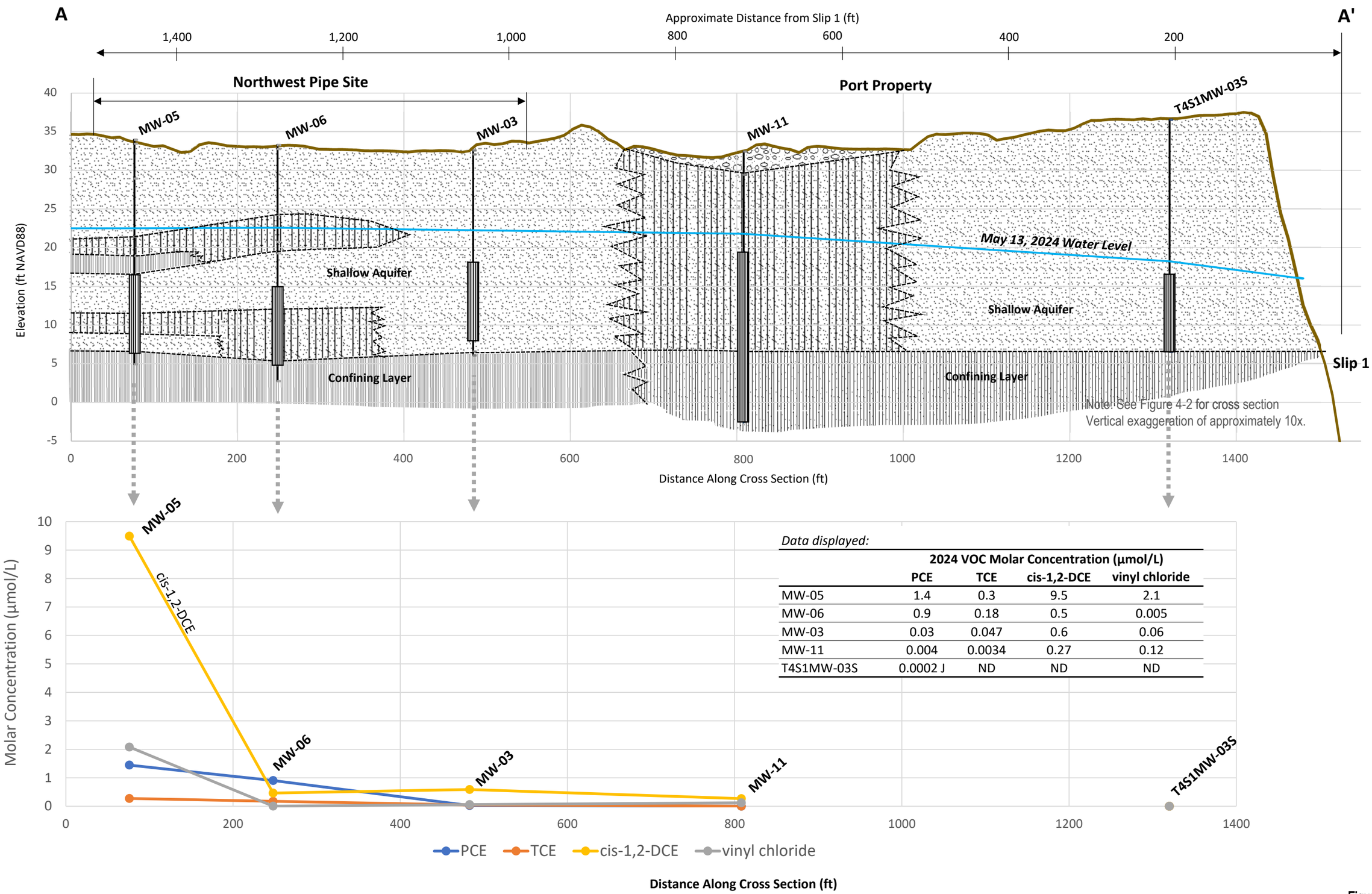


Figure 5-8
Trends in Molar Concentrations for Selected Wells (2016 - 2024)
Northwest Pipe Company
Portland, Oregon



Data displayed:

	2024 VOC Molar Concentration (µmol/L)			
	PCE	TCE	cis-1,2-DCE	vinyl chloride
MW-05	1.4	0.3	9.5	2.1
MW-06	0.9	0.18	0.5	0.005
MW-03	0.03	0.047	0.6	0.06
MW-11	0.004	0.0034	0.27	0.12
T4S1MW-03S	0.0002 J	ND	ND	ND

Figure 5-9
VOC Molar Concentrations for Selected Wells (2024)
Northwest Pipe Company
Portland, Oregon

Appendix A
Field Sampling Sheets and Notes

JACOBS WELL SAMPLING FIELD LOG

Date: 5/14/24

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** T4S/MW-03S

Field Team: C Torgerson & J DeMartino

Total Depth (ft) 30 (-) DTW (ft) 17.90 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 2.06

Field Conditions: 63 °F, sunny

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

✓	Purge Method:	Transient peristaltic pump with | | new or |X| dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): ~25 FT, ~4 FT of tubing out of well. Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
10:44	PUMP ON								17.90	
11:14	2.1	233.3	14.6	6.50	135.4	4.42	0.98	0.07	18.05	
11:19	2.4	231.7	14.8	6.37	123.8	3.57	1.47	0.06	18.02	
11:24	2.7	231.0	15.1	6.48	116.5	3.71	0.73	0.06	18.01	
11:29	2.9	230.5	15.1	6.39	119.4	3.61	0.76	0.04	18.01	
11:34	3.1	230.0	15.2	6.49	111.3	3.69	0.72	0.04	18.0	
:										
:										
:										
:										
11:40	Start Sampling T4S/MW03S-05142 4-0									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/14/24 **Time:** 11:40 **Well ID:** T45IMW-03S

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 0.02 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO2 = 35 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							

Comments:

JACOBS WELL SAMPLING FIELD LOG

Date: 5/14/24

Project #: NWP22003.A.CS.EV.05

Well I.D.: TH51MW-09

Field Team: C Torgerson, J DeMartino

Total Depth (ft) 31.56 (-) DTW (ft) 18.25 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 2.25

Field Conditions: Sunny, 58°F

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or |X| dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): ~22 FT, 3 FT tubing out of well

Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
09:10	PUMP ON								18.25	
09:45	2.3	216.8	15.4	6.77	-11.6	2.63	4.73	0.06	18.26	
09:50	2.5	209.0	15.6	6.44	~~-22.6~~ -33.4 @	2.28	4.05	0.04	18.26	
0955	2.7	196.7	15.8	6.64	-29.3	2.73	4.36	0.04	18.26	
10:00	2.9	198.6	15.9	6.65	-30.7	2.69	3.52	0.04	18.26	
10:03		197.8	15.8	6.66	-29.5	2.56	3.46	0.04	18.26	
:										
:										
:										
:										
10:05	Start Sampling TH51MW09-05142 4-C									
:	End Sampling									

* **VC** = Very cloudy **CI** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/14/24 Time: 10:05 Well ID: T45/MW89-051424

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals F								
Dissolved Ferrous Iron	Fe(II) = 0.96 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO_2 = 25 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							

Comments:

JACOBS WELL SAMPLING FIELD LOG

Project #: NWP22003.A.CS.EV.05 **Date:** 5/13/24

Well I.D.: T4S1MW-22

Field Team: C Torgerson & J DeMartino

Total Depth (ft) 23.0 (-) DTW (ft) 13.70 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 1.58

Field Conditions: 70°F, sunny

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or |X| dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): ~1 FT out of well Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
13:45	PUMP ON								13.70	
14:24	2.0	259.5	17.9	6.23	108.9	1.98	2.44	0.06	13.69	very clear
14:29	2.3	261.1	18.1	6.23	111.5	1.92	1.70	0.06	13.69	
14:34	2.6	259.8	17.6	6.33	110.0	1.61	0.57	0.06	13.69	
14:37	2.8	254.2	17.6	6.35	110.4	1.53	0.56	0.06	13.69	
14:40	3.0	256.2	17.4	6.31	111.6	1.52	0.56	0.06	13.69	
:										
:										
:										
:										
14:45	Start Sampling T4S1MW22-051324-0									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: **Time:** : **Well ID:**

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl	5/13/22	EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 0.05 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO_2 = 55 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							
Comments:	T451MW22-051324-0 @1445							

JACOBS WELL SAMPLING FIELD LOG

Date: 5/15/23

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** T4S/MW-23

Field Team: C Torgerson & J DeMartino

Total Depth (ft) 25 (-) DTW (ft) 12.47 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 2.1

Field Conditions: 68°F, SUNNY

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or X | dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): 3.5 FT tubing out of well Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
09:10	PUMP ON							~~0.08~~ C	12.47	
09:35	2.1	209.6	15.9	6.69	42.0	1.29	11.5	0.08	12.60	
09:40	2.4	210.3	17.3	6.65	4.0	0.48	14.0	0.06	12.50	
09:45	2.7	214.8	17.2	6.65	-5.2	0.65	11.7	0.06	12.50	
09:48	2.9	215.1	17.1	6.62	-6.5	0.75	10.6	0.06	12.50	
09:51	3.1	214.8	17.0	6.62	-6.2	0.78	10.7	0.06	12.50	
:										
:										
:										
:										
09:55	Start Sampling T4S/MW23-051524-W									
:	End Sampling									

* **VC** = Very cloudy **CI** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/15/24 Time: 09 : 55 Well ID: T45IMW23

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 0.02 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO2 = 30 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							

Comments:

JACOBS WELL SAMPLING FIELD LOG

Date: 5/15/24

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** MW01

Field Team: C Torgerson & J DeMartino

Total Depth (ft) 24.57 (-) DTW (ft) 11.28 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 2.3

Field Conditions: 66°F, sunny

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or X dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): ~4 Ft tubing at of well Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
10:18		PUMP	ON						11.28	
10:50	2.3	516.9	17.1	2.71	281.0	0.19	4.20	0.07	11.28	
10:55	2.6	516.0	17.1	2.62	286.2	0.17	2.15	0.06	11.28	clear
11:00	2.9	516.8	17.0	2.61	287.7	0.17	3.30	0.06	11.28	
:										
:										
:										
:										
:										
:										
11:05	Start Sampling									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/15/24 Time: 11:05 Well ID: MW01

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 0.0 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO2 = 95 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							
Comments:								

JACOBS WELL SAMPLING FIELD LOG

Date: 5/15/24

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** MW-02

Field Team: C Torgerson & J DeMartino

Total Depth (ft) 21.0 (-) DTW (ft) 8.34 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 2.15

Field Conditions: Sunny, 72°F

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or | X | dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): 2.5 FT tubing cut Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
11:24	PUMP ON								8.34	
11:56	2.1	329.3	17.6	6.87	-94.2	0.00	4.75	0.07	8.44	
12:01	2.3	327.7	17.6	6.80	-94.0	0.00	3.92	0.06	8.49	
12:06	2.6	328.9	17.5	6.84	-94.5	0.00	3.62	0.06	8.49	
:										
:										
:										
:										
:										
:										
12:10	Start Sampling									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/15/24 Time: 12 : 10 Well ID: MW-02

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 3.20 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO_2 = 45 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							
Comments:								

JACOBS WELL SAMPLING FIELD LOG

Date: 5/15/24

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** MW-03

Field Team: C Torgerson & J DeMartino

Total Depth (ft) 25.10 (-) DTW (ft) 10.76 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 2.4

Field Conditions: 75°F, SUNNY

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or |X| dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): 4 FT tubing out of well Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
12:40	PUMP	ON							10.76	
13:10	2.4	244.5	15.6	6.33	404.7	0.40	2.71	0.08	10.78	
13:15	2.7	247.9	15.9	6.51	393.1	0.43	1.48	0.06	10.78	
13:20	3.0	251.8	15.6	6.55	390.6	0.49	1.27	0.06	10.78	
13:25	3.3	252.6	15.6	6.52	387.4	0.51	1.11	0.06	10.78	
:										
:										
:										
:										
:										
13:30	Start Sampling MW03-05152				4-0					
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/15/24 **Time:** 13:30 **Well ID:** MW-03

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 0.25 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO_2 = 55 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace

Duplicate ID Time:

Comments:

JACOBS WELL SAMPLING FIELD LOG

Date: 5/16/24

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** MW-04

Field Team:

Total Depth (ft) 27.39 (-) DTW (ft) 9.95 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 3.0

Field Conditions: 54°F Partly cloudy

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or |X| dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): ~7FT tubing out of well Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
07:40	PUMP	ON							9.95	
08:20	3.0	283.7	14.7	6.51	-34.7	0.47	12.9	0.07	10.11	
08:25	3.3	274.7	14.7	6.60	-41.8	0.34	11.2	0.06	10.11	
08:30	3.6	268.4	14.7	6.62	-43.3	0.41	11.3	0.06	10.11	
08:35	3.9	266.8	14.7	6.62	-43.5	0.29	11.1	0.06	10.11	
:										
:										
:										
:										
:										
08:40	Start Sampling MW04-05162024-0									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/16/24 Time: 08:40 Well ID: MW-04

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 2.91 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO_2 = 40 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							
Comments:								

JACOBS WELL SAMPLING FIELD LOG

Date: 5/16/24

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** MW05

Field Team: C Jorgenson & J DeMartino

Total Depth (ft) 27.84 (-) DTW (ft) 11.04 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 2.8

Field Conditions: 65°F, sunny

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or X dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): ~2 FT of tubing at of well Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
10:12		PUMP	ON						11.04	
10:47	2.8	359.9	16.7	6.68	-62.3	0.10	2.97	0.08	11.05	
10:52	3.1	362.7	16.6	6.66	-66.2	0.05	3.52	0.06	11.05	
10:57	3.4	365.8	16.7	6.68	-67.8	0.05	2.30	0.06	11.05	
:										
:										
:										
:										
:										
:										
11:05	Start Sampling MW05-05162424-D									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/16/24 Time: 11:05 Well ID: MW-05

Sample I.D.	Number of Sample Containers (Circled): Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Field measurement Only: Fe(II) = 3.19 mg/L							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	Field measurement Only: CO_2 = 60 mg/L							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace

Duplicate ID Time:

Comments:

JACOBS WELL SAMPLING FIELD LOG

Date: 5/16/24

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** MW06

Field Team:

Total Depth (ft) 29.86 (-) DTW (ft) 10.45 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 3.0

Field Conditions: 60°F, Partly cloudy

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or | X dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): ~2 Ft tubing at of well Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
0857	Pump on								10.45	
09:35	3.0	296.3	16.1	6.32	76.6	0.40	4.37	0.08	10.49	clear
09:40	3.3	296.6	15.9	6.32	81.2	0.38	3.05	0.06	10.49	
09:45	3.6	296.0	16.0	6.35	81.1	0.41	1.88	0.06	10.49	
:										
:										
:										
:										
:										
:										
0950	Start Sampling MW06 - 05162									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/16/24 **Time:** 09:50 **Well ID:** MW06

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 0.21 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO_2 = 75 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							

Comments:

JACOBS WELL SAMPLING FIELD LOG

Date: 5/14/24

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** MW-10

Field Team: C Torgerson & J DeMartino

Total Depth (ft) 29 (-) DTW (ft) 10.45 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 3.15

Field Conditions: 72°F, Sunny

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or X dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): 22 FT, ~3 FT tubing out Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
12:51	PUMP ON								10.45	
13:36	3.1	307.3	16.1	7.13	-109.9	0.41	13.7	0.08	10.45	
13:41	3.4	300.5	15.9	6.86	-137.4	0.00	8.86	0.06	10.45	
13:46	3.7	300.2	16.6	6.55	-128.8	0.00	6.21	0.06	10.45	clear
13:51	3.9	299.4	16.6	6.95	-150.9	0.00	7.90	0.04	10.45	
13:54	4.0	299.6	16.6	6.97	-152.9	0.00	6.42	0.04	10.45	
13:57	4.1	299.9	16.6	6.96	-152.4	0.00	5.86	0.04	10.45	
:										
:										
:										
14:00	Start Sampling									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/14/24 **Time:** 14:00 **Well ID:** MW-10

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 3.30 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO_2 = 30 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							
Comments:								

JACOBS WELL SAMPLING FIELD LOG

Date: 5/14/24

Project #: NWP22003.A.CS.EV.05 **Well I.D.:** MW-11

Field Team: C Torgerson & J DeMartino

Total Depth (ft) 35 (-) DTW (ft) 10.29 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 4.2

Field Conditions: 74°F, sunny

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

✓	Purge Method:	Transient peristaltic pump with | | new or |X| dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): 28 FT tubing, 3 FT wt Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
14:20	0								10.29	
15:16	4.2	246.0	16.4	6.66	-59.1	0.07	12.0	0.07	10.30	
15:21	4.5	245.9	16.2	6.75	-80.5	0.00	7.33	0.06	10.30	
15:26	4.8	255.9	16.5	6.87	-98.8	0.00	6.94	0.06	10.30	
15:29	5.0	254.9	18.0	6.83	-99.0	0.03	8.74	0.06	10.30	
15:32	5.2	252.2	17.4	6.82	-99.6	0.05	6.39	0.00	10.30	
:										
:										
:										
:										
15:35	Start Sampling									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/14/24 Time: 15:35 Well ID: MW-11

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 2.75 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO_2 = 45 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID	Time:							
Comments:								

JACOBS WELL SAMPLING FIELD LOG

Date: 5/15/24

Project #: NWP22003.A.CS.EV.05 Well I.D.: MW-12

Field Team: C Torgerson & J DeMartino

Total Depth (ft) 30 (-) DTW (ft) 13.21 (X 0.17 gal\ft) = Well Casing Volume (gal.) = 2.8

Field Conditions: 60°F Sunny

Decontamination: Alconox wash, DI wash

PURGE INFORMATION

X	Purge Method:	Transient peristaltic pump with | | new or X | dedicated polyethylene/teflon-lined tubing
	Purge Method :	Dedicated submersible pump with | | new or | | dedicated polyethylene tubing
	Purge Method:	Dedicated Hydrostar pump with | | new or | | dedicated polyethylene tubing

Pump Suction Depth (ft): 26 FT tubing, 3.5 ft air Purge water disposal: IDW Drum

Comments/Exceptions to SAP:

	Purge Volume (gallons)	Specific Conduct. (µS/cm)	Temp. (°C)	pH	ORP (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)	Flow Rate (gpm)	DTW (ft)	* Clarity/ Color/Remarks
Target Stabilization Criteria	-	+/- 3%	-	+/- 0.1	+/- 10	+/- 0.3	+/- 10 if > 10 NTU	0.03 - 0.08	-	
Time										
07:40	PUMP	ON							13.21	
08:19	2.8	310.5	13.8	6.68	-24.6	0.5	13.2	0.07	13.23	
08:24	3.1	306.0	13.8	6.30	-13.6	0.29	11.6	0.06	13.23	
08:29	3.4	303.4	13.8	6.21	20.7	0.35	9.73	0.06	13.23	
08:34	3.7	297.4	13.8	6.27	20.4	0.52	6.91	0.06	13.23	
08:37	3.9	300.6	13.8	6.31	13.9	0.65	6.76	0.06	13.23	
:										
:										
:										
:										
08:40	Start Sampling MW12-05152424-0									
:	End Sampling									

* **VC** = Very cloudy **Cl** = Cloudy **SC** = Slightly Cloudy **VSC** = Very Slightly Cloudy **AC** = Almost Clear **C** = Clear **CC** = Crystal Clear

Laboratory Analytical Program
Groundwater Sampling
Project #: NWP22003.A.CS.EV.05

DATE: 5/15/24 **Time:** 08:40 **Well ID:** MW-12

Sample I.D.	Number of Sample Containers (Circled) Equip-ment	Dupli-cate	Parent Sample	Volume	Type	Pres.	Shipping Date	Analytical Method
Organic Constituents								
TCE, cis 1,2-DCE, PCE, VC	3	3	(3)	40 mL	Glass	HCl		EPA 8260SIM, no headspace
Metals								
Dissolved Ferrous Iron	Fe(II) = 2.16 mg/L Field measurement Only							HACH DR890- Ferrous Iron
Natural Attenuation Monitoring Constituents								
Nitrate, Sulfate, Chloride	1	1	(1)	125 mL	Poly	None		Nitrate (300), Sulfate & Chloride (300.0_28D)
TOC	1	1	(1)	250 mL	Glass	H2S04		SM5310
Carbon Dioxide	CO_2 = 60 mg/L Field measurement Only							HACH CO2 Test Kit
Methane	3	3	(3)	40 mL	Glass	HCl		RSK 175, no headspace
Duplicate ID MW00-051524-0 Time: 0850								
Comments:								

NWP May GWS 5/13/24

Task: Synoptic water gauging and GWS
Personnel: Caleb Torgerson
Jacob DeMartino
Weather: 55-72°F, sunny, partly cloudy
0730 Meet at NWP property, check in w/ Tim NWP
0740 Arrive on Port Property, conduct H+S tailgate on: Site orientation, PPE, train track safety, escort procedures
0750 Begin well gauging

Well ID	TIME	Water Level (ft BTOC)	Notes
TH51-MW22	1005	13.70	
MW-12	1008	13.17	
TH51-MW02S	1032	16.36	
MW-11	1015	10.26	
MW-10	1018	10.41	
TH51-MW25	1048	13.30	Broken lid
TH51-MW03S	1037	17.85	
TH51-MW09	1043	18.23	
TH51-MW10	1041	7.29	
TH51-MW23	1027	12.40	
MW-02	1104	6.36	
MW-03	1109	9.96	
MW-04	1114	10.75	
MW-01	1057	11.25	
MW-05	1100	11.06	
MW-06	1118	10.42	

1000 Begin gauging wells
1130 Finish gauging wells, take lunch
1200 Finish lunch - drive to EcoRental to pick up PeriPump
1330 Arrive back at Port TH
1345 Pump on @ TH51/MW-22, DTW = 13.70
calibrate equipment

YSI Pro Plus 47516

STD	pH 4.0	pH 7.0	pH 10.0	ORP 240.0	Spcond 1413	DO 100%
Reading	4.0	6.97	10.04	233.2	1.41	99.7
Lot #	3GE0156	3GE007	3GE083	4GC1490	4GA0218	—
Exp	5/25	5/25	5/25	12/24	1/25	—

HACH 2100Q 48642

NTU	10	20	100	800.
Reading	10.5	20.1	102	787

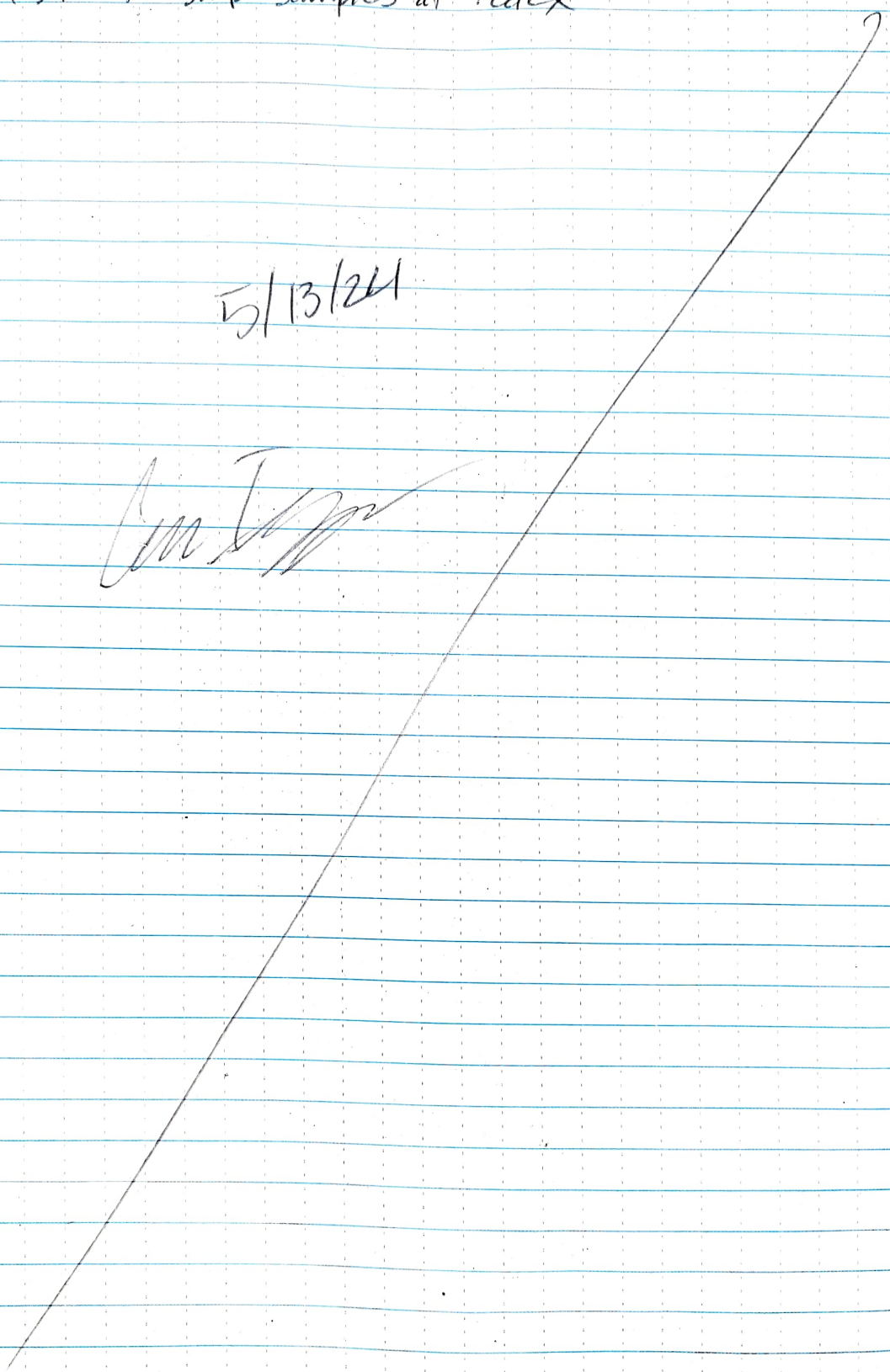
MINI RAE 3000 211309
Zero gas = 0.0 ppm 100 ppm isobutylene = 100.0 ppm
Exp: 6/25 lot # 2-171-744

Scale: 1 square = _____

NWP May GWS 5/13/24

1445 collected ITK1MW-22-05132411 Fe(II) = 0.05 mg/L, CO_2 = 55 mg/L
1520 Drop off IDW
1530 Offsite to ship samples at Fedex

5/13/24



Scale: 1 square = _____

NWP May GWM

5/14/24

Task: Continue GW Sampling
Personnel: Caleb Torgerson
Jacob DeMartino
Weather: 56-76°F, sunny

0815 Meet at NWP, check in with TM Whitsan/NWP
0830 check in at Port 14
0840 calibrate equipment

YSI Pro Plus 475116

SID	pH 4.0	pH 7.0	pH 10.0	ORP 240.0	Spcond 1413	DO 100%
Reading	4.0	7.0	10.0	240.1	1.423	99.5
Lot #	3GE0152	3GE007	3GE083	4GC1490	4GA0218	—
Exp	5/25	5/25	5/25	12/24	1/25	—

HACH 2100Q 486442

NTU	10	20	100	800
Reading	11.1	21.3	106	796

MINI RAE 3000 R11309

Zero gas = 0.0 ppm, 100 ppm isobutylene = 100.2 ppm
Exp: 6/25, Lot # 2-171-764

0910 pump on @ T14S1MW-09
1005 collected T14S1MW09-051424-0, Fe(II) = 0.46 mg/L, CO_2 = 25 mg/L
1044 pump on @ T14S1MW-03S
1140 collected T14S1MW03S-051424-0, Fe(II) = 0.02 mg/L, CO_2 = 35 mg/L
1210 Lunch
1251 Pump on @ MW-10
1400 collected ~~T14S1MW03D~~ MW10-051424-0 Fe(II) = ~~0.02~~ 3:30 0.01 mg/L, CO_2 = 30 mg/L
1420 pump on @ MW-11
1535 collected MW11-051424-0 Fe(II) = 2.75 mg/L, CO_2 = 45 mg/L
1545 Drop off IDW
1610 Offsite to ship at FedEx

5/14/24

CMT

Scale: 1 square = _____

NWP MAY GWM

5/15/24

Task: Carthage GW sampling
Personnel: Caleb Torgerson
Jacob DeMartino
Weather: 57-79°F, sunny

0720 Meet at NWP
0730 Check in at Port 14
0740 Pump on at MW-12
Calibrate equipment

YSI Pro Plus 475516

STD	pH 4.0	pH 7.0	pH 10.0	ORP 240	SpCond 1413	DO 100%
Reading	3.99	6.99	10.01	240.0	1388	99.9
Lot #	3GE0156	3GE0071	3GE083	4GC1490	4GA0218	—
Exp	5/25	5/25	5/25	12/24	'25	—

HACH 2100Q 498412

NTU	10	20	100	400
Reading	9.80	18.9	102	792

MMI RAE 3000 R11309

Zero = 0.0 ppm 100 ppm Isobutylene = 100.1 ppm
Exp 6/25 Lot # 2-171-784

0840 collect MW12-051524-0 Fe(II) = 2.16 mg/L CO_2 = 60 mg/L
0850 collect dupe MW100-051524-01
0910 PUMP on at T45/MW-23
0955 collect T45MW23-051524-0 Fe(II) = 0.02 mg/L, CO_2 = 30 mg/L
1045 Pump on at MW01
1105 collected MW01-051524-0 Fe(II) = 0 mg/L CO_2 = 95 mg/L
1124 pump on at MW02
1210 collected MW02-051524-0 Fe(II) = 3.20 mg/L, CO_2 = 45 mg/L
1240 Pump on at MW03
1330 collected MW03-051524-0 Fe(II) = 0.25 mg/L; CO_2 = 55 mg/L
1400 Drop off IDW
1440 offsite to ship samples via FedEx

5/15/24

Cont.

Scale: 1 square = _____

NWP May GWM

5/16/24

Task: Finish GW sampling
Personnel: Caleb Torgerson
Jacob DeMartino
Weather: 54-70°F, partly cloudy

0730 Meet at NWP, check in with Tim Watson
0740 Pump on at MW-04
Calibrate equipment

YSI Pro Plus 475/16

STD	pH 4.0	pH 7.0	pH 10.0	ORP 240.0	SpCond 1413	DO 100%
Reading	4.0	7.0	10.03	240.2	1414	99.4
Lot #	3GE0156	3GE0077	3GE0833	46K1490	46A0216	—
Exp	5/25	5/25	5/25	12/24	1/25	—

HACH 2100Q 416612

NTU	10	20	100	800
Reading	11.4	21.8	101	806

MiniRAE 3000 B11304

Zero gas = 0.0 ppm 100 ppm isobutylene = 98.7 ppm
Exp 6/25 Lot # 2-171-784

0840 collect [MW04-051624-0] Fe(II) = 2.91 mg/L CO_2 = 40 mg/L
0857 pump on @ MW06
0950 collect [MW06-051624-0] Fe(II) = 0.21 mg/L, CO_2 = 75 mg/L
1012 pump on @ MW05
1105 collect [MW05-051624-0] Fe(II) = 3.14 mg/L, CO_2 = 60 mg/L
1140 Drop off JDW
1200 Pack equipment and samples
1230 Offsite to return equipment and ship samples

5/16/24

Scale: 1 square = _____

Appendix B
Laboratory Analytical Reports

Provided in electronic format

Appendix C
Data Quality Evaluations

Groundwater Data Quality Evaluation for Northwest Pipe Company, Portland, Oregon

PREPARED FOR:	Stephanie Heldt-Sheller/Northwest Pipe Company
PREPARED BY:	Bernice Kidd/Jacobs
REVIEWED BY:	Mark Fesler/Jacobs
REFERENCE:	Northwest Pipe Company GWM Event – May 13 through May 16, 2024
DATE:	June 24, 2024

Introduction

The objective of this data quality evaluation (DQE) is to assess the representativeness and usability of data quality for groundwater quality samples collected to monitor the groundwater at the Northwest Pipe Company. The rationale for monitoring, the data quality objectives (DQOs), and the method for performing this DQE is provided in the *Monitored Natural Attenuation Evaluation Work Plan*, Northwest Pipe Company, Portland Plant, ECSI No. 138, April 2022 (hereafter referred to as the *NWP WP*).

This DQE report is intended as a general data quality assessment designed to summarize data issues and written using guidance from the U.S. Environmental Protection Agency (USEPA) *National Functional Guidelines for Organic Superfund Methods Data Review* (USEPA 2020a) and USEPA *National Functional Guidelines for Inorganic Superfund Methods Data Review* (USEPA 2020b).

Findings

The overall summaries of the data validation findings are contained in Tables 1 through 4 and summarized in the method sections that follow:

- **Table 1**: Sample Chronology – Data Summary. Presents the sample identifiers, methods, sampling dates, received dates, extraction dates, and analysis dates sorted by SDG number.
- **Table 2**: Sample Summary by Chain of Custody – Data Summary. Presents the sample identifiers, sampling dates, and SDG sorted by chain-of-custody (COC) number.
- **Table 3**: Overall Flagging Summary. Presents the number of occurrences for each data validation reason by method.

- **Table 4**: Site Completeness by Analyte – Qualified Data. Presents the percent completeness by method, analyte, and matrix.

This DQE report includes 13 normal groundwater samples, four trip blanks (TB), and one field duplicate (FD) collected May 13 through May 16,2024. These samples were reported under four sample delivery groups: 24E128, 24E136, 24E144 and 24E153. A list of samples included in this DQE is presented in Table 1 and Table 2. Four methods were used to analyze the groundwater samples and are provided in Table 1. The analyses were performed by EMAX Laboratories, Inc. in Torrance, California (EMXT). Samples were collected and delivered by overnight carrier to EMXT.

The data were assessed according to the requirements of the *NWP WP* and included a review of:

1. chain of custody documentation;
2. holding-time compliance;
3. required quality control (QC) samples at the specified frequencies;
4. flagging for method blanks and field blanks;
5. laboratory control sample/laboratory control sample duplicates (LCS/LCSD);
6. matrix spike/matrix spike duplicate (MS/MSD) recoveries;

and other method-specific criteria as defined by the *NWP WP*.

Field samples were also reviewed to ascertain field compliance and data quality issues. This included the review of a FD.

Data flags were assigned using the *NFGs* as guidance. These flags, as well as the reason for each flag, are entered into the electronic database and can be found in Table 3, no data were qualified for this sampling event. Multiple flags are routinely applied to specific sample method/matrix/analyte combinations, but there will be only one final flag. A final flag is applied to the data and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts.

The data flags are defined below:

- J = the analyte was detected, but the associated numerical value is considered an estimated quantity.
- R = the sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified. No associated value is reported.
- U = the analyte was analyzed for but was not detected above the detection limit.
- UJ = the analyte was not detected above the detection limit. However, the detection 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.

Overall Flagging Summary

The overall summaries of the data validation findings are summarized in the following sections. No data required qualification for this sampling event.

Temperature

Temperature requirements were met.

Blanks

Method blanks and TBs were analyzed at the required frequency and were free of contamination that affected the sample results.

Holding Times

All holding-time criteria were met.

Field Duplicates

In accordance with the *NWP WP* one field duplicate (FD) was collected from well MW12, all precision criteria were met.

Laboratory Control Samples

LCS and LCSDs were analyzed at the required frequency and the accuracy and precision criteria were met.

Matrix Spikes

Matrix spikes and matrix spike duplicates were analyzed at the required batch frequency and all accuracy and precision criteria were met.

Calibration

All initial and continuing calibration criteria were met.

Chain of Custody

There were no discrepancies.

Overall Assessment

The final activity in the DQE is an assessment of whether the data meets the data quality objectives. The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision-making process.

The following summary highlights the data evaluation findings for the above defined events:

1. No data were rejected and completeness was 100 percent for all method/matrix/analyte combinations as shown in Table 4.
2. No data were qualified due to associated blank contamination.
3. The precision and accuracy of the data, as measured by field and laboratory QC indicators, demonstrates that the NWP WP goals for project use were met.
4. The field crew followed the *NWP WP* and project documents.

Works Cited

Jacobs. 2012. Monitored Natural Attenuation Evaluation Work Plan, Northwest Pipe Company, Portland Plant, ECSI No. 138. April.

U.S. Environmental Protection Agency (USEPA). 2020a. National Functional Guidelines for Organic Superfund Methods Data Review. November.

U.S. Environmental Protection Agency (USEPA). 2020b. National Functional Guidelines for Inorganic Superfund Methods Data Review. November.

TABLE 1. Sample Chronology - Data Summary

Laboratory	SDG	Sample Identification	Method	Sample Date	Receive Date	Extract Date	Analysis Date
EMXT	24E128	T4S1MW22-051324-0	A5310B	5/13/2024	5/14/2024		5/23/2024
		T4S1MW22-051324-0	E300.0A	5/13/2024	5/14/2024		5/14/2024
		T4S1MW22-051324-0	E300.0A	5/13/2024	5/14/2024		5/15/2024
		T4S1MW22-051324-0	RSK-175	5/13/2024	5/14/2024	5/16/2024	5/16/2024
		T4S1MW22-051324-0	SW8260B-SIM	5/13/2024	5/14/2024	5/17/2024	5/17/2024
		TB01-051324	SW8260B-SIM	5/13/2024	5/14/2024	5/17/2024	5/17/2024
	24E136	MW10-051424-0	A5310B	5/14/2024	5/15/2024		5/22/2024
		MW10-051424-0	E300.0A	5/14/2024	5/15/2024		5/15/2024
		MW10-051424-0	RSK-175	5/14/2024	5/15/2024	5/16/2024	5/16/2024
		MW10-051424-0	SW8260B-SIM	5/14/2024	5/15/2024	5/17/2024	5/17/2024
		MW11-051424-0	A5310B	5/14/2024	5/15/2024		5/22/2024
		MW11-051424-0	E300.0A	5/14/2024	5/15/2024		5/15/2024
		MW11-051424-0	RSK-175	5/14/2024	5/15/2024	5/16/2024	5/16/2024
		MW11-051424-0	SW8260B-SIM	5/14/2024	5/15/2024	5/17/2024	5/17/2024
		T4S1MW03S-051424-0	A5310B	5/14/2024	5/15/2024		5/22/2024
		T4S1MW03S-051424-0	E300.0A	5/14/2024	5/15/2024		5/15/2024
		T4S1MW03S-051424-0	RSK-175	5/14/2024	5/15/2024	5/16/2024	5/16/2024
		T4S1MW03S-051424-0	SW8260B-SIM	5/14/2024	5/15/2024	5/17/2024	5/17/2024
		T4S1MW09-051424-0	A5310B	5/14/2024	5/15/2024		5/22/2024
		T4S1MW09-051424-0	E300.0A	5/14/2024	5/15/2024		5/15/2024
		T4S1MW09-051424-0	RSK-175	5/14/2024	5/15/2024	5/16/2024	5/16/2024
		T4S1MW09-051424-0	SW8260B-SIM	5/14/2024	5/15/2024	5/17/2024	5/17/2024
		TB01-051424	SW8260B-SIM	5/14/2024	5/15/2024	5/17/2024	5/17/2024
	24E144	MW01-051524-0	A5310B	5/15/2024	5/16/2024		5/23/2024
		MW01-051524-0	E300.0A	5/15/2024	5/16/2024		5/16/2024
		MW01-051524-0	E300.0A	5/15/2024	5/16/2024		5/17/2024
		MW01-051524-0	RSK-175	5/15/2024	5/16/2024	5/16/2024	5/16/2024
		MW01-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/21/2024	5/21/2024
		MW01-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/23/2024	5/23/2024
		MW02-051524-0	A5310B	5/15/2024	5/16/2024		5/23/2024
		MW02-051524-0	E300.0A	5/15/2024	5/16/2024		5/16/2024
		MW02-051524-0	RSK-175	5/15/2024	5/16/2024	5/16/2024	5/16/2024
		MW02-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/21/2024	5/21/2024
		MW02-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/23/2024	5/23/2024
		MW03-051524-0	A5310B	5/15/2024	5/16/2024		5/23/2024
		MW03-051524-0	E300.0A	5/15/2024	5/16/2024		5/16/2024
		MW03-051524-0	E300.0A	5/15/2024	5/16/2024		5/17/2024

TABLE 1. Sample Chronology - Data Summary

Laboratory	SDG	Sample Identification	Method	Sample Date	Receive Date	Extract Date	Analysis Date
EMXT	24E144	MW03-051524-0	RSK-175	5/15/2024	5/16/2024	5/16/2024	5/16/2024
		MW03-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/29/2024	5/29/2024
		MW100-051524-0	A5310B	5/15/2024	5/16/2024		5/23/2024
		MW100-051524-0	E300.0A	5/15/2024	5/16/2024		5/16/2024
		MW100-051524-0	E300.0A	5/15/2024	5/16/2024		5/17/2024
		MW100-051524-0	RSK-175	5/15/2024	5/16/2024	5/16/2024	5/16/2024
		MW100-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/21/2024	5/21/2024
		MW100-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/23/2024	5/23/2024
		MW100-051524-0MS	E300.0A	5/15/2024	5/16/2024		5/17/2024
		MW100-051524-0MS	E300.0A	5/15/2024	5/16/2024		5/16/2024
		MW100-051524-0MSD	E300.0A	5/15/2024	5/16/2024		5/16/2024
		MW100-051524-0MSD	E300.0A	5/15/2024	5/16/2024		5/17/2024
		MW12-051524-0	A5310B	5/15/2024	5/16/2024		5/23/2024
		MW12-051524-0	E300.0A	5/15/2024	5/16/2024		5/16/2024
		MW12-051524-0	RSK-175	5/15/2024	5/16/2024	5/16/2024	5/16/2024
		MW12-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/21/2024	5/21/2024
		MW12-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/23/2024	5/23/2024
		T4S1MW23-051524-0	A5310B	5/15/2024	5/16/2024		5/23/2024
		T4S1MW23-051524-0	E300.0A	5/15/2024	5/16/2024		5/17/2024
		T4S1MW23-051524-0	E300.0A	5/15/2024	5/16/2024		5/16/2024
		T4S1MW23-051524-0	RSK-175	5/15/2024	5/16/2024	5/16/2024	5/16/2024
		T4S1MW23-051524-0	SW8260B-SIM	5/15/2024	5/16/2024	5/21/2024	5/21/2024
		TB01-051524	SW8260B-SIM	5/15/2024	5/16/2024	5/21/2024	5/21/2024
	24E153	MW04-051624-0	A5310B	5/16/2024	5/17/2024		5/23/2024
		MW04-051624-0	E300.0A	5/16/2024	5/17/2024		5/17/2024
		MW04-051624-0	RSK-175	5/16/2024	5/17/2024	5/21/2024	5/21/2024
		MW04-051624-0	SW8260B-SIM	5/16/2024	5/17/2024	5/21/2024	5/21/2024
		MW05-051624-0	A5310B	5/16/2024	5/17/2024		5/23/2024
		MW05-051624-0	E300.0A	5/16/2024	5/17/2024		5/17/2024
		MW05-051624-0	RSK-175	5/16/2024	5/17/2024	5/21/2024	5/21/2024
		MW05-051624-0	SW8260B-SIM	5/16/2024	5/17/2024	5/21/2024	5/21/2024
		MW06-051624-0	A5310B	5/16/2024	5/17/2024		5/23/2024
		MW06-051624-0	E300.0A	5/16/2024	5/17/2024		5/17/2024
		MW06-051624-0	RSK-175	5/16/2024	5/17/2024	5/21/2024	5/21/2024
		MW06-051624-0	SW8260B-SIM	5/16/2024	5/17/2024	5/17/2024	5/17/2024
		MW06-051624-0	SW8260B-SIM	5/16/2024	5/17/2024	5/21/2024	5/21/2024
		MW06-051624-0MS	A5310B	5/16/2024	5/17/2024		5/23/2024

TABLE 1. Sample Chronology - Data Summary

Laboratory	SDG	Sample Identification	Method	Sample Date	Receive Date	Extract Date	Analysis Date
EMXT	24E153	MW06-051624-0MSD	A5310B	5/16/2024	5/17/2024		5/23/2024
		TB01-051624	SW8260B-SIM	5/16/2024	5/17/2024	5/17/2024	5/17/2024

SDG = sample delivery group

EMXT = EMAX Laboratories Inc

TABLE 2. Sample Summary by COC - Data Summary

CoC Number	Sample Date	Matrix	QAQC Type	Sample Identification	SDG	Laboratory
24E128	05/13/2024	WATER	N	T4S1MW22-051324-0	24E128	EMXT
			TB	TB01-051324	24E128	EMXT
24E136	05/14/2024	WATER	N	MW10-051424-0	24E136	EMXT
			N	MW11-051424-0	24E136	EMXT
			N	T4S1MW03S-051424-0	24E136	EMXT
			N	T4S1MW09-051424-0	24E136	EMXT
			TB	TB01-051424	24E136	EMXT
24E144	05/15/2024	WATER	N	MW01-051524-0	24E144	EMXT
			N	MW02-051524-0	24E144	EMXT
			N	MW03-051524-0	24E144	EMXT
			FD	MW100-051524-0	24E144	EMXT
			MS	MW100-051524-0MS	24E144	EMXT
			SD	MW100-051524-0MSD	24E144	EMXT
			N	MW12-051524-0	24E144	EMXT
			N	T4S1MW23-051524-0	24E144	EMXT
			TB	TB01-051524	24E144	EMXT
24E153	05/16/2024	WATER	N	MW04-051624-0	24E153	EMXT
			N	MW05-051624-0	24E153	EMXT
			N	MW06-051624-0	24E153	EMXT
			MS	MW06-051624-0MS	24E153	EMXT
			SD	MW06-051624-0MSD	24E153	EMXT
			TB	TB01-051624	24E153	EMXT

SDG = Sample delivery group

EMXT = EMAX Laboratories Inc

QAQC Type

FD = Field Duplicate

MS = Matrix Spike

N = Normal

SD = Matrix Spike Duplicate

TB = Trip Blank

TABLE 3. Overall Flagging Summary

No data qualified

TABLE 4. Site Completeness by Analyte - Qualified Data

Method	Matrix	Analyte	Units	Number of Occurrences							Contractor Completeness (%)	Overall Completeness (%)
				Analyses	Detects	Non-detects	Blank Flags	J-Flags	Contractor R-Flags	Total R-Flags		
A5310B	WATER	Total Organic Carbon	MG/L	14	14			2			100	100
E300.0A	WATER	Chloride	MG/L	14	14						100	100
		Nitrate-N	MG/L	14	13	1		5			100	100
		Nitrite-N	MG/L	14		14					100	100
		Sulfate	MG/L	14	14						100	100
RSK-175	WATER	Methane	UG/L	14	13	1					100	100
SW8260B-SIM	WATER	cis-1,2-Dichloroethene	UG/L	14	12	2					100	100
		Tetrachloroethene (PCE)	UG/L	14	12	2		1			100	100
		Trichloroethene (TCE)	UG/L	14	12	2					100	100
		Vinyl Chloride	UG/L	14	11	3		1			100	100

% = Percent
J-Flags = Estimated results
R-Flags = Rejected results
mg/L = milligrams per liter
ug/L = micrograms per liter

Appendix D
Bulk Attenuation Rate Constant Calculations

Provided in electronic format