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NW Natural Gasco Site

ANCHOR QEA

Hydraulic Control and Containment System Performance and Monitoring Plan: 2019 Revision

Prepared for NW Natural

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ABBREVIATIONS

CDR	*Revised Groundwater Source Control Construction Design Report*
DEQ	Oregon Department of Environmental Quality
DNAPL	dense nonaqueous phase liquid
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbon
FS	Feasibility Study
gpm	gallons per minute
HC&C	hydraulic control and containment
HMI	human-machine interface
PAH	polycyclic aromatic hydrocarbon
Plan	*Hydraulic Control and Containment System Performance and Monitoring Plan: 2019 Revision*
PLC	programmable logic control
QA/QC	quality assurance/quality control
RAO	remedial action objective
SAP	*Sampling and Analysis Plan*
Siltronic	Siltronic Corporation
SIM	Selective Ion Monitoring
TarGOST	Tar-Specific Green Optical Screening Tool
Test Plan	*Final Groundwater Source Control Extraction System Test Plan*
TMA	TarGOST Monitoring Area
TPH	total petroleum hydrocarbon
TPH-Dx	diesel-range total petroleum hydrocarbon
TPH-Gx	gasoline-range total petroleum hydrocarbon
VFD	variable frequency drive
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WBZ	water-bearing zone

1 Introduction

1.1 Purpose

This document provides an updated performance and monitoring plan for the groundwater source control system that is currently in full-time, full-scale operation at the NW Natural Gasco site in Portland, Oregon. The hydraulic control and containment (HC&C) system was installed and has been optimized to assure groundwater hydraulic containment of the Upper, Lower, and Deep Lower Alluvium Water-Bearing Zones (WBZs) along groundwater source control Segments 1 and 2 at the Gasco site. The extents of Segments 1 and 2 are shown in Figure 1-1. This *Hydraulic Control and Containment System Performance and Monitoring Plan: 2019 Revision* (Plan) covers the following three primary topics: 1) hydraulic capture performance monitoring; 2) dense nonaqueous phase liquid (DNAPL) monitoring; and 3) groundwater quality monitoring.

This Plan is an updated version of the *Hydraulic Control and Containment System Capture Performance and Monitoring Plan* that was submitted to the Oregon Department of Environmental Quality (DEQ) in May 2015 (Anchor QEA 2015a).

DEQ did not provide written comments on the 2015 version of the Plan, but DEQ and Anchor QEA, LLC, have discussed updating that version in meetings and telephone conversations. This updated Plan was prepared at DEQ's request.

As previously reported, the design, construction, interim operation, and testing of the HC&C and groundwater treatment systems were completed in general accordance with the plans described in the *Revised Groundwater Source Control Construction Design Report* (CDR; Anchor QEA 2012). The HC&C system was put into full-time, full-scale operation on May 14, 2015 after testing was complete, and the modifications DEQ and NW Natural determined were necessary to optimize system performance were made.

The remaining sections of this plan are organized as follows.

- Section 2 describes the hydraulic capture performance testing conducted to confirm that the HC&C system is containing groundwater and thereby preventing discharge of groundwater from the Alluvium WBZ to the Willamette River.
- Section 3 discusses long-term system operation and how level control and flow control are used to control pumping.
- Section 4 discusses the HC&C system real-time monitoring and system alarms.
- Section 5 describes the use of the site-wide MODFLOW groundwater flow model to assess the hydraulic capture zone.
- Section 6 describes the future source control remedy for the Fill WBZ.
- Section 7 describes the DNAPL monitoring program.

- Section 8 describes the groundwater quality monitoring program.
- Section 9 describes the reporting requirements.

This Plan is supported by the DEQ-approved *Sampling and Analysis Plan* (SAP), which includes quality assurance/quality control (QA/QC) procedures. The SAP was presented in the CDR (Anchor QEA 2012), updated in the *Final Groundwater Source Control Extraction System Test Plan* (Test Plan; Anchor QEA 2013), and is included as Appendix A to this Plan, with minor updates. For health and safety guidance, including personal protective equipment for sampling, staff should refer to the Gasco site *Health and Safety Plan: Gasco Source Control and Gasco and Siltronic Upland Site Remedy* (Anchor QEA 2014).

This Plan is a companion document to the project *Hydraulic Control and Containment System Operations and Maintenance Manual* (Anchor QEA 2015b), which provides detailed instructions and procedures for operating and maintaining the components of the HC&C system, including the extraction wells and control systems. A separate companion document, *NW Natural Groundwater Treatment System Operations and Maintenance Manual* (Sevenson 2015), describes the operation and maintenance of the groundwater treatment system.

This Plan has been updated to reflect changes in system performance, monitoring, and reporting protocols since submittal of the *Hydraulic Control and Containment System Capture Performance and Monitoring Plan* in May 2015 (Anchor QEA 2015a).

1.2 Background

This groundwater source control work is being completed consistent with the requirements of the following:

- The Joint Order (DEQ Order No. ECVC NWR 00-27 to NW Natural and Siltronic, dated October 4, 2000; DEQ 2000)
- The Voluntary Agreement (DEQ No. WMCVM-NWR-94-13, dated August 8, 1994, as amended July 19, 2006; DEQ 1994 and 2006)

Groundwater at the Gasco site occurs in several hydrogeologic units, which are described in detail in the CDR. The following are the hydrogeologic units from shallowest to deepest: the Fill WBZ, the Upper Alluvium WBZ, the Lower Alluvium WBZ, the Deep Lower Alluvium WBZ, and the Columbia River Basalt. The HC&C system, which is the subject of this report, captures groundwater in the three alluvium WBZs. The HC&C system has a drainage effect on the Fill WBZ, but additional source control action is being evaluated for the Fill WBZ, as described in Section 6.

The HC&C and groundwater treatment systems were in interim operation and testing from September 23, 2013, through May 14, 2015, when full-time, full-scale operation of the HC&C and groundwater treatment systems began.

1.3 Tables and Figures

The following paragraphs lay out the organization of the tables and figures that are discussed in subsequent sections.

Table 1 provides the construction details of the wells and piezometers used in this Plan. Table 2 shows the current operational parameters. Table 3 provides a list of the HC&C system alarms. Table 4 summarizes the DNAPL monitoring program.

Figures 1-1 through 1-5 provide location maps of the wells and piezometers used in this Plan, including separate maps indicating which wells are associated with the individual hydrogeologic units.

The following figures include detailed well location maps and geologic cross sections showing well construction details:

- Figure 2-1 Monitoring Well and Cross Section Location Map
- Figures 2-2a through 2-2d Map of Groundwater Extraction and Treatment System
- Figures 2-3a through 2-3d Cross Section A-A'
- Figure 2-4 Cross Section B-B'
- Figures 2-5a through 2-5b Cross Section C-C'
- Figures 2-6a through 2-6b Cross Section D-D'
- Figures 2-7a through 2-7b Cross Section E-E'
- Figures 2-8a through 2-8c Cross Section F-F'
- Figures 2-9a through 2-9c Cross Section G-G'

Figures 3-1a through 3-1d show operational screen captures from the HC&C system, and Figure 4-1 shows the HC&C system alarm function. Figure 5-1 shows DNAPL monitoring locations.

2 Hydraulic Capture Performance Testing

2.1 Remedial Action Objectives

This is a summary of the remedial action objectives (RAOs) described in the CDR. The source control physical removal action goals identified in the *Groundwater Source Control Interim Design Report* (Anchor QEA 2009) for Segments 1 and 2, as shown in Figure 1-1, are as follows:

- **Groundwater.** Prevent discharge of upland groundwater to the Willamette River, as measured by analyzing groundwater hydrology data from Gasco site wells and the river.
- **DNAPL.** Prevent the migration of upland DNAPL to the river.

At DEQ's request, the following clarifications apply to the RAOs:

- Source control measure alternatives have been evaluated specific to mitigating DNAPL migration to the Willamette River along shoreline Segments 1 and 2 in the Fill WBZ and Upper, Lower, and Deep Lower Alluvium WBZs and contaminated groundwater in the Upper, Lower, and Deep Lower Alluvium WBZs.
- DNAPL removal will be included to the extent necessary to control and contain the potential movement of DNAPL from former effluent management areas on the NW Natural Gasco and Siltronic Corporation (Siltronic) properties that could result from the operation of the hydraulic containment system.

On page 7, paragraph 1 of DEQ's September 22, 2011 comment letter (DEQ 2011) on the *Draft Groundwater Source Control Final Design Report* (Anchor QEA 2011), DEQ states that "the RAOs for groundwater source control are in place to prevent migration of contaminated groundwater from the uplands to the Willamette River along shoreline Segments 1 and 2 in a manner that minimizes DNAPL mobilization resulting from groundwater source control measures along the portion of Segment 1 where DNAPL occurs." This modified goal is the basis of the design of the HC&C system installed at the Gasco site. The results of the Phase 1 and 2 testing indicate that the system is meeting the RAOs.

2.2 Interim Operation and Testing

Detailed protocols for Phase 1 testing of the HC&C system are described in the Test Plan (Anchor QEA 2013). The 2013 Test Plan describes the Phase 1 and Phase 2 testing programs and the data gathering objectives. During the period from November 2013 through October 2014, six Phase 1 tests of the HC&C system were conducted. Results of the Phase 1 testing are described in the *Groundwater Source Control Phase 1 Testing Data Summary and Analysis Report* (Anchor QEA 2015c). Phase 2 testing was conducted from May 14 through July 14, 2015. The results of the Phase 2 testing were provided to DEQ on October 30, 2015 (Anchor QEA 2015d). The start of Phase 2 testing on May 14, 2015 marks the beginning of full-time, full-scale operation of the HC&C and groundwater treatment systems.

3 Long-Term HC&C System Operation

3.1 Performance Goals and Criteria

The RAOs for long-term operation of the HC&C system are unchanged from those for which the system was designed. The *Groundwater Source Control Phase 1 Testing Data Summary and Analysis Report* (Anchor QEA 2015c) described how the current HC&C operating system has proven to be effective at capturing alluvial groundwater and preventing discharge to the river. The programmed operational protocols used during Phase 2 testing of the system were proven to be effective at capturing groundwater and continue to be used for long-term operation, with minor modification to enhance system performance.

3.2 Automated Extraction Well Control System

3.2.1 Control System Description

The Phase 1 and 2 tests showed that the HC&C system can maintain hydraulic containment when the programmable logic control (PLC) system is operating the extraction wells. The PLC is designed so that each extraction well can be programmed for up to three types of controls—level control, flow control, and flow combined with level control (Level/Base Flow). All extraction wells, with the exception of PW-8U, are set to Level/Base Flow. PW-8U is set at a flow control rate of 1 gallon per minute (gpm). The well operational parameters are shown in detail in Table 2.

Each extraction well listed in Table 2 has a programmed setting for flow control and one for level control. The flow control parameter establishes the minimum base flow for that well in gpm. The pump speed and resulting flow rate of each extraction well is controlled by a variable frequency drive (VFD). The level control set point is the target elevation differential between the control well groundwater elevation and the Willamette River elevation. The VFD speed is linked to the set-point differential at each control well. As the groundwater elevation at the control well responds to river tidal fluctuations, the PLC will direct the VFD to increase the well pump speed and flow rate to achieve the set-point differential. Once the set point is reached, the PLC will direct the VFD to raise or lower the pump speed to maintain the set point differential.

For example, extraction well PW-6U has a flow control setting of 5 gpm and a level control set point of 0.15 foot at control well MW-26U. This means that well PW-6U is set to pump at a minimum base flow of 5 gpm. The 0.15-foot set point is measured by comparing the groundwater elevation at control well MW-26U with the river water elevation. To reach the 0.15 set point, the groundwater elevation at the control well would be 0.15 foot lower than the river elevation. The well will pump at least 5 gpm, even if the groundwater elevation differential reaches the 0.15-foot set point. However, the well flow will increase above 5 gpm if needed to reach the 0.15-foot set-point goal.

The flow control settings for each extraction well and the level control settings for each control well have been established by observing real-time operation of HC&C system performance. These observations have resulted in differing base flow rates for a few extraction wells and different set points for a few control wells. For example, extraction wells PW-9-92 and PW-10Lb have two control wells, one in the Upper Alluvium WBZ and one in the Lower Alluvium WBZ. The base flow of PW9-92 is 60 gpm and the base flow of PW-10Lb is 15 gpm. Both wells are programmed to achieve the 0.3-foot set point in both the Upper and Lower Alluvium WBZ control wells. Even if the set-point goal is reached in one control well, the PLC will direct the extraction well to increase flow to achieve the set point in the second control well.

All the extraction wells have control well set-point goals of 0.15 foot, except for the extraction wells located near the ends of the well network, which have higher set-point goals of at least 0.25 foot. Because wells located at or near the end of the line of extraction wells do not benefit as much from overlapping drawdown from neighboring wells, higher set points at the control wells are needed to achieve hydraulic containment.

4 Operational Monitoring and Alarm Systems

4.1 Routine Real Time Monitoring

As described in Section 3, the PLC controls the extraction system to maintain hydraulic containment. A system operator is continuously on call to monitor HC&C system operation and respond to system alarms. The system operator is trained and authorized to remotely log on to the human-machine interface (HMI) and view the current status of extraction system operations. Personnel are assigned on a rotating basis to be available to respond to HC&C system alarms. In the event of a system alarm, on-duty staff are notified by email and automated phone call, enabling them to respond as needed, including traveling to the Gasco site, if necessary.

Using the remote HMI access, the authorized system operator can operate the system, such as turning wells on or off or adjusting the pump rate of individual wells. Such remote access is needed in the event of an alarm notification or to manage the well system during routine maintenance. Adjustments to the system operational parameters that would result in significant changes to the total pumping rate are closely coordinated with the personnel operating the groundwater treatment system. Responses to system alarms are also coordinated with treatment plant personnel.

Figure 3-1 displays examples of four HMI system screens that are typically used to remotely monitor system operations. Figure 3-1a is the Overview Screen, Figure 3-1b is an example of a Well Control Screen, and Figures 3-1c and 3-1d display the Well Information Screens. The system operator can log on to view these operational screens at any time.

The Overview Screen in Figure 3-1a displays the following real-time information:

- Individual extraction well current pumping rates and the pumping rates averaged every 15 minutes
- Total flow to the NW Natural pretreatment plant and the Siltronic pretreatment plant
- River water elevation for both of the river transducers that are permanently deployed at the Gasco site
- System alarm status
- Predictive tide information for the Willamette River at the Morrison Bridge upstream of the Gasco site

The Well Control Screen in Figure 3-1b displays the following information and allows the system operator to perform the following:

- Turn the well pump on or off at either Flow Control, Level Control, or Level/Base Flow.
- Adjust the control well differential set point for each extraction well.
- Adjust the extraction well pump flow rate.

The Well Information Screens in Figures 3-1c and 3-1d display the following real time information:

- Figure 3-1c displays the water elevations at the extraction wells, the associated control wells, and the difference in elevation between the control well and the river.
- Figure 3-1d displays the water elevation at each extraction well adjacent to the well pump motor elevation.
- Figure 3-1d also displays the water elevation at selected piezometers and monitoring wells of interest that are not control wells.

4.2 Automated System Alarms

The PLC is programmed to issue an alarm to staff when certain system and performance conditions occur. The alarm enacts an email alarm or both an email and a call-out alarm to the specified phone numbers and email addresses. An alarm notification also appears on the remote HMI screen in Figure 3-1a, described in the previous section. Figure 4-1 is a diagram illustrating the function of the alarm systems. Alarm notifications will be sent by the PLC if the following conditions occur:

- **No-Flow Alarm.** This alarm would be triggered if flow ceases from any of the extraction wells while set-point differentials are not met.
- **VFD Fault.** This alarm would be triggered if any of the well pump VFDs stop working.
- **Power Loss.** This alarm would occur in the event of a power loss. This condition would start the facility emergency backup diesel generator.
- **Level Control Alarm.** This alarm would be triggered if the elevation differential between any control well and the Willamette River is less than 0.10 foot. This alarm will trigger again if the elevation differential at the control well is less than 0.05 foot.
- **Fire Alarm.** This alarm would be triggered by smoke detectors placed in each of the three site Connex boxes that house the controls for the HC&C system.
- **Secondary Pipeline Containment.** This alarm would be triggered if liquid is detected in the secondary containment pipelines that carry groundwater from the seven wells that discharge to the Siltronic pretreatment plant.

5 Capture Zone Monitoring

The site-wide MODFLOW groundwater flow model (Anchor QEA 2017) has been calibrated and validated for the purpose of mapping the extent of hydraulic containment of groundwater in the alluvium and evaluating HC&C system performance.

Particle tracking is used to assess hydraulic capture under the average condition for each 3-month period. Each quarterly figure set would include the following three particle track maps:

- Upland Upper Alluvium WBZ
- Upland Lower Alluvium WBZ
- Upland Deep Lower Alluvium WBZ

Particles are released along the upgradient boundary in the model layers that represent each WBZ. The path lines of the particles that terminate in the HC&C pumping wells define the hydraulic capture zone provided by the HC&C system. The average measured river levels, upland groundwater elevations, and HC&C pumping rates for each quarter are used to define the average hydraulic boundary conditions in the model.

6 Fill WBZ Source Control

DEQ identified control of the Fill WBZ groundwater to the river in Segments 1 and 2 as a necessary source control element for Gasco site remediation. The HC&C system does not control the relatively small proportion of groundwater in the Fill WBZ. NW Natural and DEQ agreed to incorporate the Fill WBZ source control into the selected upland remedy and to integrate the Fill WBZ source control system design with the U.S. Environmental Protection Agency's (EPA's) selected in-water remedy for the riverbank area. The *Fill WBZ Trench Design Evaluation Report* (Anchor QEA 2015e) evaluated different technologies and key design elements (e.g., length, alignment) for a Fill WBZ source control system. The results of this technology screening will be considered during assembly of remedial action alternatives for the Upland Feasibility Study (FS), which is currently under development. The sequencing and interfacing of construction elements of the Fill WBZ source control system, the overall upland remedy, and the riverbank/sediments remedy are important implementation issues that will be considered in the Upland FS.

7 DNAPL Monitoring

This section describes the program implemented at the Gasco site to monitor DNAPL from the interim operation and testing phases through current full-time operation of the HC&C system. As outlined in the CDR (Anchor QEA 2012), the DNAPL monitoring program was implemented at DEQ's request to evaluate whether operation of the HC&C system at the Gasco site could potentially mobilize and spread DNAPL from the former effluent management areas on the NW Natural and Siltronic properties. To address DEQ's request, Anchor QEA has implemented a DNAPL monitoring program that includes the following four tasks:

- **Well Monitoring.** The presence of DNAPL and, where applicable, the rate of DNAPL entry are monitored at 74 wells located along the shoreline of the Willamette River. The wells in the DNAPL monitoring program are listed in Table 4.
- **Tar-Specific Green Optical Screening Tool Borings near Extraction Wells.** Tar-Specific Green Optical Screening Tool (TarGOST) borings have been completed on multiple occasions near six extraction wells selected by DEQ with known DNAPL presence in the subsurface to assess possible changes in DNAPL distribution. The locations of the extraction well TarGOST borings are shown in Figure 5-1.
- **TarGOST Monitoring Area Borings.** TarGOST borings have been completed on multiple occasions in three 10- by 10-foot-square TarGOST Monitoring Areas (TMAs) near the edges of known DNAPL boundaries to assess possible changes in DNAPL occurrence in areas that have had no previous historical detections of DNAPL. The locations of the TMAs are shown in Figure 5-1.
- **Oil-Water Separator Monitoring.** The amount of DNAPL pulled into the HC&C system and recovered in the oil-water separators located at the beginning of the groundwater treatment system is monitored, recorded, and removed.

The DNAPL monitoring program was initiated before startup of the HC&C system to characterize baseline conditions before the effects of HC&C system operation. Monitoring the rate of DNAPL entry into wells and the volume of DNAPL removed began in April 2013, 6 months before interim operation of the HC&C system began and continues to the present as modified with DEQ concurrence. Interim operation and testing of the HC&C system began on September 23, 2013 and continued until May 14, 2015. Full-time, full-scale operation of the HC&C system began on May 14, 2015, and continues to the present.

Results of the DNAPL monitoring program are presented in detail in semiannual reports, which are submitted in March and September of each year. The latest DNAPL report was submitted to DEQ in March 2019 (Anchor QEA 2019). As described in Section 7.5, future DNAPL monitoring reports will be submitted as a component of the semiannual performance monitoring plan reports described in this Plan.

7.1 Well Monitoring

Table 4 shows which wells had DNAPL observations during installation, which have had DNAPL accumulations in the well sump, and which of those have had DNAPL removed from the sumps. Of the 74 wells being monitored, measurable DNAPL has been detected in 19 nearshore wells. The 19 wells with detected DNAPL are monitored according to the schedule in Table 4 to measure the DNAPL thickness in each well. DNAPL is removed via dedicated DNAPL pumps from 14 of the 19 wells at the frequency necessary to keep the DNAPL below the top of the well sump. DNAPL has been removed only once from three wells (DW-6U, DW-11U, and PW-11U) for DNAPL testing and characterization; the volume of DNAPL in the well has not approached the well sump capacity to otherwise trigger removal. DNAPL has not been removed from well MW-37U because the thickness of DNAPL has not approached the capacity of the well sump.

The depth intervals of DNAPL detections in the nearshore wells in the DNAPL monitoring program are shown in cross sections in Figures 2-3b and 2-3c.

7.2 Extraction Well TarGOST Borings

Six extraction wells (PW-2L, PW-3U, PW-5U, PW-6U, PW-11U, and PW-14U) were selected for TarGOST boring monitoring due to their location in or near areas with significant DNAPL in the Upper Alluvium WBZ. See Figure 5-1 for the location of the extraction wells and associated TarGOST borings.

Five of the baseline TarGOST borings (except PW-11U) were completed in April 2012, long before start-up of the HC&C system, in order to establish the zones of DNAPL occurrence with depth near the extraction wells. The PW-11U TarGOST boring was completed in August 2013, a month prior to system start-up, during the same event as the completion of the baseline TMA TarGOST borings. DEQ requested to add a sixth extraction well TarGOST boring location at PW-11U in their August 9, 2012 comment letter on the CDR (DEQ 2012).

In agreement with DEQ's request in the August 2012 comments letter on the CDR (DEQ 2012), follow-up TarGOST borings were planned to be completed to the same depth and within a few feet of the baseline borings at the 6-month and 1-year intervals following start-up of the HC&C system. Per verbal agreement with DEQ on October 30, 2013, December 2013 is considered the start-up date in regard to the TarGOST monitoring events. The 6-month TarGOST event was conducted in June 2014. Per verbal agreement with DEQ on November 24, 2014, the 1-year event was cancelled, and future TarGOST monitoring events were scheduled to take place 3 and 12 months after the Phase 2 testing start-up, which began on May 14, 2015. The 3-month TarGOST event was completed in November 2015; the 12-month event was completed in June 2016.

As approved in the October 26, 2017 comment letter from DEQ (DEQ 2017) on the *DNAPL Monitoring Summary Report—2016*, DNAPL monitoring in the vicinity of extraction wells using TarGOST technology has been suspended indefinitely unless future DNAPL monitoring indicates use of the technology is warranted.

7.3 TarGOST Monitoring Area Borings

As specified in the CDR, TMAs are 10- by 10-foot-square areas that have had no previous detections of DNAPL in the subsurface. Three TMAs were established—TMA1, TMA2, and TMA3, shown in Figure 5-1. The TMAs are located near the edge of areas that have had historical detections of DNAPL in the alluvium.

The three TMAs were established in August 2013. In order to establish TMA locations, three TarGOST borings were completed to 150 feet in depth along the edges of a 10-foot-square area. If a detection of tar or DNAPL occurred in the alluvium of any of the borings, the proposed area was rejected, and a new 10-foot-square area was selected as a possible TMA. When three borings with no detections in the alluvium were completed within one 10-foot-square area, that area was retained as a TMA. See Figure 5-1 for locations of the rejected and retained TMA borings.

Per verbal agreement with DEQ on October 30, 2013, December 2013 is considered the start-up date in regard to the TarGOST monitoring events. The 6-month TarGOST TMA event was conducted in June 2014. Per verbal agreement with DEQ on November 24, 2014, the 1-year event was cancelled, and future TarGOST monitoring events were scheduled to take place 3 and 12 months after the Phase 2 testing start-up, which began on May 14, 2015. The 3-month TarGOST event was completed in November 2015; the 12-month event was completed in June 2016.

As approved in the October 26, 2017 comment letter from DEQ (DEQ 2017) on the *DNAPL Monitoring Summary Report—2016*, DNAPL monitoring in the TMAs with TarGOST technology has been suspended indefinitely unless future DNAPL monitoring indicates use of the technology is warranted.

7.4 Monitoring of Oil-Water Separators

Oil-water separators were installed as part of the groundwater treatment system to recover DNAPL collected by the HC&C system. The HC&C system has two oil-water separators. The DNAPL quantity collected in each oil-water separator is observed and recorded during routine groundwater treatment system monitoring. During maintenance, minimal amounts of DNAPL are removed as a slurry of solids (sand and silt), water, and oil.

7.5 Future DNAPL Monitoring Program

As previously described, the wells in the DNAPL monitoring program are subject to varying monitoring frequencies based on the measured rate of DNAPL entry into each well. The frequency of DNAPL monitoring is dependent on the current rate of DNAPL entry into each well and is sometimes modified based on current conditions, in cooperation with DEQ. Table 4 shows the schedule for DNAPL monitoring currently approved by DEQ. Wells in the DNAPL monitoring program that have had no DNAPL detections to date are monitored quarterly. Wells that have had DNAPL entry but slow accumulation of DNAPL in the sump are monitored monthly. Wells with DNAPL entry and frequent accumulation of DNAPL in the sump are monitored weekly. Changes to the DNAPL monitoring program are proposed in the semiannual DNAPL monitoring reports, with the latest proposed schedule provided in the DNAPL monitoring report for July through December 2018 (Anchor QEA 2019). Future DNAPL monitoring reports will be a component of the annual performance monitoring reports described in this Plan.

8 Water Quality Monitoring

8.1 Purpose of Water Quality Monitoring

Groundwater quality trends are monitored at selected wells during operation of the source control system. The groundwater quality data are not part of the source control RAOs and will not be used for assessing whether the source control actions are successful at achieving the RAOs. Therefore, the water quality monitoring plan is not intended to be used to judge the success of the source control action but rather to measure water quality changes that occur during operation of the extraction well system for informational purposes.

8.2 Wells and Schedule

At the request of DEQ, groundwater monitoring programs conducted for NW Natural and Siltronic have been combined into a single spreadsheet referred to as the Comprehensive Groundwater Framework. This spreadsheet is included as Appendix B and includes groundwater monitoring programs conducted by Hahn and Associates, Inc., Anchor QEA, and Siltronic. The Comprehensive Groundwater Framework includes a semiannual sampling event in March and an annual sampling event in September of each year. The annual sampling event includes testing of samples from 43 monitoring wells, 7 observation wells, 23 extraction wells, and 19 piezometers installed as part of the source control monitoring network. The semiannual event includes testing of samples from 12 monitoring wells, 2 observation wells, 23 extraction wells, and 19 piezometers. These wells are in addition to the 27 monitoring wells that are sampled by Hahn and Associates annually, and 13 monitoring wells sampled semiannually in the routine monitoring program. The data analysis and reporting plans are described in Section 8.3.

8.3 Target Analytes

The target analyte list for all wells in the integrated monitoring program listed in the Comprehensive Groundwater Framework in Appendix B includes the following constituents:

- EPA Method 8260 for volatile organic compounds (VOCs)
- EPA Method 8260 Selective Ion Monitoring (SIM) for VOCs
- EPA Method 8270 SIM for polycyclic aromatic hydrocarbons (PAHs) and 1-methylnaphthalene, 2-methylnaphthalene, dibenzofuran, and carbazole
- EPA Method 335.4 for total cyanide
- EPA Method OIA-1677 for available cyanide
- EPA Method D-4282 for free cyanide
- EPA Method 6000 Series for total metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc)

The following analytes (River Parameters) are collected from the extraction wells:

- EPA Method 6000 series for total metals (calcium, potassium, sodium, and magnesium)
- EPA Method 6000 series for dissolved metals (iron and magnesium)
- EPA Method 300.0 for anions (sulfate, chloride, and nitrate)
- Standard Method 2320B for alkalinity (carbonate and bicarbonate)

The following analytes are additionally collected at extraction well PW-1L:

- EPA Method 8081B for pesticides
- EPA Method 8151A for herbicides

A subset of well samples indicated in the comprehensive framework will be analyzed for the following total petroleum hydrocarbons (TPHs) and TPH fractions:

- Gasoline-range total petroleum hydrocarbons (TPH-Gx)
- Diesel-range total petroleum hydrocarbons (TPH-Dx)
- Volatile petroleum hydrocarbons (VPH)
- Extractable petroleum hydrocarbons (EPH)

In addition, field measurements are collected at each well to be sampled, including dissolved oxygen, pH, specific conductance, turbidity, temperature, and oxidation reduction potential.

Also, as requested by DEQ, a subset of 12 piezometers (PZ2-5, PZ2-20, PZ2-43, PZ2-77, PZ7-5, PZ7-50, PZ7-100, PZ8-5, PZ8-50, PZ9-5, PZ9-50, and PZ9-75) installed along the shoreline and in the Willamette River are equipped with transducers that also record specific conductance and temperature. These data are collected at the same frequency as water level data (15-minute intervals).

The field sampling procedures, sample handling protocols, analyte testing, and QA/QC procedures are described in detail in the SAP, which is available in Appendix A.

9 Reporting

The overall plan for source control performance monitoring is to provide two deliverables to DEQ each year, including one 6-month data package and one annual report. As described in this section, the semiannual reports will cover five primary components of the program: 1) capture zone monitoring; 2) operational figures; 3) maintenance records; 4) water quality monitoring; and 5) DNAPL monitoring.

9.1 Capture Zone Monitoring

Section 5 describes the capture zone monitoring program. The capture zone monitoring output includes the following:

- Quarterly Particle Track Capture maps for the Upper Alluvium, Lower Alluvium, and Deep Lower Alluvium WBZs
- Quarterly Particle Track Capture maps for the offshore area
- Quarterly Particle Track Capture vertical profiles for the Upper, Lower, and Deep Lower Alluvium WBZs

9.2 HC&C Operational Figures

DEQ has been provided with detailed HC&C operational figures since 2015. In 2018 semiannual figure sets were provided for January through June and July through December. Consistent with the previous reports, the following list of operational figures will be included in the semiannual and annual performance monitoring reports:

- Figures 1.1 to 1.5 – Locations of the monitoring wells
- Figures 2.1 to 2.4 – Map of the Groundwater Extraction and Treatment System
- Figures 3.1 to 3.2 – Potentiometric surface contours
- Figures 3.3 to 3.4 – Contours of water elevation differences between wells and the river
- Figures 4.1 to 4.84 – Plots of water elevation differences between wells and the river
- Figures 5.1 to 5.31 – Plots of water elevation differences between select well pairs
- Figures 6.1 to 6.2 – Contours of water elevation differences between Upper and Lower Alluvium WBZ wells
- Figures 7.1 to 7.10 – Plots of water elevation differences between select well pairs and the river
- Figure 8.1 to 8.28 – Plots of individual and combined extraction well pumping rates

9.3 Extraction System Maintenance Record

Extraction system maintenance records are included in the annual report and provide the following information:

- Summary of maintenance items relevant to system performance, such as well pump repair, well screen treatment, well redevelopment, well replacement, and PLC programming changes
- Updated total volume of groundwater treated and discharged

9.4 Groundwater Quality

The water quality data are presented in an Excel database file that includes historical groundwater monitoring data, updated with the new data. The groundwater quality summary reports provide the following information:

- Summary data tables of the laboratory testing results
- Concentration trend graphs for all wells sampled for key indicator contaminants of interest, including benzo-a-pyrene, naphthalene, benzene, total cyanide, and free cyanide
- Data validation summary

9.5 DNAPL

The reports include the following DNAPL data:

- Trends in DNAPL well entry and removal rates
- Graphs of cumulative volumes of DNAPL removed from each well
- Graphs of DNAPL entry and removal rates from each well
- Graphs of monthly DNAPL accumulation and removal volumes from each well
- New TarGOST sampling logs, if new borings have been completed since the last report

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Tables

Table 1
Well Construction Details

Well Number	Water-Bearing Zone	Date Installed	Installation Method	Monument Type	Screen Type	Slot Size (inches)	Sand Pack (Colorado)	Well Diameter (inches)	Ground Surface (feet COP)	Top of Casing (feet COP)	Top of Casing (feet bgs)	Pump Inlet (feet bgs)	Pump Inlet (feet COP)	Top Screen (feet bgs)	Top Screen (feet COP)	Base Screen (feet bgs)	Base Screen (feet COP)	Well Depth[1] (feet bgs)	Well Depth[1] (feet COP)
Existing Monitoring Wells																			
MW-1-22	Surficial Fill	24-Oct-95	Hollow-Stem Auger	Above-grade	Slotted PVC	0.020	10-20	2	32.0	34.75	(2.7)	NA	NA	11.0	21.0	21.0	11.0	22.0	10.0
MW-1-55	Alluvial	10-Jul-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	33.1	35.64	(2.5)	NA	NA	45.0	-11.9	55.0	-21.9	57.0	-23.9
MW-1-82	Alluvial	9-Jul-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	33.5	35.95	(2.5)	NA	NA	72.0	-38.5	82.0	-48.5	84.0	-50.5
MW-2-32	Surficial Fill	6-Nov-95	Hollow-Stem Auger	Flush	Slotted PVC	0.020	10-20	2	34.8	34.41	0.4	NA	NA	21.5	13.3	31.5	3.3	32.5	2.3
MW-2-61	Alluvial	8-Oct-98	Hollow-Stem Auger	Flush	Slotted PVC	0.020	10-20	2	34.7	34.33	0.4	NA	NA	50.0	-15.3	60.0	-25.3	61.5	-26.8
MW-2-104	Alluvial	25-Jun-07	Sonic	Flush	Continuous wrap stainless steel	0.020	10-20	2	34.9	34.80	0.1	NA	NA	94.0	-59.1	104.0	-69.1	106.0	-71.1
MW-3-26	Surficial Fill	2-Nov-95	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.2	34.04	(2.8)	NA	NA	15.0	16.2	25.0	6.2	26.0	5.2
MW-3-56	Alluvial	1-Nov-95	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.2	34.02	(2.8)	NA	NA	45.0	-13.8	55.0	-23.8	56.0	-24.8
MW-4-35	Surficial Fill/Alluvial	31-Oct-95	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.7	34.44	(2.7)	NA	NA	24.0	7.7	34.0	-2.3	35.0	-3.3
MW-4-57	Alluvial	30-Oct-95	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.7	34.48	(2.8)	NA	NA	46.0	-14.3	56.0	-24.3	57.0	-25.3
MW-4-101	Alluvial	16-Oct-98	Dual Wall Reverse Air	Above-grade	Slotted PVC (pre-pack)	0.010	20-40	2	31.8	34.26	(2.5)	NA	NA	89.5	-57.7	99.5	-67.7	101.0	-69.2
MW-5-32	Surficial Fill/Alluvial	27-Oct-95	Hollow-Stem Auger	Above-grade	Slotted PVC	0.020	10-20	2	25.1	27.72	(2.6)	NA	NA	21.0	4.1	31.0	-5.9	32.0	-6.9
MW-5-100	Alluvial	23-Oct-98	Dual Wall Reverse Air	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	25.4	27.27	(1.9)	NA	NA	88.0	-62.6	98.0	-72.6	100.0	-74.6
MW-5-175	Alluvial	22-Oct-98	Dual Wall Reverse Air	Above-grade	Slotted PVC (pre-pack)	0.010	20-40	2	25.2	27.12	(1.9)	NA	NA	163.0	-137.8	173.0	-147.8	175.0	-149.8
MW-16-45	Alluvial	20-Jul-04	Sonic	Above-grade	Slotted stainless steel	0.010	10-20	2	30.8	33.10	(2.3)	NA	NA	30.0	0.8	45.0	-14.2	47.5	-16.7
MW-16-65	Alluvial	19-Jul-04	Sonic	Above-grade	Slotted stainless steel	0.010	10-20	2	30.6	33.13	(2.5)	NA	NA	55.0	-24.4	65.0	-34.4	67.5	-36.9
MW-18-30	Surficial Fill	27-Feb-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.7	34.18	(2.5)	NA	NA	19.0	12.7	29.0	2.7	30.0	1.7
MW-18-125	Alluvial	22-Apr-10	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.9	34.57	(2.6)	NA	NA	115.0	-83.1	125.0	-93.1	126.0	-94.1
MW-18-180	Alluvial	26-Feb-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.7	33.81	(2.1)	NA	NA	170.0	-138.3	180.0	-148.3	181.0	-149.3

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Well Number	Water-Bearing Zone	Date Installed	Installation Method	Monument Type	Screen Type	Slot Size (inches)	Sand Pack (Colorado)	Well Diameter (inches)	Ground Surface (feet COP)	Top of Casing (feet COP)	Top of Casing (feet bgs)	Pump Inlet (feet bgs)	Pump Inlet (feet COP)	Top Screen (feet bgs)	Top Screen (feet COP)	Base Screen (feet bgs)	Base Screen (feet COP)	Well Depth[1] (feet bgs)	Well Depth[1] (feet COP)
MW-19-22	Surficial Fill	6-Mar-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	27.4	29.72	(2.3)	NA	NA	12.0	15.4	22.0	5.4	23.0	4.4
MW-19-125	Alluvial	12-Mar-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	27.2	29.33	(2.1)	NA	NA	115.0	-87.8	125.0	-97.8	126.0	-98.8
MW-19-180	Alluvial	2-Mar-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	27.3	29.73	(2.4)	NA	NA	170.0	-142.7	180.0	-152.7	181.0	-153.7
MW-20-120	Alluvial	8-Mar-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	25.6	27.69	(2.1)	NA	NA	110.0	-84.4	120.0	-94.4	121.0	-95.4
MW-21-12	Surficial Fill	6-Jul-07	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	20.3	23.16	(2.8)	NA	NA	7.0	13.3	12.0	8.3	14.0	6.3
MW-21U	Alluvial	24-Sep-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	20.5	22.38	(1.9)	NA	NA	25.0	-4.5	35.0	-14.5	38.0	-17.5
MW-21-75	Alluvial	5-Jul-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	20.4	23.03	(2.6)	NA	NA	65.0	-44.6	75.0	-54.6	77.0	-56.6
MW-21-115	Alluvial	2-Jul-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	20.5	23.35	(2.8)	NA	NA	105.0	-84.5	115.0	-94.5	117.0	-96.5
MW-21-165	Alluvial	28-Jun-07	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	20.5	23.06	(2.6)	NA	NA	156.0	-135.5	166.0	-145.5	168.0	-147.5
MW-22U	Alluvial	20-Sep-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	33.5	36.37	(2.9)	NA	NA	45.0	-11.5	55.0	-21.5	58.0	-24.5
MW-22-80	Alluvial	28-Jan-10	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	33.6	35.89	(2.3)	NA	NA	69.9	-36.3	79.9	-46.3	80.9	-47.3
MW-23-27	Surficial Fill	16-Feb-10	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	32.8	34.63	(1.9)	NA	NA	17.7	15.1	27.7	5.1	28.0	4.8
MW-23U	Alluvial	24-Sep-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.9	35.51	(2.6)	NA	NA	40.0	-7.1	50.0	-17.1	53.0	-20.1
MW-23-75	Alluvial	16-Feb-10	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	32.9	34.78	(1.9)	NA	NA	64.7	-31.8	74.7	-41.8	75.7	-42.8
MW-23-123	Alluvial	5-Feb-10	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	32.9	34.96	(2.1)	NA	NA	113.3	-80.4	123.3	-90.4	124.3	-91.4
MW-24-70	Alluvial	3-Feb-10	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	31.4	33.74	(2.3)	NA	NA	60.1	-28.7	70.1	-38.7	71.1	-39.7
MW-24-130	Alluvial	2-Feb-10	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	31.3	33.66	(2.3)	NA	NA	120.1	-88.8	130.1	-98.8	131.1	-99.8
MW-25L	Alluvial	19-Sep-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.3	34.12	(2.8)	NA	NA	54.0	-22.7	64.0	-32.7	67.0	-35.7
MW-26U	Alluvial	25-Sep-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.4	33.93	(2.5)	NA	NA	38.5	-7.1	48.5	-17.1	51.7	-20.3
MW-27U	Alluvial	20-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.9	34.18	(2.3)	NA	NA	66.1	-34.2	76.1	-44.2	79.1	-47.2
MW-27L	Alluvial	16-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.9	34.16	(2.3)	NA	NA	106.0	-74.1	116.0	-84.1	119.0	-87.1
MW-28U	Alluvial	5-Oct-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.0	34.73	(2.7)	NA	NA	75.0	-43.0	85.0	-53.0	88.0	-56.0
MW-28L	Alluvial	4-Oct-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.4	34.87	(2.5)	NA	NA	109.8	-77.4	119.8	-87.4	122.8	-90.4

Table 1
Well Construction Details

Well Number	Water-Bearing Zone	Date Installed	Installation Method	Monument Type	Screen Type	Slot Size (inches)	Sand Pack (Colorado)	Well Diameter (inches)	Ground Surface (feet COP)	Top of Casing (feet COP)	Top of Casing (feet bgs)	Pump Inlet (feet bgs)	Pump Inlet (feet COP)	Top Screen (feet bgs)	Top Screen (feet COP)	Base Screen (feet bgs)	Base Screen (feet COP)	Well Depth[1] (feet bgs)	Well Depth[1] (feet COP)
MW-29U	Alluvial	27-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.0	34.84	(2.8)	NA	NA	46.0	-14.0	56.0	-24.0	59.0	-27.0
MW-30U	Alluvial	14-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	27.4	30.46	(3.1)	NA	NA	40.1	-12.7	50.1	-22.7	53.1	-25.7
MW-31U	Alluvial	28-Sep-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	25.8	28.37	(2.6)	NA	NA	84.9	-59.1	94.9	-69.1	97.9	-72.1
MW-31L	Alluvial	27-Sep-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	26.0	28.53	(2.5)	NA	NA	105.0	-79.0	115.0	-89.0	118.0	-92.0
MW-32U	Alluvial	6-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	25.8	28.48	(2.7)	NA	NA	39.9	-14.1	49.9	-24.1	52.9	-27.1
MW-33U	Alluvial	5-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	24.8	27.66	(2.9)	NA	NA	38.0	-13.2	48.0	-23.2	51.0	-26.2
MW-34U	Alluvial	12-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	24.2	26.81	(2.6)	NA	NA	63.3	-39.1	73.3	-49.1	76.3	-52.1
MW-34L	Alluvial	8-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	24.1	26.91	(2.8)	NA	NA	99.0	-74.9	109.0	-84.9	112.0	-87.9
MW-35U	Alluvial	28-Sep-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	33.9	36.45	(2.6)	NA	NA	54.0	-20.1	64.0	-30.1	67.0	-33.1
MW-36U	Alluvial	27-Sep-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	35.1	37.93	(2.8)	NA	NA	44.0	-8.9	54.0	-18.9	57.0	-21.9
MW-37U	Alluvial	21-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.3	34.90	(2.6)	NA	NA	40.1	-7.8	50.1	-17.8	53.1	-20.8
MW-38U	Alluvial	28-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.8	34.74	(2.9)	NA	NA	50.1	-18.3	60.1	-28.3	63.1	-31.3
MW-39F	Surficial Fill	17-Nov-14	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	31.1	34.25	(3.2)	NA	NA	11.8	19.3	16.8	14.3	17.1	14.0
MW-40F	Surficial Fill	18-Nov-14	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	36.0	39.25	(3.3)	NA	NA	21.6	14.4	26.6	9.4	27.1	8.9
MW-41U	Alluvial	16-Jan-15	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	37.6	40.69	(3.1)	NA	NA	17.6	20.0	27.6	10.0	28.0	9.6
MW-42F	Surficial Fill	21-Nov-14	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	33.5	36.84	(3.4)	NA	NA	26.0	7.5	31.0	2.5	31.4	2.1
MW-43F	Surficial Fill	8-Aug-17	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	37.5	37.05	0.5	NA	NA	7.0	30.5	17.0	20.5	18.0	19.5
MW-44F	Surficial Fill	9-Aug-17	Sonic	Above-grade	Continuous wrap stainless steel	0.010	10-20	2	35.8	38.86	(3.1)	NA	NA	6.0	29.8	16.0	19.8	17.0	18.8
MW-45F	Surficial Fill	8-Aug-17	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	34.9	34.84	0.1	NA	NA	7.0	27.9	17.0	17.9	18.0	16.9
MW-46F	Surficial Fill	1-May-18	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	35.5	37.94	(2.4)	NA	NA	6.1	29.4	16.1	19.4	17.1	18.4
MW-47F	Surficial Fill	30-Apr-18	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	34.6	37.54	(2.9)	NA	NA	22.0	12.6	32.0	2.6	33.0	1.6
MW-48F	Surficial Fill	1-May-18	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	35.2	38.05	(2.8)	NA	NA	15.6	19.6	25.6	9.6	26.6	8.6

Table 1
Well Construction Details

Well Number	Water-Bearing Zone	Date Installed	Installation Method	Monument Type	Screen Type	Slot Size (inches)	Sand Pack (Colorado)	Well Diameter (inches)	Ground Surface (feet COP)	Top of Casing (feet COP)	Top of Casing (feet bgs)	Pump Inlet (feet bgs)	Pump Inlet (feet COP)	Top Screen (feet bgs)	Top Screen (feet COP)	Base Screen (feet bgs)	Base Screen (feet COP)	Well Depth[1] (feet bgs)	Well Depth[1] (feet COP)
MW-49F	Surficial Fill	1-May-18	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	35.8	38.57	(2.8)	NA	NA	19.0	16.8	29.0	6.8	30.0	5.8
MW-PW2L[2]	Alluvial	17-Jan-14	Sonic	Above-grade	Continuous wrap stainless steel	0.010	10-20	2	34.0	35.92	(1.9)	NA	NA	119.8	-85.8	139.8	-105.8	145.4	-111.4
MW-PW10L[2]	Alluvial	30-Sep-13	Sonic	Above-grade	Continuous wrap stainless steel	0.010	10-20	2	31.6	34.04	(2.4)	NA	NA	60.2	-28.6	80.2	-48.6	85.2	-53.6
PW-1-80	Alluvial	9-Aug-05	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	6	32.0	34.07	(2.1)	NA	NA	39.5	-7.5	79.5	-47.5	82.0	-50.0
PW-3-85	Alluvial	20-Jun-07	Cable Tool	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	25.2	26.72	(1.5)	NA	NA	75.0	-49.8	85.0	-59.8	95.0	-69.8
WS-12-125	Alluvial	21-Sep-03	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	34.5	34.04	0.5	NA	NA	109.0	-74.5	124.0	-89.5	125.0	-90.5
WS-12-161	Alluvial	21-Sep-03	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	34.5	34.13	0.4	NA	NA	145.0	-110.5	160.0	-125.5	161.0	-126.5
WS-21-112	Alluvial	13-Jun-06	Sonic	Flush	Slotted PVC	0.010	10-20	2	35.4	34.69	0.7	NA	NA	101.0	-65.6	111.0	-75.6	112.0	-76.6
WS-26-86	Alluvial	29-Oct-08	Sonic	Flush	NA	0.010	10-20	2	34.9	34.43	0.5	NA	NA	75.0	-40.1	85.0	-50.1	86.0	-51.1
WS-47-183	Alluvial	16-Apr-15	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	34.0	33.75	0.3	NA	NA	172.0	-138.0	182.0	-148.0	183.0	-149.0
Existing Observation Wells																			
OW-1F	Surficial Fill	23-Mar-12	Sonic	Above-grade	Slotted PVC	0.010	10-20	2	35.3	37.60	(2.3)	NA	NA	30.0	5.3	35.0	0.3	35.3	0.0
OW-2F	Surficial Fill	22-Mar-12	Sonic	Above-grade	Slotted PVC	0.010	10-20	2	34.5	36.86	(2.4)	NA	NA	25.6	8.9	30.6	3.9	30.9	3.6
OW-5F	Surficial Fill	29-Nov-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	32.2	34.70	(2.5)	NA	NA	28.5	3.7	33.5	-1.3	33.8	-1.6
OW-7-17	Surficial Fill	23-Feb-10	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	24.2	26.42	(2.2)	NA	NA	12.5	11.7	17.5	6.7	17.7	6.5
OW-8-15	Surficial Fill	12-Feb-10	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	24.6	26.31	(1.8)	NA	NA	10.1	14.5	15.1	9.5	15.3	9.3
OW-8-28	Alluvial	13-Aug-10	Hollow-Stem Auger	Above-grade	Slotted PVC	0.020	10-20	2	23.8	26.27	(2.5)	NA	NA	23.1	0.7	28.1	-4.3	28.7	-4.9
OW-9-25	Surficial Fill	8-Mar-10	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	33.1	35.29	(2.2)	NA	NA	20.0	13.1	25.0	8.1	25.3	7.8
OW-10F	Surficial Fill	20-Sep-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	30.8	33.75	(3.0)	NA	NA	20.7	10.1	25.7	5.1	26.0	4.8
Existing Extraction Wells																			
PW-1U	Alluvial	9-Jan-13	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	35.0	37.50	(2.5)	54.0	-19.0	55.1	-20.1	70.1	-35.1	75.1	-40.1
PW-1Ub	Alluvial	17-Feb-16	Cable Tool	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	34.7	37.32	(2.6)	64.4	-29.7	64.8	-30.1	79.8	-45.1	84.3	-49.6
PW-1L	Alluvial	8-Jan-13	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	34.9	37.32	(2.4)	111.6	-76.7	114.8	-79.9	134.8	-99.9	139.6	-104.7
PW-2U	Alluvial	25-Apr-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	34.5	36.70	(2.2)	57.8	-23.3	57.8	-23.3	72.8	-38.3	77.8	-43.3

Table 1
Well Construction Details

Well Number	Water-Bearing Zone	Date Installed	Installation Method	Monument Type	Screen Type	Slot Size	Sand Pack	Well Diameter	Ground Surface	Top of Casing		Pump Inlet		Top Screen		Base Screen		Well Depth[1]	
						(inches)	(Colorado)	(inches)	(feet COP)	(feet COP)	(feet bgs)	(feet bgs)	(feet COP)	(feet bgs)	(feet COP)	(feet bgs)	(feet COP)	(feet bgs)	(feet COP)
PW-2L	Alluvial	6-Feb-13	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	34.5	37.14	(2.6)	116.4	-81.9	120.1	-85.6	140.1	-105.6	145.1	-110.6
PW-3U	Alluvial	11-Apr-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	25.6	27.52	(1.9)	43.8	-18.2	42.8	-17.2	57.8	-32.2	62.8	-37.2
PW-3-118	Alluvial	13-Jun-07	Cable Tool	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	25.5	27.01	(1.5)	106.5	-81.0	108.0	-82.5	118.0	-92.5	128.0	-102.5
PW-4U	Alluvial	16-Jan-13	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	28.3	31.01	(2.7)	45.8	-17.5	47.2	-18.9	62.2	-33.9	67.2	-38.9
PW-4L	Alluvial	10-Jan-13	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	28.2	30.27	(2.1)	99.4	-71.2	105.4	-77.2	125.4	-97.2	130.4	-102.2
PW-5U	Alluvial	20-Apr-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	32.5	34.82	(2.3)	49.7	-17.2	49.9	-17.4	64.9	-32.4	69.9	-37.4
PW-5L	Alluvial	23-Jan-13	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	32.3	34.19	(1.9)	102.6	-70.3	105.7	-73.4	125.7	-93.4	130.7	-98.4
PW-6U	Alluvial	17-Apr-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	31.5	33.93	(2.4)	50.6	-19.1	49.4	-17.9	64.4	-32.9	69.4	-37.9
PW-6L	Alluvial	6-Nov-12	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	31.0	33.32	(2.3)	99.7	-68.7	103.7	-72.7	123.7	-92.7	128.7	-97.7
PW-7-93	Alluvial	22-Feb-10	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	24.2	26.81	(2.6)	69.4	-45.2	73.5	-49.3	93.5	-69.3	95.5	-71.3
PW-8-39	Alluvial	13-Aug-10	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	23.2	25.75	(2.5)	23.5	-0.3	24.2	-1.0	39.2	-16.0	42.2	-19.0
PW-8-68	Alluvial	11-Feb-10	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	24.6	27.18	(2.5)	45.0	-20.4	48.0	-23.4	68.0	-43.4	70.0	-45.4
PW-9-92	Alluvial	1-Mar-10	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	33.0	35.84	(2.8)	69.7	-36.7	72.6	-39.6	92.6	-59.6	94.6	-61.6
PW-10U	Alluvial	6-Apr-17	Cable Tool	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	32.9	35.41	(2.5)	35.0	-5.3	40.0	-7.1	55.4	-22.5	60.0	-27.1
PW-10Lb	Alluvial	23-Oct-18	Cable Tool	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	32.2	34.78	(2.6)	73.0	-40.8	76.0	-43.8	93.0	-60.8	101.0	-68.8
PW-11U	Alluvial	26-Jan-13	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	24.0	26.78	(2.7)	48.3	-24.3	49.8	-25.8	64.8	-40.8	69.8	-45.8
PW-12U	Alluvial	21-Dec-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	26.2	28.58	(2.4)	46.6	-20.4	47.8	-21.6	62.8	-36.6	67.8	-41.6
PW-13U	Alluvial	28-Dec-12	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	32.2	34.60	(2.4)	58.9	-26.7	57.6	-25.4	72.6	-40.4	77.6	-45.4
PW-14U	Alluvial	14-Jan-13	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	31.9	34.68	(2.7)	55.8	-23.9	57.8	-25.9	67.8	-35.9	72.8	-40.9
PW-15U	Alluvial	3-Sep-14	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	24.5	27.01	(2.5)	49.5	-25.0	35.1	-10.6	55.1	-30.6	60.1	-35.6

Table 1
Well Construction Details

Well Number	Water-Bearing Zone	Date Installed	Installation Method	Monument Type	Screen Type	Slot Size (inches)	Sand Pack (Colorado)	Well Diameter (inches)	Ground Surface (feet COP)	Top of Casing (feet COP)	Top of Casing (feet bgs)	Pump Inlet (feet bgs)	Pump Inlet (feet COP)	Top Screen (feet bgs)	Top Screen (feet COP)	Base Screen (feet bgs)	Base Screen (feet COP)	Well Depth[1] (feet bgs)	Well Depth[1] (feet COP)
PW-16U	Alluvial	28-Aug-14	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	26.1	28.13	(2.0)	42.5	-16.4	30.4	-4.3	50.4	-24.3	55.4	-29.3
Existing DNAPL Wells																			
DW-6U	Alluvial	27-Dec-13	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	31.4	34.22	(2.8)	NA	NA	36.3	-4.9	48.3	-16.9	53.3	-21.9
DW-11U	Alluvial	18-Dec-13	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	24.6	27.69	(3.1)	NA	NA	21.7	2.9	33.7	-9.1	38.7	-14.1
DW-14U	Alluvial	20-Dec-13	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	31.8	34.75	(3.0)	NA	NA	31.8	0.0	46.8	-15.0	51.8	-20.0
Existing Piezometers																			
Koppers Basin Piezo	NA		Manual	Above-grade	Solinst push point	NA	NA	1	36.2	37.16	(1.0)	NA	NA		36.2		36.2		36.2
PZ1-5	Surficial Fill	18-Mar-09	Manual	Above-grade	Solinst push point	NA	NA	1	10.0	35.82	(25.9)	NA	NA	4.5	5.5	5.4	4.6	5.6	4.3
PZ1-20	Alluvial	18-Mar-09	Manual	Above-grade	Solinst push point	NA	NA	1	10.2	36.34	(26.2)	NA	NA	19.3	-9.2	20.2	-10.1	20.5	-10.3
PZ1-50	Alluvial	23-Nov-09	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.2	37.58	(27.4)	NA	NA	45.1	-34.9	50.1	-39.9	50.4	-40.2
PZ2-5	Surficial Fill	19-Mar-05	Manual	Above-grade	Solinst push point	NA	NA	1	2.9	37.83	(34.9)	NA	NA	5.5	-2.6	6.4	-3.5	6.7	-3.8
PZ2-20	Alluvial	18-Mar-09	Manual	Above-grade	Solinst push point	NA	NA	1	3.4	37.81	(34.4)	NA	NA	20.6	-17.2	21.5	-18.1	21.7	-18.4
PZ2-43	Alluvial	3-Dec-09	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	3.8	37.87	(34.1)	NA	NA	38.3	-34.5	43.3	-39.5	43.6	-39.8
PZ2-77	Alluvial	2-Dec-09	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	3.1	38.55	(35.5)	NA	NA	71.9	-68.9	76.9	-73.9	77.2	-74.2
PZ4-12	Alluvial	4-Dec-09	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	-8.6	34.59	(43.2)	NA	NA	6.7	-15.3	11.7	-20.3	12.0	-20.6
PZ4-41	Alluvial	24-Nov-09	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	-8.3	34.48	(42.8)	NA	NA	36.1	-44.4	41.1	-49.4	41.4	-49.7
PZ5-5	Surficial Fill	20-Nov-09	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.7	16.46	(5.7)	NA	NA	3.8	6.9	4.8	5.9	5.0	5.7
PZ5-20	Alluvial	20-Nov-09	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.8	16.20	(5.4)	NA	NA	15.0	-4.2	20.0	-9.2	20.3	-9.5
PZ5-55	Alluvial	20-Nov-09	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.9	16.25	(5.4)	NA	NA	50.0	-39.1	55.0	-44.1	55.3	-44.4
PZ5-85	Alluvial	19-Nov-09	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.9	16.38	(5.5)	NA	NA	79.9	-69.0	84.9	-74.0	85.2	-74.3
PZ6-5	Surficial Fill	17-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	7.8	14.72	(6.9)	NA	NA	3.9	3.9	4.9	2.9	5.0	2.8
PZ6-50	Alluvial	17-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	8.1	14.88	(6.8)	NA	NA	45.2	-37.1	50.2	-42.1	50.5	-42.4
PZ6-115	Alluvial	18-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	7.4	13.79	(6.3)	NA	NA	110.1	-102.7	115.1	-107.7	115.4	-108.0
PZ6-150	Alluvial	26-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	7.7	14.15	(6.4)	NA	NA	145.4	-137.7	150.4	-142.7	150.7	-143.0
PZ7-5	Surficial Fill	22-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.6	16.36	(5.8)	NA	NA	4.1	6.5	5.2	5.4	5.3	5.3
PZ7-50	Alluvial	19-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.7	16.40	(5.7)	NA	NA	43.2	-32.5	48.2	-37.5	48.5	-37.8
PZ7-100	Alluvial	23-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	9.9	16.13	(6.2)	NA	NA	94.3	-84.4	99.3	-89.4	99.6	-89.7
PZ7-150	Alluvial	31-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.0	15.50	(5.5)	NA	NA	145.3	-135.3	150.3	-140.3	150.6	-140.6
PZ8-5	Surficial Fill	9-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	6.8	12.21	(5.4)	NA	NA	4.5	2.3	5.4	1.4	5.5	1.3
PZ8-50	Alluvial	9-Oct-12	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	6.9	12.45	(5.5)	NA	NA	44.7	-37.8	49.7	-42.8	50.0	-43.1

Table 1
Well Construction Details

Well Number	Water-Bearing Zone	Date Installed	Installation Method	Monument Type	Screen Type	Slot Size (inches)	Sand Pack (Colorado)	Well Diameter (inches)	Ground Surface (feet COP)	Top of Casing (feet COP)	Top of Casing (feet bgs)	Pump Inlet (feet bgs)	Pump Inlet (feet COP)	Top Screen (feet bgs)	Top Screen (feet COP)	Base Screen (feet bgs)	Base Screen (feet COP)	Well Depth[1] (feet bgs)	Well Depth[1] (feet COP)
PZ9-5	Surficial Fill	4-Apr-14	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	6.1	12.09	(6.0)	NA	NA	4.5	1.6	5.5	0.6	5.7	0.4
PZ9-50	Alluvial	7-Apr-14	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	4.7	11.62	(6.9)	NA	NA	45.4	-40.7	50.4	-45.7	50.7	-46.0
PZ9-75	Alluvial	10-Apr-14	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	5.0	11.57	(6.6)	NA	NA	67.5	-62.5	72.5	-67.5	72.8	-67.8
PZ9-110	Alluvial	9-Apr-14	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	5.1	12.19	(7.1)	NA	NA	105.6	-100.5	110.6	-105.5	110.8	-105.7
PZ9-150	Alluvial	3-Apr-14	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	6.0	11.73	(5.7)	NA	NA	146.1	-140.1	151.1	-145.1	151.4	-145.4
River 1 (upstream)	Willamette R	23-May-13	Manual	NA	NA	NA	NA	2	-8.6	34.41	(43.0)	NA	NA	NA	NA	NA	NA	NA	NA
River 2 (downstream)	Willamette R	23-May-13	Manual	NA	NA	NA	NA	2	-8.6	34.39	(43.0)	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1. Actual completion depths may differ depending on actual lithology encountered during drilling.
2. 2-inch PVC monitoring well installed inside a pre-existing 6-inch well
bgs: below ground surface
COP: City of Portland datum
DNAPL: dense nonaqueous phase liquid
NA: not applicable
PVC: polyvinyl chloride

Table 2
General Operational Parameters

Siltronic/MGP-TCE			
Well Identification	**Flow Control (gpm)**	**Level Control (feet)**	**Control Well**
PW-1U	5.0	0.30	WS-26-86
PW1Ub	5.0	0.30	WS-26-86
PW-1L	7.0	0.25	WS-12-125
PW-2U	5.0	0.15	MW-36U
PW-2L	10.0	0.30	WS-21-112
PW-11U	2.0	0.15	MW-35U
PW-3U	3.0	0.15	MW-33U
PW-3L	10.0	0.15	MW-34L

NW Natural/MGP-only			
Well Identification	**Flow Control (gpm)**	**Level Control (feet)**	**Control Well**
PW-12U	3.0	0.15	MW-32U
PW-4U	2.0	0.15	MW-30U
PW-4L	10.0	0.15	MW-31L
PW-13U	5.0	0.15	MW-29U
PW-5U	3.0	0.15	MW-38U
PW-5L	10.0	0.15	MW-28L
PW-14U	5.0	0.15	MW-37U
PW-6U	5.0	0.15	MW-26U
PW-6L	10.0	0.15	MW-27L
PW-7-93	10.0	0.15	MW-24-130
PW-15U	5.0	0.15	MW-21U
PW-8-39	1.0	NA	NA
PW-8-68	8.0	0.15	MW-21-75
PW-16U	3.0	0.15	MW-21U
PW-9-92	60.0	0.30	MW-23U and MW-23-75
PW-10U	5.0	0.15	MW-22U
PW-10Lb	15.0	0.30	MW-22U and MW-22-80

Notes:
gpm: gallons per minute
MGP: manufactured gas plant
NA: not applicable
TCE: trichloroethene

Table 3
HC&C System Alarms

Alarm Type	Email	Callout	Error Message
Differential Between Control Well and Willamette River is Less than 0.10 feet	Yes	No	(Extraction Well ID), LT(Control Well ID) Difference Less than 0.1 ft
Differential Between Control Well and Willamette River is Less than 0.05 feet	Yes	No	(Extraction Well ID), LT(Control Well ID) Difference Less than 0.05 ft
Pump Level High	No	No	(WELL ID)_ LEVEL_ALM
VFD/Pump Fault	No	No	(WELL ID) VFD FAULT
Low Flow Trip	Yes	Yes	(WELL ID)_LOW_FLOW
No Flow Alarm	Yes	Yes	(WELL ID)_FAULT_LATCH
Pump Fault	Yes	Yes	STOP_(Site)_LATCH
Fire Alarm	Yes	Yes	FIRE_(Location)
Secondary Pipeline Containment on Siltronic Site	Yes	Yes	(Location)_BASIN_LSH
Communication Error to Well	Yes	Yes	COMM_ERROR_(WELL ID)
Communication Error to Connex Box	Yes	Yes	COMM_WATCHDOG_(Location)

Table 4
DNAPL Monitoring Program

Well ID	Unit	DNAPL Monitoring Frequency			DNAPL Visibly Observed During Well Installation?	DNAPL Entry into Well?	DNAPL Removed from Well Sump?[1]
		Weekly	Monthly	Quarterly			
MW-3-26	Surficial Fill			X	Yes	No	
MW-3-56	Upper Alluvium			X	Yes	No	
MW-4-35	Fill/Upper Alluvium			X	No	No	
MW-4-57	Upper Alluvium			X	No	No	
MW-4-101	Lower Alluvium			X	No	No	
MW-5-32	Fill/Upper Alluvium			X	No	No	
MW-5-100	Upper Alluvium			X	No	No	
MW-5-175	Deep Alluvium			X	No	No	
MW-16-45	Upper Alluvium		X		Yes	Yes	Yes
MW-16-65	Upper Alluvium			X	Yes	No	
MW-18-30	Surficial Fill	X			Yes	Yes	Yes
MW-18-125	Lower Alluvium			X	Yes	No	
MW-18-180	Deep Alluvium			X	Yes	No	
MW-19-22	Surficial Fill			X	Yes	No	
MW-19-125	Lower Alluvium			X	Yes	No	
MW-19-180	Deep Alluvium			X	Yes	No	
MW-20-120	Lower Alluvium			X	Yes	No	
MW-24-70	Upper Alluvium			X	Yes	No	
MW-24-130	Lower Alluvium			X	Yes	No	
MW-26U	Upper Alluvium	X			Yes	Yes	Yes
MW-27L	Lower Alluvium			X	Yes	No	
MW-27U	Upper Alluvium	X			Yes	Yes	Yes
MW-28L	Lower Alluvium			X	Yes	No	
MW-28U	Upper Alluvium			X	Yes	No	
MW-29U	Upper Alluvium			X	No	No	
MW-30U	Upper Alluvium		X		Yes	Yes	Yes
MW-31L	Lower Alluvium			X	Yes	No	
MW-31U	Upper Alluvium			X	Yes	No	
MW-32U	Upper Alluvium			X	Yes	No	
MW-33U	Upper Alluvium			X	Yes	No	
MW-34L	Lower Alluvium		X		Yes	Yes	Yes
MW-34U	Upper Alluvium			X	Yes	No	
MW-35U	Upper Alluvium			X	No	No	
MW-36U	Upper Alluvium			X	No	No	
MW-37U	Upper Alluvium		X		Yes	Yes	No
MW-38U	Upper Alluvium	X			Yes	Yes	Yes
MW-42F	Surficial Fill			X	No	No	
MW-PW2L	Lower Alluvium	X			Yes	Yes	Yes
WS-21-112	Lower Alluvium			X	NA[2]	No	
WS-47-183	Lower Alluvium			X	Yes	No	
OW-2F	Surficial Fill			X	Yes	No	
OW-5F	Surficial Fill			X	Yes	No	

Table 4
DNAPL Monitoring Program

Well ID	Unit	DNAPL Monitoring Frequency			DNAPL Visibly Observed During Well Installation?	DNAPL Entry into Well?	DNAPL Removed from Well Sump?[1]
		Weekly	Monthly	Quarterly			
PW-1-80	Upper Alluvium		X		Yes	Yes	Yes
PW-2L	Lower Alluvium	X			Yes	Yes	Yes
PW-2U	Upper Alluvium			X	Yes	No	
PW-3-85	Upper Alluvium		X		NA[2]	Yes	Yes[3]
PW-3-118	Lower Alluvium			X	NA[2]	No	
PW-3U	Upper Alluvium			X	No	No	
PW-4L	Lower Alluvium			X	Yes	No	
PW-4U	Upper Alluvium			X	Yes	No	
PW-5L	Lower Alluvium			X	Yes	No	
PW-5U	Upper Alluvium			X	Yes	No	
PW-6L	Lower Alluvium			X	Yes	No	
PW-6U	Upper Alluvium	X			Yes	Yes	Yes
PW-11U	Upper Alluvium		X		Yes	Yes	Yes[3]
PW-12U	Upper Alluvium			X	Yes	No	
PW-13U	Upper Alluvium	X			Yes	Yes	Yes
PW-14U	Upper Alluvium	X			Yes	Yes	Yes
DW-6U	Upper Alluvium		X		Yes	Yes	Yes[3]
DW-11U	Upper Alluvium		X		Yes	Yes	Yes[3]
DW-14U	Upper Alluvium	X			Yes	Yes	Yes
PZ6-5	Surficial Fill			X	No	No	
PZ6-50	Upper Alluvium			X	No	No	
PZ6-115	Lower Alluvium			X	No	No	
PZ6-150	Deep Alluvium			X	No	No	
PZ7-5	Surficial Fill			X	No	No	
PZ7-50	Upper Alluvium			X	Yes	No	
PZ7-100	Lower Alluvium			X	Yes	No	
PZ7-150	Deep Alluvium			X	Yes	No	
PZ9-5	Surficial Fill			X	No	No	
PZ9-50	Upper Alluvium			X	Yes	No	
PZ9-75	Deep Alluvium			X	Yes	No	
PZ9-110	Deep Alluvium			X	Yes	No	
PZ9-150	Deep Alluvium			X	Yes	No	
Totals		**10**	**9**	**55**	**54**	**19**	**19**

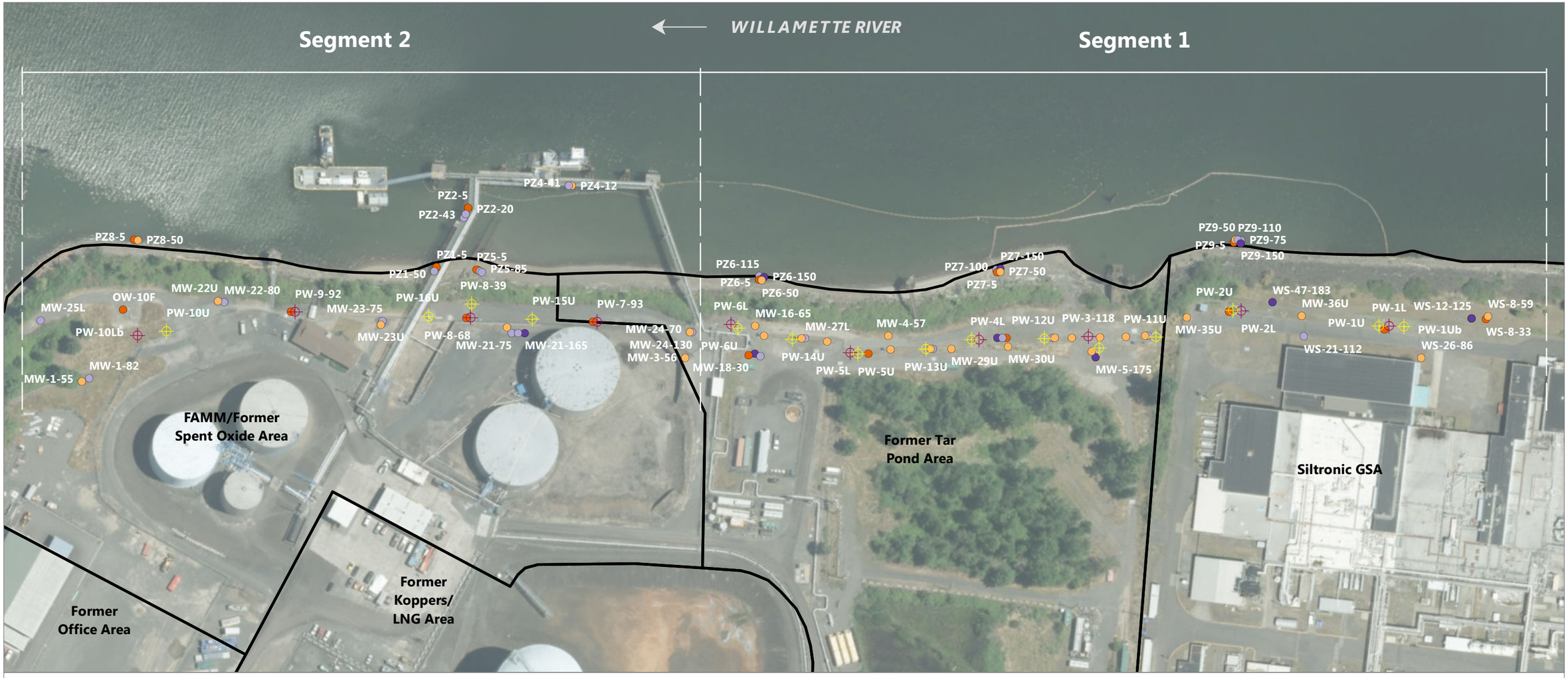
Notes:

1. DNAPL is removed on an as-needed basis when the level of DNAPL approaches the top of the well sump.
2. No data; no boring log exists.
3. DNAPL was removed on a one-time basis for testing and characterization.

DNAPL: dense nonaqueous phase liquid, specifically oil and/or semisolid tar

NA: not available

Figures



LEGEND:

- Geographic Subareas

Extraction Wells

- Lower Alluvium WBZ
- Upper Alluvium WBZ

Monitoring Wells

- Fill WBZ
- Upper Alluvium WBZ
- Lower Alluvium WBZ
- Deep Lower Alluvium WBZ

NOTES:

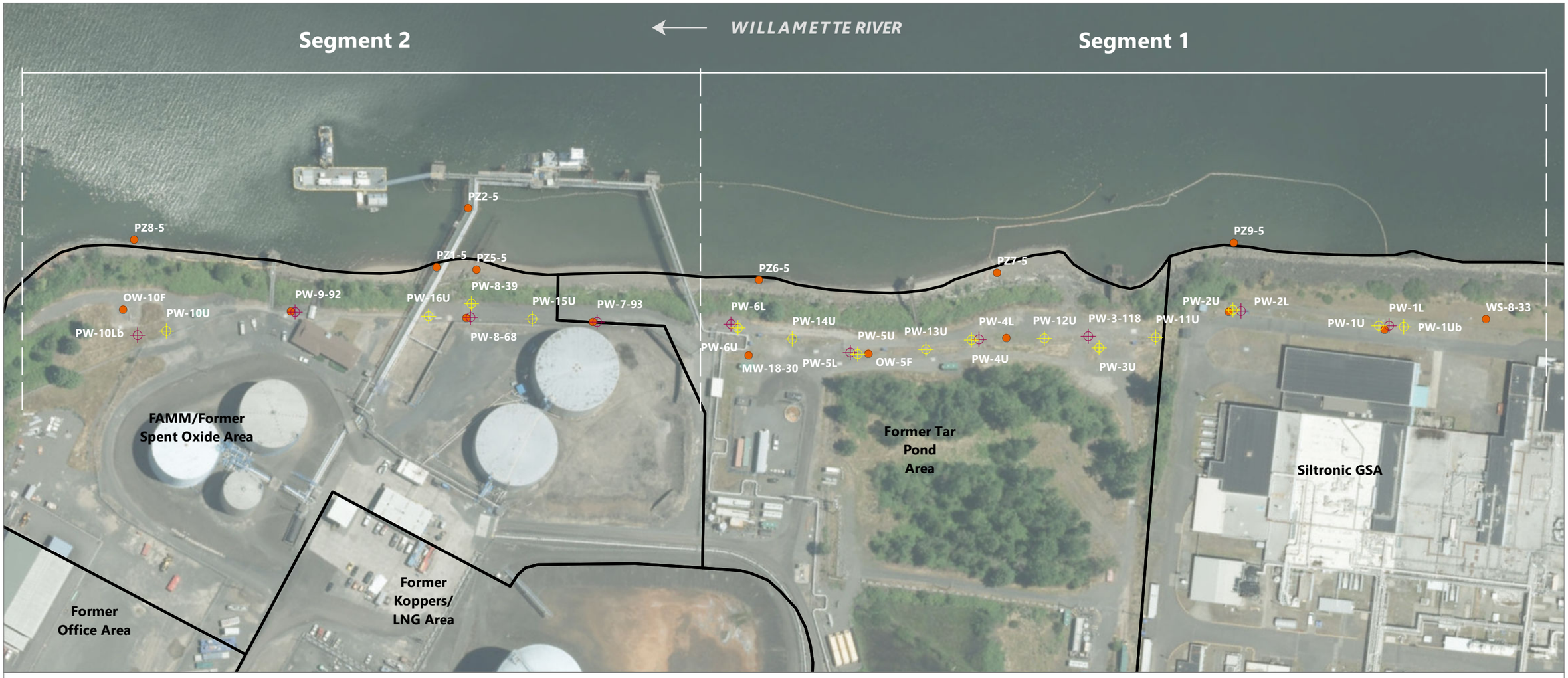
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 (HARN91) Oregon State Plane North, International Feet.
3. Vertical datum is City of Portland (COP), Feet.
4. Aerial imagery from City of Portland 2016.

0 200
Feet

Publish Date: 2019/05/13, 4:43 PM | User: eiverson
Filepath: \\orcas\GIS\Jobs\NW_Natural_Gas_0029\Gasco_Source_Controls\Maps\PerformanceMonitoring\AQ_PMP_Fig1_1_ExtractionMonitoring_AllWBZ.mxd

ANCHOR QEA

Figure 1-1
Locations of HC&C Extraction Wells and Monitoring Wells
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- Geographic Subareas

Extraction Wells

- Lower Alluvium WBZ
- Upper Alluvium WBZ

Monitoring Wells

- Fill WBZ

NOTES:

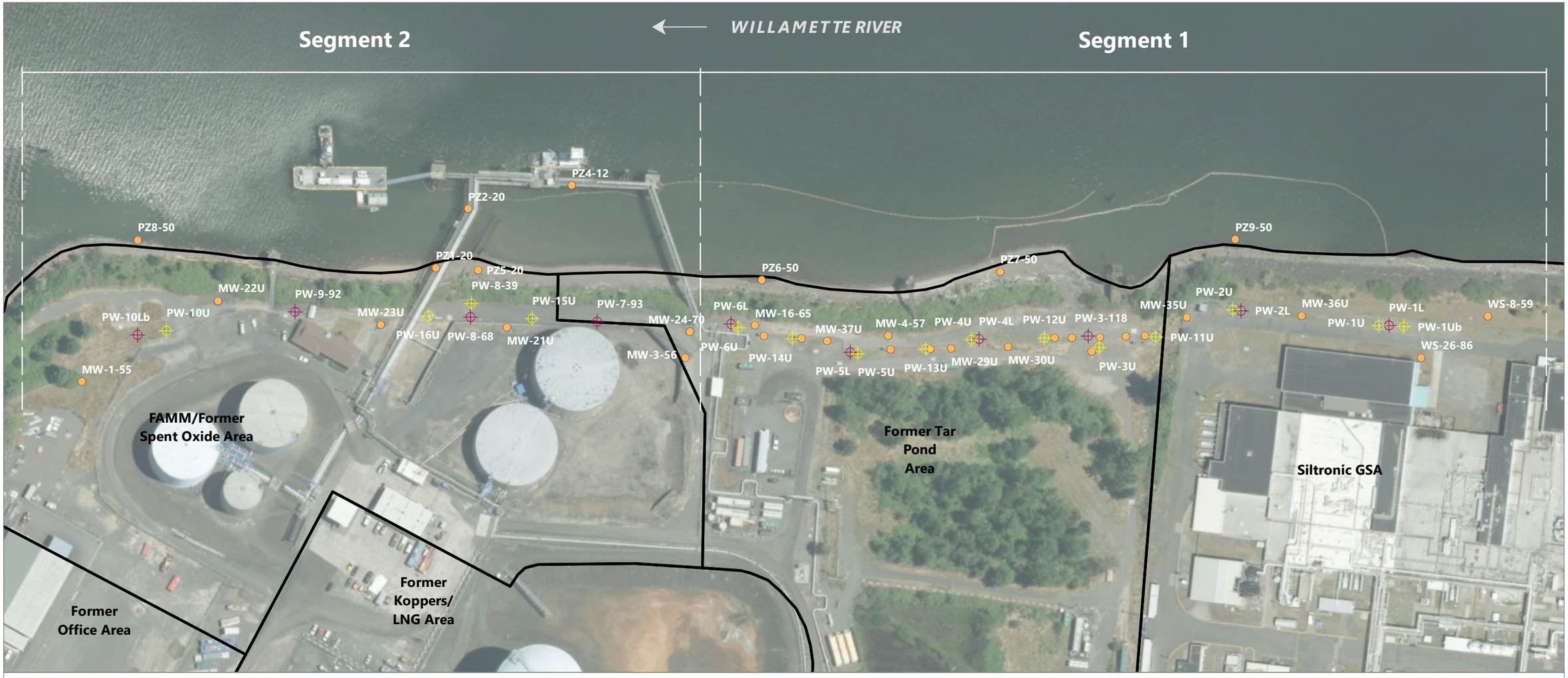
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 (HARN91) Oregon State Plane North, International Feet.
3. Vertical datum is City of Portland (COP), Feet.
4. Aerial imagery from City of Portland 2016.

0 200
Feet

Publish Date: 2019/06/05, 12:23 PM | User: eiverson
Filepath: \\orcas\GIS\Jobs\NW_Natural_Gas_0029\Gasco_Source_Controls\Maps\PerformanceMonitoring\AQ_PMP_Fig1_2_ExtractionMonitoring_Fill.mxd

ANCHOR QEA

Figure 1-2
Locations of HC&C Extraction Wells and Monitoring Wells in Fill WBZ
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- Geographic Subareas

Extraction Wells

- Lower Alluvium WBZ
- Upper Alluvium WBZ

Monitoring Wells

- Upper Alluvium WBZ

NOTES:

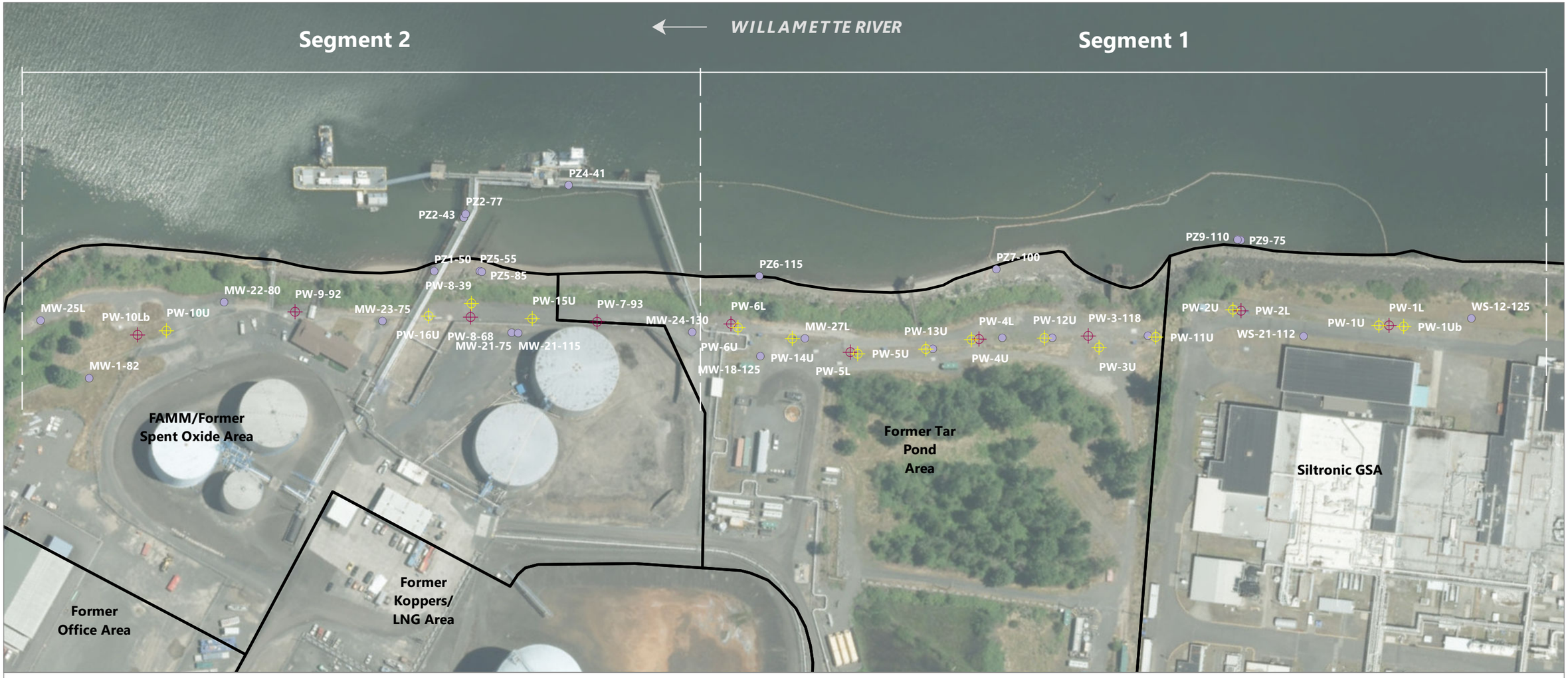
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 (HARN91) Oregon State Plane North, International Feet.
3. Vertical datum is City of Portland (COP), Feet.
4. Aerial imagery from City of Portland 2016.

0 200
Feet

Publish Date: 2019/06/05, 12:23 PM | User: eiverson
Filepath: \\orcas\GIS\Jobs\NW_Natural_Gas_0029\Gasco_Source_Controls\Maps\PerformanceMonitoring\AQ_PMP_Fig1_3_ExtractionMonitoring_UpperAlluvium.mxd

ANCHOR QEA

Figure 1-3
Locations of HC&C Extraction Wells and Monitoring Wells in Upper Alluvium WBZ
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- Geographic Subareas

Extraction Wells

- Lower Alluvium WBZ
- Upper Alluvium WBZ

Monitoring Wells

- Lower Alluvium WBZ

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 (HARN91) Oregon State Plane North, International Feet.
3. Vertical datum is City of Portland (COP), Feet.
4. Aerial imagery from City of Portland 2016.

0 200
Feet

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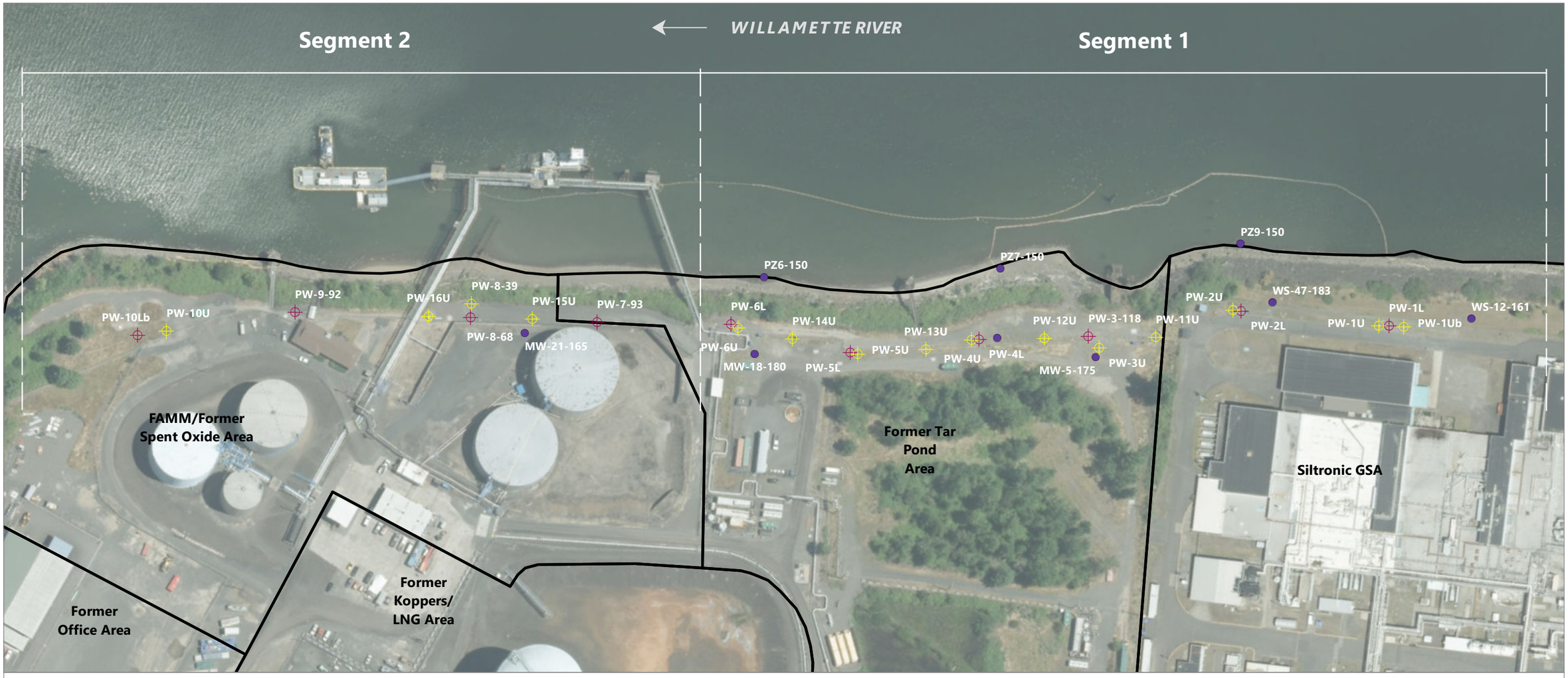
Filepath: \\orcas\GIS\Jobs\NW_Natural_Gas_0029\Gasco_Source_Controls\Maps\PerformanceMonitoring\AQ_PMP_Fig1_4_ExtractionMonitoring_LowerAlluvium.mxd

ANCHOR QEA

Figure 1-4
Locations of HC&C Extraction Wells and Monitoring Wells in Lower Alluvium WBZ
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- Geographic Subareas

Extraction Wells

- Lower Alluvium WBZ
- Upper Alluvium WBZ

Monitoring Wells

- Deep Lower Alluvium WBZ

NOTES:

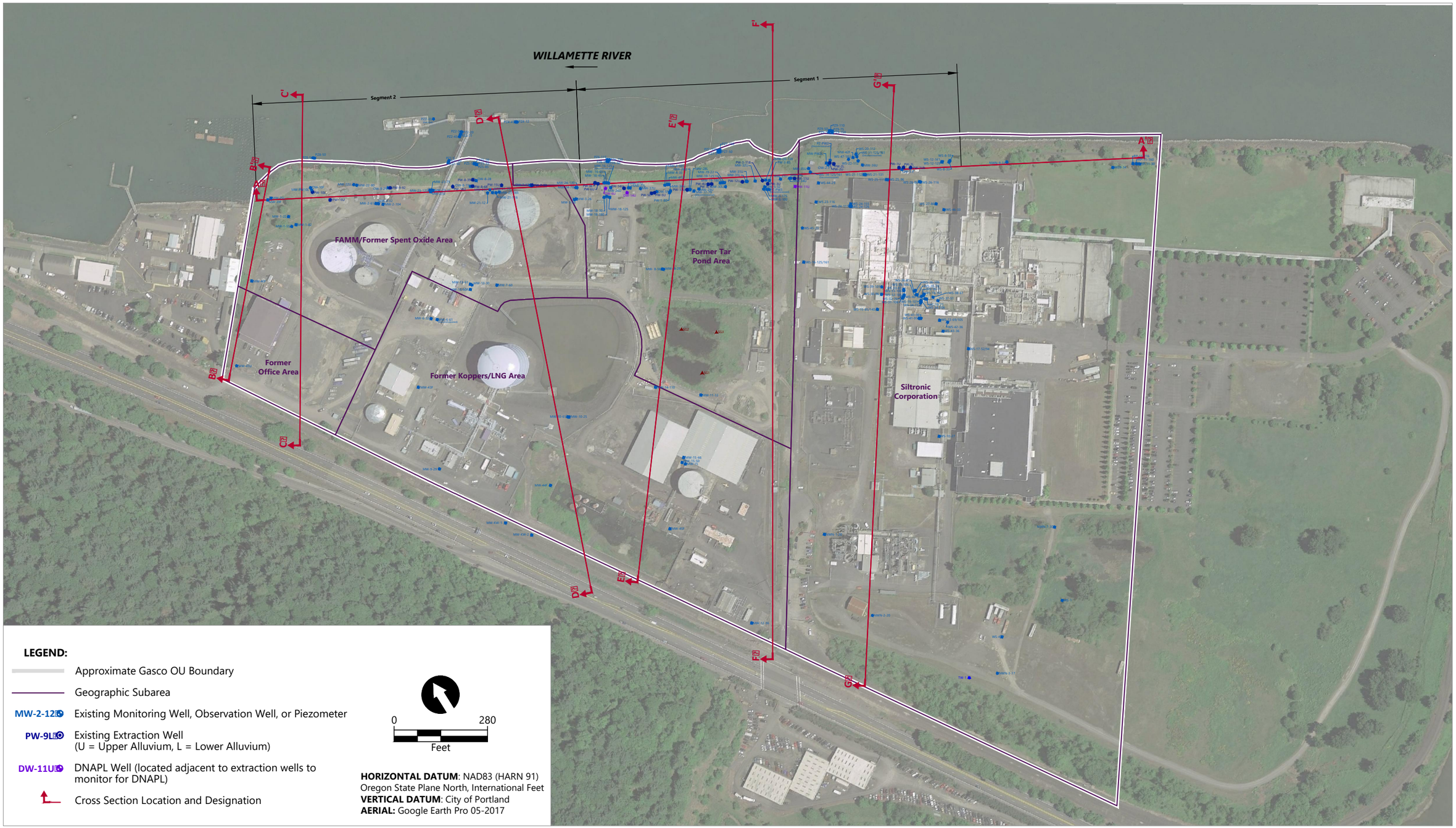
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 (HARN91) Oregon State Plane North, International Feet.
3. Vertical datum is City of Portland (COP), Feet.
4. Aerial imagery from City of Portland 2016.

0 200
Feet

Publish Date: 2019/06/05, 12:23 PM | User: eiverson
Filepath: \\orcas\GIS\Jobs\NW_Natural_Gas_0029\Gasco_Source_Controls\Maps\PerformanceMonitoring\AQ_PMP_Fig1_5_ExtractionMonitoring_DeepLowerAlluvium.mxd

ANCHOR QEA

Figure 1-5
Locations of HC&C Extraction Wells and Monitoring Wells in Deep Lower Alluvium WBZ
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



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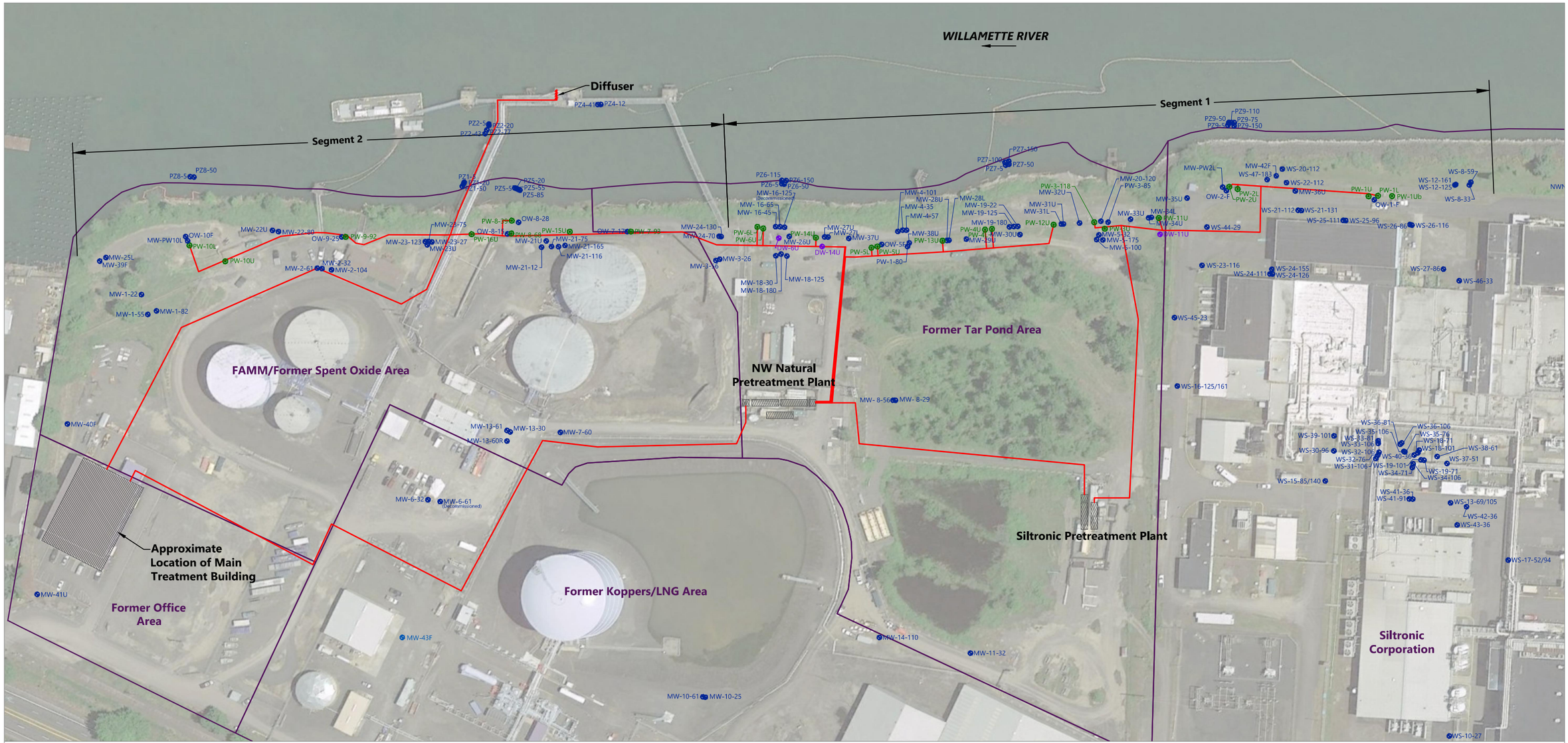
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-001 (XSEC MAP 2018).dwg 2-1

ANCHOR QEA

Figure 2-1
Monitoring Well and Cross Section Location Map

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- **MW-2-126** Existing Monitoring Well, Observation Well, or Piezometer
- **PW-9L** Existing Extraction Well (U = Upper Alluvium, L = Lower Alluvium)
- **DW-11U** DNAPL Well
- Source Control Main Pipeline Route
- Geographic Subarea

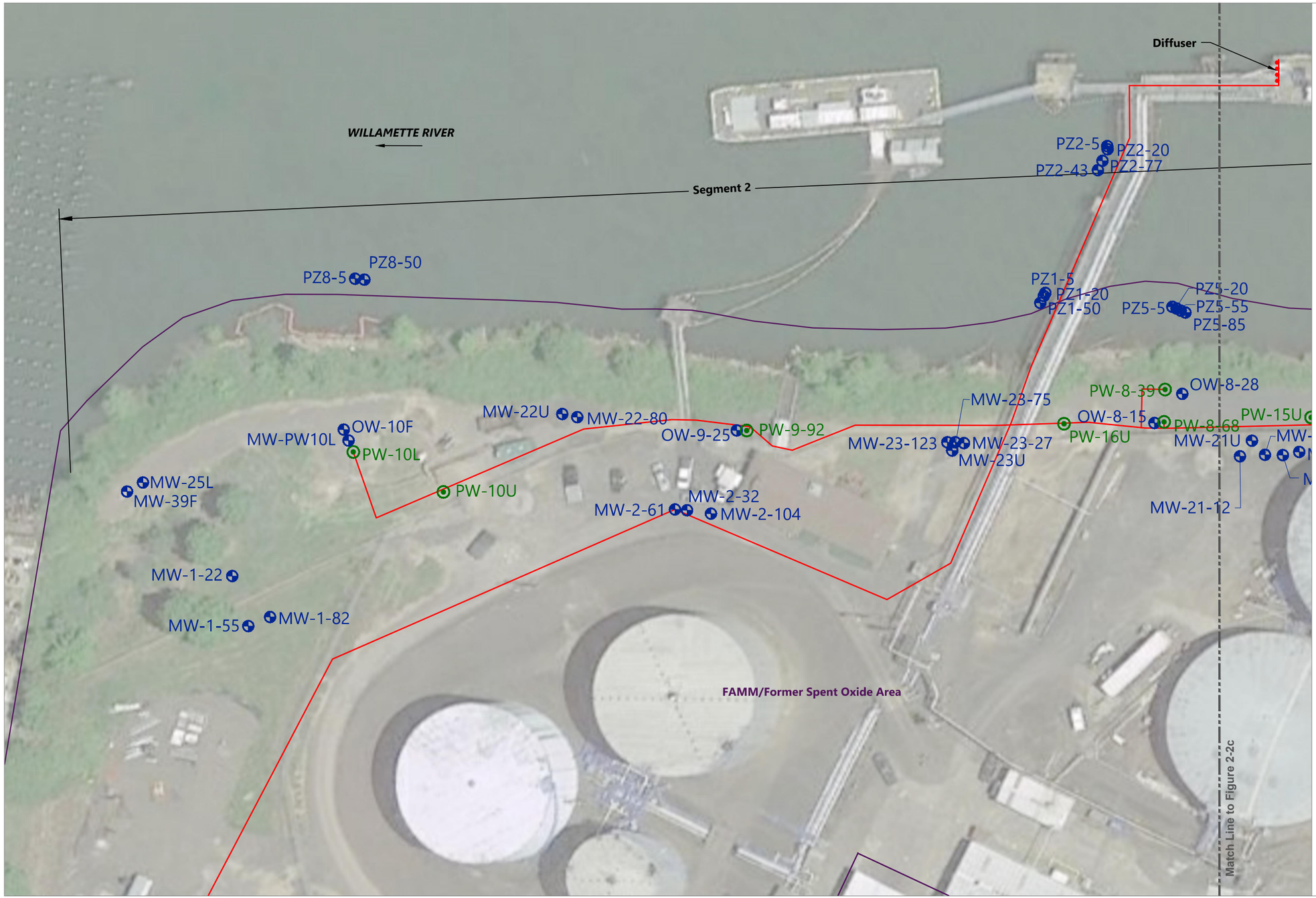
0 150 Feet

HORIZONTAL DATUM: NAD83 (HARN 91) Oregon State Plane North, International Feet
VERTICAL DATUM: City of Portland
NOTE: Drawing prepared from CAD file provided by Advanced Remediation Technologies Co., dated January 5, 2012.

Publish Date: 2019/05/21 4:27 PM | User: hmerrick
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-003 (GW Ext System).dwg Figure 2-2a

ANCHOR QEA

Figure 2-2a
Map of Groundwater Extraction and Treatment System
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- MW-2-12 — Existing Monitoring Well, Observation Well, or Piezometer
- PW-9L — Existing Extraction Well (U = Upper Alluvium, L = Lower Alluvium)
- DW-11U — DNAPL Well
- Source Control Main Pipeline Route

0 60
Feet

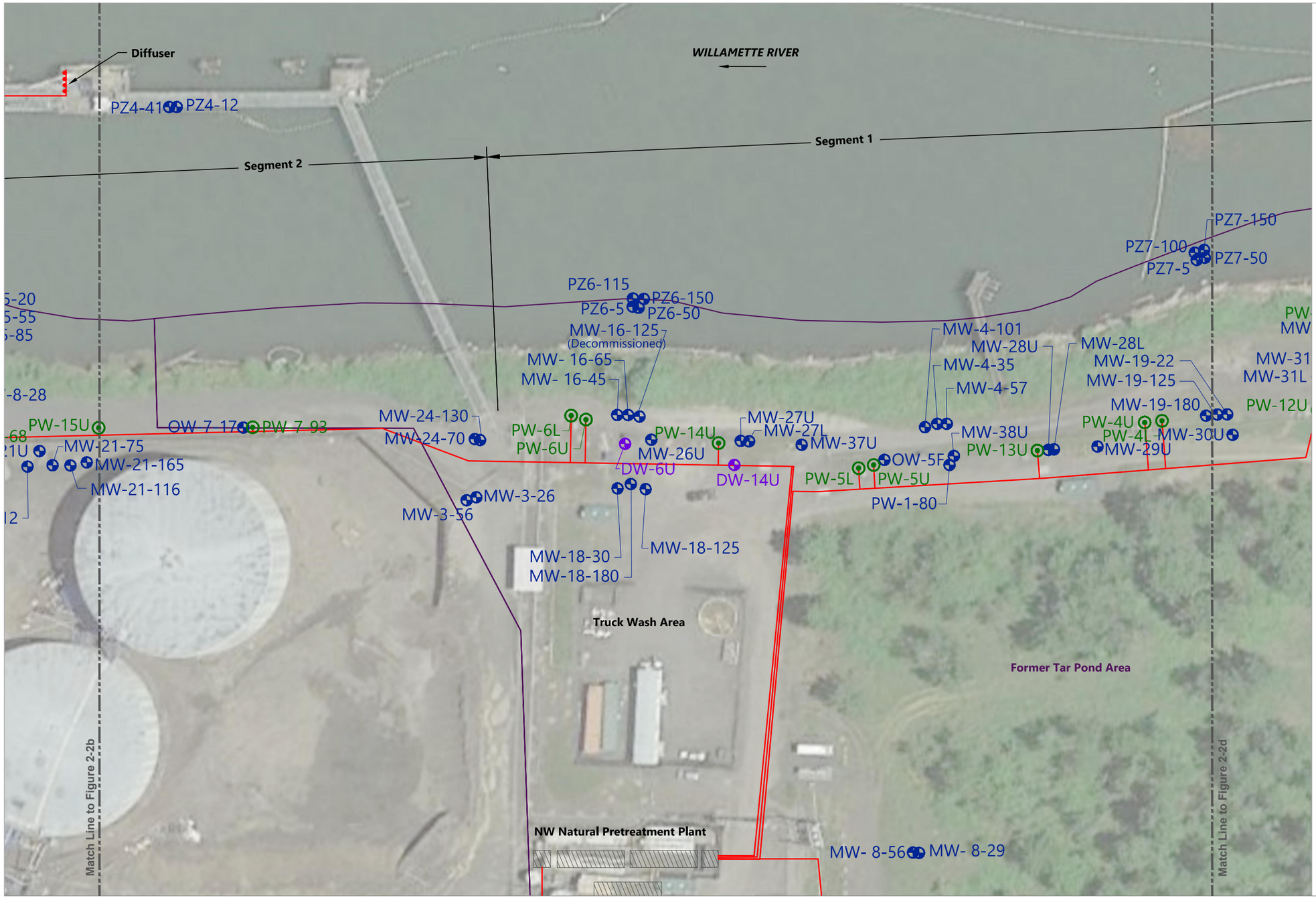
HORIZONTAL DATUM: NAD83 (HARN 91) Oregon State Plane North, International Feet
VERTICAL DATUM: City of Portland
NOTE: Drawing prepared from CAD file provided by Advanced Remediation Technologies Co., dated January 5, 2012.

Publish Date: 2019/05/21 4:27 PM | User: hmerrick
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-003 (GW Ext System).dwg Figure 2-2b

ANCHOR QEA

Figure 2-2b
Map of Groundwater Extraction and Treatment System

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- MW-2-12 — Existing Monitoring Well, Observation Well, or Piezometer
- PW-9L — Existing Extraction Well (U = Upper Alluvium, L = Lower Alluvium)
- DW-11U — DNAPL Well
- Source Control Main Pipeline Route

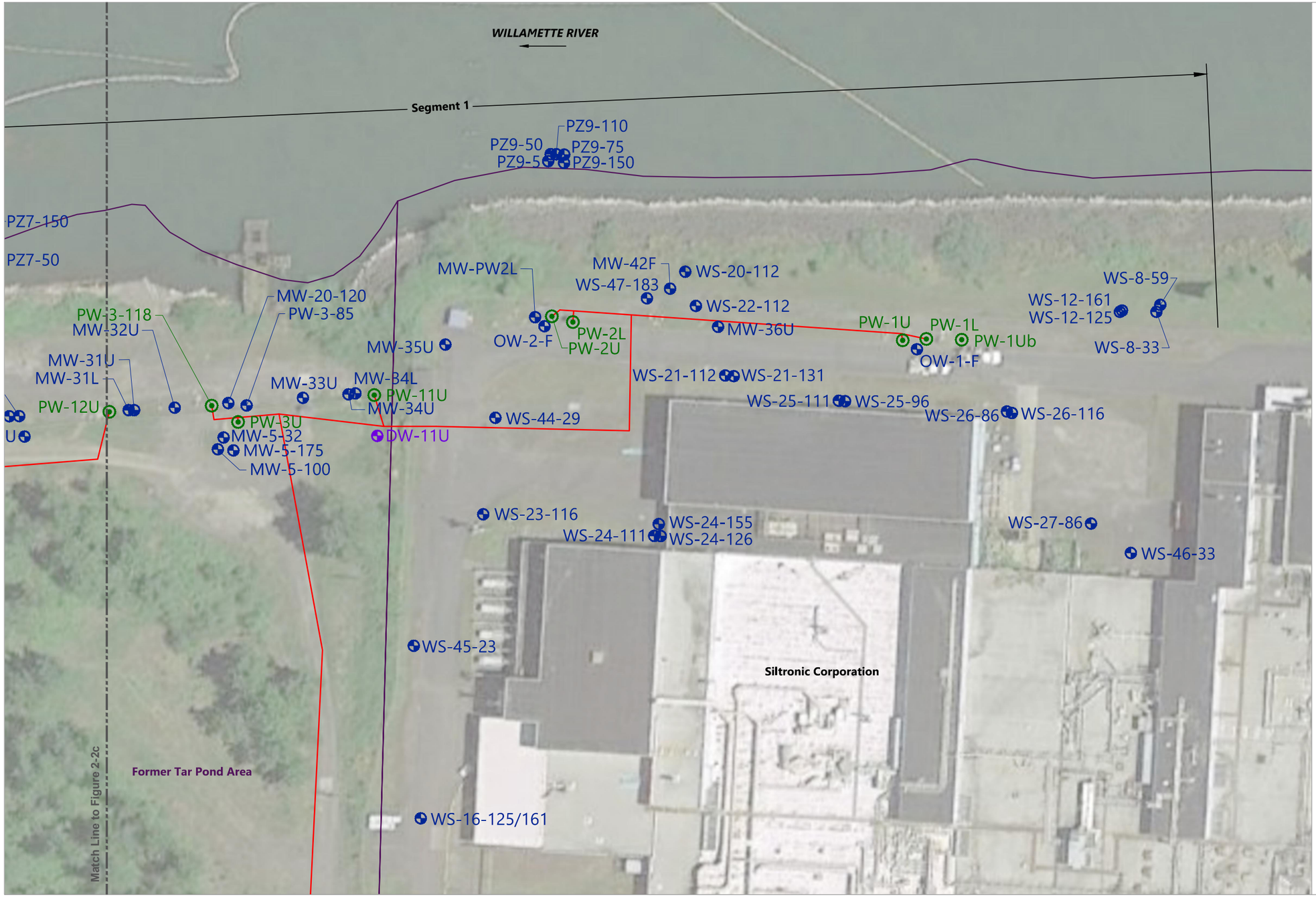
0 60
Feet

HORIZONTAL DATUM: NAD83 (HARN 91) Oregon State Plane North, International Feet
VERTICAL DATUM: City of Portland
NOTE: Drawing prepared from CAD file provided by Advanced Remediation Technologies Co., dated January 5, 2012.

Publish Date: 2019/05/21 4:27 PM | User: hmerrick
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-003 (GW Ext System).dwg Figure 2-2c

ANCHOR QEA

Figure 2-2c
Map of Groundwater Extraction and Treatment System
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- MW-2-12 — Existing Monitoring Well, Observation Well, or Piezometer
- PW-9L — Existing Extraction Well (U = Upper Alluvium, L = Lower Alluvium)
- DW-11U — DNAPL Well
- Source Control Main Pipeline Route

0 60
Feet

HORIZONTAL DATUM: NAD83 (HARN 91) Oregon State Plane North, International Feet
VERTICAL DATUM: City of Portland
NOTE: Drawing prepared from CAD file provided by Advanced Remediation Technologies Co., dated January 5, 2012.

Publish Date: 2019/05/21 4:27 PM | User: hmerrick
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-003 (GW Ext System).dwg Figure 2-2d

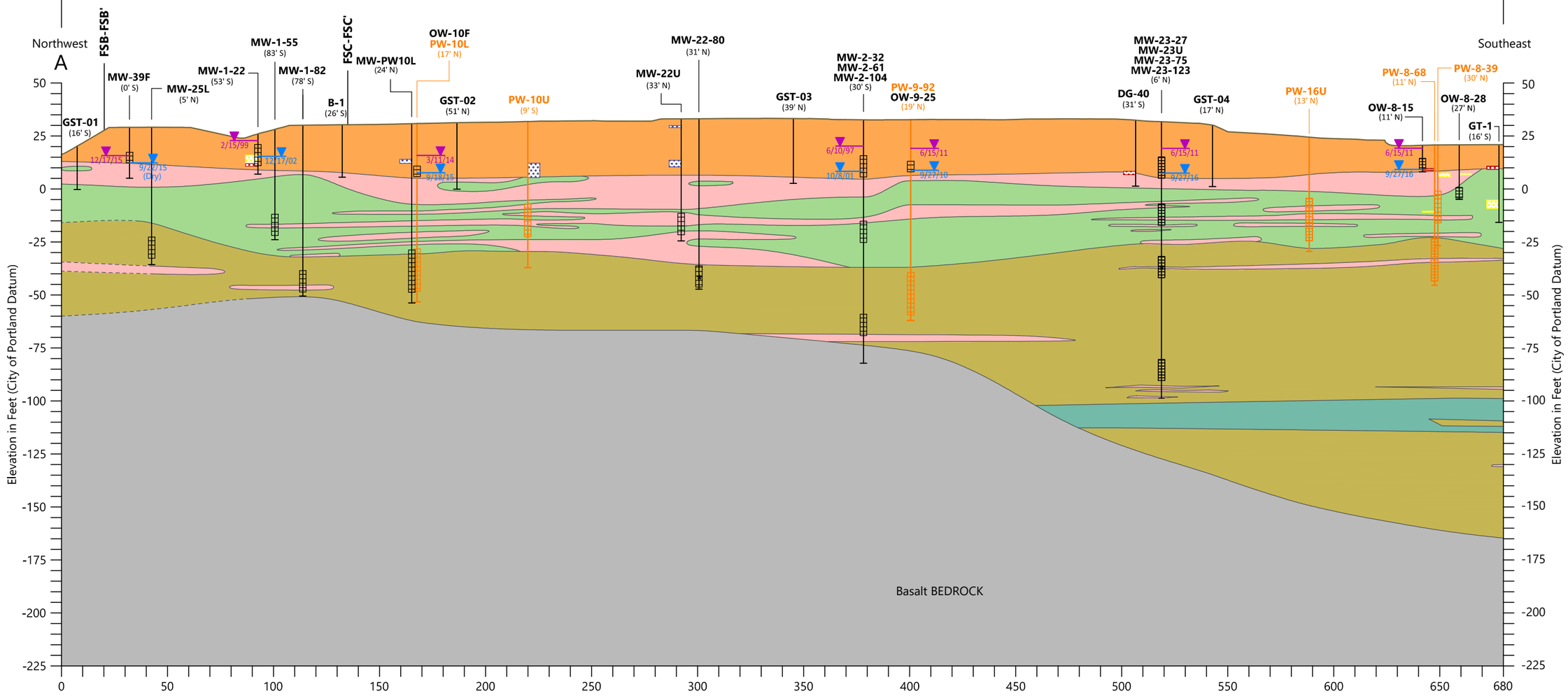
ANCHOR QEA

Figure 2-2d
Map of Groundwater Extraction and Treatment System
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Sheet 1 — Viewing Northeast — Sheet 1

FAMM/Former Spent Oxide Area

Northwest — A — Southeast



Horizontal Distance in Feet
No Vertical Exaggeration

0 50 Feet

LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 — Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 — Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016

P-46 — Boring ID
(4.6' N) — Offset Distance in Feet

- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

Existing Extraction Well
Existing Well or Piezometer

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

* Control well

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Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-002 (XSECS 2018).dwg 2-3a

ANCHOR QEA

Figure 2-3a
Cross Section A-A' – Sheet 1 of 4

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Sheet 2

Viewing Northeast

Sheet 2

FAMM/Former Spent Oxide Area

Former Tar Pond Area

Northwest

Southeast

MW-21-12 (11' N)
MW-21U (2' N)
MW-21-75 (11' N)
B-8 (28' N)
MW-21-116 (12' N)
MW-21-165 (10' S)
PW-15U (10' N)
GST-05 (22' N)
FSD-FSD'
OW-7-17
PW-7-93 (6' N)
TG-1 (11' S)
MW-24-70
MW-24-130 (8' S)
GST-06 (13' N)
B-1 (26.5' N)
PW-6L (4' S)
PW-6U (5' S)
TG-PW6-130 (5' S)
DW-6U (14.6' S)
B-57 (46' S)
MW-16-45
MW-16-65
MW-18-30
MW-18-125
MW-18-180 1 (23' S)
MW-26U (18' S)
TG-2 (55' S)
B-59 (2' S)
TG-PW6-130-062614 (5' S)
B-29 (15' N)
B-5 (14' N)
TG-PW14-100 (31' S)
PW-14U (17' S)
MW-27U
MW-27L (17' S)
DW-14U (30' S)
B-58 (31' S)
B-53 (4' N)
GSM-07 (34' N)
MW-37U (20' S)
PW-5L (36' S)
TG-PW5-85 (25' S)
PW-5U (38' S)
B-2 (7' N)
OW-5F (31' S)
MW-4-35
MW-4-57
MW-4-101 (1' S)
PW-1-80 (48' S)
MW-38U (31' S)
TG-3 (37' S)
B-6 (12' N)
FSE-FSE'
PW-13U (30' S)
MW-28U
MW-28L (30' S)
MW-17-79 (Decommissioned) (22.5' S)
MW-29U (30' S)
PW-4U (17' S)
PW-4L (16' S)

6/15/11
9/21/15
6/15/11
12/30/14
6/15/11
6/10/97
3/13/14
9/21/15

Basalt BEDROCK

Elevation in Feet (City of Portland Datum)

50 25 0 -25 -50 -75 -100 -125 -150 -175 -200 -225

680 700 750 800 850 900 950 1000 1050 1100 1150 1200 1250 1300 1350 1370

Horizontal Distance in Feet
No Vertical Exaggeration

0 50
Feet

LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- Existing Extraction Well
- Existing Well or Piezometer
- P-46 (4.6' N) — Boring ID; Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

* Control well
★ Not used for geologic interpretation

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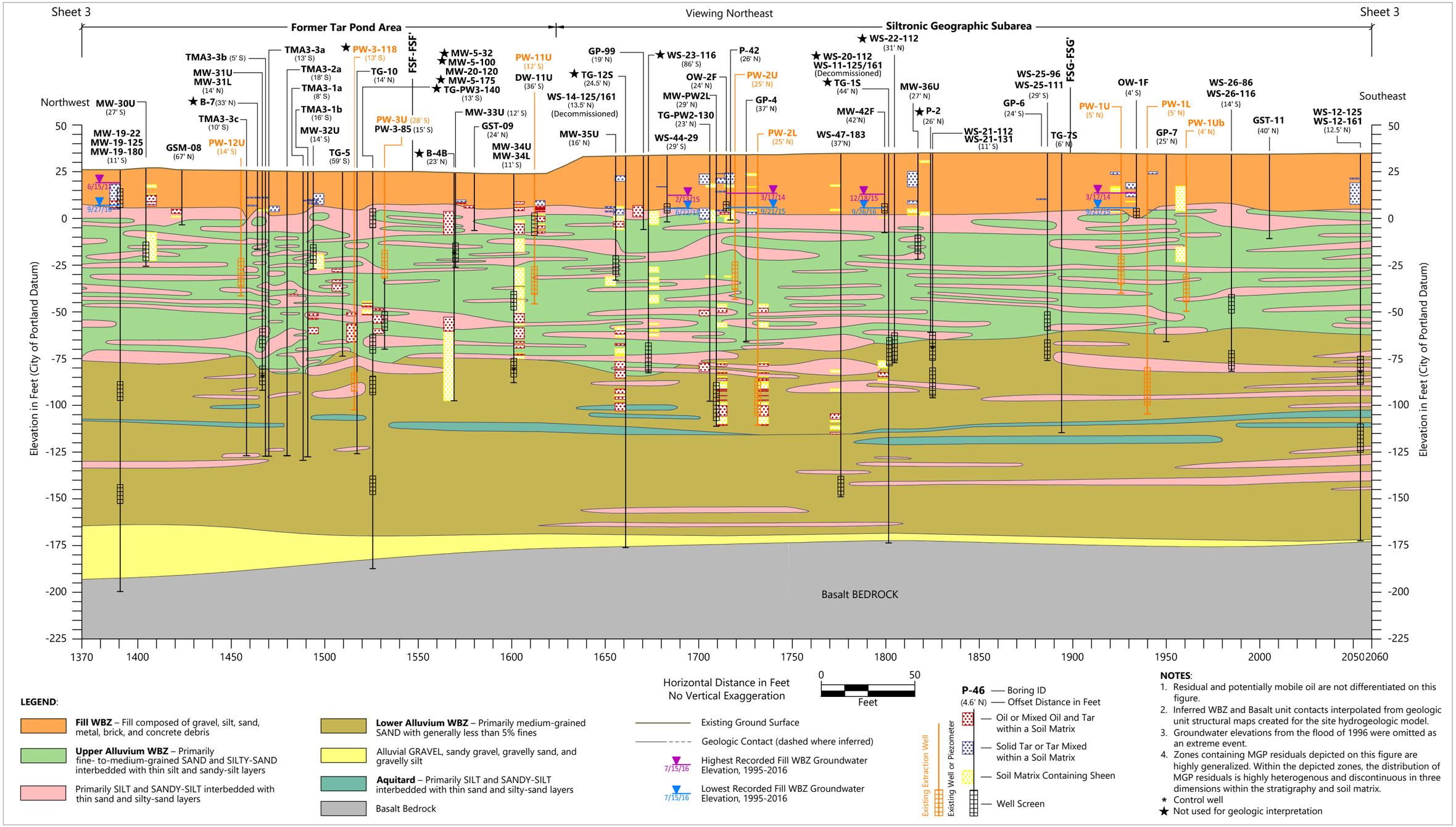
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-002 (XSECS 2018).dwg 2-3b

ANCHOR QEA

Figure 2-3b
Cross Section A-A' – Sheet 2 of 4

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



Horizontal Distance in Feet
No Vertical Exaggeration

0 50
Feet

LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016

P-46 (4.6' N) — Boring ID; Offset Distance in Feet

Existing Extraction Well
Existing Well or Piezometer

- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

* Control well
★ Not used for geologic interpretation

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Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-002 (XSECS 2018).dwg 2-3c

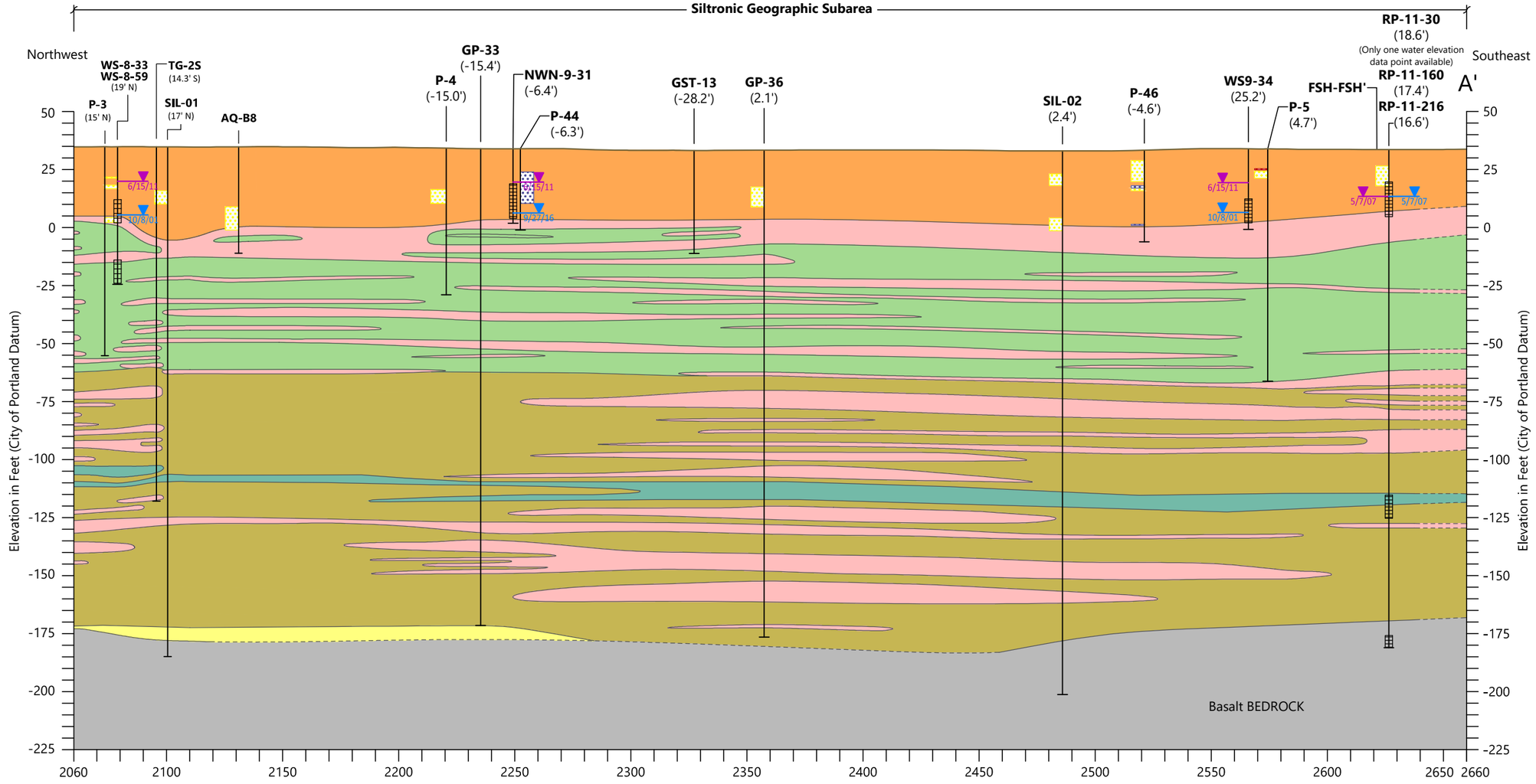
ANCHOR QEA

Figure 2-3c
Cross Section A-A' – Sheet 3 of 4

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Viewing Northeast

Sheet 4



Horizontal Distance in Feet
No Vertical Exaggeration

0 50
Feet

LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016

P-46 — Boring ID
(4.6' N) — Offset Distance in Feet

- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

Existing Extraction Well
Existing Well or Piezometer

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

* Control well
★ Not used for geologic interpretation

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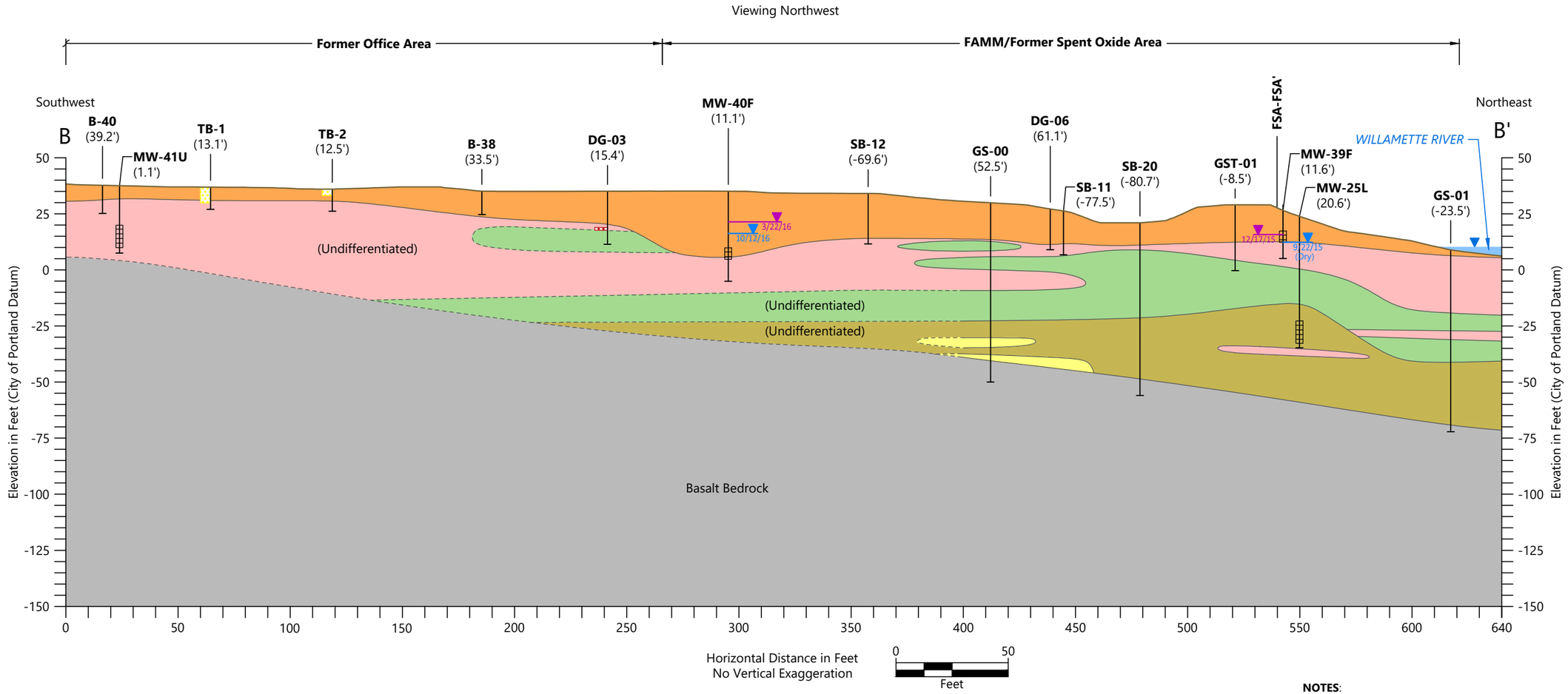
Figure 2-3d
Cross Section A-A' – Sheet 4 of 4

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen
- Existing Extraction Well
- Existing Well or Piezometer

NOTES:

1. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
2. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
3. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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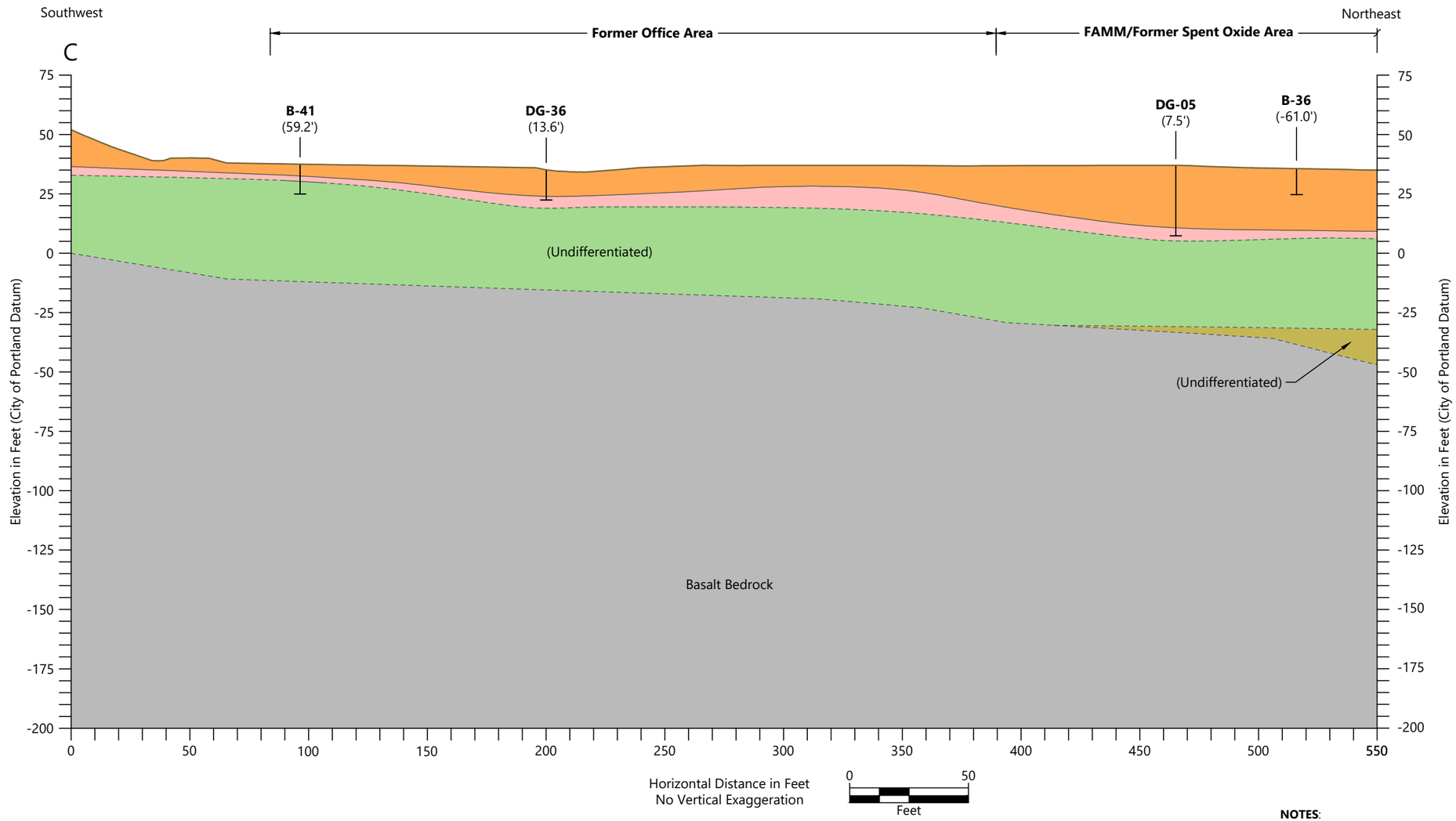
Figure 2-4
Cross Section B-B'

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Viewing Northwest

Sheet 1



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- Existing Extraction Well
- Existing Well or Piezometer
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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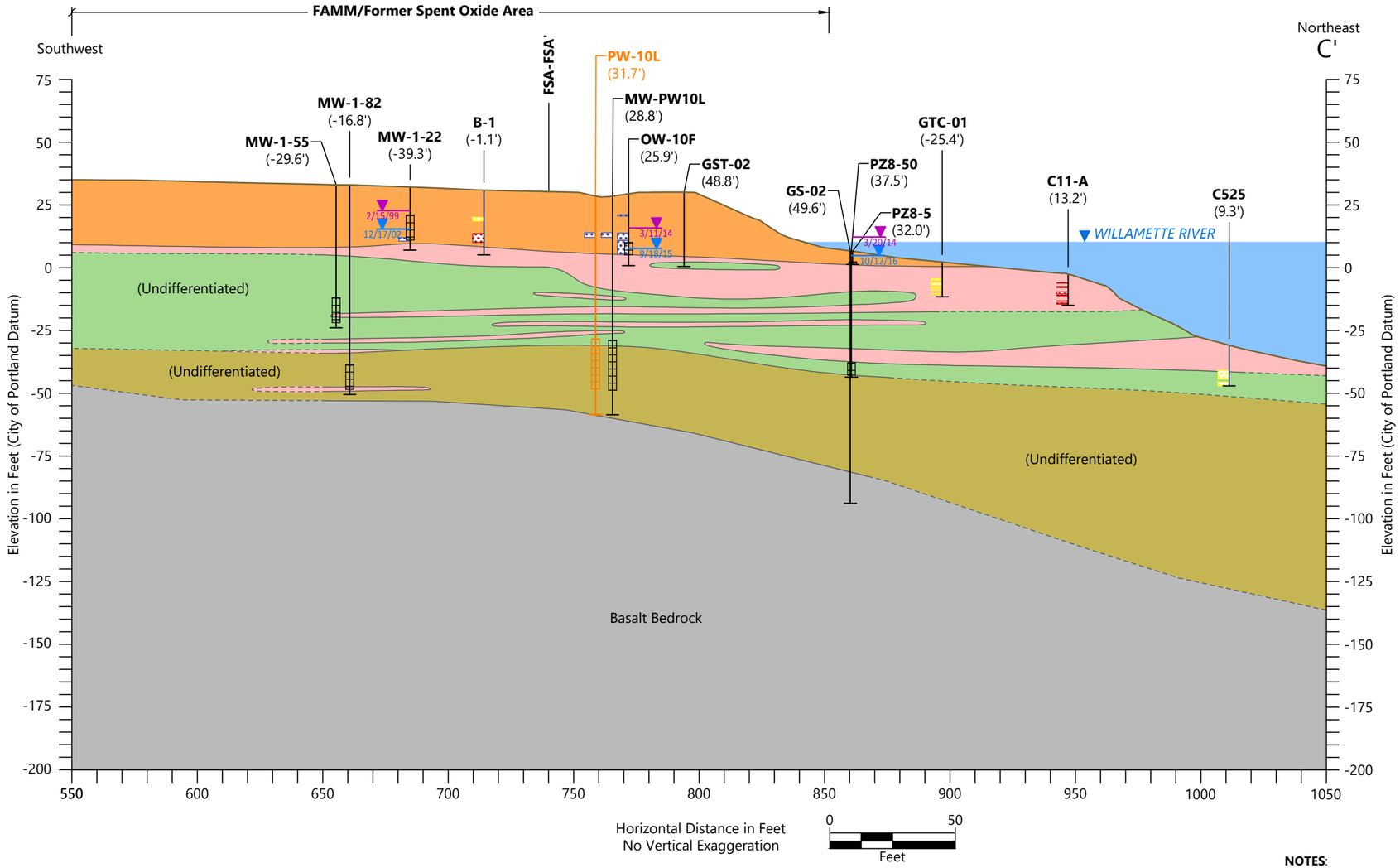
Figure 2-5a
Cross Section C-C' – Sheet 1 of 2

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

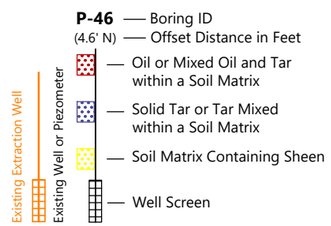
Viewing Northwest

Sheet 2



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016



NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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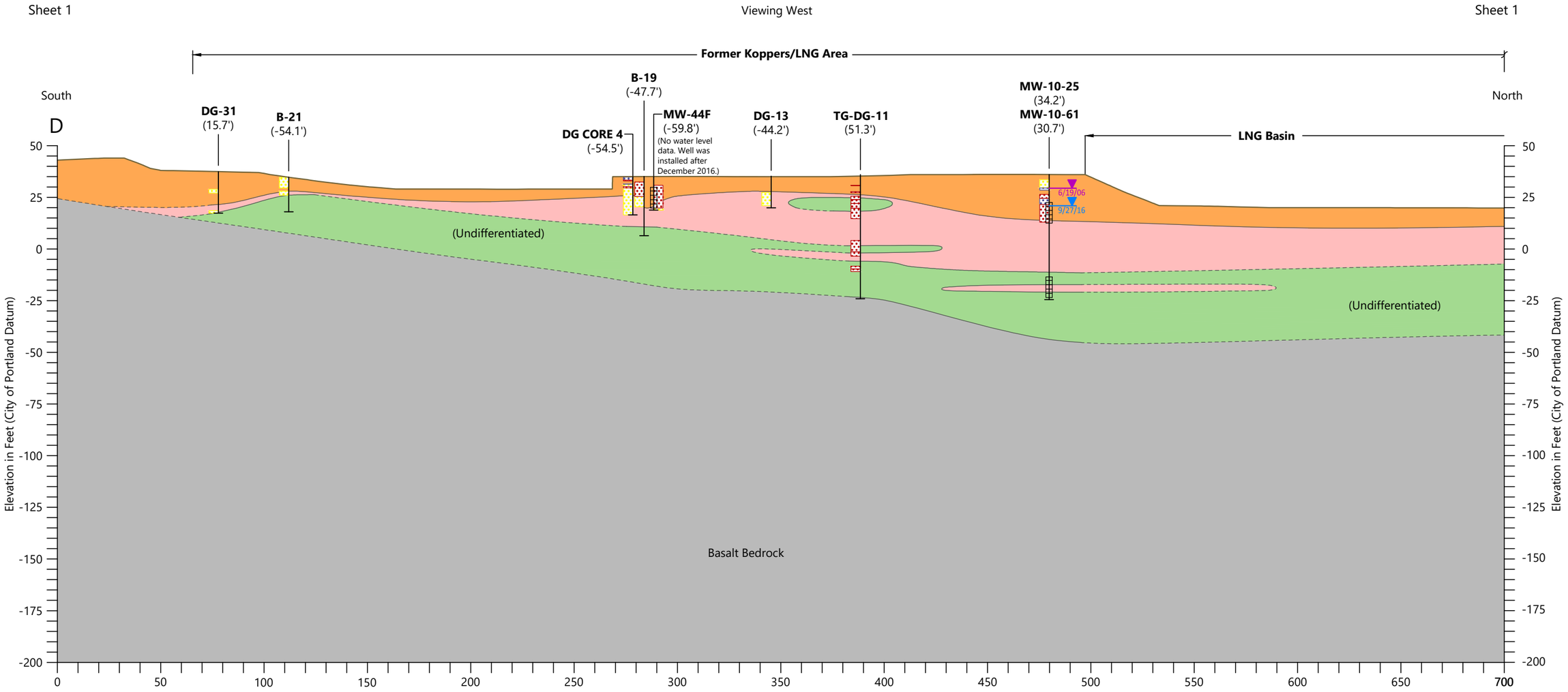
Figure 2-5b
Cross Section C-C' – Sheet 2 of 2

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Sheet 1 | Viewing West | Sheet 1



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 — Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 — Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen
- Existing Extraction Well
- Existing Well or Piezometer

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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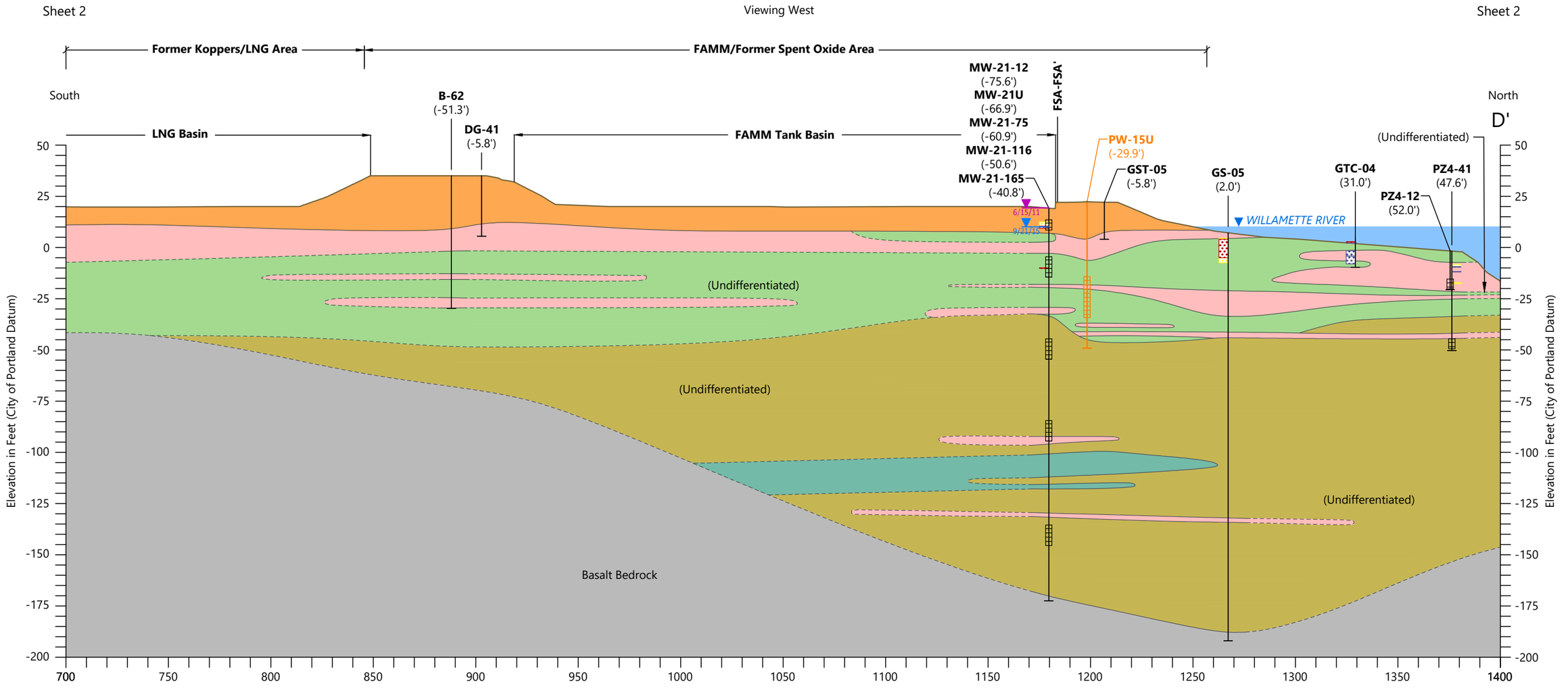
Figure 2-6a
Cross Section D-D' – Sheet 1 of 2

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Sheet 2 | Viewing West | Sheet 2



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- Existing Extraction Well
- Existing Well or Piezometer
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Tar Interval
- Oil or Mixed Oil and Tar Interval
- Sheen Interval
- Well Screen

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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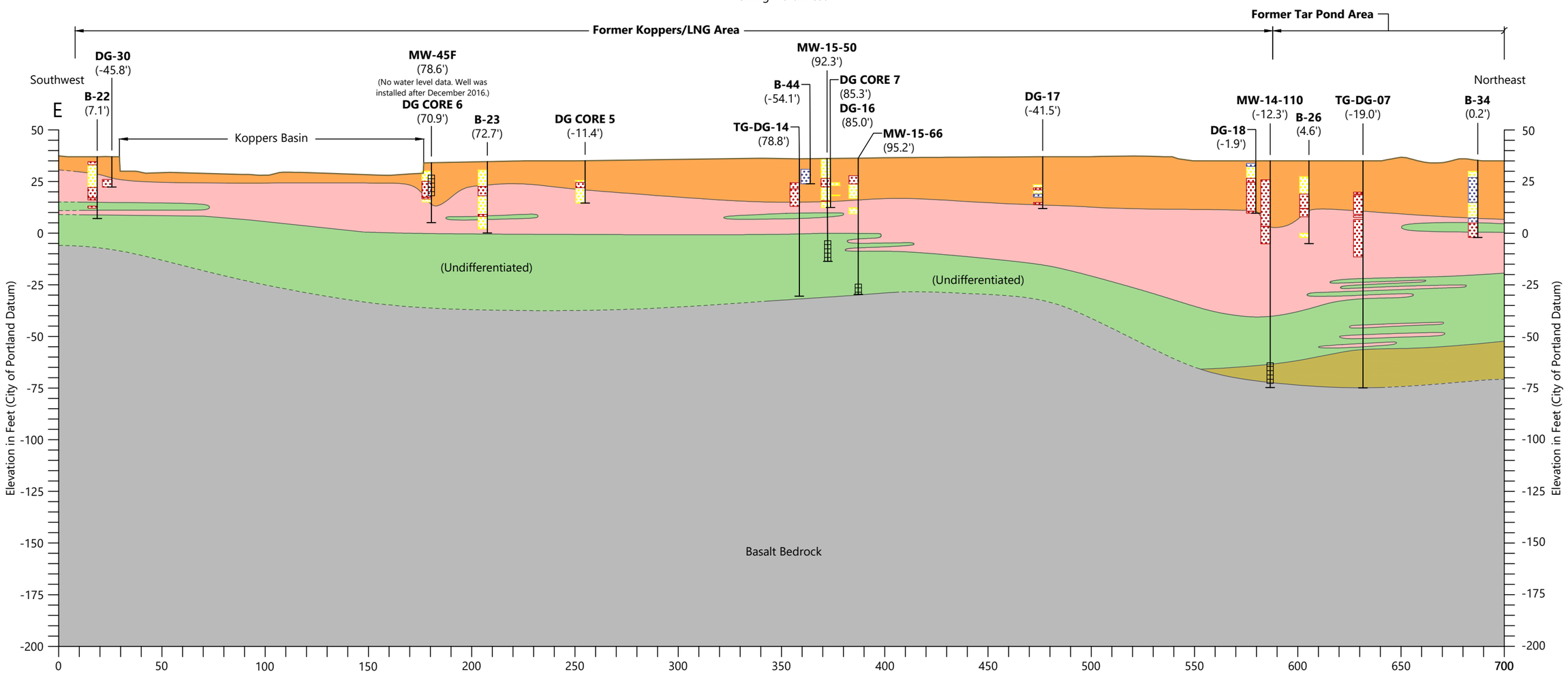
Figure 2-6b
Cross Section D-D' – Sheet 2 of 2

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Sheet 1

Viewing Northwest

Sheet 1



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- Existing Extraction Well
- Existing Well or Piezometer
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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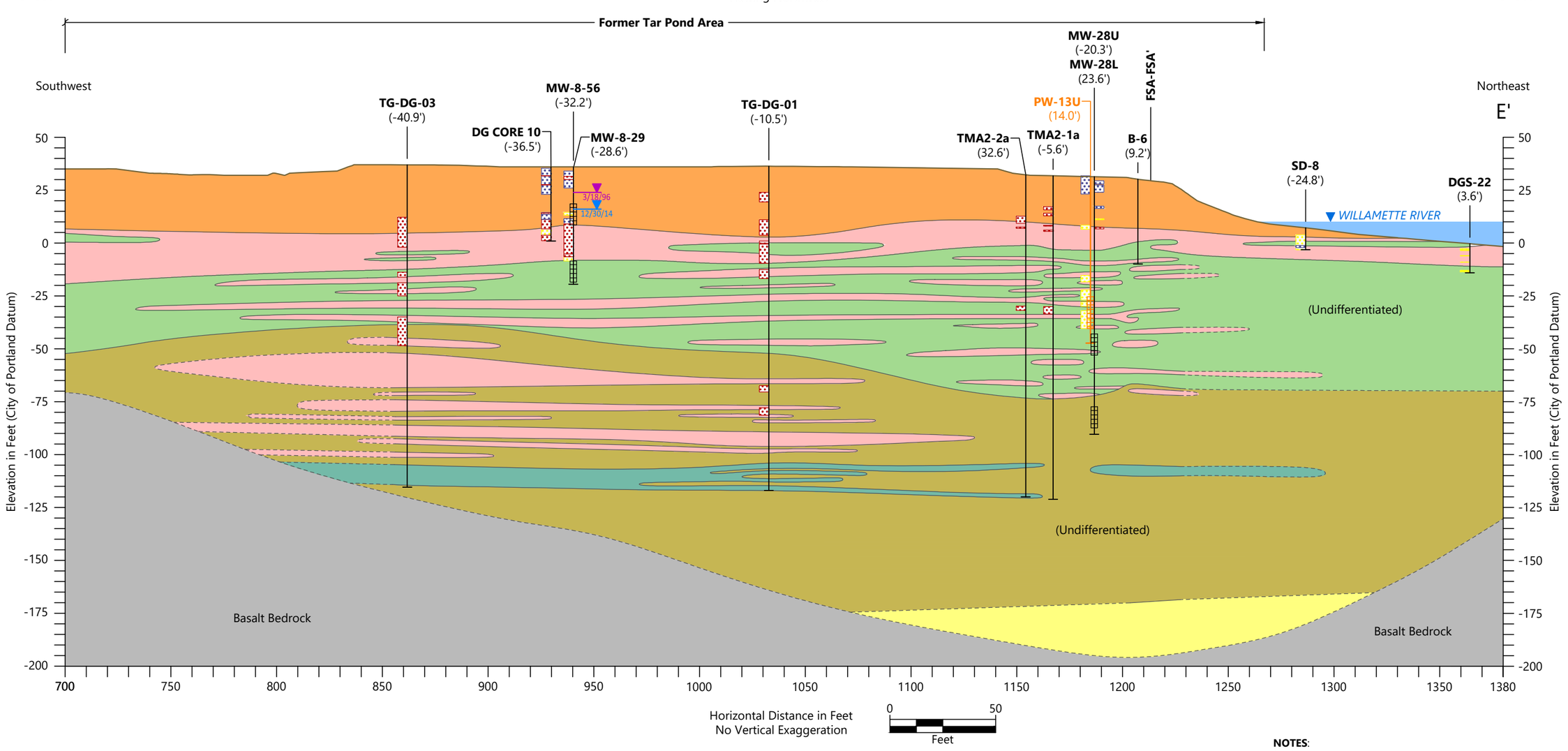
Figure 2-7a
Cross Section E-E' – Sheet 1 of 2

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Sheet 2 | Viewing Northwest | Sheet 2



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- Existing Extraction Well
- Existing Well or Piezometer
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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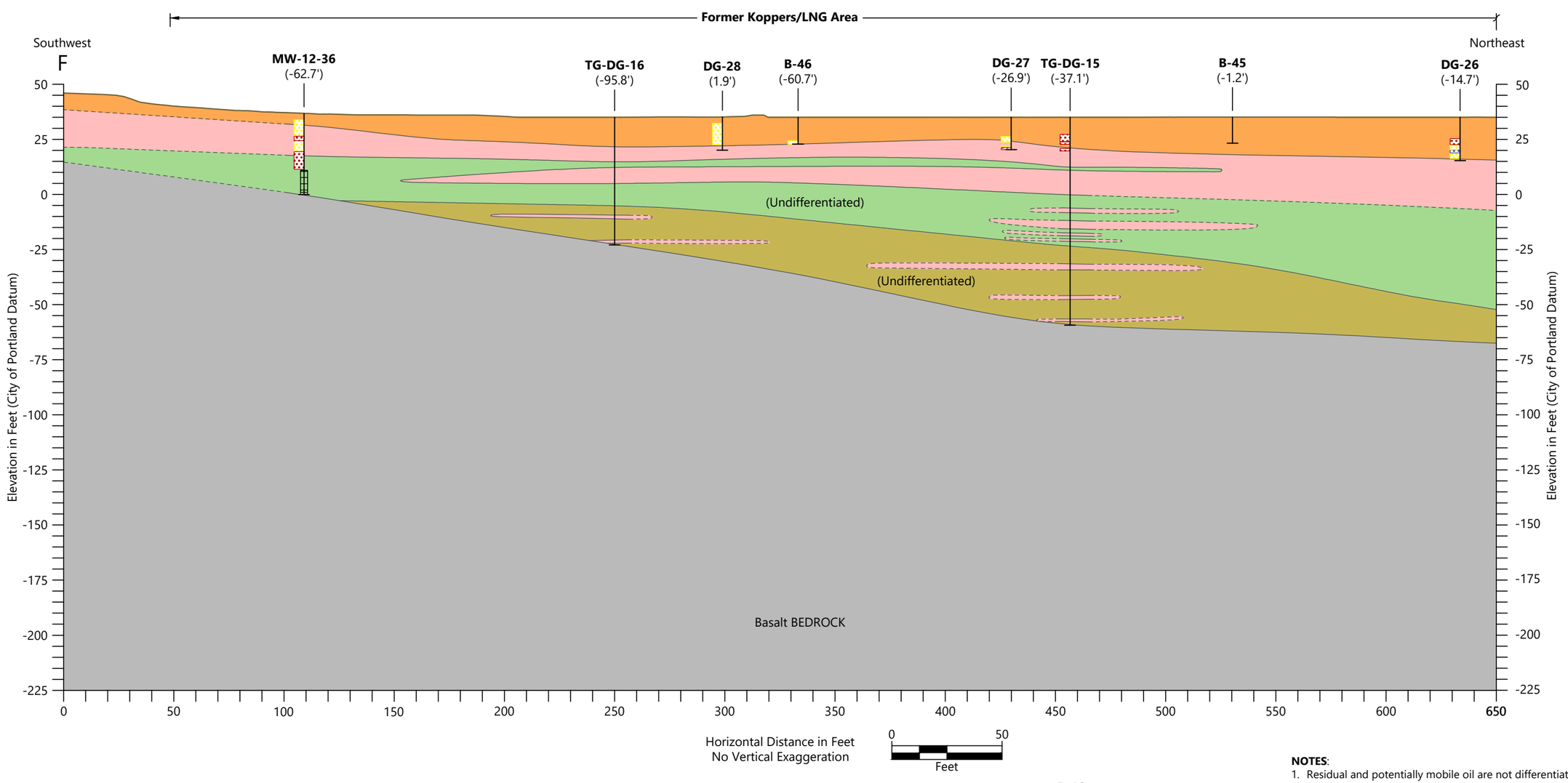
Figure 2-7b
Cross Section E-E' – Sheet 2 of 2

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Sheet 1 | Viewing Northwest | Sheet 1



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen
- Existing Extraction Well
- Existing Well or Piezometer

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Locations GS-B7 and GS-C7 were logged for geologic contacts to 15 feet below mudline and then advanced without logging until refusal. Questionable contacts below that depth are interpolated from geologic unit structural maps created for the site hydrogeological model.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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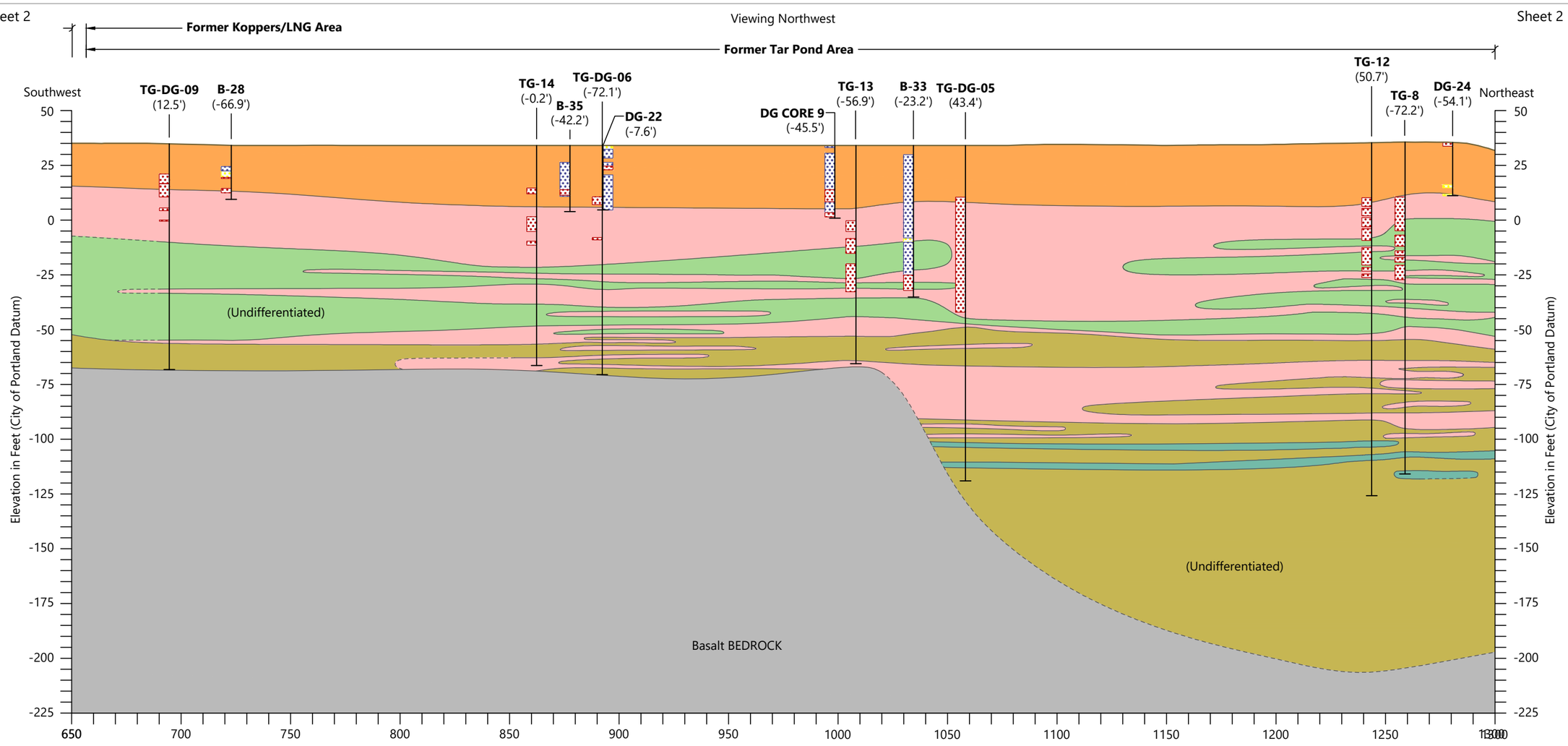
Figure 2-8a
Cross Section F-F' – Sheet 1 of 3

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Sheet 2

Viewing Northwest

Sheet 2



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen
- Existing Extraction Well
- Existing Well or Piezometer

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Locations GS-B7 and GS-C7 were logged for geologic contacts to 15 feet below mudline and then advanced without logging until refusal. Questionable contacts below that depth are interpolated from geologic unit structural maps created for the site hydrogeological model.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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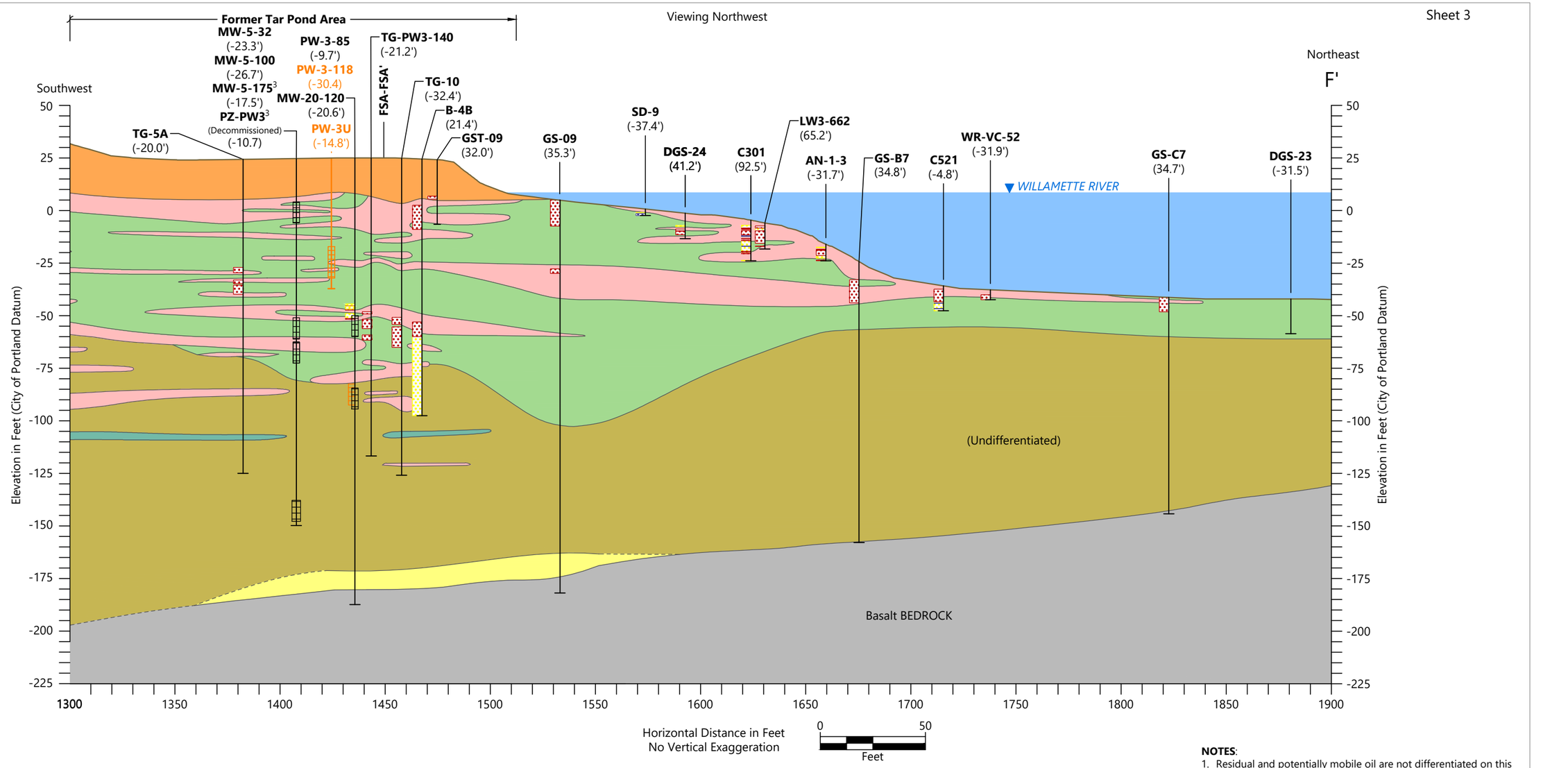
Figure 2-8b
Cross Section F-F' – Sheet 2 of 3

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Viewing Northwest

Sheet 3



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen
- Existing Extraction Well
- Existing Well or Piezometer

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Locations GS-B7 and GS-C7 were logged for geologic contacts to 15 feet below mudline and then advanced without logging until refusal. Questionable contacts below that depth are interpolated from geologic unit structural maps created for the site hydrogeological model.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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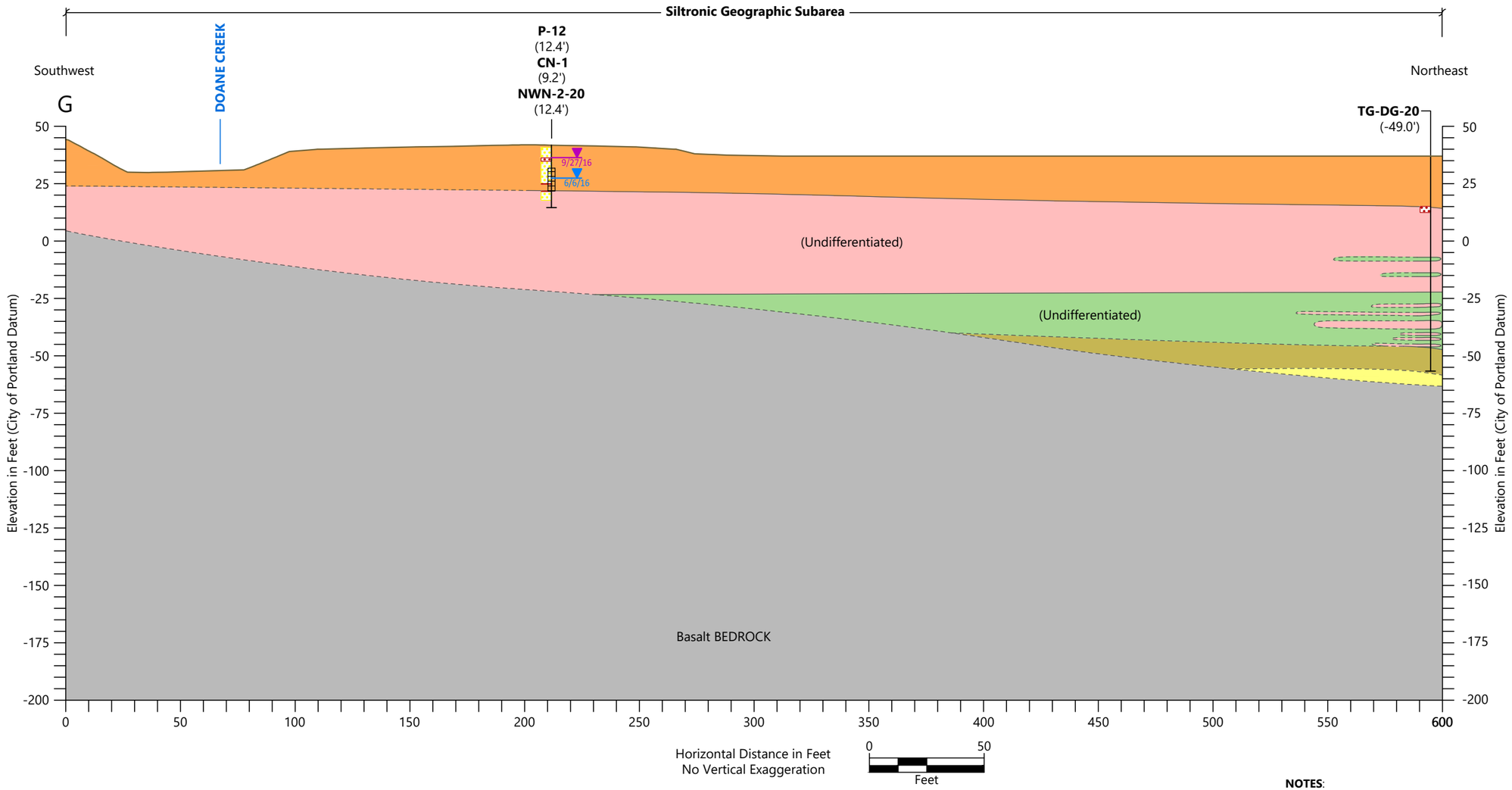
Figure 2-8c
Cross Section F-F' – Sheet 3 of 3

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Viewing Northwest

Sheet 1



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- Existing Extraction Well
- Existing Well or Piezometer
- **P-46** (4.6' N) — Boring ID; Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

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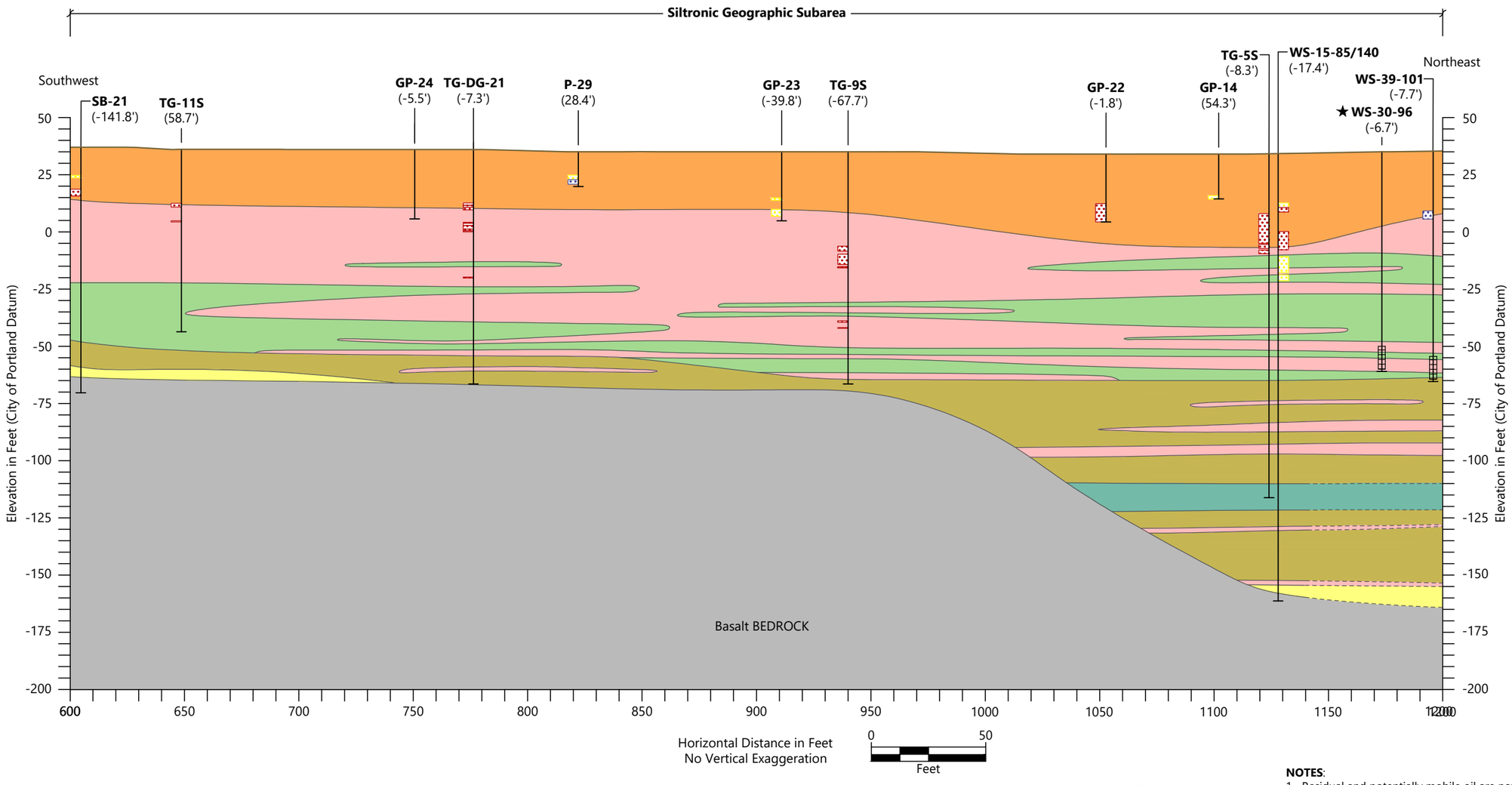
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-002 (XSECS 2018).dwg 2-9a

ANCHOR QEA

Figure 2-9a
Cross Section G-G' – Sheet 1 of 3

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- Existing Extraction Well
- Existing Well or Piezometer
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

★ Not used for geologic interpretation

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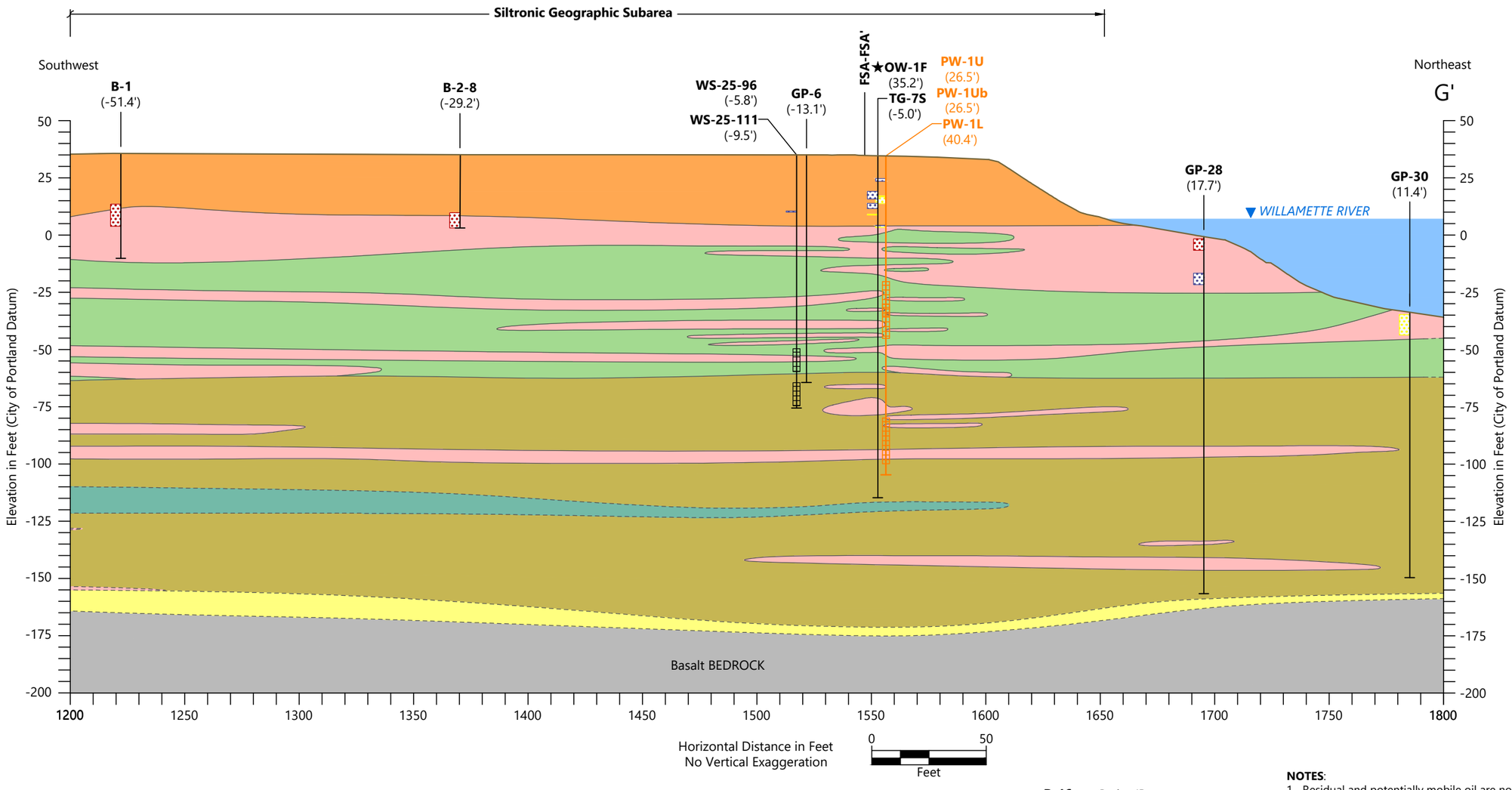
Figure 2-9b
Cross Section G-G' – Sheet 2 of 3

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Viewing Northwest

Sheet 3



LEGEND:

- **Fill WBZ** – Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** – Primarily fine- to-medium-grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- **Lower Alluvium WBZ** – Primarily medium-grained SAND with generally less than 5% fines
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- **Aquitard** – Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Basalt Bedrock
- Existing Ground Surface
- Geologic Contact (dashed where inferred)
- 7/15/16 Highest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- 7/15/16 Lowest Recorded Fill WBZ Groundwater Elevation, 1995-2016
- **P-46** — Boring ID
- (4.6' N) — Offset Distance in Feet
- Existing Extraction Well
- Existing Well or Piezometer
- Oil or Mixed Oil and Tar within a Soil Matrix
- Solid Tar or Tar Mixed within a Soil Matrix
- Soil Matrix Containing Sheen
- Well Screen

NOTES:

1. Residual and potentially mobile oil are not differentiated on this figure.
2. Inferred WBZ and Basalt unit contacts interpolated from geologic unit structural maps created for the site hydrogeologic model.
3. Groundwater elevations from the flood of 1996 were omitted as an extreme event.
4. Zones containing MGP residuals depicted on this figure are highly generalized. Within the depicted zones, the distribution of MGP residuals is highly heterogenous and discontinuous in three dimensions within the stratigraphy and soil matrix.

★ Not used for geologic interpretation

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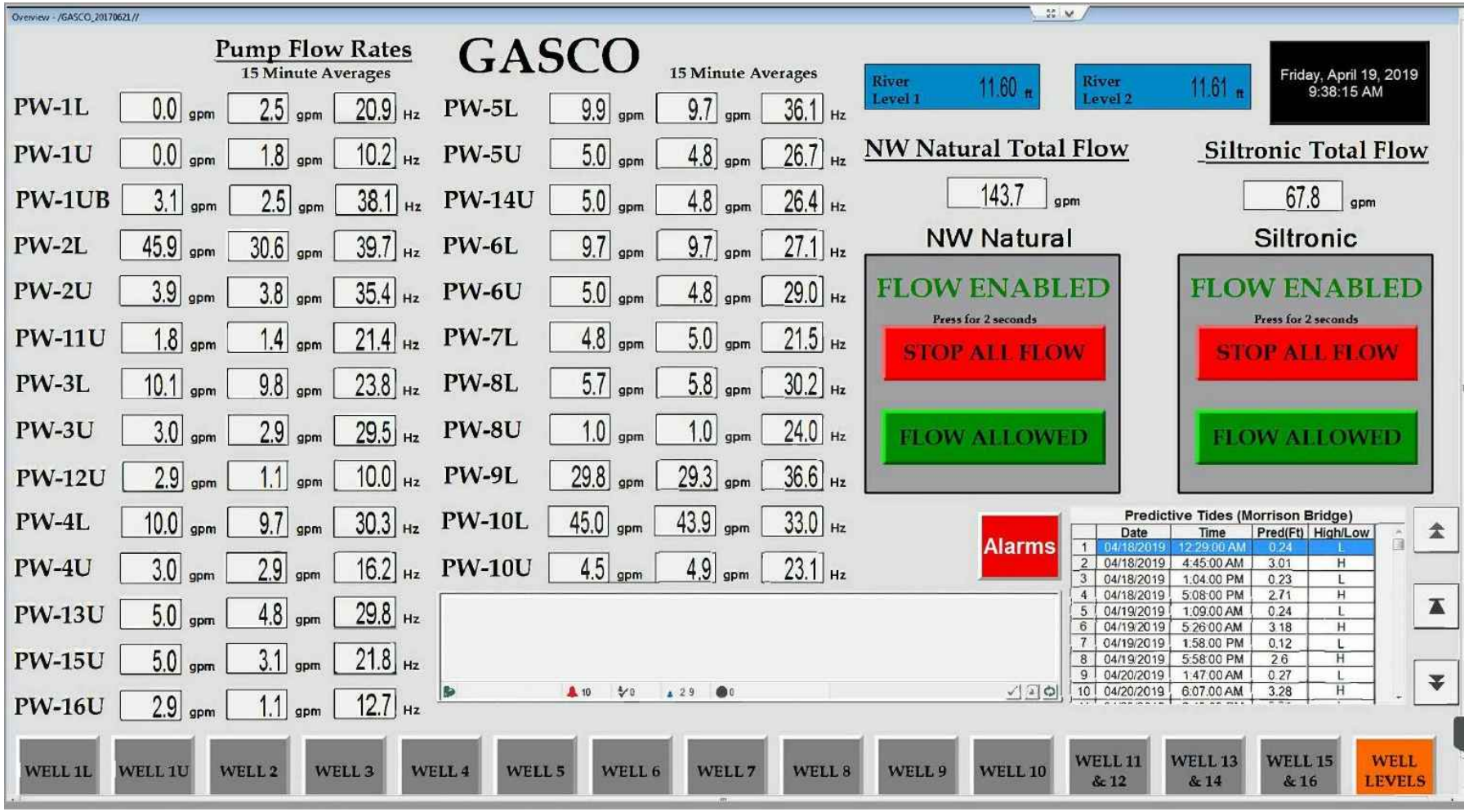
Figure 2-9c
Cross Section G-G' – Sheet 3 of 3

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



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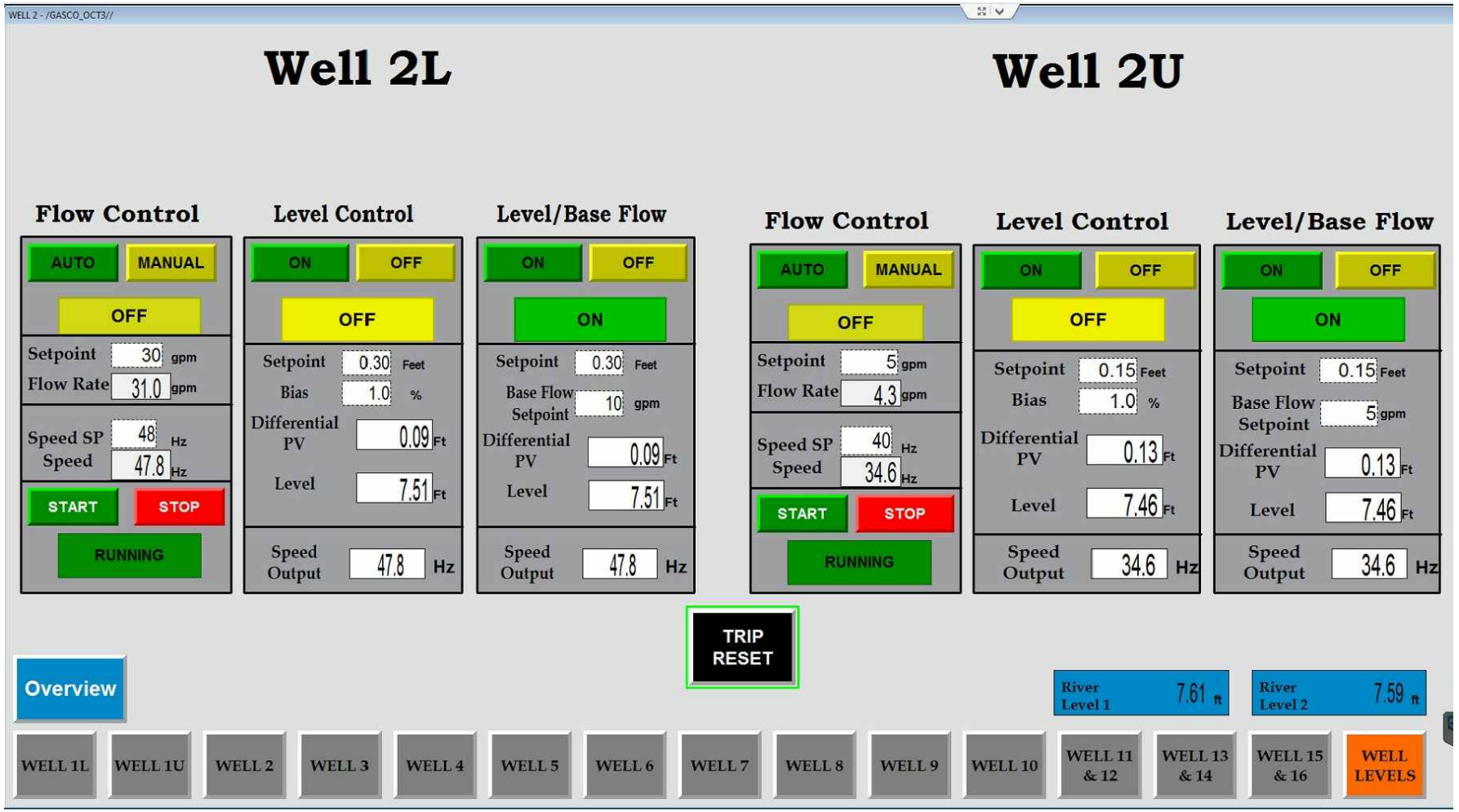
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-005 (HMI).dwg Figure 3-1a

ANCHOR QEA

Figure 3-1a
Human-Machine Interface Overview Screen

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

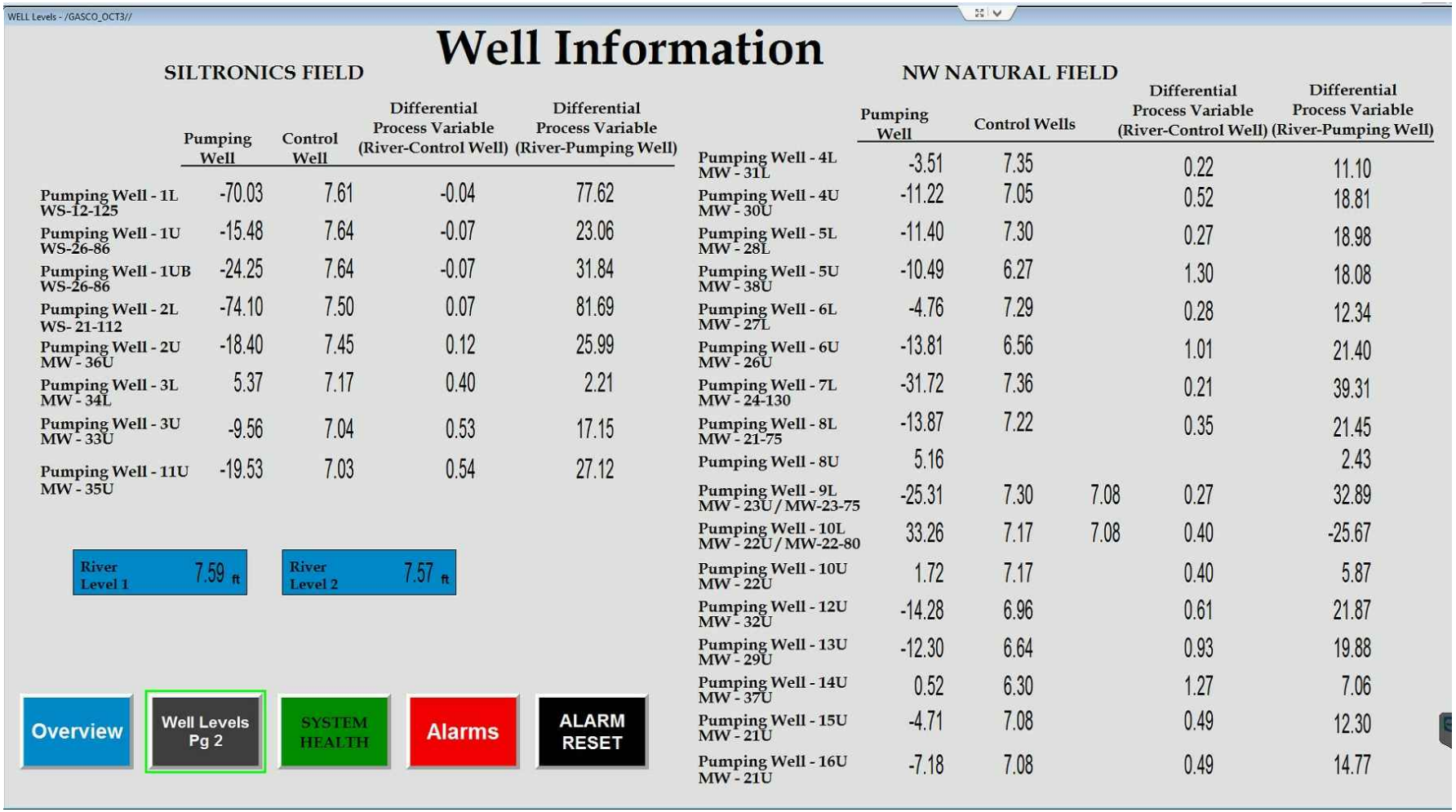


Publish Date: 2019/05/21 4:30 PM | User: hmerrick
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-005 (HMI).dwg Figure 3-1b

ANCHOR QEA

Figure 3-1b
Human-Machine Interface Well Control Screen

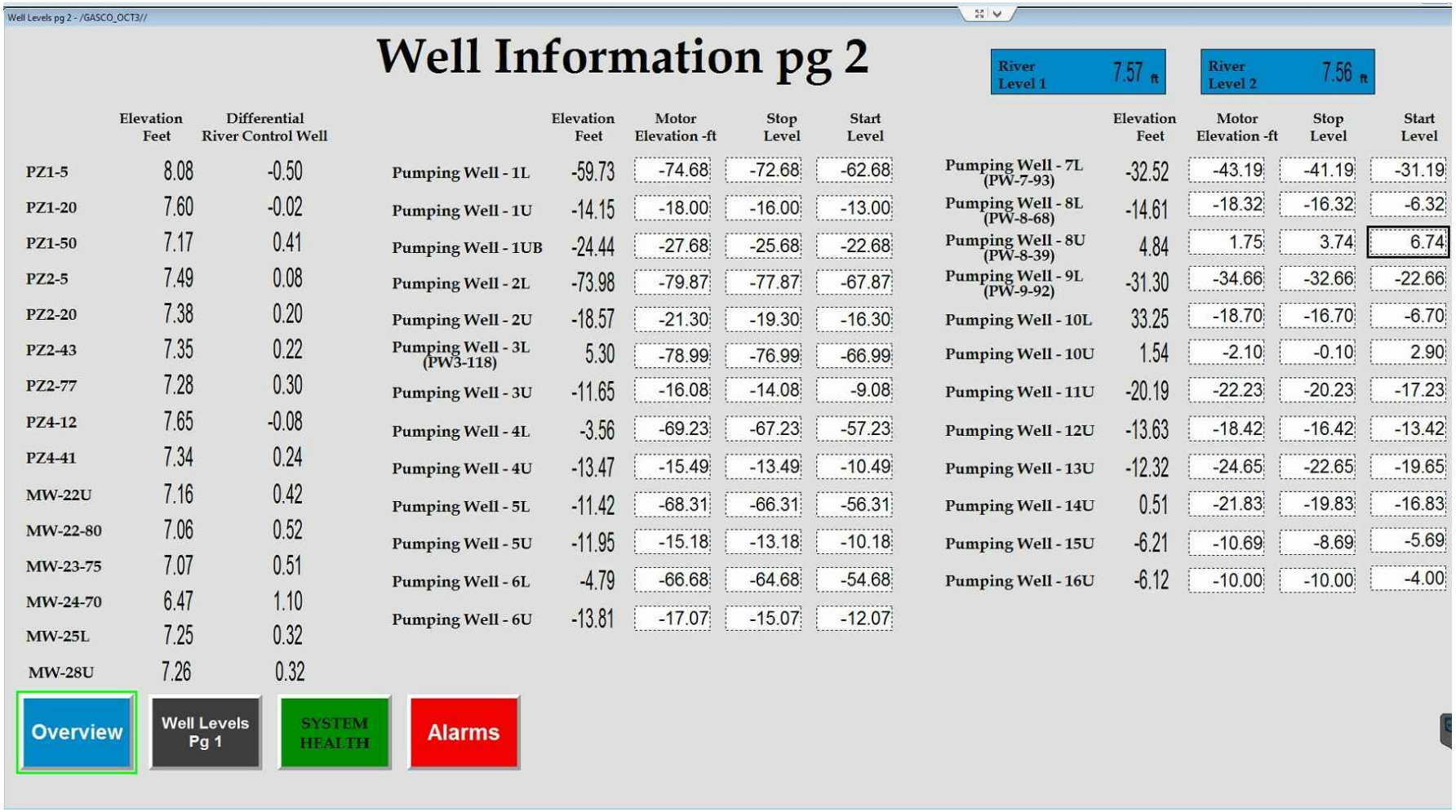
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



Publish Date: 2019/05/21 4:30 PM | User: hmerrick
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-005 (HMI).dwg Figure 3-1c

ANCHOR QEA

Figure 3-1c
Human-Machine Interface Well Information Screen Page 1



	Elevation Feet	Differential River Control Well
PZ1-5	8.08	-0.50
PZ1-20	7.60	-0.02
PZ1-50	7.17	0.41
PZ2-5	7.49	0.08
PZ2-20	7.38	0.20
PZ2-43	7.35	0.22
PZ2-77	7.28	0.30
PZ4-12	7.65	-0.08
PZ4-41	7.34	0.24
MW-22U	7.16	0.42
MW-22-80	7.06	0.52
MW-23-75	7.07	0.51
MW-24-70	6.47	1.10
MW-25L	7.25	0.32
MW-28U	7.26	0.32

	Elevation Feet	Motor Elevation -ft	Stop Level	Start Level
Pumping Well - 1L	-59.73	-74.68	-72.68	-62.68
Pumping Well - 1U	-14.15	-18.00	-16.00	-13.00
Pumping Well - 1UB	-24.44	-27.68	-25.68	-22.68
Pumping Well - 2L	-73.98	-79.87	-77.87	-67.87
Pumping Well - 2U	-18.57	-21.30	-19.30	-16.30
Pumping Well - 3L (PW3-118)	5.30	-78.99	-76.99	-66.99
Pumping Well - 3U	-11.65	-16.08	-14.08	-9.08
Pumping Well - 4L	-3.56	-69.23	-67.23	-57.23
Pumping Well - 4U	-13.47	-15.49	-13.49	-10.49
Pumping Well - 5L	-11.42	-68.31	-66.31	-56.31
Pumping Well - 5U	-11.95	-15.18	-13.18	-10.18
Pumping Well - 6L	-4.79	-66.68	-64.68	-54.68
Pumping Well - 6U	-13.81	-17.07	-15.07	-12.07

	Elevation Feet	Motor Elevation -ft	Stop Level	Start Level
Pumping Well - 7L (PW-7-93)	-32.52	-43.19	-41.19	-31.19
Pumping Well - 8L (PW-8-68)	-14.61	-18.32	-16.32	-6.32
Pumping Well - 8U (PW-8-39)	4.84	1.75	3.74	6.74
Pumping Well - 9L (PW-9-92)	-31.30	-34.66	-32.66	-22.66
Pumping Well - 10L	33.25	-18.70	-16.70	-6.70
Pumping Well - 10U	1.54	-2.10	-0.10	2.90
Pumping Well - 11U	-20.19	-22.23	-20.23	-17.23
Pumping Well - 12U	-13.63	-18.42	-16.42	-13.42
Pumping Well - 13U	-12.32	-24.65	-22.65	-19.65
Pumping Well - 14U	0.51	-21.83	-19.83	-16.83
Pumping Well - 15U	-6.21	-10.69	-8.69	-5.69
Pumping Well - 16U	-6.12	-10.00	-10.00	-4.00

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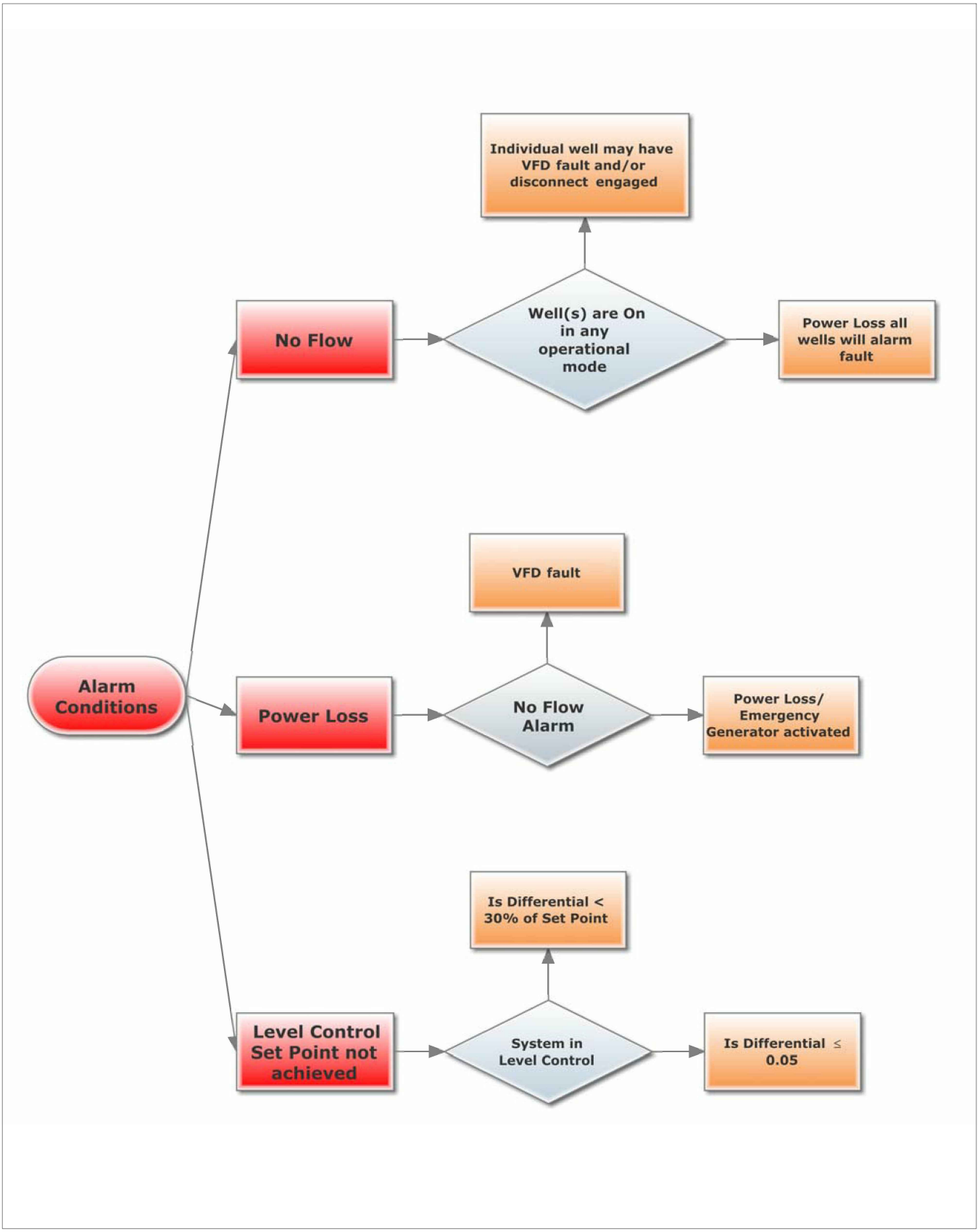
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-005 (HMI).dwg Figure 3-1d

ANCHOR QEA

Figure 3-1d
Human-Machine Interface Well Information Screen Page 2
Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



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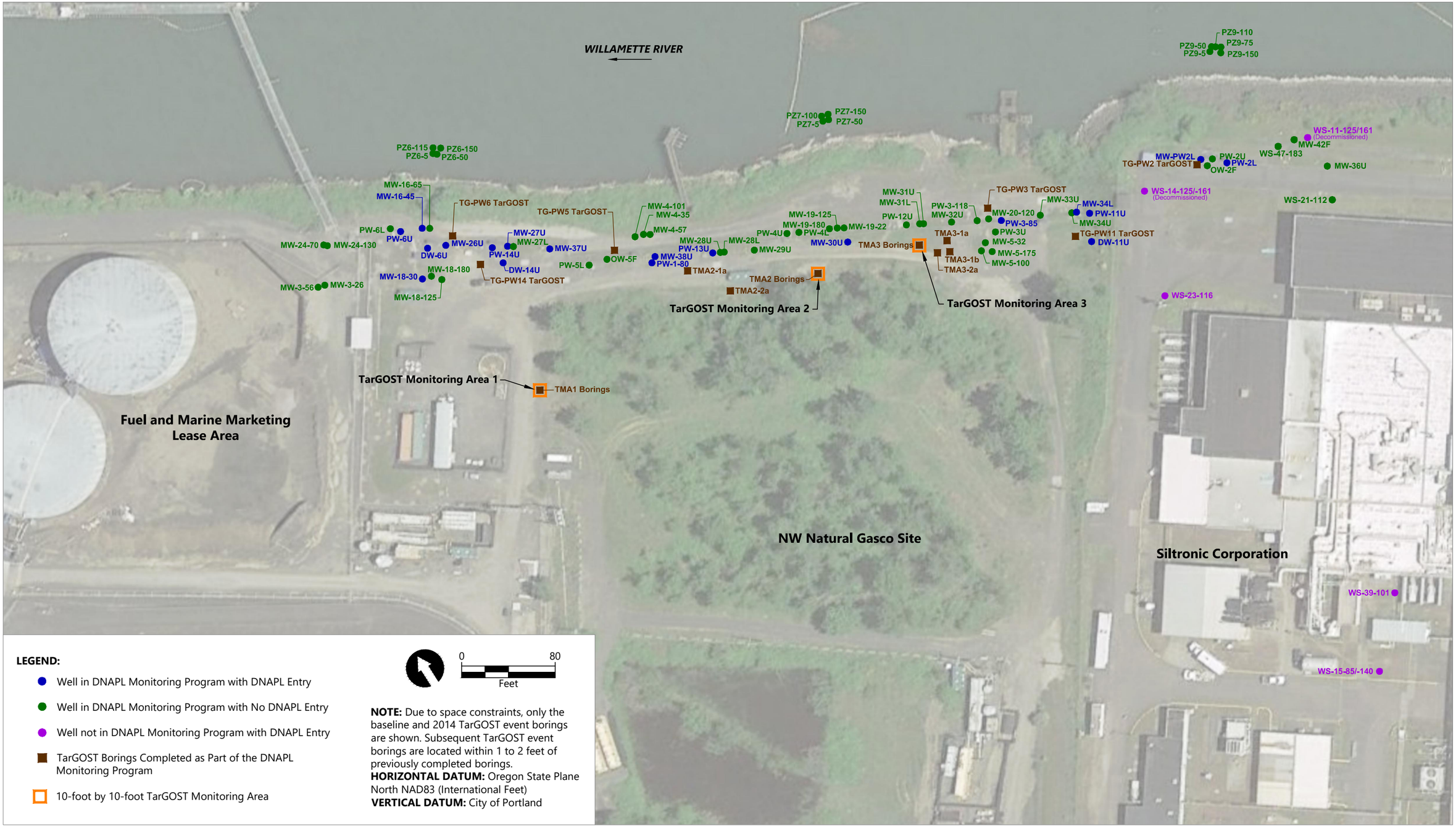
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-005 (HMI).dwg Figure 4-1

ANCHOR QEA

Figure 4-1
HC&C Alarm System Diagram

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site



LEGEND:

- Well in DNAPL Monitoring Program with DNAPL Entry
- Well in DNAPL Monitoring Program with No DNAPL Entry
- Well not in DNAPL Monitoring Program with DNAPL Entry
- TarGOST Borings Completed as Part of the DNAPL Monitoring Program
- 10-foot by 10-foot TarGOST Monitoring Area

0 80
Feet

NOTE: Due to space constraints, only the baseline and 2014 TarGOST event borings are shown. Subsequent TarGOST event borings are located within 1 to 2 feet of previously completed borings.
HORIZONTAL DATUM: Oregon State Plane North NAD83 (International Feet)
VERTICAL DATUM: City of Portland

Publish Date: 2019/06/07 8:56 AM | User: hmerrick
Filepath: K:\Projects\0029-NW Natural Gas Co\Gasco Source Controls\HC&C SCPMP\0029-RP-004 (DNAPL Mon Locs).dwg Figure 5-1

ANCHOR QEA

Figure 5-1
DNAPL Monitoring Locations

Hydraulic Control and Containment System Performance and Monitoring Plan
NW Natural Gasco Site

Appendix A
Sampling and Analysis Plan

ECSI No. 84
June 7, 2019
NW Natural Gasco Site

ANCHOR QEA

Sampling and Analysis Plan

Prepared for NW Natural

ECSI No. 84
June 7, 2019
NW Natural Gasco Site

Sampling and Analysis Plan

Prepared for
NW Natural
220 NW Second Avenue
Portland, Oregon 97209

Prepared by
Anchor QEA, LLC
6720 SW Macadam Avenue, Suite 125
Portland, Oregon 97219

TABLE OF CONTENTS

TABLES

ATTACHMENTS

ABBREVIATIONS

%R	percent recovery
ASTM	ASTM International
CCV	continuing calibration verification
COC	chain-of-custody
DEQ	Oregon Department of Environmental Quality
DO	dissolved oxygen
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FC	field coordinator
GC	gas chromatography
HC&C	hydraulic control and containment
L/min	liter per minute
MDL	method detection limit
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
NIST	National Institute of Standards and Technology
ORP	oxidation reduction potential
OSHA	Occupational Safety and Health Administration
QA	quality assurance
QC	quality control
RL	reporting limit
RPD	relative percent difference
SAP	*Sampling and Analysis Plan*
SOP	standard operating procedure
VOC	volatile organic compounds

1 Introduction

This *Sampling and Analysis Plan* (SAP) has been prepared as Appendix A to the *Hydraulic Control and Containment System Performance and Monitoring Plan*. This plan was adapted from the SAP prepared as Appendix C of the *Final Groundwater Source Control Extraction System Test Plan* for the NW Natural Gasco site in Portland, Oregon (Anchor QEA 2013). This SAP covers monitoring of groundwater hydrology and chemistry in select monitoring wells during full-time, full-scale operation of the groundwater source control hydraulic control and containment (HC&C) system for Segments 1 and 2 at the site.

2 Hydrology Monitoring

2.1 Manual Water Level Monitoring

Following the procedures described herein, manual water level measurements will be made in selected monitoring wells, pumping wells, observation wells, and piezometers before and after the water level transducers are in place. The manual measurements will be used as reference points for the data generated by the transducer equipment. Measurements will be taken with an electronic water level indicator. Levels will be measured to the nearest 0.01 foot from a surveyed notch or mark at the top of the well casing or other reference point. Measurements will be recorded immediately on a Transducer Data Form with the date, time (on a 24-hour clock), reference point, and initials of the person who made the measurement. The manual measurements will be used to calibrate the pressure transducers and monitor for "drift" of the readings. The water level indicator will be decontaminated in between wells, as specified in Section 4.

2.2 Transducer Water Level Monitoring

Accurate, time-coincident measurements will be used to evaluate the performance of the HC&C system. Pressure transducers have been installed in selected wells and in the Willamette River to collect time-coincident water level data for several depth intervals. For long-term monitoring, the data download frequency will be a minimum of once per month to recalibrate the transducers and make sure that excessive drift is not occurring. However, data download frequency could be more frequent for short-term tests that require downloads at the beginning and end of the tests. Groundwater levels will be measured with a water level indicator to the nearest 0.01 foot from a surveyed notch or mark at the top of the well casing or other reference point. Measurements will be recorded immediately on a Transducer Data Form level record sheet with the date, time (on a 24-hour clock), reference point, and initials of the person who made the measurement. If the manual measurement is off by more than 0.05 foot from the transducer reading, the transducer will be corrected. If the time difference between the transducer and computer is greater than 5 minutes , the transducer clock will be resynchronized.

2.2.1 Pressure Transducer Installation

Pressure transducers (15 and 30 pounds per square inch, In-Situ mini-TROLL professional, In-Situ level TROLL, or similar) have been installed at the selected locations. The pressure transducers were installed using cables that extend from the surface to the instrument that is submerged in the well or river water. The cables allow in situ calibration of depth-to-water measurements from the surface. The full-length cables also allow for venting to the atmosphere, eliminating the need for barometric data correction.

The following procedure will be used to install the transducers:

1. Each instrument will be connected to a communication/vent cable of the appropriate length.
2. The instrument and cable will be decontaminated before and after installation using the procedures detailed in Section 4.
3. The instrument will be calibrated to zero in ambient air conditions.
4. The instrument and cable will be slowly fed down into the well to a depth that will ensure submersion throughout the monitoring period.
5. The instrument cable will be securely attached to the well casing.
6. The instrument and cable will cause displacement of water in the well casing; therefore, the water level in the well will be allowed to equilibrate for 30 to 60 minutes before depth-to-water reference measurements are entered into the instrument.
7. The installer will connect to the instrument cable with a portable personal computer.
8. The installer will use an electric water level indicator to measure the depth-to-water from the reference point and enter the result into the instrument as a real-time reference value. The installer will repeat the measurement and record both readings for quality control (QC).
9. The installer will program the instrument to collect one measurement of temperature and depth-to-water (pressure) at least every 15 minutes.
10. The aboveground connector on the cable will be protected by a desiccant filter that is designed specifically for this application.

3 Water Quality Monitoring

Groundwater samples will be collected from selected wells during full-time, full-scale HC&C system operation. Groundwater samples will be collected from extraction wells, monitoring wells, observation wells, and piezometers along the shoreline of the site. The selected wells and frequency of sampling are listed in the Comprehensive Groundwater Framework, included as Appendix B to the *Hydraulic Control and Containment System Performance Monitoring Plan*. The Comprehensive Groundwater Framework lists the target analytes, including volatile organic compounds (VOCs); polycyclic aromatic hydrocarbons; total metals; and total, available, and free cyanide.

3.1 Groundwater Sample Collection Procedures

Prior to groundwater sample collection, depth-to-water readings from the top of the well casing will be measured using a water level indicator. The water level indicator will be decontaminated between wells using the procedures outlined in Section 4.

The wells will then be purged using low flow (minimal drawdown) or standard groundwater sampling procedures (EPA 1996). Purging will be completed using a Waterra displacement pump, peristaltic pump, or dedicated submersible pump. Once started, turning the pump on and off should be avoided because this allows the water column in the tubing to surge back into the well, possibly mobilizing particulate material. Similarly, significant variations in flow rate should be avoided, as these actions can result in surging.

When using the low flow technique, flow rates will be adjusted to ensure no more than 0.3 foot of drawdown occurs within the well. The U.S. Environmental Protection Agency (EPA) low flow guidance document suggests typical flow rates of less than 0.5 liter per minute (L/min), but they can be as high as 1 L/min. The lowest possible sustainable flow rate should be achieved. If the water table level cannot be maintained, standard purging methods may be used, as described subsequently. Stabilization parameter measurements will be recorded on a Field Sampling Data Sheet at an appropriate time interval (every 3 to 5 minutes). Parameter measurements include time, purge volume, depth-to-water, temperature, specific conductivity, dissolved oxygen (DO), pH, oxidation reduction potential (ORP), and turbidity. Stabilization has occurred after three successive readings within ± 0.1 for pH, ± 3% for conductivity, ± 10 millivolts for redox potential, and ± 10% for turbidity and DO. Once stabilization has occurred in the selected parameters, sampling may begin. Should individual parameters not stabilize after a reasonable amount of purging (two to three casing volumes), pumping rates will be increased, and standard purging techniques will be followed. The pump will not be stopped until the sample collection is complete.

As discussed previously, if low flow sampling is not possible due to drawdown or unstable field parameters, the well will be sampled by purging of at least three well casing volumes before

groundwater is collected. Purging will be accomplished with one of the following methods: peristaltic pump with dedicated polyethylene tubing, Waterra inertial pump with dedicated Waterra tubing and check-valve, a disposable polyethylene bailer, or a submersible pump. Note that dedicated tubing or piping will be installed in all wells, either for use with a peristaltic pump for wells with shallow depths-to-water or an inertial pump or as a discharge line to a submersible pump. A bailer is only noted above as a contingent sampling device due to pump failure. After each well casing volume has been purged, water quality parameters (pH, specific conductance, temperature, turbidity, DO, and ORP) will be recorded using a calibrated water quality meter. The well will be considered adequately purged when the water quality parameters have stabilized to within ± 10% of the previous measurement. Care will be taken to produce low turbidity samples with a goal of 50 Nephelometric Turbidity Units or lower; however, this is not always possible with poorly producing wells or with wells screened in highly silty or clayey soil.

After the water quality parameters have stabilized, the sample will be collected directly from the dedicated tubing or disposable bailer into the sample container. If standard purging techniques are used, pumping rates will be reduced during sample collection. In the event that a bailer is used, a low flow, bottom emptying device will be used to fill VOC containers. The samples will then be stored on ice for shipment to an analytical laboratory.

4 Equipment Cleaning and Decontamination Procedures

Decontamination procedures are specified in this section. The objective for decontamination is to reduce the chance of cross-contaminating samples. All waters generated by cleaning and decontamination will be contained and disposed of. The water from sampling the site wells will be treated in the on-site treatment system.

4.1 Groundwater Monitoring Equipment

Groundwater sampling equipment includes items used during groundwater sampling and water level monitoring. Dedicated or single-use sampling equipment will be used for sample collection; however, equipment such as water level probes and oil/water interface probes will require decontamination. All equipment that contacts groundwater will be decontaminated before its first use and between sampling locations. Decontamination will proceed as follows:

- Distilled-water rinse
- Non-phosphatic detergent (e.g., Liquinox) and water wash
- Distilled water rinse
- Final distilled water rinse

5 Quality Assurance Plan

5.1 Data Quality Objectives and Criteria

The overall data quality objective (DQO) for this project is to ensure that the data collected are of known and acceptable quality so the project objectives described in this document can be achieved. The quality of the laboratory data is assessed by precision, accuracy, representativeness, comparability, and completeness (the "PARCC" parameters). Definitions of these parameters and the applicable QC procedures are given in the subsequent sections. Applicable quantitative goals for these data quality parameters are listed or referenced in Table A-1.

5.1.1 Precision

Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sampling, sample handling, and laboratory analysis. ASTM International (ASTM) recognizes two levels of precision: 1) repeatability—the random error associated with measurements made by a single test operator on identical aliquots of test material in a given laboratory, with the same apparatus, under constant operating conditions; and 2) reproducibility—the random error associated with measurements made by different test operators, in different laboratories, using the same method but different equipment to analyze identical samples of test material.

In the laboratory, "within-batch" precision is measured using replicate sample or QC analyses and is expressed as the relative percent difference (RPD) between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analysis of standard solutions or laboratory control samples from multiple analytical batches.

Field precision will be evaluated by the collection of blind field duplicates for chemistry samples at a frequency of one in 10 samples. Field chemistry duplicate precision will be screened against an RPD of 50% for groundwater samples. However, no data will be qualified based solely on field duplicate precision.

Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit (MDL), where the percent error (expressed as RPD) increases. The equation used to express precision is shown in Equation A-1.

Equation A-1

$$\text{RPD} = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

where:

RPD	=	relative percent difference
C_1	=	larger of the two observed values
C_2	=	smaller of the two observed values

5.1.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the mean value of results from ongoing analyses of laboratory-fortified blanks, standard reference materials, and standard solutions. In addition, laboratory-fortified (i.e., matrix-spiked) samples are also measured; this indicates the accuracy or bias in the actual sample matrix. Accuracy is expressed as percent recovery (%R) of the measured value relative to the true or expected value. If a measurement process produces results for which the mean is not the true or expected value, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination). Analytical laboratories utilize several QC measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples, and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net (or total) bias can be evaluated in a measurement.

Laboratory accuracy will be evaluated against quantitative matrix spike (MS) and surrogate spike recovery performance criteria provided by the laboratory. Accuracy can be expressed as a percentage of the true or reference value or as a %R in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is shown in Equation A-2.

Equation A-2

$$\%R = 100\% \times \frac{S - U}{Csa}$$

where:

%R	=	percent recovery
S	=	measured concentration in the spiked aliquot
U	=	measured concentration in the unspiked aliquot
C_{sa}	=	actual concentration of spike added

Field accuracy will be controlled by adherence to sample collection procedures outlined in the SAP.

5.1.3 Bias

Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction. Bias assessments for environmental measurements are made using personnel, equipment, and spiking or reference materials as independent as possible from those used in the calibration of the measurement system. When possible, bias assessments should be based on analysis of spiked samples rather than reference materials, so the effect of the matrix on recovery is incorporated into the assessment. A documented spiking protocol, and consistency in following that protocol, is important to obtaining meaningful data quality estimates.

5.1.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an environmental condition. For the site, the list of analytes has been identified to provide a comprehensive assessment of the known and potential contaminants at the site.

5.1.5 Comparability

Comparability expresses the confidence with which one dataset can be evaluated in relation to another dataset. For this program, comparability of data will be established through the use of standard analytical methodologies and reporting formats, as well as the use of common traceable calibration and reference materials.

5.1.6 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as shown in Equation A-3.

Equation A-3

C = (Number of acceptable data points) x 100/(Total number of data points)

The DQO for completeness for all components of this project is 90. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

5.1.7 Sensitivity

Analytical sensitivities must be consistent with or lower than the regulated criteria values to demonstrate compliance with this section. When they are achievable, target detection limits specified will be at least a factor of two less than the analyte's corresponding regulated criteria value.

The MDL is defined as the minimum concentration at which a given target analyte can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Laboratory practical quantitation limits or reporting limits (RLs) are defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. Laboratory MDLs and RLs will be used to evaluate the method sensitivity and applicability prior to the acceptance of a method for this program.

The sample-specific MDL and RL will be reported by the laboratory and will take into account any factors relating to the sample analysis that might decrease or increase the RL (e.g., dilution factor, percent moisture, sample volume, or sparge volume). In the event that the MDL and RL are elevated for a sample due to matrix interferences and subsequent dilution or reduction in the sample aliquot, the data will be evaluated by Anchor QEA, LLC, and the laboratory to determine if an alternative course of action is required or possible. If this situation cannot be resolved readily (i.e., detection limits are less than criteria are achieved), the Oregon Department of Environmental Quality (DEQ) will be contacted to discuss an acceptable resolution. The sample-specific RL will be the value provided in the project database and subsequent EQuIS deliverable.

5.1.8 Special Training Requirements/Certifications

The 29 Code of Federal Regulations 1910.120 Occupational Safety and Health Administration (OSHA) regulations require training to provide employees with the knowledge and skills enabling them to perform their jobs safely and with minimum risk to their personal health. All sampling personnel will have completed the 40-hour HAZWOPER training course and 8-hour refresher courses, as necessary, to meet the OSHA regulations.

5.2 Documentation and Records

This project will require central project files to be maintained at Anchor QEA. Project records will be stored and maintained in a secure manner. Each project team member is responsible for filing all necessary project information or providing it to the person responsible for the filing system. Individual team members may maintain files for individual tasks but must provide such files to the central project files upon completion of each task. A project-specific index of file contents is to be kept with the project files. Hard copy documents will be kept on file at Anchor QEA or at a document storage facility throughout the duration of the project, and all electronic data will be maintained in the database at Anchor QEA.

5.2.1 Field Records

All documents generated during the field effort are controlled documents that become part of the project file.

5.2.1.1 Field Forms

Field team members will keep a daily record of significant events, observations, and measurements on field forms. Copies of typical field forms are in Attachment A-1. All field activities will be recorded on forms specific to the collection activity and will be maintained by the field coordinator (FC). Field forms will be the main source of field documentation for all field activities. The on-site field representative will record on the field log form information pertinent to the investigation program. The sampling documentation will contain information on each sample collected and will include at a minimum the following information:

- Project name
- Field personnel on site
- Facility visitors
- Weather conditions
- Field observations and any deviations from the SAP
- Maps and drawings
- Date and time sample collected
- Sampling method and description of activities
- Identification or serial numbers of instruments or equipment used
- Deviations from the SAP
- Conferences associated with field sampling activities

The field forms will be on water-resistant, durable paper for adverse field conditions. Notes will be taken in indelible, waterproof blue or black ink. Errors will be corrected by crossing out with a single line, dating, and initialing. Each form will be marked with the project name, number, and date. The

field forms will be scanned into Anchor QEA's project file directory, as convenient during the sampling event or upon completion of each sampling event.

Sample collection tables will be prepared prior to each sampling program. The checklist will include proposed coordinates of each location, the sampling scheme, and whether any QC samples are to be collected.

5.2.2 Analytical and Chemistry Records

Analytical data records will be retained by the laboratory and in the Anchor QEA central project files. For all analyses, the data reporting requirements will include those items necessary to complete data validation, including copies of all raw data. The analytical laboratory will be required, where applicable, to report the following:

- **Project Narrative.** This summary, in the form of a cover letter, will discuss problems, if any, encountered during any aspect of analysis. This summary should discuss, but not be limited to, QC, sample shipment, sample storage, and analytical difficulties. Any problems encountered, actual or perceived, and their resolutions will be documented in as much detail as appropriate.
- **Chain-of-Custody Records.** Legible copies of the chain-of-custody (COC) forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented on a sample receipt form. The form must include all sample shipping container temperatures measured at the time of sample receipt.
- **Sample Results.** The data package will summarize the results for each sample analyzed. The summary will include the following information, when applicable:
  - Field sample identification code and the corresponding laboratory identification code
  - Sample matrix
  - Date of sample extraction
  - Date and time of analysis
  - Weight and volume used for analysis
  - Final dilution volumes or concentration factor for the sample
  - Identification of the instrument used for analysis
  - MDLs
  - Method reporting limits (MRLs) accounting for sample-specific factors (e.g., dilution, total solids)
  - Analytical results with reporting units identified
  - Data qualifiers and their definitions
  - A computer disk with the data in a format specified in advance by Anchor QEA

- **Quality Assurance/Quality Control Summaries.** This section will contain the results of the laboratory quality assurance (QA)/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results. No recovery or blank corrections will be made by the laboratory. The required summaries are listed subsequently; additional information may be requested.
- **Calibration Data Summary.** This summary will report the concentrations of the initial calibration and daily calibration standards and the date and time of analysis. The response factor, percent relative standard deviation, percent difference, and retention time for each analyte will be listed, as appropriate. Results for standards to indicate instrument sensitivity will be documented.
- **Internal Standard Area Summary.** The stability of internal standard areas will be reported.
- **Method Blank Analysis.** The method blank analyses associated with each sample and the concentration of all compounds of interest identified in these blanks will be reported.
- **Surrogate Spike Recovery.** This will include all surrogate spike recovery data for organic compounds. The name and concentration of all compounds added, %Rs, and range of recoveries will be listed.
- **Matrix Spike Recovery.** This will report all MS recovery data for organic and metal compounds. The name and concentration of all compounds added, %Rs, and range of recoveries will be listed. The RPD for all duplicate analyses will be included.
- **Matrix Spike Duplicate.** This will include the %R and associated RPD for all matrix spike duplicate (MSD) analyses.
- **Laboratory Control Sample.** All laboratory control sample recovery data for organic and metal compounds will be reported. The name and concentration of all compounds added, %Rs, and range of recoveries will be listed. The RPD for all duplicate analyses will be included.
- **Relative Retention Time.** This will include a report of the relative retention time of each analyte detected in the samples for both primary and conformational analyses.
- **Original Data.** Legible copies of the original data generated by the laboratory will include the following:
  - Sample extraction, preparation, identification of extraction method used, and cleanup logs
  - Instrument specifications and analysis logs for all instruments used on days of calibration and analysis
  - Calculation worksheets for inorganic analyses
  - Reconstructed ion chromatograms for all samples, standards, blanks, calibrations, spikes, replicates, and reference materials
  - Original printouts of full scan chromatograms and quantitation reports for all gas chromatography (GC) and/or GC/MS samples, standards, blanks, calibrations, spikes, replicates, and reference materials

- Enhanced spectra of detected compounds with associated best-match spectra for each sample

All instrument data shall be fully restorable at the laboratory from electronic backup. Laboratories will be required to maintain all records relevant to project analyses for a minimum of 7 years. Data validation reports will be maintained in the central project files with the analytical data reports.

5.2.3 Data Reduction

Data reduction is the process by which original data (analytical measurements) are converted or reduced to a specified format or unit to facilitate analysis of the data. Data reduction requires that all aspects of sample preparation that could affect the test result, such as sample volume analyzed or dilutions required, be taken into account in the final result. It is the laboratory analyst's responsibility to reduce the data, which are subjected to further review by the laboratory manager, the project manager, the QA/QC manager, and independent reviewers. Data reduction may be performed manually or electronically. If performed electronically, all software used must be demonstrated to be true and free from unacceptable error. The following will be included in the data report:

- Copies of complete laboratory data packages as appendices or attachments
- Copies of applicable sections of the field log as appendices or attachments
- Copies of validation reports and/or findings

5.3 Overview of Data Generation and Acquisition

The rationale for the sampling design and design assumptions for locating and selecting environmental samples is detailed in the *Draft Groundwater Source Control Final Design Report*. The methods and procedures for collection of field samples are also provided in the *Draft Groundwater Source Control Final Design Report*.

5.3.1 Analytical Methods

This section summarizes the target chemical analyses for the samples. All sample analyses will be conducted in accordance with DEQ-approved methods. Table A-1 presents the proposed analytes, the analytical methods to be used, and the targeted RLs for the chemical testing. Prior to analysis, all samples will be maintained according to the appropriate holding times and temperatures for each analysis as defined in Table A-2. The analytical laboratory will prepare a detailed report in accordance with this section to be included as an appendix in the data report.

Prior to the analysis of the samples, the laboratory will calculate MDLs for each analyte of interest, where applicable. MRLs will be below the values specified in Table A-1 if technically feasible. To achieve the required detection limits, some modifications to the methods may be necessary. These

modifications from the specified analytical methods will be provided by the laboratory at the time of establishing the laboratory contract and must be approved by DEQ prior to implementation.

Chemical testing will be conducted at an accredited laboratory under the National Environmental Laboratories Accreditation Program. In completing chemical analyses for this project, the contract laboratory is expected to meet the following minimum requirements:

- Adhere to the methods outlined in this section, including methods referenced for each analytical procedure (see Table A-1).
- Deliver facsimile, hard copy, and electronic data as specified.
- Meet reporting requirements for deliverables.
- Meet turnaround times for deliverables.
- Implement QA/QC procedures, including DQOs, laboratory QC requirements, and performance evaluation testing requirements.
- Notify the project QA/QC manager of any QA/QC problems when they are identified to allow for quick resolution.
- Allow laboratory and data audits to be performed, if deemed necessary.

5.3.2 Quality Assurance and Quality Control

Field and laboratory activities must be conducted in such a manner that the results meet specified quality objectives and are fully defensible. Guidance for QA/QC is derived from the protocols developed for the EPA SW-846 (1986), the EPA Contract Laboratory Program (EPA 2008), and the cited methods.

5.3.2.1 Field Quality Control

Anchor QEA personnel will identify and label samples in a consistent manner to ensure that field samples are traceable and that labels provide all information necessary for the laboratory to conduct required analyses properly. Samples will be placed in appropriate containers and preserved for shipment to the laboratory.

5.3.2.1.1 Sample Containers

Sample containers and preservatives will be provided by the laboratory. The laboratory will maintain documentation certifying the cleanliness of bottles and the purity of preservatives provided. Specific container requirements will be subject to the sample design as described in this section.

5.3.2.1.2 Sample Identification and Labels

Each sample will have an adhesive plastic or waterproof paper label affixed to the container and will be labeled at the time of collection. The following information will be recorded on the container label at the time of collection:

- Project name
- Sample identification
- Date and time of sample collection
- Preservative type (if applicable)
- Analysis to be performed

Samples will be uniquely identified with a sample identification that at a minimum specifies sample matrix, sample number, sample location, and type of sample.

5.3.2.1.3 Sample Custody and Shipping Requirements

Samples are considered to be in one's custody if they are: 1) in the custodian's possession or view, 2) in a secured location (under lock) with restricted access, or 3) in a container that is secured with an official seals such that the sample cannot be reached without breaking the seals.

COC procedures will be followed for all samples throughout the collection, handling, and analysis process. The principal document used to track possession and transfer of samples is the COC form. Each sample will be represented on a COC form the day it is collected. All data entries will be made using indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, then dating and initialing the change. Blank lines or spaces on the COC form will be lined-out, dated, and initialed by the individual maintaining custody.

A COC form will accompany each cooler of samples to the analytical laboratories. Each person who has custody of the samples will sign the COC form and ensure that the samples are not left unattended unless properly secured. Copies of all COC forms will be retained in the project files.

All samples will be shipped to the analytical laboratory no later than the day after collection. Samples collected on Friday may be held until the following Monday for shipment provided that this does not jeopardize any hold time requirements. Specific sample shipping procedures are as follows:

- Each cooler or container containing the samples for analysis will be hand-delivered by courier or shipped via overnight delivery to the appropriate analytical laboratory. In the event that Saturday delivery is required, the FC will contact the analytical laboratory before 3:00 p.m. on Friday to ensure that the laboratory is aware of the number of coolers shipped and the airbill tracking numbers for those coolers. Following each shipment, the FC will call the laboratory and verify that the shipment from the day before has been received and is in good condition.

- Coolant ice will be placed in the shipping containers. It will be placed in durable sealable plastic bags to limit leakage during transit.
- Individual sample containers will be packed to prevent breakage and transported in a sealed ice chest or other suitable container.
- Glass jars will be separated in the shipping container by shock-absorbent material (e.g., bubble wrap) to prevent breakage.
- The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification.
- A sealed envelope containing COC forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.
- A minimum of two signed and dated COC seals will be placed on adjacent sides of each cooler prior to shipping.
- Each cooler will be wrapped securely with strapping tape and will be clearly labeled with the laboratory's shipping address and the consultant's return address.
- Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the COC form. Upon receipt of samples at the laboratory, the shipping container seal will be broken, and the receiver will record the condition of the samples on a sample receipt form. The temperature of each cooler will be measured upon receipt and recorded on the sample receipt form. COC forms will be used in the laboratory to track sample handling and final disposition.

5.3.2.1.4 Field Quality Assurance Sampling

Field QA procedures will consist of following procedures for acceptable practices for collecting and handling of samples. Adherence to these procedures will be complemented by periodic and routine equipment inspection.

Field QA samples will be collected along with the environmental samples. Field QA samples are useful in identifying possible problems resulting from sample collection or sample processing in the field. The collection of field QA samples includes field blanks and duplicate samples. Duplicate samples will be collected at a frequency of one duplicate sample per 20 (5% frequency) and field blanks will be collected at a frequency of one sample per 20 (5% frequency). The field blank will be analyzed for the identical chemical list as the groundwater samples. In addition, a trip blank will be included in each shipping container that includes samples for volatiles analysis. The trip blank samples will be analyzed for VOCs.

Field QA samples will also include the collection of additional sample volume to ensure that the laboratory has sufficient sample volume to run the program-required analytical QA/QC (MS/MSD) samples for analysis as specified in Table A-3. Additional sample volume to meet this requirement

will be collected at a frequency of one per sampling event or one in 20 samples processed, whichever is more frequent. The samples designated for MS/MSD analyses should be clearly marked on the COC form.

All field QA samples will be documented on the field forms and verified by the QA/QC manager or designee.

5.3.2.2 Laboratory Quality Control

Laboratory QC procedures, where applicable, include initial and continuing instrument calibrations, standard reference materials, laboratory control samples, matrix replicates, MSs, surrogate spikes (for organic analyses), and method blanks. Table A-3 lists the frequency of analysis for laboratory QA/QC samples, and Table A-4 summarizes the DQOs of sample testing for precision, accuracy, and completeness.

Results of the QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, the QA/QC manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

5.3.2.2.1 Laboratory Instrument Calibration and Frequency

An initial calibration will be performed on each laboratory instrument to be used at the start of the project, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet method control criteria. A calibration verification will be analyzed following each initial calibration and will meet method criteria prior to analysis of samples. Continuing calibration verifications (CCVs) will be performed daily prior to any sample analysis to track instrument performance. The frequency of CCVs varies with method. For GC/MS methods, one will be analyzed every 12 hours. For GC, metals, and inorganic methods, one will be analyzed for every 10 field samples, or daily, whichever is more frequent. If the ongoing continuing calibration is out of control, the analysis must come to a halt until the source of the control failure is eliminated or reduced to meet control specifications. All project samples analyzed while instrument calibration was out of control will be reanalyzed.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately prior to CCV at the instrument for each type of applicable analysis.

5.3.2.2.2 Laboratory Duplicates/Replicates

Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates and replicates are subsamples of the original sample that are prepared and analyzed as separate samples.

5.3.2.2.3 Matrix Spikes and Matrix Spike Duplicates

Analysis of MS samples provides information on the extraction efficiency of the method on the sample matrix. By performing duplicate MS analyses, information on the precision of the method is also provided for organic analyses.

5.3.2.2.4 Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. The method blank for all analyses must be less than the MRL of any single target analyte/compound. If a laboratory method blank exceeds this criterion for any analyte/compound, and the concentration of the analyte/compound in any of the samples is less than five times the concentration found in the blank (10 times for common contaminants), analyses must stop, and the source of contamination must be eliminated or reduced.

5.3.2.2.5 Laboratory Control Samples

Laboratory control samples are analyzed to assess possible laboratory bias at all stages of sample preparation and analysis. The laboratory control sample is a matrix-dependent spiked sample prepared at the time of sample extraction along with the preparation of sample and MSs. The laboratory control sample will provide information on the precision of the analytical process and, when analyzed in duplicate, will provide accurate information.

5.3.2.2.6 Laboratory Deliverables

Data packages will be checked for completeness immediately upon receipt from the laboratory to ensure that data and QA/QC information requested are present. Data quality will be assessed by considering the following:

- Holding times
- All compounds of interest reported
- RLs
- Surrogate spike results
- MS/MSD results
- Blank spikes
- Laboratory control samples/laboratory control sample duplicates
- Standard reference material results

- Method blanks
- Detection limits

5.3.3 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

This section describes procedures for testing, inspection, and maintenance of field and laboratory equipment.

5.3.3.1 Field Instruments/Equipment

In accordance with the QA program, Anchor QEA shall maintain an inventory of field instruments and equipment. The frequency and types of maintenance will be based on the manufacturer's recommendations and/or previous experience with the equipment.

The frequency of maintenance is dependent on the type and stability of the equipment, the methods used, the intended use of the equipment, and the recommendations of the manufacturer. Detailed information regarding the calibration and frequency of equipment calibration is provided in specific manufacturer's instruction manuals.

All maintenance records will be verified prior to each sampling event. The FC will be responsible for verifying that required maintenance has been performed prior to using the equipment in the field.

5.3.3.2 Laboratory Instruments/Equipment

In accordance with the QA program, the laboratory shall maintain an inventory of instruments and equipment, and the frequency of maintenance will be based on the manufacturer's recommendations and/or previous experience with the equipment.

The laboratory preventative maintenance program, as detailed in their QA Plan, is organized to maintain proper instrument and equipment performance and to prevent instrument and equipment failure during use. The program considers instrumentation, equipment, and parts that are subject to wear, deterioration, or other changes in operational characteristics; the availability of spare parts; and the frequency at which maintenance is required. Any equipment that has been overloaded, mishandled, gives suspect results, or has been determined to be defective will be taken out of service, tagged with the discrepancy noted, and stored in a designated area until the equipment has been repaired. After repair, the equipment will be tested to ensure that it is in proper operational condition. The client will be promptly notified in writing if defective equipment casts doubt on the validity of analytical data. The client will also be notified immediately regarding any delays due to instrument malfunctions that could impact holding times.

Laboratories will be responsible for the preparation, documentation, and implementation of the preventative maintenance program. All maintenance records will be checked on an annual basis,

according to the schedule, and will be recorded by the responsible individual. The laboratory QA/QC manager or designee shall be responsible for verifying compliance.

5.3.4 Instrument Calibration

Proper calibration of equipment and instrumentation is an integral part of the process that provides quality data. Instrumentation and equipment used to generate data must be calibrated at a frequency that ensures sufficient and consistent accuracy and reproducibility.

5.3.4.1 Field Instrument/Equipment Calibration

Field equipment will be calibrated prior to each sampling event according to manufacturer's recommendations and using manufacturer's standards. The equipment, calibration, and maintenance information will be documented. The frequency of calibration is dependent on the type and stability of the equipment, the methods used, the intended use of the equipment, and the recommendations of the manufacturer. Detailed information regarding the calibration and frequency of equipment calibration is provided in specific manufacturer's instruction manuals.

Equipment that fails calibration or becomes inoperable during use will be removed from service and tagged (time and date of action) to prevent inadvertent use. Such equipment will be satisfactorily recalibrated or repaired and tagged (date and time of return to service) prior to use.

5.3.4.2 Laboratory Instrument/Equipment Calibration

As part of their QC program, laboratories perform two types of calibrations. A periodic calibration is performed at prescribed intervals for certain equipment (i.e., balances, drying ovens, refrigerators, and thermometers), and operational calibrations are performed daily, at a specified frequency, or prior to analysis (i.e., initial calibrations), according to method requirements. Calibration procedures and frequency are discussed in the laboratory QA Plan. Calibrations are discussed in the laboratory standard operating procedures (SOPs) for analyses.

The laboratory QA/QC manager will be responsible for ensuring that the laboratory instrumentation is calibrated in accordance with specifications. Implementation of the calibration program shall be the responsibility of the respective laboratory group supervisors. Recognized procedures (EPA, ASTM, or the manufacturer's instructions) shall be used when available.

Physical standards (i.e., weights or certified thermometers) shall be traceable to nationally recognized standards such as the National Institute of Standards and Technology (NIST). Chemical reference standards shall be NIST Standard Reference Materials or vendor-certified materials traceable to these standards.

The calibration requirements for each method and respective corrective actions shall be accessible, either in the laboratory SOPs or the laboratory's QA Plan for each instrument or analytical method in use. All calibrations shall be preserved on electronic media.

5.3.5 Inspection/Acceptance Requirements for Supplies and Consumables

Inspection and acceptance of field supplies, including laboratory-prepared sampling bottles, will be performed by the FC. All primary chemical standards and standard solutions used in this project either in the field or laboratory will be traceable to documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in the standard will be documented.

6 References

Anchor QEA (Anchor QEA, LLC), 2013. *Final Groundwater Source Control Extraction System Test Plan*. NW Natural Gasco Site. Prepared for NW Natural. November 2013.

EPA (U.S. Environmental Protection Agency), 1986. *Test methods for Evaluating Solid Waste: Physical/Chemical Methods*. Office of Solid Waste and Emergency Response. EPA 530/SW-846.

EPA, 1996. *Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures*. EPA/540/S-95/504. April 1996.

EPA, 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*. Office of Superfund Remediation and Technology Innovation. EPA 540-R-08-01. June 2008.

Tables

Table A-1
Sampling Parameters and Analytical Methods for Groundwater

Parameter	Analytical Method	Unit	Reporting Limit[a]
Volatile Organic Compounds			
1,1,1,2-Tetrachloroethane	8260C	µg/L	0.5
1,1,1-Trichloroethane (TCA)	8260C	µg/L	0.5
1,1,2,2-Tetrachloroethane	8260C	µg/L	0.5
1,1,2-Trichloroethane	8260C	µg/L	0.5
1,1-Dichloroethane	8260C	µg/L	0.5
1,1-Dichloroethene	8260C	µg/L	0.5
1,1-Dichloropropene	8260C	µg/L	1.0
1,2,3-Trichloropropane	8260C	µg/L	1.0
1,2,3-Trichlorobenzene	8260C	µg/L	2.0
1,2,4-Trichlorobenzene	8260C	µg/L	2.0
1,2,4-Trimethylbenzene	8260C	µg/L	1.0
1,2-Dibromoethane (EDB)	8260C	µg/L	0.5
1,2-Dibro-3-chloropropane	8260C	µg/L	5.0
1,2-Dichlorobenzene	8260C	µg/L	0.5
1,2-Dichloroethane (EDC)	8260C	µg/L	0.5
1,2-Dichloropropane	8260C	µg/L	0.5
1,3-Dichlorobenzene	8260C	µg/L	0.5
1,3-Dichloropropane	8260C	µg/L	1.0
1,3,5-Trimethylbenzene	8260C	µg/L	1.0
1,4-Dichlorobenzene	8260C	µg/L	0.5
2,2-Dichloropropane	8260C	µg/L	1.0
2-Butanone (MEK)	8260C	µg/L	10.0
2-Chlorotoluene	8260C	µg/L	1.0
2-Hexanone	8260C	µg/L	10.0
4-Chlorotoluene	8260C	µg/L	1.0
4-Isopropyltoluene	8260C	µg/L	1.0
4-Methyl-2-pentanone (MIBK)	8260C	µg/L	10.0
Acetone	8260C	µg/L	20
Benzene	8260C	µg/L	0.5
Bromobenzene	8260C	µg/L	0.5
Bromochloromethane	8260C	µg/L	1.0
Bromodichloromethane	8260C	µg/L	1.0
Bromoform	8260C	µg/L	1.0
Bromomethane	8260C	µg/L	5.0
n-Butylbenzene	8260C	µg/L	1.0
sec-Butylbenzene	8260C	µg/L	1.0
tert-Butylbenzene	8260C	µg/L	1.0
Carbon Tetrachloride	8260C	µg/L	0.5
Chlorobenzene	8260C	µg/L	0.5
Chloroethane	8260C	µg/L	5.0
Chloroform	8260C	µg/L	1.0
Chloromethane	8260C	µg/L	5.0

Table A-1
Sampling Parameters and Analytical Methods for Groundwater

Parameter	Analytical Method	Unit	Reporting Limit[a]
cis-1,2-Dichloroethene	8260C	µg/L	0.5
cis-1,3-Dichloropropene	8260C	µg/L	1.0
Dibromochloromethane	8260C	µg/L	1.0
Dibromomethane	8260C	µg/L	1.0
Dichlorodifluoromethane	8260C	µg/L	1.0
Ethylbenzene	8260C	µg/L	0.5
Hexachlorobutadiene	8260C	µg/L	5.0
Isopropylbenzene	8260C	µg/L	1.0
m,p-Xylenes	8260C	µg/L	1.0
Methyl tert-Butyl Ether	8260C	µg/L	1.0
Methylene Chloride	8260C	µg/L	5.0
n-Propylbenzene	8260C	µg/L	0.5
Naphthalene	8260C	µg/L	2.0
o-Xylene	8260C	µg/L	0.5
Styrene	8260C	µg/L	1.0
Tetrachloroethene (PCE)	8260C	µg/L	0.5
Toluene	8260C	µg/L	1.0
trans-1,2-Dichloroethene	8260C	µg/L	0.5
trans-1,3-Dichloropropene	8260C	µg/L	1.0
Trichloroethene (TCE)	8260C	µg/L	0.5
Trichlorofluoromethane	8260C	µg/L	0.5
Vinyl Acetate	8260C	µg/L	5
Vinyl Chloride	8260C	µg/L	0.5
PAHs/SVOCs (µg/L)			
Acenaphthene	8270D-SIM	µg/L	0.04
Acenapthylene	8270D-SIM	µg/L	0.04
Anthracene	8270D-SIM	µg/L	0.04
Benzo(a)anthracene	8270D-SIM	µg/L	0.04
Benzo(a)pyrene	8270D-SIM	µg/L	0.04
Benzo(b)fluoranthene	8270D-SIM	µg/L	0.04
Benzo(k)fluoranthene	8270D-SIM	µg/L	0.04
Chrysene	8270D-SIM	µg/L	0.04
Dibenzo(a,h)anthracene	8270D-SIM	µg/L	0.04
Fluoranthene	8270D-SIM	µg/L	0.04
Fluorene	8270D-SIM	µg/L	0.04
Indeno(1,2,3-cd)pyrene	8270D-SIM	µg/L	0.04
1-Methylnaphthalene	8270D-SIM	µg/L	0.08
2-Methylnaphthalene	8270D-SIM	µg/L	0.08
Naphthalene	8270D-SIM	µg/L	0.08
Phenanthrene	8270D-SIM	µg/L	0.04
Pyrene	8270D-SIM	µg/L	0.04
Benzo(g,h,i)perylene	8270D-SIM	µg/L	0.04
Dibenzofuran	8270D-SIM	µg/L	0.04

Table A-1
Sampling Parameters and Analytical Methods for Groundwater

Parameter	Analytical Method	Unit	Reporting Limit[a]
Carbazole	8270D-SIM	µg/L	0.04
Inorganics			
Available Cyanide	OIA-1677	mg/L	0.002
Total Cyanide	EPA 335.4	mg/L	0.005
Free Cyanide	ASTM D4282	mg/L	0.005
Metals			
Aluminum	EPA 6020A	µg/L	50
Antimony	EPA 6020A	µg/L	1
Arsenic	EPA 6020A	µg/L	2
Barium	EPA 6020A	µg/L	1
Beryllium	EPA 6020A	µg/L	1
Cadmium	EPA 6020A	µg/L	1
Chromium	EPA 6020A	µg/L	2
Copper	EPA 6020A	µg/L	4
Iron	EPA 6020A	µg/L	100
Lead	EPA 6020A	µg/L	1
Manganese	EPA 6020A	µg/L	1
Mercury	EPA 6020A	µg/L	0.2
Nickel	EPA 6020A	µg/L	2
Selenium	EPA 6020A	µg/L	2
Silver	EPA 6020A	µg/L	1
Thallium	EPA 6020A	µg/L	1
Vanadium	EPA 6020A	µg/L	2
Zinc	EPA 6020A	µg/L	4
River Parameters			
Carbonate	SM 2320B	mg/L	20.0
Bicarbonate	SM 2320B	mg/L	20.0
Chloride	EPA 300.0	mg/L	1.00
Nitrate	EPA 300.0	mg/L	0.250
Sulfate	EPA 300.0	mg/L	1.00
Calcium	EPA 6020A	µg/L	100
Iron (total and dissolved)	EPA 6020A	µg/L	100
Magnesium (total and dissolved)	EPA 6020A	µg/L	50
Potassium	EPA 6020A	µg/L	100
Sodium	EPA 6020A	µg/L	100
Extractable Petroleum Hydrocarbons			
C8-C10 Aliphatics	WA EPH	µg/L	40
C10-C12 Aliphatics	WA EPH	µg/L	40
C12-C16 Aliphatics	WA EPH	µg/L	40
C16-C21 Aliphatics	WA EPH	µg/L	40
C21-C34 Aliphatics	WA EPH	µg/L	40
C8-C10 Aromatics	WA EPH	µg/L	40
C10-C12 Aromatics	WA EPH	µg/L	40

Table A-1
Sampling Parameters and Analytical Methods for Groundwater

Parameter	Analytical Method	Unit	Reporting Limit[a]
C12-C16 Aromatics	WA EPH	µg/L	40
C16-C21 Aromatics	WA EPH	µg/L	40
C21-C34 Aromatics	WA EPH	µg/L	40
Volatile Petroleum Hydrocarbons			
C5-C6 Aliphatics	WA VPH	µg/L	50
C6-C8 Aliphatics	WA VPH	µg/L	50
C8-C10 Aliphatics	WA VPH	µg/L	50
C10-C12 Aliphatics	WA VPH	µg/L	50
C8-C10 Aromatics	WA VPH	µg/L	50
C10-C12 Aromatics	WA VPH	µg/L	50
C12-C13 Aromatics	WA VPH	µg/L	50
Total Petroleum Hydrocarbons			
Gasoline range hydrocarbons	NWTPH - Gx	mg/L	0.1
Diesel range hydrocarbons	NWTPH - Dx	mg/L	0.2
Oil range organics	NWTPH - Dx	mg/L	0.4
Pesticides			
4,4'-DDD	EPA 8081B	ug/L	0.0100
4,4'-DDE	EPA 8081B	ug/L	0.0100
4,4'-DDT	EPA 8081B	ug/L	0.0100
Aldrin	EPA 8081B	ug/L	0.0100
alpha-BHC	EPA 8081B	ug/L	0.0100
beta-BHC	EPA 8081B	ug/L	0.0100
Chlordane (Technical)	EPA 8081B	ug/L	0.375
cis-Chlordane	EPA 8081B	ug/L	0.0100
delta-BHC	EPA 8081B	ug/L	0.0100
Dieldrin	EPA 8081B	ug/L	0.0100
Endosulfan I	EPA 8081B	ug/L	0.0100
Endosulfan II	EPA 8081B	ug/L	0.0100
Endosulfan sulfate	EPA 8081B	ug/L	0.0100
Endrin	EPA 8081B	ug/L	0.0100
Endrin Aldehyde	EPA 8081B	ug/L	0.0100
Endrin ketone	EPA 8081B	ug/L	0.0100
gamma-BHC (Lindane)	EPA 8081B	ug/L	0.0100
Heptachlor	EPA 8081B	ug/L	0.0100
Heptachlor epoxide	EPA 8081B	ug/L	0.0100
Methoxychlor	EPA 8081B	ug/L	0.0300
Toxaphene (Total)	EPA 8081B	ug/L	0.375
trans-Chlordane	EPA 8081B	ug/L	0.0100
Herbicides			
MCPP	EPA 8151A	µg/L	500
MCPA	EPA 8151A	µg/L	500
Dalapon	EPA 8151A	µg/L	13
Dicamba	EPA 8151A	µg/L	0.50

Table A-1
Sampling Parameters and Analytical Methods for Groundwater

	Parameter	Analytical Method	Unit	Reporting Limit[a]
	Dichloroprop	EPA 8151A	µg/L	5.0
	2,4-D	EPA 8151A	µg/L	5.0
	2,4-DB	EPA 8151A	µg/L	5.0
	2,4,5-T	EPA 8151A	µg/L	0.50
	2,4,5-TP (Silvex)	EPA 8151A	µg/L	0.50
	Dinoseb	EPA 8151A	µg/L	2.5

Notes:
a. Reporting limits are estimated. Actual reporting limits will be verified upon laboratory selection.
µg/L: micrograms per liter
BHC: hexachlorocyclohexane
DB: dichlorophenoxy butyric acid
DDD: dichlorodiphenyldichloroethane
DDE: dichlorodiphenyldichloroethylene
DDT: dichlorodiphenyltrichloroethane
EPA: U.S. Environmental Protection Agency
EPH: extractable petroleum hydrocarbon
MCPA: 2-methyl-4-chlorophenoxyacetic acid
MCPP: Methylchlorophenoxypropionic acid
mg/L: milligrams per liter
NWTPH-Dx: Northwest Total Petroleum Hydrocarbon-Diesel
NWTPH-Gx: Northwest Total Petroleum Hydrocarbon-Gasoline
PAH: polycylic aromatic hydrocarbon
SIM: selected ion monitoring
SM: standard method
SVOC: semivolatile organic compound
TP: Trichlorophenoxyacetic acid
VPH: volatile petroleum hydrocarbon
WA: Washington

Table A-2
Container Requirements, Holding Times, and Preservation Methods for Groundwater

Parameter	Method	Sample Size	Container Size and Type	Holding Time	Sample Preservation Technique
PAHs	EPA 8270D SIM	2 x 1 L	1-L Amber glass	7 days to extraction, 40 days to analysis	Cool/4°C
VOCs	EPA 8260C	3 x 40 mL	40-mL glass VOA vials, Teflon-lined septum cap	14 days	Zero head space/pH < 2 with HCl Cool/4°C
VOCs	EPA 8260B SIM	3 x 40 mL	40-mL glass VOA vials, Teflon-lined septum cap	14 days	Zero head space/pH < 2 with HCl Cool/4°C
Available Cyanide	OIA-1677	1 L	1-L Amber glass	14 days	NaOH, pH >12, Cool, 4°C
Free Cyanide	D4282	250 mL	250-mL HDPE	48 hours	NaOH, pH >12, Cool, 4°C
Total Cyanide	EPA 335.4	500 mL	500-mL HDPE	14 days	NaOH, pH >12, Cool, 4°C
Total Metals	6020A/7470A	500 mL	500-mL HDPE	6 months/ 28 days Hg	HNO_3; Cool/4°C
Dissolved Metals	6020A/7470A	500 mL	500-mL HDPE	6 months/ 28 days Hg	HNO_3; Cool/4°C
Total Petroleum Hydrocarbons – Gas Range	NWTPH-Gx	3 x 40 mL	40-mL glass VOA vials, Teflon-lined septum cap	14 days	Zero head space/pH < 2 with HCl Cool/4°C
Total Petroleum Hydrocarbons – Diesel Range	NWTPH-Dx	2	1-L Amber glass	14 days	HCl; Cool/4°C
Volatile Petroleum Hydrocarbons	WA VPH	3 x 40 mL	40-mL glass VOA vials, Teflon-lined septum cap	14 days	Zero head space/pH < 2 with HCl Cool/4°C
Extractable Petroleum Hydrocarbons	WA EPH	2 x 1 L	1-L Amber glass	7 days to extraction, 40 days to analysis	Cool/4°C
Alkalinity (Carbonate and Bicarbonate)	SM 2320B	500 mL	500-mL HDPE	14 days	Cool/4°C

Table A-2
Container Requirements, Holding Times, and Preservation Methods for Groundwater

Parameter	Method	Sample Size	Container Size and Type	Holding Time	Sample Preservation Technique
Anions (Chloride, Nitrate, Sulfate)	EPA 300.0	500 mL	500-mL HDPE	48 hours (nitrate); 28 days (chloride, sulfate)	Cool/4°C
Pesticides	8081B	2 x 1 L	1-L Amber glass	7 days to extraction, 40 days to analysis	Cool/4°C
Herbicides	8151A	2 x 1 L	1-L Amber glass	7 days to extraction, 40 days to analysis	Cool/4°C

Notes:
EPA: U.S. Environmental Protection Agency
EPH: extractable petroleum hydrocarbon
HCl: hydrochloric acid
HDPE: high-density polyethylene
Hg: mercury
HNO_3: nitric acid
L: liter
mL: milliliter
NaOH: sodium hydroxide
SIM: selected ion monitoring
SM: standard method

Table A-3

Laboratory Quality Control Sample Analysis Frequency for Groundwater

Analysis Type	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes	LCS	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Cyanide	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Metals	Daily	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
SVOCs/PAHs	As needed[a]	Every 12 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
Volatile organics	As needed[a]	Every 12 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
EPH	As needed[a]	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
VPH	As needed[a]	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
NWTPH-Gx	As needed[a]	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
NWTPH-Dx	As needed[a]	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
Alkalinity	Daily	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Anions	Daily	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Pesticides	As needed[a]	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
Herbicides	As needed[a]	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample

Notes:

a. Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.

EPH: extractable petroleum hydrocarbon

LCS: laboratory control sample

NA: not applicable

NWTPH-Dx: Northwest Total Petroleum Hydrocarbon-Diesel

NWTPH-Gx: Northwest Total Petroleum Hydrocarbon-Gasoline

PAH: polycyclic aromatic hydrocarbon

SVOC: semivolatile organic compound

VPH: volatile petroleum hydrocarbon

Table A-4
Data Quality Objectives for Groundwater

Parameter	Precision (Duplicates)	Accuracy (Spike Recoveries)	Completeness
Volatile organic compounds	± 30% RPD	70%–130%	95%
PAHs/SVOCs	± 30% RPD	60%–140%	95%
Metals	± 20% RPD	75%–125%	95%
Cyanide (total and available)	± 20% RPD	75%–125%	95%
EPH	± 30% RPD	60%–140%	95%
VPH	± 30% RPD	60%–140%	95%
NWTPH-Gx	± 30% RPD	60%–140%	95%
NWTPH-Dx	± 30% RPD	60%–140%	95%
Alkalinity	± 20% RPD	75%–125%	95%
Anions	± 20% RPD	75%–125%	95%
Pesticides	± 30% RPD	60%–140%	95%
Herbicides	± 30% RPD	60%–140%	95%

Notes:
EPH: extractable petroleum hydrocarbon
NWTPH-Dx: Northwest Total Petroleum Hydrocarbon-Diesel
NWTPH-Gx: Northwest Total Petroleum Hydrocarbon-Gasoline
PAH: polycyclic aromatic hydrocarbon
R: recovery
RPD: relative percent difference
SVOC: semivolatile organic compound
VPH: volatile petroleum hydrocarbon

Attachment A-1
Field Forms

Daily Log

Anchor QEA, LLC
6720 SW Macadam Ave., Suite 125
Portland, OR 97219
Phone 503.670.1108

PROJECT NAME: _____ **DATE:** _____

SITE ADDRESS: _____ **PERSONNEL:** _____

WEATHER: **WIND FROM:**

N	NE	E	SE	S	SW	W	NW	NONE

LIGHT	MEDIUM	HEAVY

SUNNY	CLOUDY	RAIN	?

TEMPERATURE: ° F . ° C
[Circle appropriate units]

TIME	COMMENTS

Signature: _____

FIELD SAMPLING DATA SHEET

ANCHOR QEA

6720 SW Macadam Ave., Suite 125
Portland, OR 97219
(503) 670-1108

PROJECT NAME: **WELL ID:**

SITE ADDRESS: **BLIND ID:**

DUP ID: **NA**

WIND FROM:	N	NE	E	SE	S	SW	W	NW	LIGHT	MEDIUM	HEAVY
WEATHER:	SUNNY		CLOUDY		RAIN		?		**TEMPERATURE:**	° F .	° C

HYDROLOGY/LEVEL MEASUREMENTS (Nearest 0.01 ft)

[Product Thickness] [Water Column] [Circle appropriate units] [Water Column x Gal/ft]

Date	Time	DT-Bottom	DT-Product	DT-Water	DTP-DTW	DTB-DTW		Volume (gal)
/ /	:	.	.	.	.	.	X 1	.
/ /	:	.	.	.	.		X 3	.

Gal/ft = (dia./2)^2 x 0.163	1" = 0.041	2" = 0.163	3" = 0.367	4" = 0.653	6" = 1.469	10" = 4.080	12" = 5.875

§ METHODS: (A) Submersible Pump (B) Peristaltic Pump (C) Disposable Bailer (D) PVC/Teflon Bailer (E) Dedicated Bailer (F) Dedicated Pump (G) Other =

GROUNDWATER SAMPLING DATA (if product is detected, do NOT sample)

Sample Depth: [√ if used]

Bottle Type	Date	Time	Method §	Amount & Volume mL	Preservative [circle]	Ice	Filter	pH	√
VOA Glass	/ /	:		3	40 ml	HCl	YES	NO		
Amber Glass	/ /	:			250, 500, 1L	(None) (HCl) (H_2SO_4)	YES	NO		
White Poly	/ /	:			250, 500, 1L	None	YES	NO	NA	
Yellow Poly	/ /	:			250, 500, 1L	H_2SO_4	YES	NO		
Green Poly	/ /	:			250, 500, 1L	NaOH	YES	NO		
Red Total Poly	/ /	:			250, 500, 1L	HNO_3	YES	NO		
Red Diss. Poly	/ /	:			250, 500, 1L	HNO_3	YES	YES		
	/ /	:			250, 500, 1L		YES			
Total Bottles (include duplicate count):										

Analysis Allowed per Bottle Type

BOTTLE TYPE	TYPICAL ANALYSIS ALLOWED PER BOTTLE TYPE (Circle applicable or write non-standard analysis below)
VOA - Glass	(8021) (8260B) (BTEX) (NWTPH-Gx)
AMBER - Glass	(PAH) (TPH-HCID) (NWTPH-Dx) (TPH-418.1) (Oil &Grease) (8081A)
WHITE - Poly	(pH) (Conductivity) (TDS) (TSS) (BOD) (Turbidity) (Alkalinity) (HCO_3/CO_3) (Cl) (SO_4) (NO_3) (NO_2) (F)
YELLOW - Poly	(COD) (TOC) (Total PO_4) (Total Keldahl Nitrogen) (NH_3) (NO_3/NO_2)
GREEN - Poly	(Cyanide)
RED TOTAL - Poly	(As) (Sb) (Ba) (Be) (Ca) (Cd) (Co) (Cr) (Cu) (Fe) (Pb) (Mg) (Mn) (Ni) (Ag) (Se) (Tl) (V) (Zn) (Hg) (K) (Na)
RED DISSOLVED - Poly	(As) (Sb) (Ba) (Be) (Ca) (Cd) (Co) (Cr) (Cu) (Fe) (Pb) (Mg) (Mn) (Ni) (Ag) (Se) (Tl) (V) (Zn) (Hg) (K) (Na) (Hardness) (Silica)

WATER QUALITY DATA

Purge Start Time: : Pump/Bailer Inlet Depth:

Meas.	Method §	Purged (gal)	pH	E Cond (µS)	°F Temp °C	Other	Diss O_2 (mg/l)	Water Quality
4		.	.		.		.	
3		.	.		.		.	
2		.	.		.		.	
1		.	.		.		.	
0		**0.00**	.		.		.	

[Casing] [Select A-G] [Cumulative Totals] [Circle units] [Clarity, Color]

SAMPLER:

(PRINTED NAME) (SIGNATURE)

ANCHOR QEA

Transducer Data Form

			Calibration Check									
Well ID	Date	Test Extract Time	DTW Time	TOC Elev. C.O.P. (feet)	Manual DTW (feet TOC)	Manual Elevation (TOC - DTW)	Instrument DTW (feet)	Δ feet	New Test (Y/N)	New Ref. Elev. Conf.	% Batt Life	Time Sync Diff (mm:ss)

Technicain: Water Level Meter #:

APEX LABS

CHAIN OF CUSTODY

Lab # _____ COC ___ of ___

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company:	Project Mgr:	Project Name:	Project #
Address:	Phone:	Fax:	Email:
Sampled by:			

ANALYSIS REQUEST

	Site Location: OR WA Other: _____ SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	BTEX	8260 RBDM VOCs	8260 Halo VOCs	8260 VOCs	8270 SIM PAHs	8082 PCBs	8081 Chlor. Pest	RCRA Metals (8)	Priority Metals (13)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn	TCLP Metals (8)	1200- COLS	1200-Z							
1																												
2																												
3																												
4																												
5																												
6																												
7																												
8																												
9																												
10																												

Normal Turn Around Time (TAT) = 7-10 Business Days **YES** **NO**

TAT Requested (circle)

1 Day **2 Day** **3 Day**

4 DAY **5 DAY** **Other:** _____

SPECIAL INSTRUCTIONS:

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:		**RECEIVED BY:**	
Signature:	Date:	Signature:	Date:
Printed Name:	Time:	Printed Name:	Time:
Company:		Company:	

RELINQUISHED BY:		**RECEIVED BY:**	
Signature:	Date:	Signature:	Date:
Printed Name:	Time:	Printed Name:	Time:
Company:		Company:	

Appendix B
Comprehensive Groundwater Framework

Comprehensive Well Network Description – NW Natural and Siltronic Properties
Data Collection Program and Sampling Schedule
Revision Date: 5/2/2019

Well Information											NW Natural MGP Data Collection Program				
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Quarterly GW Measurement: ◆Manual (M) ◆Transducer (T)	DNAPL Measurement:	HC&C Control Well	Source Control Monitoring	RI/HERA & Data Trends
Monitoring Wells															
MW-1-22	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623089.8	705897.6	11	21	M	Quarterly	-	X	X
MW-1-55	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623083.3	705869.1	45	55	M/T	-	-	X	X
MW-1-82	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623095.0	705868.1	72	82	M/T	-	-	X	X
MW-2-32	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623338.8	705787.9	21.5	31.5	M	-	-	X	X
MW-2-61	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623333.0	705792.2	50	60	M	-	-	X	X
MW-2-104	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623343.6	705784.9	94	104	M	-	-	X	X
MW-3-26	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623842.6	705486.8	15	25	M	Quarterly	-	X	X
MW-3-56	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623848.3	705485.4	45	55	M/T	Quarterly	-	X	X
MW-4-35	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624102.6	705378.2	24	34	M	Quarterly	-	X	X
MW-4-57	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624107.4	705375.2	46	56	M/T	Quarterly	-	X	X
MW-4-101	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624095.4	705380.3	89.5	99.5	M	Quarterly	-	X	X
MW-5-32	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624346.9	705217.2	21	31	M/T	Quarterly	-	X	X
MW-5-100	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624340.3	705213.1	88	98	M	Quarterly	-	X	X
MW-5-175	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624347.8	705207.6	163	173	M/T	Quarterly	-	X	X
MW-7-60	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623510.3	705392.9	50.0	60.0	M	-	-	-	X
MW-8-29	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623959.0	705168.7	18.0	28.0	M	-	-	-	X
MW-8-56	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623956.1	705170.8	45.0	55.0	M	-	-	-	X
MW-9-29	NW Natural	Gasco	Gasco OU	HAI	Fill/Alluvium	Upland	7623072.8	705017.3	18.0	28.0	M	-	-	-	X
MW-10-25	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623484.2	704943.6	14.0	24.0	M	Quarterly	-	-	-
MW-10-61	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623481.4	704946.0	50.0	60.0	M	-	-	-	X
MW-11-32	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623854.1	704790.0	21.0	31.0	M	Quarterly	-	-	-
MW-12-36	NW Natural	Gasco	Gasco OU	HAI	Fill/Alluvium	Upland	7623621.3	704130.4	25.0	35.0	M	-	-	-	X
MW-14-110	NW Natural	Gasco	Gasco OU	HAI	Lower Alluvium	Upland	7623751.3	704881.7	98.0	108.0	M	-	-	-	X
MW-15-50	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623699.5	704648.7	40.0	50.0	M	-	-	-	X
MW-15-66	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623705.5	704639.7	60.5	65.5	M	-	-	-	X
MW-16-45	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623944.8	705482.9	30	45	M/T	Monthly	-	-	X
MW-16-65	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623950.4	705478.8	55	65	M/T	Quarterly	-	X	X
MW-18-30	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623922.4	705446.9	19	29	M/T	Weekly	-	-	X
MW-18-125	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623935.8	705436.8	115	125	M/T	Quarterly	-	X	X
MW-18-180	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7623930.4	705444.2	170	180	M/T	Quarterly	-	X	X
MW-19-22	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624251.0	705292.0	12	22	M/T	Quarterly	-	X	X
MW-19-125	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624246.0	705295.0	115	125	M/T	Quarterly	-	X	X
MW-19-180	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624240.0	705298.0	170	180	M/T	Quarterly	-	X	X
MW-20-120	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624360.0	705233.0	110	120	M	Quarterly	-	X	X
MW-21-12	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623633.5	705643.0	7	12	M	-	-	X	X
MW-21-75	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623645.9	705635.6	65	75	M/T	-	X	X	X
MW-21-115	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623653.4	705631.1	105.0	115.0	M/T	-	-	X	X
MW-21-165	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7623661.9	705626.6	156.0	166.0	M/T	-	-	X	X
MW-21U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623643.7	705645.9	25	35	T	-	X	X	-
MW-22-80	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623312.7	705869.2	69.9	79.9	M/T	-	X	-	X
MW-22U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623306.2	705875.4	45.0	55.0	T	-	X	X	-
MW-23-27	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623498.5	705734.9	17.7	27.7	M	-	-	X	X
MW-23-75	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623494.4	705738.2	64.7	74.7	M/T	-	X	-	X
MW-23-123	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623490.4	705740.6	113.3	123.3	M	-	-	X	X

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Data Collection Program and Sampling Schedule
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Well Information											NW Natural MGP Data Collection Program				
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Quarterly GW Measurement: ◆Manual (M) ◆Transducer (T)	DNAPL Measurement:	HC&C Control Well	Source Control Monitoring	RI/HERA & Data Trends
MW-23U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623490.3	705734.9	40.0	50.0	T	-	X	X	X
MW-24-70	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623865.8	705515.5	60.1	70.1	M/T	Quarterly	-	X	X
MW-24-130	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623868.1	705513.3	120.1	130.1	M/T	Quarterly	X	-	-
MW-25L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623074.4	705972.6	54.0	64.0	T	-	-	-	-
MW-26U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623954.2	705459.8	38.5	48.5	T	Weekly	X	-	-
MW-27L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624002.7	705428.4	106.0	116.0	T	Quarterly	X	-	-
MW-27U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623998.7	705431.2	66.1	76.1	T	Weekly	-	X	-
MW-28L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624153.1	705328.7	109.8	119.8	T	Quarterly	X	-	-
MW-28U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624150.1	705330.3	75.0	85.0	T	Quarterly	-	X	-
MW-29U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624175.9	705316.5	46.0	56.0	T	Quarterly	X	-	-
MW-30U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624247.3	705280.1	40.1	50.1	T	Monthly	X	-	-
MW-31L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624307.8	705260.7	105.0	115.0	T	Quarterly	X	-	-
MW-31U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624310.6	705259.0	84.9	94.9	T	Quarterly	-	X	-
MW-32U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624331.6	705247.5	39.9	49.9	T	Quarterly	X	-	-
MW-33U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624399.1	705212.2	38.0	48.0	T	Quarterly	X	-	-
MW-34L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624426.8	705198.0	99.0	109.0	T	Monthly	X	-	-
MW-34U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624423.0	705199.7	63.3	73.3	T	Quarterly	-	X	-
MW-35U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624487.2	705194.3	54.0	64.0	T	Quarterly	X	-	-
MW-36U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624629.6	705117.8	44.0	54.0	T	Quarterly	X	-	-
MW-37U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624028.0	705410.2	40.1	50.1	T	Monthly	X	-	-
MW-38U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624100.8	705356.9	50.1	60.1	T	Weekly	X	-	-
MW-39F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623063.6	705973.0	11.8	16.8	M	-	-	-	X
MW-40F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7622894.1	705792.6	21.6	26.6	M	-	-	-	X
MW-41U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Upland	7622721.4	705601.2	17.6	27.6	M	-	-	-	X
MW-42F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624617.5	705151.9	26.0	31.0	M	Quarterly	-	-	X
MW-43F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623148.6	705258.5	7.0	17.0	T	Monthly	-	-	-
MW-44F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623328.7	704799.5	6.0	16.0	T	Monthly	-	-	-
MW-45F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623563.4	704499.7	7.0	17.0	T	Monthly	-	-	-
MW-46F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623476.0	704733.0	6.1	16.1	T	-	-	-	-
MW-47F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623719.2	705298.7	22.0	32.0	T	-	-	-	-
MW-48F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623850.1	705158.8	15.6	25.6	T	-	-	-	-
MW-49F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623476.8	705461.6	19.0	29.0	T	-	-	-	-
MW-PW-2L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624540.9	705179.9	119.8	139.8	-	Weekly	-	-	-
NWN-1-20	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7623946.7	704240.4	10.0	20.0	M	-	-	-	X
NWN-2-20	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7623940.1	703958.0	10.0	20.0	M	-	-	-	X
NWN-3-17	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624165.6	703613.0	7.0	17.0	M	-	-	-	X
NWN-4-15	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7624417.0	703176.5	5.0	15.0	M	-	-	-	X
NWN-5-20	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7624797.3	702900.2	10.0	20.0	M	-	-	-	X
NWN-6-31	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625094.4	702865.2	21.0	31.0	M	-	-	-	X
NWN-7-30	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624543.0	703893.5	20.0	30.0	M	-	-	-	X
NWN-8-30	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625491.7	703329.4	15.0	30.0	M	-	-	-	X
NWN-9-31	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7625000.8	704896.3	16.0	31.0	M	-	-	-	X
NWN-10-26	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Nearshore	7625813.7	704369.3	11.0	26.0	M	-	-	-	X
NWN-11-24	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7625080.5	704323.5	14.0	24.0	M	-	-	-	X
NWN-12-20	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625552.3	704097.9	10.0	20.0	M	-	-	-	X
NWN-13-23	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624041.9	704353.4	13.0	23.0	M	-	-	-	X
NWN-13-73	NW Natural	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624031.8	704361.5	63.0	73.0	M	-	-	-	X

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Well Information											NW Natural MGP Data Collection Program				
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NWN-13-106	NW Natural	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624023.9	704368.0	96.0	106.0	M	-	-	-	X
PW-01-80	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624095.8	705353.7	39.5	79.5	M	Monthly	-	-	
PW-3-85	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624367.0	705229.0	75.0	85.0	T	Monthly	-	-	
WS-8-33	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7624854.1	704987.9	22.5	32.5	T	-	-	-	X
WS-8-59	NW Natural	Siltronic	Gasco OU	HAI	Upper Alluvium	Nearshore	7624858.3	704990.2	48.5	58.5	T	-	-	-	X
WS-9-34	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7625261.8	704714.1	23.5	33.5	M	-	-	-	X
WS-10-27	Siltronic	Siltronic	Gasco OU	HAI	Fill	Upland	7624393.1	704306.6	11.0	26.0	M	-	-	-	
WS-12-125	Siltronic	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624836.2	704998.7	109.0	124.0	M	-	X	-	X
WS-12-161	Siltronic	Siltronic	Gasco OU	HAI	Deep Lower Alluvium	Nearshore	7624836.2	704998.7	145.0	160.0	M/T	-	-	-	X
WS-13-69	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624575.1	704633.4	52.6	67.6	M	-	-	-	X
WS-13-105	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624575.1	704633.4	89.0	104.0	M	-	-	-	X
WS-16-125	Siltronic	Siltronic	Gasco OU	HAI	Deep Lower Alluvium	Upland	7624326.8	704965.0	109.0	124.0	M	-	-	-	
WS-16-161	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624326.8	704965.0	145.0	160.0	M	-	-	-	X
WS-17-52	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624607.5	704484.3	41.0	51.0	M	-	-	-	X
WS-17-94	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624607.5	704484.3	78.0	93.0	M	-	-	-	X
WS-18-71	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624577.5	704689.9	60.0	70.0	M	-	-	-	-
WS-18-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624581.4	704692.3	91.0	101.0	-	-	-	-	-
WS-19-71	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624579.5	704675.8	60.0	70.0	M	-	-	-	-
WS-19-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624575.9	704678.6	92.0	102.0	-	-	-		-
WS-21-112	Siltronic	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624617.9	705091.1	94.5	109.5	T	Quarterly	X	-	X
WS-21-131	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Nearshore	7624622.6	705086.1	115.0	130.0	-	-	-	-	-
WS-23-116	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624452.6	705097.3	100.0	115.0	-	-	-	-	-
WS-24-111	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624532.1	705032.9	100.0	110.0	M	-	-	-	-
WS-24-155	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624538.3	705037.4	99.0	109.6	-	-	-	-	-
WS-25-96	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Nearshore	7624670.2	705040.6	85.0	95.0	-	-	-	-	-
WS-25-111	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Nearshore	7624667.3	705042.8	100.0	110.0	M	-	-	-	-
WS-26-86	Siltronic	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624747.8	704984.7	75.0	85.0	T	-	X	-	
WS-26-116	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Nearshore	7624750.4	704982.4	105.0	115.0	-	-	-	-	-
WS-27-86	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624754.5	704902.1	70.0	85.0	-	-	-	-	-
WS-30-96	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624472.5	704758.7	85.0	95.0	-	-	-	-	-
WS-31-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624519.8	704716.0	95.0	105.0	-	-	-	-	-
WS-32-76	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624524.7	704718.5	65.0	75.0	-	-	-	-	-
WS-32-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624528.9	704721.4	90.0	100.0	-	-	-	-	-
WS-33-81	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624536.7	704736.7	70.0	80.0	-	-	-	-	-
WS-33-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624535.5	704733.1	95.0	105.0	-	-	-	-	-
WS-34-71	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624559.1	704675.8	60.0	70.0	-	-	-	-	-
WS-34-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624563.5	704679.8	95.0	105.0	-	-	-	-	-
WS-35-76	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624562.0	704701.3	65.0	75.0	-	-	-	-	-
WS-35-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624561.0	704702.9	95.0	105.0	-	-	-	-	-
WS-36-81	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624561.7	704714.7	70.0	80.0	-	-	-	-	-
WS-36-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624564.7	704715.3	95.0	105.0	-	-	-	-	-
WS-37-51	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624606.5	704653.5	40.0	50.0	-	-	-	-	-
WS-38-61	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624598.9	704670.1	50.0	60.0	-	-	-	-	-
WS-39-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624485.1	704777.6	90.0	100.0	-	-	-	-	-
WS-40-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624571.0	704690.2	25.8	35.8	-	-	-	-	-

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WS-41-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624534.6	704635.5	26.3	36.3	-	-	-	-	-
WS-41-91	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624530.2	704638.5	75.3	90.3	-	-	-	-	-
WS-42-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624596.5	704583.4	25.8	35.8	-	-	-	-	-
WS-43-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624570.3	704567.9	25.8	35.8	-	-	-	-	-
WS-44-29	Siltronic	Siltronic	Gasco OU	-	Fill	Nearshore	7624504.6	705143.3	24.0	29.0	-	-	-	-	-
WS-45-23	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624392.2	705054.5	18.0	23.0	-	-	-	-	-
WS-46-33	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624781.0	704876.3	28.5	33.5	-	-	-	-	-
WS-47-183	Siltronic	Siltronic	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624602.8	705154.3	172.0	182.0	M/T	Quarterly	-	-	-
DNAPL Removal or Observation Wells															
DW-6U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623939.8	705466.0	36.3	48.3	-	Monthly	-	-	-
DW-11U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624424.4	705169.8	21.7	33.7	-	Monthly	-	-	-
DW-14U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623987.9	705421.1	31.8	46.8	-	Weekly	-	-	-
MW-6-32	NW Natural	Gasco	Gasco OU	HAI	Fill	Nearshore	7623289.8	705412.1	21.0	31.0	-	Auto-recovery	-	-	X
MW-13-30	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623447.2	705432.9	19.0	29.0	-	Auto-recovery	-	-	X
OW-1F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624722.3	705044.2	30.0	35.0	T	-	-	X	-
OW-2F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624542.7	705172.5	25.6	30.6	T	Quarterly	-	X	-
OW-5F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624070.3	705366.7	28.5	33.5	T	Quarterly	-	X	-
OW-7-17	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623753.3	705593.8	12.5	17.5	M/T	-	-	X	-
OW-8-15	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623600.4	705685.4	10.1	15.1	M/T	-	-	X	-
OW-8-28	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623623.5	705691.3	23.1	28.1	M	-	-	X	-
OW-9-25	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623388.5	705812.5	20.0	25.0	M/T	-	-	X	-
OW-10F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623183.5	705929.8	20.7	25.7	T	-	-	X	-
Groundwater Extraction Wells															
PW-1L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624730.3	705046.4	114.8	134.8	T	-	-	X	-
PW-1U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624718.0	705053.1	55.1	70.1	T	-	-	-	-
PW-1Ub	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624747.8	705034.9	64.8	79.8	T	-	-	X	-
PW-2L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624558.2	705165.7	120.1	140.1	T	Weekly	-	X	-
PW-2U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624548.9	705171.6	57.8	72.8	T	Quarterly	-	X	-
PW-3-118	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624353.0	705238.0	108.0	118.0	T	Quarterly	-	X	-
PW-3U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624358.3	705216.9	42.8	57.8	T	Quarterly	-	X	-
PW-4L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624216.3	705309.2	105.4	125.4	T	Quarterly	-	X	-
PW-4U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624207.1	705313.8	47.2	62.2	T	Quarterly	-	X	-
PW-5L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624049.2	705380.6	105.7	125.7	T	Quarterly	-	X	-
PW-5U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624057.4	705374.2	49.9	64.9	T	Quarterly	-	X	-
PW-6L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623921.5	705497.0	103.7	123.7	T	Quarterly	-	X	-
PW-6U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623927.6	705487.4	49.4	64.4	T	Weekly	-	X	-
PW-7-93	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623758.1	705591.0	73.5	93.5	M/T	-	-	X	-
PW-8-39	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623616.2	705698.8	24.2	39.2	M/T	-	-	-	-
PW-8-68	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623605.5	705682.9	48.0	68.0	M/T	-	-	X	-
PW-9-92	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623393.5	705809.4	72.6	92.6	M/T	-	-	X	-
PW-10L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623189.4	705921.9	59.8	79.8	-	-	-	-	-
PW-10Lb	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623183.7	705887.8	76.0	96.0	T	-	-	X	-
PW-10U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623222.1	705873.6	40.0	55.4	T	-	-	X	-

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Well Information											NW Natural MGP Data Collection Program				
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Quarterly GW Measurement: ◆Manual (M) ◆Transducer (T)	DNAPL Measurement:	HC&C Control Well	Source Control Monitoring	RI/HERA & Data Trends
PW-11U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624435.7	705191.3	49.8	64.8	T	Monthly	-	X	-
PW-12U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624297.6	705265.9	47.8	62.8	T	Quarterly	-	X	-
PW-13U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624144.5	705333.4	57.6	72.6	T	Weekly	-	X	-
PW-14U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623986.8	705437.0	57.8	67.8	T	Weekly	-	X	-
PW-15U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623680.7	705639.0	35.1	55.1	T	-	-	X	-
PW-16U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623554.8	705713.3	30.4	50.4	T	-	-	X	-
Piezometers															
PZ1-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623598.3	705767.9	4.5	5.4	T	-	-	X	-
PZ1-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623596.6	705766.9	19.3	20.2	T	-	-	X	-
PZ1-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623592.6	705764.4	45.1	50.1	T	-	-	X	-
PZ2-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623677.3	705819.3	5.5	6.4	T	-	-	X	-
PZ2-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623676.5	705817.6	20.6	21.5	T	-	-	X	-
PZ2-43	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623665.1	705810.2	38.3	43.3	T	-	-	X	-
PZ2-77	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623670.3	705813.4	71.9	76.9	T	-	-	X	-
PZ4-12	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623820.4	705775.4	6.7	11.7	T	-	-	X	-
PZ4-41	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623816.5	705777.8	36.1	41.1	T	-	-	X	-
PZ5-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623645.7	705738.0	3.8	4.8	M/T	-	-	X	-
PZ5-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623647.3	705735.8	15.0	20.0	M/T	-	-	X	-
PZ5-55	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623648.8	705733.4	50.0	55.0	M/T	-	-	X	-
PZ5-85	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623650.5	705731.0	79.9	84.9	M/T	-	-	X	-
PZ6-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623986.5	705532.4	3.9	4.9	T	Quarterly	-	X	-
PZ6-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623989.1	705530.0	45.2	50.2	T	Quarterly	-	X	-
PZ6-115	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623989.2	705536.4	110.1	115.1	T	Quarterly	-	X	-
PZ6-150	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7623994.6	705532.7	145.4	150.4	T	Quarterly	-	X	-
PZ7-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7624284.1	705379.0	4.1	5.2	T	Quarterly	-	X	-
PZ7-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7624288.8	705377.5	43.2	48.2	T	Quarterly	-	X	-
PZ7-100	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624285.4	705383.2	94.3	99.3	T	Quarterly	-	X	-
PZ7-150	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7624290.9	705381.7	145.3	150.3	T	Quarterly	-	X	-
PZ8-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623244.6	706008.2	4.5	5.4	T	-	-	X	-
PZ8-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623249.0	706004.8	44.7	49.7	T	-	-	X	-
PZ9-5	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Fill	NA	7624596.3	705254.1	4.5	5.5	T	Quarterly	-	X	-
PZ9-50	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624599.7	705256.9	45.4	50.4	T	Quarterly	-	X	-
PZ9-75	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624606.4	705252.4	67.5	72.5	T	Quarterly	-	X	-
PZ9-110	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624602.6	705255.0	105.6	110.6	T	Quarterly	-	X	-
PZ9-150	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7624603.7	705248.3	146.1	151.1	T	Quarterly	-	X	-

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Well Information											NW Natural Sampling Schedule			
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		New Well Monitoring (Quarterly as Indicated)	TPH-Dx and -Gx	Integrated Monitoring[1]	Integrated Monitoring[1] with TPH-Dx, +A1-Gx
Monitoring Wells														
MW-1-22	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623089.8	705897.6	11	21	-	-	-	-
MW-1-55	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623083.3	705869.1	45	55	-	-	-	1Q and 3Q
MW-1-82	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623095.0	705868.1	72	82	-	-	-	3Q
MW-2-32	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623338.8	705787.9	21.5	31.5	-	-	-	-
MW-2-61	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623333.0	705792.2	50	60	-	-	-	1Q and 3Q
MW-2-104	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623343.6	705784.9	94	104	-	-	-	3Q
MW-3-26	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623842.6	705486.8	15	25	-	-	-	-
MW-3-56	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623848.3	705485.4	45	55	-	-	-	-
MW-4-35	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624102.6	705378.2	24	34	-	-	-	-
MW-4-57	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624107.4	705375.2	46	56	-	-	-	-
MW-4-101	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624095.4	705380.3	89.5	99.5	-	-	-	-
MW-5-32	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624346.9	705217.2	21	31	-	-	-	-
MW-5-100	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624340.3	705213.1	88	98	-	-	-	-
MW-5-175	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624347.8	705207.6	163	173	-	-	-	3Q
MW-7-60	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623510.3	705392.9	50.0	60.0	-	-	-	3Q
MW-8-29	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623959.0	705168.7	18.0	28.0	-	-	-	3Q
MW-8-56	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623956.1	705170.8	45.0	55.0	-	-	-	3Q
MW-9-29	NW Natural	Gasco	Gasco OU	HAI	Fill/Alluvium	Upland	7623072.8	705017.3	18.0	28.0	-	-	-	3Q
MW-10-25	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623484.2	704943.6	14.0	24.0	-	-	-	-
MW-10-61	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623481.4	704946.0	50.0	60.0	-	-	-	3Q
MW-11-32	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623854.1	704790.0	21.0	31.0	-	-	-	-
MW-12-36	NW Natural	Gasco	Gasco OU	HAI	Fill/Alluvium	Upland	7623621.3	704130.4	25.0	35.0	-	-	-	3Q
MW-14-110	NW Natural	Gasco	Gasco OU	HAI	Lower Alluvium	Upland	7623751.3	704881.7	98.0	108.0	-	-	-	3Q
MW-15-50	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623699.5	704648.7	40.0	50.0	-	-	-	3Q
MW-15-66	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623705.5	704639.7	60.5	65.5	-	-	-	3Q
MW-16-45	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623944.8	705482.9	30	45	-	-	-	-
MW-16-65	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623950.4	705478.8	55	65	-	-	-	-
MW-18-30	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623922.4	705446.9	19	29	-	-	-	-
MW-18-125	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623935.8	705436.8	115	125	-	-	-	-
MW-18-180	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7623930.4	705444.2	170	180	-	-	-	3Q
MW-19-22	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624251.0	705292.0	12	22	-	-	-	-
MW-19-125	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624246.0	705295.0	115	125	-	-	-	-
MW-19-180	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624240.0	705298.0	170	180	-	-	-	3Q
MW-20-120	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624360.0	705233.0	110	120	-	-	-	-
MW-21-12	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623633.5	705643.0	7	12	-	-	-	-
MW-21-75	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623645.9	705635.6	65	75	-	-	-	-
MW-21-115	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623653.4	705631.1	105.0	115.0	-	-	-	-
MW-21-165	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7623661.9	705626.6	156.0	166.0	-	-	-	-
MW-21U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623643.7	705645.9	25	35	-	-	-	-
MW-22-80	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623312.7	705869.2	69.9	79.9	-	-	-	-
MW-22U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623306.2	705875.4	45.0	55.0	-	-	-	1Q and 3Q
MW-23-27	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623498.5	705734.9	17.7	27.7	-	-	-	-
MW-23-75	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623494.4	705738.2	64.7	74.7	-	-	-	-
MW-23-123	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623490.4	705740.6	113.3	123.3	-	-	-	3Q

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Well Information											NW Natural Sampling Schedule			
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MW-23U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623490.3	705734.9	40.0	50.0	-	-	-	3Q
MW-24-70	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623865.8	705515.5	60.1	70.1	-	-	-	-
MW-24-130	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623868.1	705513.3	120.1	130.1	-	-	-	-
MW-25L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623074.4	705972.6	54.0	64.0	-	-	-	-
MW-26U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623954.2	705459.8	38.5	48.5	-	-	-	-
MW-27L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624002.7	705428.4	106.0	116.0	-	-	-	-
MW-27U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623998.7	705431.2	66.1	76.1	-	-	-	-
MW-28L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624153.1	705328.7	109.8	119.8	-	-	-	-
MW-28U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624150.1	705330.3	75.0	85.0	-	-	-	-
MW-29U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624175.9	705316.5	46.0	56.0	-	-	-	-
MW-30U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624247.3	705280.1	40.1	50.1	-	-	-	-
MW-31L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624307.8	705260.7	105.0	115.0	-	-	-	-
MW-31U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624310.6	705259.0	84.9	94.9	-	-	3Q	-
MW-32U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624331.6	705247.5	39.9	49.9	-	-	-	-
MW-33U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624399.1	705212.2	38.0	48.0	-	-	-	-
MW-34L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624426.8	705198.0	99.0	109.0	-	-	-	-
MW-34U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624423.0	705199.7	63.3	73.3	-	-	3Q	-
MW-35U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624487.2	705194.3	54.0	64.0	-	-	-	-
MW-36U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624629.6	705117.8	44.0	54.0	-	-	-	-
MW-37U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624028.0	705410.2	40.1	50.1	-	-	-	-
MW-38U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624100.8	705356.9	50.1	60.1	-	-	-	-
MW-39F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623063.6	705973.0	11.8	16.8	-	-	-	-
MW-40F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7622894.1	705792.6	21.6	26.6	-	-	-	-
MW-41U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Upland	7622721.4	705601.2	17.6	27.6	-	-	-	3Q
MW-42F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624617.5	705151.9	26.0	31.0	-	-	-	-
MW-43F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623148.6	705258.5	7.0	17.0	-	-	-	-
MW-44F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623328.7	704799.5	6.0	16.0	-	-	-	-
MW-45F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623563.4	704499.7	7.0	17.0	-	-	-	-
MW-46F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623476.0	704733.0	6.1	16.1	-	-	-	1Q and 3Q
MW-47F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623719.2	705298.7	22.0	32.0	-	-	-	1Q and 3Q
MW-48F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623850.1	705158.8	15.6	25.6	-	-	-	1Q and 3Q
MW-49F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623476.8	705461.6	19.0	29.0	-	-	-	1Q and 3Q
MW-PW-2L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624540.9	705179.9	119.8	139.8	-	-	-	-
NWN-1-20	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7623946.7	704240.4	10.0	20.0	-	-	-	3Q
NWN-2-20	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7623940.1	703958.0	10.0	20.0	-	-	-	-
NWN-3-17	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624165.6	703613.0	7.0	17.0	-	-	-	1Q and 3Q
NWN-4-15	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7624417.0	703176.5	5.0	15.0	-	-	-	-
NWN-5-20	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7624797.3	702900.2	10.0	20.0	-	-	-	-
NWN-6-31	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625094.4	702865.2	21.0	31.0	-	-	-	-
NWN-7-30	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624543.0	703893.5	20.0	30.0	-	-	-	1Q and 3Q
NWN-8-30	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625491.7	703329.4	15.0	30.0	-	-	-	-
NWN-9-31	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7625000.8	704896.3	16.0	31.0	-	-	-	-
NWN-10-26	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Nearshore	7625813.7	704369.3	11.0	26.0	-	-	-	-
NWN-11-24	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7625080.5	704323.5	14.0	24.0	-	-	-	1Q and 3Q
NWN-12-20	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625552.3	704097.9	10.0	20.0	-	-	-	-
NWN-13-23	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624041.9	704353.4	13.0	23.0	-	-	-	1Q and 3Q
NWN-13-73	NW Natural	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624031.8	704361.5	63.0	73.0	-	-	-	1Q and 3Q

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Well Information											NW Natural Sampling Schedule			
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		New Well Monitoring (Quarterly as Indicated)	TPH-Dx and -Gx	Integrated Monitoring[1]	Integrated Monitoring[1] with TPH-Dx, +A1-Gx
NWN-13-106	NW Natural	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624023.9	704368.0	96.0	106.0	-	-	-	1Q and 3Q
PW-01-80	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624095.8	705353.7	39.5	79.5	-	-	-	-
PW-3-85	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624367.0	705229.0	75.0	85.0	-	-	-	-
WS-8-33	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7624854.1	704987.9	22.5	32.5	-	-	-	-
WS-8-59	NW Natural	Siltronic	Gasco OU	HAI	Upper Alluvium	Nearshore	7624858.3	704990.2	48.5	58.5	-	-	-	1Q and 3Q
WS-9-34	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7625261.8	704714.1	23.5	33.5	-	-	-	-
WS-10-27	Siltronic	Siltronic	Gasco OU	HAI	Fill	Upland	7624393.1	704306.6	11.0	26.0	-	-	-	-
WS-12-125	Siltronic	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624836.2	704998.7	109.0	124.0	-	-	-	-
WS-12-161	Siltronic	Siltronic	Gasco OU	HAI	Deep Lower Alluvium	Nearshore	7624836.2	704998.7	145.0	160.0	-	-	-	1Q and 3Q
WS-13-69	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624575.1	704633.4	52.6	67.6	-	-	-	3Q
WS-13-105	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624575.1	704633.4	89.0	104.0	-	-	-	3Q
WS-16-125	Siltronic	Siltronic	Gasco OU	HAI	Deep Lower Alluvium	Upland	7624326.8	704965.0	109.0	124.0	-	-	-	-
WS-16-161	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624326.8	704965.0	145.0	160.0	-	-	-	1Q and 3Q
WS-17-52	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624607.5	704484.3	41.0	51.0	-	-	-	3Q
WS-17-94	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624607.5	704484.3	78.0	93.0	-	-	-	3Q
WS-18-71	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624577.5	704689.9	60.0	70.0	-	-	-	-
WS-18-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624581.4	704692.3	91.0	101.0	-	-	-	-
WS-19-71	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624579.5	704675.8	60.0	70.0	-	-	-	-
WS-19-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624575.9	704678.6	92.0	102.0	-	-	-	-
WS-21-112	Siltronic	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624617.9	705091.1	94.5	109.5	-	-	-	-
WS-21-131	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Nearshore	7624622.6	705086.1	115.0	130.0	-	-	-	-
WS-23-116	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624452.6	705097.3	100.0	115.0	-	-	-	-
WS-24-111	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624532.1	705032.9	100.0	110.0	-	-	-	-
WS-24-155	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624538.3	705037.4	99.0	109.6	-	-	-	-
WS-25-96	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Nearshore	7624670.2	705040.6	85.0	95.0	-	-	-	-
WS-25-111	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Nearshore	7624667.3	705042.8	100.0	110.0	-	-	-	-
WS-26-86	Siltronic	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624747.8	704984.7	75.0	85.0	-	-	-	-
WS-26-116	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Nearshore	7624750.4	704982.4	105.0	115.0	-	-	-	-
WS-27-86	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624754.5	704902.1	70.0	85.0	-	-	-	-
WS-30-96	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624472.5	704758.7	85.0	95.0	-	-	-	-
WS-31-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624519.8	704716.0	95.0	105.0	-	-	-	-
WS-32-76	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624524.7	704718.5	65.0	75.0	-	-	-	-
WS-32-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624528.9	704721.4	90.0	100.0	-	-	-	-
WS-33-81	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624536.7	704736.7	70.0	80.0	-	-	-	-
WS-33-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624535.5	704733.1	95.0	105.0	-	-	-	-
WS-34-71	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624559.1	704675.8	60.0	70.0	-	-	-	-
WS-34-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624563.5	704679.8	95.0	105.0	-	-	-	-
WS-35-76	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624562.0	704701.3	65.0	75.0	-	-	-	-
WS-35-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624561.0	704702.9	95.0	105.0	-	-	-	-
WS-36-81	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624561.7	704714.7	70.0	80.0	-	-	-	-
WS-36-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624564.7	704715.3	95.0	105.0	-	-	-	-
WS-37-51	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624606.5	704653.5	40.0	50.0	-	-	-	-
WS-38-61	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624598.9	704670.1	50.0	60.0	-	-	-	-
WS-39-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624485.1	704777.6	90.0	100.0	-	-	-	-
WS-40-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624571.0	704690.2	25.8	35.8	-	-	-	-

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Well Information											NW Natural Sampling Schedule			
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		New Well Monitoring (Quarterly as Indicated)	TPH-Dx and -Gx	Integrated Monitoring[1]	Integrated Monitoring[1] with TPH-Dx, +A1-Gx
WS-41-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624534.6	704635.5	26.3	36.3	-	-	-	-
WS-41-91	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624530.2	704638.5	75.3	90.3	-	-	-	-
WS-42-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624596.5	704583.4	25.8	35.8	-	-	-	-
WS-43-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624570.3	704567.9	25.8	35.8	-	-	-	-
WS-44-29	Siltronic	Siltronic	Gasco OU	-	Fill	Nearshore	7624504.6	705143.3	24.0	29.0	-	-	-	-
WS-45-23	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624392.2	705054.5	18.0	23.0	-	-	-	-
WS-46-33	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624781.0	704876.3	28.5	33.5	-	-	-	-
WS-47-183	Siltronic	Siltronic	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624602.8	705154.3	172.0	182.0	-	-	-	-
DNAPL Removal or Observation Wells														
DW-6U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623939.8	705466.0	36.3	48.3	-	-	-	-
DW-11U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624424.4	705169.8	21.7	33.7	-	-	-	-
DW-14U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623987.9	705421.1	31.8	46.8	-	-	-	-
MW-6-32	NW Natural	Gasco	Gasco OU	HAI	Fill	Nearshore	7623289.8	705412.1	21.0	31.0	-	-	-	-
MW-13-30	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623447.2	705432.9	19.0	29.0	-	-	-	-
OW-1F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624722.3	705044.2	30.0	35.0	-	-	-	-
OW-2F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624542.7	705172.5	25.6	30.6	-	-	-	-
OW-5F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624070.3	705366.7	28.5	33.5	-	-	3Q	-
OW-7-17	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623753.3	705593.8	12.5	17.5	-	-	3Q	-
OW-8-15	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623600.4	705685.4	10.1	15.1	-	-	3Q	-
OW-8-28	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623623.5	705691.3	23.1	28.1	-	-	-	-
OW-9-25	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623388.5	705812.5	20.0	25.0	-	-	3Q	-
OW-10F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623183.5	705929.8	20.7	25.7	-	-	3Q	-
Groundwater Extraction Wells														
PW-1L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624730.3	705046.4	114.8	134.8	-	-	1Q and 3Q	-
PW-1U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624718.0	705053.1	55.1	70.1	-	-	-	-
PW-1Ub	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624747.8	705034.9	64.8	79.8	-	-	1Q and 3Q	-
PW-2L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624558.2	705165.7	120.1	140.1	-	-	1Q and 3Q	-
PW-2U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624548.9	705171.6	57.8	72.8	-	-	1Q and 3Q	-
PW-3-118	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624353.0	705238.0	108.0	118.0	-	-	1Q and 3Q	-
PW-3U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624358.3	705216.9	42.8	57.8	-	-	1Q and 3Q	-
PW-4L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624216.3	705309.2	105.4	125.4	-	-	1Q and 3Q	-
PW-4U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624207.1	705313.8	47.2	62.2	-	-	1Q and 3Q	-
PW-5L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624049.2	705380.6	105.7	125.7	-	-	1Q and 3Q	-
PW-5U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624057.4	705374.2	49.9	64.9	-	-	1Q and 3Q	-
PW-6L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623921.5	705497.0	103.7	123.7	-	-	1Q and 3Q	-
PW-6U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623927.6	705487.4	49.4	64.4	-	-	1Q and 3Q	-
PW-7-93	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623758.1	705591.0	73.5	93.5	-	-	1Q and 3Q	-
PW-8-39	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623616.2	705698.8	24.2	39.2	-	-	-	-
PW-8-68	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623605.5	705682.9	48.0	68.0	-	-	1Q and 3Q	-
PW-9-92	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623393.5	705809.4	72.6	92.6	-	-	1Q and 3Q	-
PW-10L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623189.4	705921.9	59.8	79.8	-	-	-	-
PW-10Lb	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623183.7	705887.8	76.0	96.0	-	-	1Q and 3Q	-
PW-10U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623222.1	705873.6	40.0	55.4	-	-	1Q and 3Q	-

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Well Information											NW Natural Sampling Schedule			
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		New Well Monitoring (Quarterly as Indicated)	TPH-Dx and -Gx	Integrated Monitoring[1]	Integrated Monitoring[1] with TPH-Dx, +A1-Gx
PW-11U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624435.7	705191.3	49.8	64.8	-	-	1Q and 3Q	-
PW-12U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624297.6	705265.9	47.8	62.8	-	-	1Q and 3Q	-
PW-13U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624144.5	705333.4	57.6	72.6	-	-	1Q and 3Q	-
PW-14U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623986.8	705437.0	57.8	67.8	-	-	1Q and 3Q	-
PW-15U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623680.7	705639.0	35.1	55.1	-	-	1Q and 3Q	-
PW-16U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623554.8	705713.3	30.4	50.4	-	-	1Q and 3Q	-
Piezometers														
PZ1-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623598.3	705767.9	4.5	5.4	-	-	-	-
PZ1-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623596.6	705766.9	19.3	20.2	-	-	-	-
PZ1-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623592.6	705764.4	45.1	50.1	-	-	-	-
PZ2-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623677.3	705819.3	5.5	6.4	-	-	-	-
PZ2-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623676.5	705817.6	20.6	21.5	-	-	-	-
PZ2-43	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623665.1	705810.2	38.3	43.3	-	-	-	-
PZ2-77	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623670.3	705813.4	71.9	76.9	-	-	-	-
PZ4-12	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623820.4	705775.4	6.7	11.7	-	-	-	-
PZ4-41	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623816.5	705777.8	36.1	41.1	-	-	-	-
PZ5-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623645.7	705738.0	3.8	4.8	-	-	1Q and 3Q	-
PZ5-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623647.3	705735.8	15.0	20.0	-	-	1Q and 3Q	-
PZ5-55	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623648.8	705733.4	50.0	55.0	-	-	1Q and 3Q	-
PZ5-85	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623650.5	705731.0	79.9	84.9	-	-	1Q and 3Q	-
PZ6-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623986.5	705532.4	3.9	4.9	-	-	1Q and 3Q	-
PZ6-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623989.1	705530.0	45.2	50.2	-	-	1Q and 3Q	-
PZ6-115	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623989.2	705536.4	110.1	115.1	-	-	1Q and 3Q	-
PZ6-150	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7623994.6	705532.7	145.4	150.4	-	-	1Q and 3Q	-
PZ7-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7624284.1	705379.0	4.1	5.2	-	-	1Q and 3Q	-
PZ7-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7624288.8	705377.5	43.2	48.2	-	-	1Q and 3Q	-
PZ7-100	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624285.4	705383.2	94.3	99.3	-	-	1Q and 3Q	-
PZ7-150	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7624290.9	705381.7	145.3	150.3	-	-	1Q and 3Q	-
PZ8-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623244.6	706008.2	4.5	5.4	-	-	1Q and 3Q	-
PZ8-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623249.0	706004.8	44.7	49.7	-	-	1Q and 3Q	-
PZ9-5	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Fill	NA	7624596.3	705254.1	4.5	5.5	-	-	1Q and 3Q	-
PZ9-50	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624599.7	705256.9	45.4	50.4	-	-	1Q and 3Q	-
PZ9-75	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624606.4	705252.4	67.5	72.5	-	-	1Q and 3Q	-
PZ9-110	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624602.6	705255.0	105.6	110.6	-	-	1Q and 3Q	-
PZ9-150	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7624603.7	705248.3	146.1	151.1	-	-	1Q and 3Q	-

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Well Information											Siltronic cVOC Data Collection Objectives					
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Integrated Monitoring[1] with TPH-Dx, -Gx, EPH and VPH	Quarterly GW Measurement: Manual (M) or Transducer (T)	DNAPL Monitoring	EIB Performance Monitoring	HC&C Performance Monitoring	RI N&E Monitoring
Monitoring Wells																
MW-1-22	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623089.8	705897.6	11	21	3Q	-	-	-	-	-
MW-1-55	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623083.3	705869.1	45	55	-	-	-	-	-	-
MW-1-82	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623095.0	705868.1	72	82	-	-	-	-	-	-
MW-2-32	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623338.8	705787.9	21.5	31.5	3Q	-	-	-	-	-
MW-2-61	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623333.0	705792.2	50	60	-	-	-	-	-	-
MW-2-104	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623343.6	705784.9	94	104	-	-	-	-	-	-
MW-3-26	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623842.6	705486.8	15	25	3Q	-	-	-	-	-
MW-3-56	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623848.3	705485.4	45	55	3Q	-	-	-	-	-
MW-4-35	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624102.6	705378.2	24	34	3Q	-	-	-	-	-
MW-4-57	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624107.4	705375.2	46	56	3Q	-	-	-	-	-
MW-4-101	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624095.4	705380.3	89.5	99.5	3Q	-	-	-	-	-
MW-5-32	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624346.9	705217.2	21	31	3Q	-	-	-	-	-
MW-5-100	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624340.3	705213.1	88	98	3Q	-	-	-	-	-
MW-5-175	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624347.8	705207.6	163	173	-	-	-	-	-	-
MW-7-60	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623510.3	705392.9	50.0	60.0	-	-	-	-	-	-
MW-8-29	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623959.0	705168.7	18.0	28.0	-	-	-	-	-	-
MW-8-56	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623956.1	705170.8	45.0	55.0	-	-	-	-	-	-
MW-9-29	NW Natural	Gasco	Gasco OU	HAI	Fill/Alluvium	Upland	7623072.8	705017.3	18.0	28.0	-	-	-	-	-	-
MW-10-25	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623484.2	704943.6	14.0	24.0	-	-	-	-	-	-
MW-10-61	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623481.4	704946.0	50.0	60.0	-	-	-	-	-	-
MW-11-32	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623854.1	704790.0	21.0	31.0	-	-	-	-	-	-
MW-12-36	NW Natural	Gasco	Gasco OU	HAI	Fill/Alluvium	Upland	7623621.3	704130.4	25.0	35.0	-	-	-	-	-	-
MW-14-110	NW Natural	Gasco	Gasco OU	HAI	Lower Alluvium	Upland	7623751.3	704881.7	98.0	108.0	-	-	-	-	-	-
MW-15-50	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623699.5	704648.7	40.0	50.0	-	-	-	-	-	-
MW-15-66	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623705.5	704639.7	60.5	65.5	-	-	-	-	-	-
MW-16-45	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623944.8	705482.9	30	45	-	-	-	-	-	-
MW-16-65	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623950.4	705478.8	55	65	3Q	-	-	-	-	-
MW-18-30	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623922.4	705446.9	19	29	-	-	-	-	-	-
MW-18-125	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623935.8	705436.8	115	125	3Q	-	-	-	-	-
MW-18-180	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7623930.4	705444.2	170	180	-	-	-	-	-	-
MW-19-22	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624251.0	705292.0	12	22	3Q	-	-	-	-	-
MW-19-125	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624246.0	705295.0	115	125	3Q	-	-	-	-	-
MW-19-180	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624240.0	705298.0	170	180	-	-	-	-	-	-
MW-20-120	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624360.0	705233.0	110	120	3Q	-	-	-	-	-
MW-21-12	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623633.5	705643.0	7	12	3Q	-	-	-	-	-
MW-21-75	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623645.9	705635.6	65	75	3Q	-	-	-	-	-
MW-21-115	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623653.4	705631.1	105.0	115.0	3Q	-	-	-	-	-
MW-21-165	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7623661.9	705626.6	156.0	166.0	3Q	-	-	-	-	-
MW-21U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623643.7	705645.9	25	35	3Q	-	-	-	-	-
MW-22-80	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623312.7	705869.2	69.9	79.9	-	-	-	-	-	-
MW-22U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623306.2	705875.4	45.0	55.0	-	-	-	-	-	-
MW-23-27	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623498.5	705734.9	17.7	27.7	3Q	-	-	-	-	-
MW-23-75	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623494.4	705738.2	64.7	74.7	-	-	-	-	-	-
MW-23-123	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623490.4	705740.6	113.3	123.3	-	-	-	-	-	-

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Well Information											Siltronic cVOC Data Collection Objectives					
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Integrated Monitoring[1] with TPH-Dx, -Gx, EPH and VPH	Quarterly GW Measurement: Manual (M) or Transducer (T)	DNAPL Monitoring	EIB Performance Monitoring	HC&C Performance Monitoring	RI N&E Monitoring
MW-23U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623490.3	705734.9	40.0	50.0	-	-	-	-	-	-
MW-24-70	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623865.8	705515.5	60.1	70.1	-	-	-	-	-	-
MW-24-130	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623868.1	705513.3	120.1	130.1	-	-	-	-	-	-
MW-25L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623074.4	705972.6	54.0	64.0	-	-	-	-	-	-
MW-26U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623954.2	705459.8	38.5	48.5	-	-	-	-	-	-
MW-27L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624002.7	705428.4	106.0	116.0	-	-	-	-	-	-
MW-27U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623998.7	705431.2	66.1	76.1	-	-	-	-	-	-
MW-28L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624153.1	705328.7	109.8	119.8	-	-	-	-	-	-
MW-28U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624150.1	705330.3	75.0	85.0	3Q	-	-	-	-	-
MW-29U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624175.9	705316.5	46.0	56.0	-	-	-	-	-	-
MW-30U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624247.3	705280.1	40.1	50.1	-	-	-	-	-	-
MW-31L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624307.8	705260.7	105.0	115.0	-	-	-	-	-	-
MW-31U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624310.6	705259.0	84.9	94.9	-	-	-	-	-	-
MW-32U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624331.6	705247.5	39.9	49.9	-	-	-	-	-	-
MW-33U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624399.1	705212.2	38.0	48.0	-	-	-	-	-	-
MW-34L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624426.8	705198.0	99.0	109.0	-	-	-	-	-	-
MW-34U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624423.0	705199.7	63.3	73.3	-	-	-	-	-	-
MW-35U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624487.2	705194.3	54.0	64.0	-	-	-	-	-	-
MW-36U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624629.6	705117.8	44.0	54.0	-	-	-	-	-	-
MW-37U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624028.0	705410.2	40.1	50.1	-	-	-	-	-	-
MW-38U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624100.8	705356.9	50.1	60.1	-	-	-	-	-	-
MW-39F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623063.6	705973.0	11.8	16.8	1Q and 3Q	-	-	-	-	-
MW-40F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7622894.1	705792.6	21.6	26.6	1Q and 3Q	-	-	-	-	-
MW-41U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Upland	7622721.4	705601.2	17.6	27.6	-	-	-	-	-	-
MW-42F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624617.5	705151.9	26.0	31.0	1Q and 3Q	-	-	-	-	-
MW-43F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623148.6	705258.5	7.0	17.0	-	-	-	-	-	-
MW-44F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623328.7	704799.5	6.0	16.0	-	-	-	-	-	-
MW-45F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623563.4	704499.7	7.0	17.0	-	-	-	-	-	-
MW-46F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623476.0	704733.0	6.1	16.1	-	-	-	-	-	-
MW-47F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623719.2	705298.7	22.0	32.0	-	-	-	-	-	-
MW-48F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623850.1	705158.8	15.6	25.6	-	-	-	-	-	-
MW-49F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623476.8	705461.6	19.0	29.0	-	-	-	-	-	-
MW-PW-2L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624540.9	705179.9	119.8	139.8	-	-	-	-	-	-
NWN-1-20	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7623946.7	704240.4	10.0	20.0	-	-	-	-	-	-
NWN-2-20	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7623940.1	703958.0	10.0	20.0	1Q and 3Q	-	-	-	-	-
NWN-3-17	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624165.6	703613.0	7.0	17.0	-	-	-	-	-	-
NWN-4-15	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7624417.0	703176.5	5.0	15.0	-	-	-	-	-	-
NWN-5-20	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7624797.3	702900.2	10.0	20.0	-	-	-	-	-	-
NWN-6-31	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625094.4	702865.2	21.0	31.0	-	-	-	-	-	-
NWN-7-30	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624543.0	703893.5	20.0	30.0	-	-	-	-	-	-
NWN-8-30	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625491.7	703329.4	15.0	30.0	-	-	-	-	-	-
NWN-9-31	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7625000.8	704896.3	16.0	31.0	1Q and 3Q	-	-	-	-	-
NWN-10-26	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Nearshore	7625813.7	704369.3	11.0	26.0	-	-	-	-	-	-
NWN-11-24	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7625080.5	704323.5	14.0	24.0	-	-	-	-	-	-
NWN-12-20	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625552.3	704097.9	10.0	20.0	-	-	-	-	-	-
NWN-13-23	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624041.9	704353.4	13.0	23.0	-	-	-	-	-	-
NWN-13-73	NW Natural	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624031.8	704361.5	63.0	73.0	-	-	-	-	-	-

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NWN-13-106	NW Natural	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624023.9	704368.0	96.0	106.0	-	-	-	-	-	-
PW-01-80	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624095.8	705353.7	39.5	79.5	-	-	-	-	-	-
PW-3-85	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624367.0	705229.0	75.0	85.0	-	-	-	-	-	-
WS-8-33	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7624854.1	704987.9	22.5	32.5	1Q and 3Q	-	-	-	-	-
WS-8-59	NW Natural	Siltronic	Gasco OU	HAI	Upper Alluvium	Nearshore	7624858.3	704990.2	48.5	58.5	-	-	-	-	-	-
WS-9-34	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7625261.8	704714.1	23.5	33.5	1Q and 3Q	-	-	-	-	-
WS-10-27	Siltronic	Siltronic	Gasco OU	HAI	Fill	Upland	7624393.1	704306.6	11.0	26.0	-	-	-	-	-	-
WS-12-125	Siltronic	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624836.2	704998.7	109.0	124.0	1Q and 3Q	-	-	-	-	-
WS-12-161	Siltronic	Siltronic	Gasco OU	HAI	Deep Lower Alluvium	Nearshore	7624836.2	704998.7	145.0	160.0	-	-	-	-	-	-
WS-13-69	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624575.1	704633.4	52.6	67.6	-	T	-	X	-	-
WS-13-105	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624575.1	704633.4	89.0	104.0	-	-	-	X	-	-
WS-16-125	Siltronic	Siltronic	Gasco OU	HAI	Deep Lower Alluvium	Upland	7624326.8	704965.0	109.0	124.0	-	-	-	-	-	-
WS-16-161	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624326.8	704965.0	145.0	160.0	-	-	-	-	-	-
WS-17-52	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624607.5	704484.3	41.0	51.0	-	-	-	-	-	-
WS-17-94	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624607.5	704484.3	78.0	93.0	-	-	-	-	-	-
WS-18-71	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624577.5	704689.9	60.0	70.0	-	M	-	X	-	-
WS-18-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624581.4	704692.3	91.0	101.0	-	-	-	X	-	-
WS-19-71	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624579.5	704675.8	60.0	70.0	-	M	-	X	-	-
WS-19-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624575.9	704678.6	92.0	102.0	-	M	-	X	-	-
WS-21-112	Siltronic	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624617.9	705091.1	94.5	109.5	-	-	-	X	-	-
WS-21-131	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Nearshore	7624622.6	705086.1	115.0	130.0	-	-	-	X	-	-
WS-23-116	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624452.6	705097.3	100.0	115.0	-	-	-	X	-	-
WS-24-111	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624532.1	705032.9	100.0	110.0	-	-	-	X	-	-
WS-24-155	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624538.3	705037.4	99.0	109.6	-	-	-	-	-	-
WS-25-96	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Nearshore	7624670.2	705040.6	85.0	95.0	-	-	-	X	-	-
WS-25-111	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Nearshore	7624667.3	705042.8	100.0	110.0	-	-	-	X	-	-
WS-26-86	Siltronic	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624747.8	704984.7	75.0	85.0	-	-	-	X	-	-
WS-26-116	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Nearshore	7624750.4	704982.4	105.0	115.0	-	M	-	X	-	-
WS-27-86	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624754.5	704902.1	70.0	85.0	-	M	-	X	-	-
WS-30-96	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624472.5	704758.7	85.0	95.0	-	-	-	X	-	-
WS-31-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624519.8	704716.0	95.0	105.0	-	M	Quarterly	X	-	-
WS-32-76	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624524.7	704718.5	65.0	75.0	-	-	-	X	-	-
WS-32-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624528.9	704721.4	90.0	100.0	-	-	-	X	-	-
WS-33-81	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624536.7	704736.7	70.0	80.0	-	-	Quarterly	X	-	-
WS-33-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624535.5	704733.1	95.0	105.0	-	-	-	X	-	-
WS-34-71	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624559.1	704675.8	60.0	70.0	-	M	-	X	-	-
WS-34-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624563.5	704679.8	95.0	105.0	-	M	-	X	-	-
WS-35-76	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624562.0	704701.3	65.0	75.0	-	M	-	X	-	-
WS-35-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624561.0	704702.9	95.0	105.0	-	-	-	X	-	-
WS-36-81	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624561.7	704714.7	70.0	80.0	-	-	-	X	-	-
WS-36-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624564.7	704715.3	95.0	105.0	-	M	-	X	-	-
WS-37-51	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624606.5	704653.5	40.0	50.0	-	-	-	X	-	-
WS-38-61	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624598.9	704670.1	50.0	60.0	-	M	-	X	-	-
WS-39-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624485.1	704777.6	90.0	100.0	-	-	--	X	-	-
WS-40-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624571.0	704690.2	25.8	35.8	-	-	-	X	-	-

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Well Information											Siltronic cVOC Data Collection Objectives					
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Integrated Monitoring[1] with TPH-Dx, -Gx, EPH and VPH	Quarterly GW Measurement: Manual (M) or Transducer (T)	DNAPL Monitoring	EIB Performance Monitoring	HC&C Performance Monitoring	RI N&E Monitoring
WS-41-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624534.6	704635.5	26.3	36.3	-	-	-	X	-	-
WS-41-91	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624530.2	704638.5	75.3	90.3	-	-	-	X	-	-
WS-42-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624596.5	704583.4	25.8	35.8	-	-	-	X	-	-
WS-43-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624570.3	704567.9	25.8	35.8	-	-	Quarterly	X	-	-
WS-44-29	Siltronic	Siltronic	Gasco OU	-	Fill	Nearshore	7624504.6	705143.3	24.0	29.0	-	-	-	-	-	-
WS-45-23	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624392.2	705054.5	18.0	23.0	-	-	-	-	-	-
WS-46-33	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624781.0	704876.3	28.5	33.5	-	-	-	-	-	-
WS-47-183	Siltronic	Siltronic	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624602.8	705154.3	172.0	182.0	1Q and 3Q	-	-	-		
DNAPL Removal or Observation Wells																
DW-6U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623939.8	705466.0	36.3	48.3	-	-	-	-	-	-
DW-11U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624424.4	705169.8	21.7	33.7	-	-	-	-	-	-
DW-14U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623987.9	705421.1	31.8	46.8	-	-	-	-	-	-
MW-6-32	NW Natural	Gasco	Gasco OU	HAI	Fill	Nearshore	7623289.8	705412.1	21.0	31.0	-	-	-	-	-	-
MW-13-30	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623447.2	705432.9	19.0	29.0	-	-	-	-	-	-
OW-1F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624722.3	705044.2	30.0	35.0	1Q and 3Q	-	-	-	-	-
OW-2F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624542.7	705172.5	25.6	30.6	1Q and 3Q	-	-	-	-	-
OW-5F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624070.3	705366.7	28.5	33.5	-	-	-	-	-	-
OW-7-17	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623753.3	705593.8	12.5	17.5	-	-	-	-	-	-
OW-8-15	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623600.4	705685.4	10.1	15.1	-	-	-	-	-	-
OW-8-28	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623623.5	705691.3	23.1	28.1	-	-	-	-	-	-
OW-9-25	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623388.5	705812.5	20.0	25.0	-	-	-	-	-	-
OW-10F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623183.5	705929.8	20.7	25.7	-	-	-	-	-	-
Groundwater Extraction Wells																
PW-1L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624730.3	705046.4	114.8	134.8	-	-	-	-	-	-
PW-1U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624718.0	705053.1	55.1	70.1	-	-	-	-	-	-
PW-1Ub	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624747.8	705034.9	64.8	79.8	-	-	-	-	-	-
PW-2L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624558.2	705165.7	120.1	140.1	-	-	-	-	-	-
PW-2U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624548.9	705171.6	57.8	72.8	-	-	-	-	-	-
PW-3-118	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624353.0	705238.0	108.0	118.0	-	-	-	-	-	-
PW-3U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624358.3	705216.9	42.8	57.8	-	-	-	-	-	-
PW-4L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624216.3	705309.2	105.4	125.4	-	-	-	-	-	-
PW-4U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624207.1	705313.8	47.2	62.2	-	-	-	-	-	-
PW-5L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624049.2	705380.6	105.7	125.7	-	-	-	-	-	-
PW-5U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624057.4	705374.2	49.9	64.9	-	-	-	-	-	-
PW-6L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623921.5	705497.0	103.7	123.7	-	-	-	-	-	-
PW-6U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623927.6	705487.4	49.4	64.4	-	-	-	-	-	-
PW-7-93	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623758.1	705591.0	73.5	93.5	-	-	-	-	-	-
PW-8-39	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623616.2	705698.8	24.2	39.2	-	-	-	-	-	-
PW-8-68	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623605.5	705682.9	48.0	68.0	-	-	-	-	-	-
PW-9-92	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623393.5	705809.4	72.6	92.6	-	-	-	-	-	-
PW-10L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623189.4	705921.9	59.8	79.8	-	-	-	-	-	-
PW-10Lb	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623183.7	705887.8	76.0	96.0	-	-	-	-	-	-
PW-10U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623222.1	705873.6	40.0	55.4	-	-	-	-	-	-

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Well Information											Siltronic cVOC Data Collection Objectives					
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Integrated Monitoring[1] with TPH-Dx, -Gx, EPH and VPH	Quarterly GW Measurement: Manual (M) or Transducer (T)	DNAPL Monitoring	EIB Performance Monitoring	HC&C Performance Monitoring	RI N&E Monitoring
PW-11U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624435.7	705191.3	49.8	64.8	-	-	-	-	-	-
PW-12U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624297.6	705265.9	47.8	62.8	-	-	-	-	-	-
PW-13U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624144.5	705333.4	57.6	72.6	-	-	-	-	-	-
PW-14U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623986.8	705437.0	57.8	67.8	-	-	-	-	-	-
PW-15U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623680.7	705639.0	35.1	55.1	-	-	-	-	-	-
PW-16U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623554.8	705713.3	30.4	50.4	-	-	-	-	-	-
Piezometers																
PZ1-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623598.3	705767.9	4.5	5.4	-	-	-	-	-	-
PZ1-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623596.6	705766.9	19.3	20.2	-	-	-	-	-	-
PZ1-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623592.6	705764.4	45.1	50.1	-	-	-	-	-	-
PZ2-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623677.3	705819.3	5.5	6.4	-	-	-	-	-	-
PZ2-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623676.5	705817.6	20.6	21.5	-	-	-	-	-	-
PZ2-43	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623665.1	705810.2	38.3	43.3	-	-	-	-	-	-
PZ2-77	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623670.3	705813.4	71.9	76.9	-	-	-	-	-	-
PZ4-12	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623820.4	705775.4	6.7	11.7	-	-	-	-	-	-
PZ4-41	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623816.5	705777.8	36.1	41.1	-	-	-	-	-	-
PZ5-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623645.7	705738.0	3.8	4.8	-	-	-	-	-	-
PZ5-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623647.3	705735.8	15.0	20.0	-	-	-	-	-	-
PZ5-55	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623648.8	705733.4	50.0	55.0	-	-	-	-	-	-
PZ5-85	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623650.5	705731.0	79.9	84.9	-	-	-	-	-	-
PZ6-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623986.5	705532.4	3.9	4.9	-	-	-	-	-	-
PZ6-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623989.1	705530.0	45.2	50.2	-	-	-	-	-	-
PZ6-115	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623989.2	705536.4	110.1	115.1	-	-	-	-	-	-
PZ6-150	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7623994.6	705532.7	145.4	150.4	-	-	-	-	-	-
PZ7-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7624284.1	705379.0	4.1	5.2	-	-	-	-	-	-
PZ7-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7624288.8	705377.5	43.2	48.2	-	-	-	-	-	-
PZ7-100	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624285.4	705383.2	94.3	99.3	-	-	-	-	-	-
PZ7-150	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7624290.9	705381.7	145.3	150.3	-	-	-	-	-	-
PZ8-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623244.6	706008.2	4.5	5.4	-	-	-	-	-	-
PZ8-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623249.0	706004.8	44.7	49.7	-	-	-	-	-	-
PZ9-5	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Fill	NA	7624596.3	705254.1	4.5	5.5	-	-	-	-	-	-
PZ9-50	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624599.7	705256.9	45.4	50.4	-	-	-	-	-	-
PZ9-75	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624606.4	705252.4	67.5	72.5	-	-	-	-	-	-
PZ9-110	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624602.6	705255.0	105.6	110.6	-	-	-	-	-	-
PZ9-150	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7624603.7	705248.3	146.1	151.1	-	-	-	-	-	-

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Well Information											Siltronic Sampling Schedule
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Schedule
Monitoring Wells											
MW-1-22	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623089.8	705897.6	11	21	-
MW-1-55	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623083.3	705869.1	45	55	-
MW-1-82	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623095.0	705868.1	72	82	-
MW-2-32	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623338.8	705787.9	21.5	31.5	-
MW-2-61	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623333.0	705792.2	50	60	-
MW-2-104	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623343.6	705784.9	94	104	-
MW-3-26	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623842.6	705486.8	15	25	-
MW-3-56	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623848.3	705485.4	45	55	-
MW-4-35	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624102.6	705378.2	24	34	-
MW-4-57	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624107.4	705375.2	46	56	-
MW-4-101	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624095.4	705380.3	89.5	99.5	-
MW-5-32	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624346.9	705217.2	21	31	-
MW-5-100	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624340.3	705213.1	88	98	-
MW-5-175	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624347.8	705207.6	163	173	-
MW-7-60	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623510.3	705392.9	50.0	60.0	-
MW-8-29	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623959.0	705168.7	18.0	28.0	-
MW-8-56	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623956.1	705170.8	45.0	55.0	-
MW-9-29	NW Natural	Gasco	Gasco OU	HAI	Fill/Alluvium	Upland	7623072.8	705017.3	18.0	28.0	-
MW-10-25	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623484.2	704943.6	14.0	24.0	-
MW-10-61	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623481.4	704946.0	50.0	60.0	-
MW-11-32	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623854.1	704790.0	21.0	31.0	-
MW-12-36	NW Natural	Gasco	Gasco OU	HAI	Fill/Alluvium	Upland	7623621.3	704130.4	25.0	35.0	-
MW-14-110	NW Natural	Gasco	Gasco OU	HAI	Lower Alluvium	Upland	7623751.3	704881.7	98.0	108.0	-
MW-15-50	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623699.5	704648.7	40.0	50.0	-
MW-15-66	NW Natural	Gasco	Gasco OU	HAI	Upper Alluvium	Upland	7623705.5	704639.7	60.5	65.5	-
MW-16-45	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623944.8	705482.9	30	45	-
MW-16-65	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623950.4	705478.8	55	65	-
MW-18-30	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623922.4	705446.9	19	29	-
MW-18-125	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623935.8	705436.8	115	125	-
MW-18-180	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7623930.4	705444.2	170	180	-
MW-19-22	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624251.0	705292.0	12	22	-
MW-19-125	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624246.0	705295.0	115	125	-
MW-19-180	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624240.0	705298.0	170	180	-
MW-20-120	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624360.0	705233.0	110	120	-
MW-21-12	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623633.5	705643.0	7	12	-
MW-21-75	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623645.9	705635.6	65	75	-
MW-21-115	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623653.4	705631.1	105.0	115.0	-
MW-21-165	NW Natural	Gasco	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7623661.9	705626.6	156.0	166.0	-
MW-21U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623643.7	705645.9	25	35	-
MW-22-80	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623312.7	705869.2	69.9	79.9	-
MW-22U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623306.2	705875.4	45.0	55.0	-
MW-23-27	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623498.5	705734.9	17.7	27.7	-
MW-23-75	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623494.4	705738.2	64.7	74.7	-
MW-23-123	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623490.4	705740.6	113.3	123.3	-

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Well Information											Siltronic Sampling Schedule
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Schedule
MW-23U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623490.3	705734.9	40.0	50.0	-
MW-24-70	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623865.8	705515.5	60.1	70.1	-
MW-24-130	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623868.1	705513.3	120.1	130.1	-
MW-25L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623074.4	705972.6	54.0	64.0	-
MW-26U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623954.2	705459.8	38.5	48.5	-
MW-27L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624002.7	705428.4	106.0	116.0	-
MW-27U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623998.7	705431.2	66.1	76.1	-
MW-28L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624153.1	705328.7	109.8	119.8	-
MW-28U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624150.1	705330.3	75.0	85.0	-
MW-29U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624175.9	705316.5	46.0	56.0	-
MW-30U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624247.3	705280.1	40.1	50.1	-
MW-31L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624307.8	705260.7	105.0	115.0	-
MW-31U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624310.6	705259.0	84.9	94.9	-
MW-32U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624331.6	705247.5	39.9	49.9	-
MW-33U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624399.1	705212.2	38.0	48.0	-
MW-34L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624426.8	705198.0	99.0	109.0	-
MW-34U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624423.0	705199.7	63.3	73.3	-
MW-35U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624487.2	705194.3	54.0	64.0	-
MW-36U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624629.6	705117.8	44.0	54.0	-
MW-37U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624028.0	705410.2	40.1	50.1	-
MW-38U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624100.8	705356.9	50.1	60.1	-
MW-39F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623063.6	705973.0	11.8	16.8	-
MW-40F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7622894.1	705792.6	21.6	26.6	-
MW-41U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Upland	7622721.4	705601.2	17.6	27.6	-
MW-42F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624617.5	705151.9	26.0	31.0	-
MW-43F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623148.6	705258.5	7.0	17.0	-
MW-44F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623328.7	704799.5	6.0	16.0	-
MW-45F	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623563.4	704499.7	7.0	17.0	-
MW-46F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623476.0	704733.0	6.1	16.1	
MW-47F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623719.2	705298.7	22.0	32.0	
MW-48F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623850.1	705158.8	15.6	25.6	
MW-49F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Upland	7623476.8	705461.6	19.0	29.0	
MW-PW-2L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624540.9	705179.9	119.8	139.8	-
NWN-1-20	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7623946.7	704240.4	10.0	20.0	-
NWN-2-20	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7623940.1	703958.0	10.0	20.0	-
NWN-3-17	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624165.6	703613.0	7.0	17.0	-
NWN-4-15	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7624417.0	703176.5	5.0	15.0	-
NWN-5-20	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7624797.3	702900.2	10.0	20.0	-
NWN-6-31	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625094.4	702865.2	21.0	31.0	-
NWN-7-30	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624543.0	703893.5	20.0	30.0	-
NWN-8-30	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625491.7	703329.4	15.0	30.0	-
NWN-9-31	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7625000.8	704896.3	16.0	31.0	-
NWN-10-26	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Nearshore	7625813.7	704369.3	11.0	26.0	-
NWN-11-24	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7625080.5	704323.5	14.0	24.0	-
NWN-12-20	NW Natural	Siltronic	Siltronic OU	HAI	Fill	Upland	7625552.3	704097.9	10.0	20.0	-
NWN-13-23	NW Natural	Siltronic	Gasco OU	HAI	Fill	Upland	7624041.9	704353.4	13.0	23.0	-
NWN-13-73	NW Natural	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624031.8	704361.5	63.0	73.0	-

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Well Information											Siltronic Sampling Schedule
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Schedule
NWN-13-106	NW Natural	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624023.9	704368.0	96.0	106.0	-
PW-01-80	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624095.8	705353.7	39.5	79.5	-
PW-3-85	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624367.0	705229.0	75.0	85.0	-
WS-8-33	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7624854.1	704987.9	22.5	32.5	-
WS-8-59	NW Natural	Siltronic	Gasco OU	HAI	Upper Alluvium	Nearshore	7624858.3	704990.2	48.5	58.5	-
WS-9-34	NW Natural	Siltronic	Gasco OU	HAI	Fill	Nearshore	7625261.8	704714.1	23.5	33.5	-
WS-10-27	Siltronic	Siltronic	Gasco OU	HAI	Fill	Upland	7624393.1	704306.6	11.0	26.0	-
WS-12-125	Siltronic	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624836.2	704998.7	109.0	124.0	-
WS-12-161	Siltronic	Siltronic	Gasco OU	HAI	Deep Lower Alluvium	Nearshore	7624836.2	704998.7	145.0	160.0	-
WS-13-69	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624575.1	704633.4	52.6	67.6	1Q, 2Q, 3Q, and 4Q[5]
WS-13-105	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624575.1	704633.4	89.0	104.0	1Q, 2Q, 3Q, and 4Q[5]
WS-16-125	Siltronic	Siltronic	Gasco OU	HAI	Deep Lower Alluvium	Upland	7624326.8	704965.0	109.0	124.0	-
WS-16-161	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624326.8	704965.0	145.0	160.0	-
WS-17-52	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624607.5	704484.3	41.0	51.0	-
WS-17-94	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624607.5	704484.3	78.0	93.0	-
WS-18-71	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624577.5	704689.9	60.0	70.0	1Q and 3Q[5]
WS-18-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624581.4	704692.3	91.0	101.0	1Q and 3Q[5]
WS-19-71	Siltronic	Siltronic	Gasco OU	HAI	Upper Alluvium	Upland	7624579.5	704675.8	60.0	70.0	1Q and 3Q[5]
WS-19-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624575.9	704678.6	92.0	102.0	1Q and 3Q[5]
WS-21-112	Siltronic	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624617.9	705091.1	94.5	109.5	1Q, 2Q, 3Q, and 4Q[6]
WS-21-131	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Nearshore	7624622.6	705086.1	115.0	130.0	1Q, 2Q, 3Q, and 4Q[6]
WS-23-116	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624452.6	705097.3	100.0	115.0	1Q, 2Q, 3Q, and 4Q[6]
WS-24-111	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Upland	7624532.1	705032.9	100.0	110.0	1Q, 2Q, 3Q, and 4Q[6]
WS-24-155	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624538.3	705037.4	99.0	109.6	-
WS-25-96	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Nearshore	7624670.2	705040.6	85.0	95.0	1Q, 2Q, 3Q, and 4Q[6]
WS-25-111	Siltronic	Siltronic	Gasco OU	HAI	Lower Alluvium	Nearshore	7624667.3	705042.8	100.0	110.0	1Q, 2Q, 3Q, and 4Q[6]
WS-26-86	Siltronic	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624747.8	704984.7	75.0	85.0	1Q and 3Q[6]
WS-26-116	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Nearshore	7624750.4	704982.4	105.0	115.0	1Q, 2Q, 3Q, and 4Q[6]
WS-27-86	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624754.5	704902.1	70.0	85.0	1Q and 3Q[6]
WS-30-96	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624472.5	704758.7	85.0	95.0	1Q and 3Q[5]
WS-31-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624519.8	704716.0	95.0	105.0	1Q and 3Q[5]
WS-32-76	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624524.7	704718.5	65.0	75.0	1Q and 3Q[5]
WS-32-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624528.9	704721.4	90.0	100.0	1Q and 3Q[5]
WS-33-81	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624536.7	704736.7	70.0	80.0	1Q and 3Q[5]
WS-33-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624535.5	704733.1	95.0	105.0	1Q and 3Q[5]
WS-34-71	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624559.1	704675.8	60.0	70.0	1Q and 3Q[5]
WS-34-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624563.5	704679.8	95.0	105.0	1Q and 3Q[5]
WS-35-76	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624562.0	704701.3	65.0	75.0	1Q and 3Q[5]
WS-35-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624561.0	704702.9	95.0	105.0	1Q and 3Q[5]
WS-36-81	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624561.7	704714.7	70.0	80.0	1Q and 3Q[5]
WS-36-106	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624564.7	704715.3	95.0	105.0	1Q and 3Q[5]
WS-37-51	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624606.5	704653.5	40.0	50.0	1Q and 3Q[5]
WS-38-61	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624598.9	704670.1	50.0	60.0	1Q and 3Q[5]
WS-39-101	Siltronic	Siltronic	Gasco OU	-	Lower Alluvium	Upland	7624485.1	704777.6	90.0	100.0	1Q and 3Q[5]
WS-40-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624571.0	704690.2	25.8	35.8	1Q and 3Q[5]

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Well Information											Siltronic Sampling Schedule
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Schedule
WS-41-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624534.6	704635.5	26.3	36.3	1Q and 3Q[5]
WS-41-91	Siltronic	Siltronic	Gasco OU	-	Upper Alluvium	Upland	7624530.2	704638.5	75.3	90.3	1Q and 3Q[5]
WS-42-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624596.5	704583.4	25.8	35.8	1Q and 3Q[5]
WS-43-36	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624570.3	704567.9	25.8	35.8	1Q and 3Q[5]
WS-44-29	Siltronic	Siltronic	Gasco OU	-	Fill	Nearshore	7624504.6	705143.3	24.0	29.0	-
WS-45-23	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624392.2	705054.5	18.0	23.0	-
WS-46-33	Siltronic	Siltronic	Gasco OU	-	Fill	Upland	7624781.0	704876.3	28.5	33.5	-
WS-47-183	Siltronic	Siltronic	Gasco OU	Anchor QEA	Deep Lower Alluvium	Nearshore	7624602.8	705154.3	172.0	182.0	-
DNAPL Removal or Observation Wells											
DW-6U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623939.8	705466.0	36.3	48.3	-
DW-11U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624424.4	705169.8	21.7	33.7	-
DW-14U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623987.9	705421.1	31.8	46.8	-
MW-6-32	NW Natural	Gasco	Gasco OU	HAI	Fill	Nearshore	7623289.8	705412.1	21.0	31.0	-
MW-13-30	NW Natural	Gasco	Gasco OU	HAI	Fill	Upland	7623447.2	705432.9	19.0	29.0	-
OW-1F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624722.3	705044.2	30.0	35.0	-
OW-2F	NW Natural	Siltronic	Gasco OU	Anchor QEA	Fill	Nearshore	7624542.7	705172.5	25.6	30.6	-
OW-5F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7624070.3	705366.7	28.5	33.5	-
OW-7-17	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623753.3	705593.8	12.5	17.5	-
OW-8-15	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623600.4	705685.4	10.1	15.1	-
OW-8-28	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623623.5	705691.3	23.1	28.1	-
OW-9-25	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623388.5	705812.5	20.0	25.0	-
OW-10F	NW Natural	Gasco	Gasco OU	Anchor QEA	Fill	Nearshore	7623183.5	705929.8	20.7	25.7	-
Groundwater Extraction Wells											
PW-1L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624730.3	705046.4	114.8	134.8	-
PW-1U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624718.0	705053.1	55.1	70.1	-
PW-1Ub	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624747.8	705034.9	64.8	79.8	-
PW-2L	NW Natural	Siltronic	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624558.2	705165.7	120.1	140.1	-
PW-2U	NW Natural	Siltronic	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624548.9	705171.6	57.8	72.8	-
PW-3-118	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624353.0	705238.0	108.0	118.0	-
PW-3U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624358.3	705216.9	42.8	57.8	-
PW-4L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624216.3	705309.2	105.4	125.4	-
PW-4U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624207.1	705313.8	47.2	62.2	-
PW-5L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7624049.2	705380.6	105.7	125.7	-
PW-5U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624057.4	705374.2	49.9	64.9	-
PW-6L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623921.5	705497.0	103.7	123.7	-
PW-6U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623927.6	705487.4	49.4	64.4	-
PW-7-93	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623758.1	705591.0	73.5	93.5	-
PW-8-39	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623616.2	705698.8	24.2	39.2	-
PW-8-68	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623605.5	705682.9	48.0	68.0	-
PW-9-92	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623393.5	705809.4	72.6	92.6	-
PW-10L	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623189.4	705921.9	59.8	79.8	-
PW-10Lb	NW Natural	Gasco	Gasco OU	Anchor QEA	Lower Alluvium	Nearshore	7623183.7	705887.8	76.0	96.0	-
PW-10U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623222.1	705873.6	40.0	55.4	-

Comprehensive Well Network Description – NW Natural and Siltronic Properties
Data Collection Program and Sampling Schedule
Revision Date: 5/2/2019

Well Information											Siltronic Sampling Schedule
Well ID	Installed By	Site Location	Operable Unit (OU)[2,3]	NW Natural Monitoring Entity	Water-Bearing Zone	◆Nearshore (200 feet) ◆Upland ◆River	Easting[4]	Northing[4]	Screened Interval (feet bgs)		Schedule
PW-11U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624435.7	705191.3	49.8	64.8	-
PW-12U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624297.6	705265.9	47.8	62.8	-
PW-13U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7624144.5	705333.4	57.6	72.6	-
PW-14U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623986.8	705437.0	57.8	67.8	-
PW-15U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623680.7	705639.0	35.1	55.1	-
PW-16U	NW Natural	Gasco	Gasco OU	Anchor QEA	Upper Alluvium	Nearshore	7623554.8	705713.3	30.4	50.4	-
Piezometers											
PZ1-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623598.3	705767.9	4.5	5.4	-
PZ1-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623596.6	705766.9	19.3	20.2	-
PZ1-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623592.6	705764.4	45.1	50.1	-
PZ2-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623677.3	705819.3	5.5	6.4	-
PZ2-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623676.5	705817.6	20.6	21.5	-
PZ2-43	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623665.1	705810.2	38.3	43.3	-
PZ2-77	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623670.3	705813.4	71.9	76.9	-
PZ4-12	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623820.4	705775.4	6.7	11.7	-
PZ4-41	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623816.5	705777.8	36.1	41.1	-
PZ5-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623645.7	705738.0	3.8	4.8	-
PZ5-20	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623647.3	705735.8	15.0	20.0	-
PZ5-55	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623648.8	705733.4	50.0	55.0	-
PZ5-85	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623650.5	705731.0	79.9	84.9	-
PZ6-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623986.5	705532.4	3.9	4.9	-
PZ6-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623989.1	705530.0	45.2	50.2	-
PZ6-115	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7623989.2	705536.4	110.1	115.1	-
PZ6-150	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7623994.6	705532.7	145.4	150.4	-
PZ7-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7624284.1	705379.0	4.1	5.2	-
PZ7-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7624288.8	705377.5	43.2	48.2	-
PZ7-100	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624285.4	705383.2	94.3	99.3	-
PZ7-150	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7624290.9	705381.7	145.3	150.3	-
PZ8-5	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Fill	NA	7623244.6	706008.2	4.5	5.4	-
PZ8-50	NW Natural	Gasco-River	Gasco OU	Anchor QEA	Upper Alluvium	NA	7623249.0	706004.8	44.7	49.7	-
PZ9-5	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Fill	NA	7624596.3	705254.1	4.5	5.5	-
PZ9-50	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624599.7	705256.9	45.4	50.4	-
PZ9-75	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624606.4	705252.4	67.5	72.5	-
PZ9-110	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Lower Alluvium	NA	7624602.6	705255.0	105.6	110.6	-
PZ9-150	NW Natural	Siltronic-River	Gasco OU	Anchor QEA	Deep Lower Alluvium	NA	7624603.7	705248.3	146.1	151.1	-

Notes:
ASTM = American Society for Testing and Materials
cVOC = chlorinated volatile organic compound
DNAPL = dense non-aqueous phase liquid
DO = dissolved oxygen
EIB = enhanced in-situ bioremediation
EPA = U.S. Environmental Protection Agency
EPH = extractable petroleum hydrocarbons
HARN = High Accuracy Reference Network
HC&C = hydraulic control and containment
NA = not applicable
NAD = North American Datum
ORP = oxidation-reduction potential
PAHs = polycyclic aromatic hydrocarbons
RI N&E = remedial investigation nature and extent
SIM = selective ion monitoring
SVOCs = semivolatile organic compounds
TPH = total petroleum hydrocarbons
VOCs = volatile organic compounds
VPH = volatile petroleum hydrocarbons

NW Natural Notes:
1 = Analyses at all locations include PAHs OR SVOCs (EPA 8270-SIM), VOCs (EPA 8260B), Total Cyanide (EPA 335.4), Free Cyanide (ASTM D-4282-02),Available Cyanide (OIA-1677), and Total Metals (EPA 6000 Series).** In addition, field measurements will be collected including DO, pH, Conductivity, Turbidity, Temperature, and ORP.
2 = Former Gasco MGP Operable Unit (Gasco OU) includes the NW Natural Gasco Site and norther portion of the Siltronic Site formerly used by NW Natural for MGP operations (i.e., the "Allen Tract").
3 = DNAPL Monitoring conducted by Hahn and Associates
** = aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium,
silver, thallium, vanadium, and zinc.

Siltronic Notes:
3 = Southern Siltronic Site Operable Unit (Siltronic OU) consists of the portion of the Siltronic Corporation property south of the Gasco OU.
4 = Horizontal Datum / Coordinate System is NAD83/91 (HARN) State Plane Oregon North International Feet.
5 = Semiannual sampling will occur during March and September. Analyses include low level VOCs (EPA 8260B), fixed gases (ASTM D1945), Total and Dissolved Iron and Manganese (EPA 6020), Chloride and Sulfate (SW9056), SiREM Gene-Trac Dehalococcoides Assay, and SiREM Gene-Trac Functional Gene Assay. In addition, field measurements will be collected including DO, pH, Conductivity, Turbidity, Temperature, and ORP.

6 = Quarterly sampling will occur during March, June, September and December. Analyses include low level VOCs (EPA 8260B), fixed gases (ASTM D1945), Total and Dissolved Iron and Manganese (EPA 6020), and Chloride and Sulfate (SW9056). In addition, field measurements will be collected including DO, pH, Conductivity, Turbidity, Temperature, and ORP.