Washington
Issaquah | Bellingham | Seattle
Oregon
Portland | Bend | Baker City
California
Oakland | Folsom | Irvine

DRAFT FINAL

PER- AND POLY-FLUOROALKYL SUBSTANCES CHARACTERIZATION STUDY WORK PLAN
LOWER ISSAQUAH VALLEY
ISSAQUAH, WASHINGTON

Submitted by:
Farallon Consulting, L.L.C.
975 5th Avenue Northwest
Issaquah, Washington 98027

Farallon PN: 1754-002

For:
Eastside Fire & Rescue
175 Newport Way Northwest
Issaquah, Washington 98027

August 1, 2018

Prepared by:

Eric F. Buer, L.G., L.H.G.
Associate Hydrogeologist

Reviewed by:

Clifford T. Schmitt, L.G., L.H.G.
Principal Hydrogeologist

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1.0 INTRODUCTION

Farallon Consulting, L.L.C. (Farallon) has prepared this Work Plan on behalf of Eastside Fire & Rescue (EFR) to present the work elements and rationale to further characterize the nature and extent of per- and poly-fluoroalkyl substances (PFAS) in soil and groundwater in a portion of the Lower Issaquah Valley in Issaquah, Washington (Figure 1). The overall objective of the characterization work to be performed is to assess the potential source(s) of PFAS in soil and groundwater; evaluate the direct exposure pathway for soil; evaluate the pathway for migration from soil to groundwater; and where appropriate, evaluate the distribution of PFAS in groundwater emanating from confirmed sources.

Although PFAS are not regulated as hazardous substances under federal or Washington State law, the characterization work will be performed consistent with the requirements of the Washington State Model Toxics Control Act Cleanup Regulation (MTCA), as established in Chapter 173-340 of the Washington Administrative Code (WAC 173-340). If necessary in the future, all data collected as part of the characterization work described in this Work Plan can be used to support the development and evaluation of any future cleanup actions that may be necessary under the supervision of the Washington State Department of Ecology (Ecology).

1.1 PURPOSE

The specific purposes of this Work Plan are to:

- Describe characterization work elements and their rationale;
- Identify sample locations and media in the Lower Issaquah Valley, sample quantities, analytical methods, and documentation protocols for the sampling program;
- Describe standard operating procedures (SOPs) for field sampling of soil and groundwater;
- Ensure collection of representative and defensible data through application of the procedures and processes identified in the project Quality Assurance Project Plan (QAPP) (Appendix A); and
- Describe the documentation of field work, analytical and other results, and other relevant information that will be incorporated into a Final PFAS Characterization Summary Report.

1.2 ORGANIZATION

The Work Plan and Quality Assurance Project Plan have been developed in accordance with the *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* revised December 2016, prepared by Ecology (2004). The Work Plan is organized in the following sections:

- **Section 1**, **Introduction**, defines the purposes and organization of the Work Plan;

- **Section 2**, **Background**, provides the problem statement, identified areas of interest, study areas and previously completed work, parameters of interest, and regulatory criteria;
- **Section 3**, **Project Description**, provides a description of project goals and objectives, required tasks, organization, and schedule;
- **Section 4**, **Field Procedures**, provides a detailed description of the sampling equipment and protocols that will be used for collection of characterization samples;
- **Section 5**, **Sample Handling**, provides details on sample documentation, soil and groundwater sampling containers, sample preservation and holding times, collection of quality assurance/quality control (QA/QC) samples, and sample packaging and shipment;
- **Section 6**, **Field Documentation**, summarizes the procedures and forms that will be used to document the field activities conducted for the characterization work;
- **Section 7**, **Management of Investigation-Derived Waste**, provides details on waste sampling, profiling, handling, and disposal; and lists the analytical laboratories and laboratory analytical methods that will be used in conducting the characterization work;
- **Section 8**, **Laboratory Analysis,** identifies analytical laboratories, preparation methods, method requirements, and accreditations;
- **Section 9**, **Reporting,** describes project reporting, including the frequency and distribution of reports, responsible personnel for preparation of reports, and data reduction and analysis to be included in summary reports; and
- **Section 10**, **References**, provides citations for documents referenced in this Work Plan.

2.0 BACKGROUND

This section provides some background on PFAS and describes the project problem statement, areas of interest to be assessed, the environmental setting of the Lower Issaquah Valley, previous studies and existing data, parameters of interest, and regulatory criteria.

2.1 PER- AND POLY-FLUOROALKYL SUBSTANCES BACKGROUND

PFAS are a class of chemicals that were developed for a wide range of uses, including imparting oil and/or water repellency, firefighting, and friction and surface tension reduction, beginning in the 1940s. Due to the unique properties associated with PFAS carbon-fluorine chemistry, these chemicals have found use in a wide array of industries, including aerospace, photographic imaging, metal plating, firefighting, carpet cleaning, food and beverage packaging, automotive, construction, printing, and oil and gas production (Interstate Technology Regulatory Council [ITRC] 2017).

Two commonly detected PFAS are perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA). These chemicals are structured with a weakly ionic “head” (a sulfate or carboxylate group) and a fully fluorinated (perfluorinated) tail of eight carbons. Due to their stability at high temperatures and surfactant properties associated with the stable fluorine tail, PFOS and PFOA have found widespread use in aqueous film-forming foams (AFFF) for fighting and extinguishing hydrocarbon fuel fires (Moody and Field 1999). Other PFAS have variable carbon chain lengths and some are not fully fluorinated (i.e., polyfluorinated).

The effectiveness of PFAS-bearing concentrates in particular at “knocking down” and smothering hydrocarbon fuel fires resulted in widespread use by agencies and facilities such as fire departments, municipal airports, and military bases, which regularly handle aviation fuel or other hydrocarbons. Typical AFFF consisted of concentrate mixed with water to yield a 3 percent solution. Because special handling was needed to generate and deploy AFFF at a fire, regular training to set up and use AFFF firefighting equipment was common among the product’s firefighting entities. Due to the nature of the training exercises, which typically included equipment setup and practice mixing concentrate and water to the desired proportion with a foam aerator by multiple individuals, AFFF training currently is recognized as one of the primary pathways for release of concentrated PFAS to the environment (ITRC 2017).

Since their invention, PFAS have been incorporated into more than 3,000 manmade chemicals (Wang et al. 2017) and currently have achieved a global environmental distribution. Concerns regarding PFAS health effects were first raised in the 1970s when PFOA was detected in 3M Manufacturing Company worker blood, and subsequently in human blood bank samples in 1998. The U.S. Environmental Protection Agency (EPA) began development of Enforceable Consent Agreements with PFAS manufacturers in 2003 to set in place industry-sponsored testing to identify sources of PFOA in the environment and the pathways for human exposure (EPA 2003). In 2009, PFOS and related compounds were listed under the Stockholm Convention on Persistent Organic

Pollutants Annex B, which targets listed chemicals for restricted production and use (Lindstrom et al. 2011).

In 2016, EPA (2016b) established lifetime health advisory levels for PFOA and PFOS in drinking water, the primary pathway for exposure for most adults, of a combined value of 70 nanograms per liter (0.07 microgram per liter [µg/l]). The Health Advisory for PFOS identifies both cancer and non-cancer health risks associated with increased body burdens of the chemical. Identified risks include cancer of the bladder, colon, thyroid, breast, and prostate; increases in total cholesterol; and changes in thyroid function and hormone levels. Additional risks were identified for fertility and development (low birth weight) (EPA 2016a).

The Washington State Legislature introduced Engrossed Substitute Senate Bill (ESSB) 6413 in 2017. ESSB 6413 aims to reduce PFAS use and distribution in the environment by targeting PFAS-bearing AFFF in Washington State for elimination in firefighting training in 2018, and prohibiting the manufacture, distribution, and sale of PFAS-bearing AFFF with some exceptions[1] in 2020. A second bill, ESSB 2658, aims to eliminate PFAS in food packaging by 2022, replacing these compounds with safer alternative chemicals.

2.2 STUDY AREA AND SURROUNDINGS

The Lower Issaquah Valley is located east of Seattle and south of Lake Sammamish (Figure 1). Valley floor elevations range from approximately 40 to 160 feet North American Vertical Datum of 1988. The Lower Issaquah Valley is roughly bisected by Issaquah Creek, which runs longitudinally along the valley floor and flows to the north into Lake Sammamish. The City of Issaquah is located in the northern portion of the Lower Issaquah Valley. Drinking water for the City of Issaquah is pumped from a system of four wells (two in the northeastern and two in the northwestern portions of Issaquah) and through service water delivery by the Cascade Water Alliance.

According to the Western Regional Climate Center (2016), the climate of the greater Seattle area, including Puget Sound and the Lower Issaquah Valley, is maritime and characterized by cool summers and mild winters influenced by ocean air. Based on data published for the Snoqualmie Falls, Washington meteorological station (Identification No. 457773), the average annual minimum temperature for the Lower Issaquah Valley is 32 degrees Fahrenheit, and the average annual maximum temperature is 76 degrees Fahrenheit. The average annual precipitation ranges from 33 to 81 inches, with an average of 5 to 8 inches per month from October through March (U.S. Climate Data 2016).

The Puget Sound region is underlain by Quaternary sediments deposited by multiple glacial episodes. Deposition occurred during glacial advances and retreats, which created the existing subsurface conditions. The regional sediments consist primarily of interlayered and/or sequential deposits of alluvial clays, silts, and sands that typically are situated over deposits of glacial till that

---

[1] Exceptions include use at Federal Aviation Administration-regulated airports, petroleum refineries and terminals, and large chemical plants.

consist of silty sand to sandy silt with gravel. Outwash sediments consisting of sands, silts, clays, and gravels were deposited by rivers, streams, and post-glacial lakes during the glacial retreats and have been largely over-consolidated by the overriding ice sheets.

The geology of the Lower Issaquah Valley comprises a series of interbedded sand-gravel and silt-clay layers overlying the bedrock units that form the adjacent foothills to the east and west of the Lower Issaquah Valley.

2.3 PROJECT PROBLEM STATEMENT

PFAS, including PFOA and PFOS, were detected at concentrations ranging from 0.0258 to 0.6 µg/l in groundwater samples collected from the City of Issaquah production well COI-PW04 as part of Unregulated Contaminant Monitoring Rule sampling performed by the EPA in 2013. PFAS were again detected at concentrations ranging from 0.0234 to 0.514 µg/l in groundwater samples collected from production well COI-PW04 by EPA in 2014 (EPA 2013).

EFR, the City of Issaquah, and the Sammamish Plateau Water and Sewer District have previously performed limited characterization work to evaluate a suspected source area (175 Newport Way Northwest in Issaquah, Washington), and to characterize the nature and extent of PFAS in groundwater below the shallowest water-bearing zone at the Lower Issaquah Valley. These previous investigations have confirmed the release of PFAS to soil at 175 Newport Way Northwest and a plume of impacted groundwater extending north toward City of Issaquah Production Well #4. Additional sampling performed by the City of Issaquah in 2016 confirmed the presence of PFAS in soil on the eastern portion of the Lower Issaquah Valley proximate to 190 East Sunset Way and west of 135 East Sunset Way (City of Issaquah Public Works Engineering [City of Issaquah] 2017).

The suspected primary mechanism for the release of PFAS to the environment is the historical use of AFFF during training exercises and for fighting flammable liquid fires (primarily petroleum). Releases of AFFF are suspected or confirmed at the following locations (collectively referred to as areas of interest) (Figure 2):

- Issaquah Valley Elementary West Playfield;
- Issaquah Valley Elementary East Ballfields (Dodd Fields Park);
- North of 190 East Sunset Way (Memorial Field);
- West of 135 East Sunset Way on the former rail grade (Rainier Trail Area); and
- 175 Newport Way Northwest.

2.4 AREAS OF INTEREST

Areas of interest were identified through environmental sampling and analysis that confirmed releases to soil and/or groundwater at select locations and through interviews with EFR firefighting personnel, Mr. Bob Butterfield and Ms. Kelly Revfem (Farallon 2016, 2018). Details regarding the locations of firefighting training exercises, historical features at the training areas, and AFFF use, storage, and disposal were obtained during these interviews and reconnaissance of each area of interest.

In general, training exercises involved setting up AFFF application systems and practice by participants to produce an effective AFFF mixture at the hose nozzle. Farallon's understanding based on interviews with EFR firefighting personnel is that the foam mixtures were typical 3 percent solutions prior to 2002, after which reformulation of the AFFF concentrate allowed for more-diluted 1 percent solutions to be used. Typical volumes used for training were on the order of one to three 5-gallon buckets per event, requiring between approximately 1,500 to 4,500 gallons of water; the resulting foam volume would have been considerably larger. Training exercises initially included practice with in-line induction systems to pull concentrate from buckets, and were later replaced by "around the pump" mixing systems incorporated into modern fire trucks.

During training exercises, AFFF was sprayed on the ground, vegetation, and adjacent buildings (including the Issaquah Valley Elementary gymnasium) and then was washed down with service water from fire hydrants at each training area. Equipment on fire trucks and hoses in contact with AFFF typically was washed off in the field at the end of the training event, and foam remaining in the training area was dispersed to the extent possible by spraying additional water on the area.

A description of each area of interest and relevant historical information is summarized below.

2.4.1 Issaquah Valley Elementary West Playfield

Historical AFFF training was performed on Issaquah Valley Elementary West Playfield (Figure 3) during the period from approximately the early 1970s through the early 1980s at a frequency of approximately once or twice per year. Typically, one to three 5-gallon buckets of AFFF concentrate was expended during each training event. No sampling for PFAS has been conducted at the Issaquah Valley Elementary West Playfield to date.

Training was performed in the West Playfield area proximate to the western wall of the Issaquah Valley Elementary gymnasium building. Service water was obtained for training from the fire hydrant south of the gymnasium building. The ground surface in this area is lawn, with the exception of an approximately 5- to 6-foot-wide sidewalk adjacent and parallel to the gymnasium building wall. The lawn is slightly sloped down to the east to a lower flat area of approximately 30 by 70 feet (decision unit DU-1A). A catch basin is present on the southern portion of decision unit DU-1A and would capture surface runoff in this area. To the west and south is a grass-covered playfield (decision unit DU-1B). Surface water runoff in this area would flow to decision unit DU-1A. A rectangular area with playground equipment that is surfaced in wood chips is present to the north of decision units DU-1A and DU-1B. Beyond the playfield to the west are a fence, a ditch, and Newport Way Northwest. A two-lane driveway is present to the south.

It is expected from the descriptions of training activities that AFFF mixture was sprayed across both decision units DU- 1A and DU-1B, but predominately in the area of the small swale and adjacent sidewalk and gymnasium building wall (decision unit DU-1A). At this and other training areas, the fire truck was parked in the vicinity of the fire hydrant and either a 100- or 150-foot fire hose was used in training. This setup resulted in AFFF mixture discharge primarily in an area approximately 150 to 200 feet from where the fire truck was parked. Based on topography and the presence of impermeable surfaces (i.e., the sidewalk and building), it is expected that the small swale and catch basin area would have received the highest mass loading to surficial soil (decision unit DU-1A). The relatively flat playground surface and sloped lawn area outside the shallow swale and concrete- or building-capped surface, but within 200 feet of the fire hydrant, would likely have received lower mass loading to surficial soil (decision unit DU-1B).

2.4.2 Dodd Fields Park

Historical AFFF training was performed on Dodd Fields Park (Figure 3) during the period from approximately the early 1970s through the early 1980s on a similar schedule to the Issaquah Valley Elementary West Playfield at a frequency of approximately once or twice per year. Typically, one to three 5-gallon buckets of AFFF concentrate was expended during each training event. No sampling for PFAS has been conducted at Dodd Fields Park to date.

At Dodd Fields Park, an irregular strip of land is present between the driveway and adjacent parking lot to the west and the ballfields to the east that is covered in lawn with widely spaced deciduous trees. Prior to development of Dodd Fields Park, this area was overgrown with vegetation described as blackberry bramble. Service water for training using AFFF was obtained from the fire hydrant southeast of the Issaquah Valley Elementary school building.

Spraying of the AFFF mixture occurred in the vegetated area that is now a lawn with trees and likely extended onto land that is occupied by the ballfields. It is presumed that the historical extent of the overgrown vegetation area extended eastward prior to regrading and construction of the ballfields. The surface of the ballfields likely is imported fill material that postdates the training exercises; therefore, no sampling currently is planned in the footprint of the ballfields.

It appears that rainfall primarily infiltrates into the ground surface in this area; however, there is also a catch basin at the edge of the lawn between the baseball diamonds (Figure 3). The catch basin likely was added during ballfield construction and was probably not present during the period when training was being conducted at Dodd Fields Park.

A sidewalk extending from the parking lot to the area between the ballfields separates this area into northern and southern portions (Figure 3). The northern portion of the area where training occurred is generally flat with a modest slope to the north (less than 1 foot). No stormwater drainage system is present in this area. The southern portion of the area has localized relief up to 2 feet with an overall slope to the north.

Based on the observed topography, likely regrading of surface soil during construction of the ballfields, and presence of impermeable surfaces (i.e., sidewalk and driveway), it is expected that the northern portion of the vegetated area closest to the fire hydrant would have received the highest mass loading to surficial soil. This area is designated decision unit DU-2A. The southern portion of the vegetated area within 200 feet of the fire hydrant would have received lower mass loading to surficial soil. This area is designated decision unit DU-2B.

Three groundwater monitoring points were installed during a recent geotechnical study in the vicinity of Dodd Fields Park[2] (Associated Earth Sciences Inc. 2018). Monitoring wells DF-MW01 and DF-MW03 are located to the east and northeast of Dodd Fields Park, respectively, some distance from where firefighting training exercises were conducted at the Issaquah Valley Elementary West Playfield or Dodd Fields Park and in the presumed direction of groundwater flow.

Monitoring well DF-MW02 is located in the central portion of the northern area, directly west of the southeastern corner of the Issaquah Valley Elementary school building and nearest to the fire hydrant. The wells are constructed of 2-inch polyvinyl chloride casing and completed in a flush-mounted well-head enclosure. Each well has 10 feet of screened casing ranging from 15 feet total depth (monitoring well DF-MW01) to 30 feet total depth (monitoring well DF-MW03). Groundwater is reported to be present in monitoring wells DF-MW02 and DF-MW03, but monitoring well DF-MW01 is too shallow to intercept the groundwater table.

2.4.3 Memorial Field

Historical training using AFFF was performed north of the fire station at 190 East Sunset Way on the southern portion of Memorial Field during the period from approximately the early 1980s through the mid-1990s at a frequency of approximately once or twice per year (Figure 4). Training exercises in both areas were similar to those performed at the Issaquah Valley Elementary West Playfield and Dodd Fields Park, and included setting up AFFF application systems and practice producing an effective AFFF mixture at the end of a 100- to 150-foot fire hose. AFFF was sprayed on the ground during exercises and then was washed down with service water from the fire hydrant on the southeastern corner of Memorial Field. Typically, one to three 5-gallon buckets of AFFF concentrate was expended during each training event.

An asphalt-paved parking lot is present north of the fire station at 190 East Sunset Way followed by a lawn with a number of trees, then a grass ballfield at Memorial Field. Surface runoff in the paved area is captured by catch basins in the central portion of the drive lane. Memorial Field slopes slightly to the northwest; however, there is no evidence of overland flow on the field. Therefore, precipitation on, and surface runoff onto, the lawn primarily infiltrate into the ground. The open field north of the treed area, within a radius of 200 feet from the fire hydrant, has been identified as decision unit DU-3.

Previous sampling performed by the City of Issaquah in 2016 confirmed the presence of long-chain PFAS (nine carbon and above) in soil immediately north of the fire station at 190 East Sunset Way (City of Issaquah 2017). PFAS were not detected at concentrations exceeding the laboratory

---

[2] Original well identifiers were EB-1W, EB-3W, and EB-5W. For consistency with other areas of interest and the proposed monitoring wells to be installed as part of the PFAS characterization study, the existing wells have been assigned identifiers of DF-MW01, DF-MW03, and DF-MW02, respectively.

practical quantitation limit (PQL) in the composite soil sample collected among mature trees north-adjacent to the parking lot on Memorial Field (City of Issaquah 2017). Information provided during interviews with EFR firefighting personnel suggests the composite soil sample collected in 2016 was not collected from the training area, which would have been the open field north of the treed area.

2.4.4 Rainier Trail Area

Training at the Rainier Trail Area (Figure 4) occurred during the period from approximately the early 1970s through the early 1980s at a frequency of once per year. Typically, one to three 5-gallon buckets of AFFF concentrate was expended during each training event. Training service water was provided by the fire hydrant on the northeastern corner of the parking lot.

During the period that training was occurring, the Rainier Trail Area was an abandoned railroad grade with a gravel surface. This area was later redeveloped as parking with an irregular-shaped north-northwest to south-southeast landscaped strip along the orientation of the railroad tracks and east-adjacent parking lot. This area has been identified as decision unit DU-4. It is not known if this area was served by a stormwater collection system during the period when training was occurring.

Previous sampling performed by the City of Issaquah in 2016 confirmed the presence of PFOA at a concentration of 0.91 nanogram per gram (0.00091 milligram per kilogram) in the soil sample collected from the landscaped area that bounds the western portion of the parking lot (City of Issaquah 2017). The PFOA soil investigatory level for protection of groundwater is 0.44 nanogram per gram. PFAS were reported non-detect at the laboratory PQL in a second soil sample collected west-adjacent to the building at 135 East Sunset Way.

2.4.5 175 Newport Way Northwest

Training, including producing an effective AFFF mixture at the hose nozzle, and equipment cleaning and servicing were performed at 175 Newport Way Northwest (Figure 5) during the period from approximately the early 1980s through the late 1990s at a frequency of up to 12 times per year. Typically, one to three 5-gallon buckets of AFFF concentrate was expended during each training event. Training was performed at an area that currently is covered with lawn near the fire hydrant on the north-central portion of the property (decision unit DU-5) and at the western gravel-surfaced portion of the property. Some AFFF mixture may have been sprayed at the base of the hillside west of the western property boundary.

Residual AFFF associated with training exercises was washed down with service water on the property, some of which was captured by the property’s stormwater management system that routed water to a detention pond on the eastern portion of the property near Newport Way Northwest (decision unit DU-6). Discarded AFFF concentrate associated with equipment cleaning and servicing was disposed of off the property.

Soil sampling performed by the City of Issaquah with permission from EFR confirmed the presence of PFAS, including PFOA and PFOS, in soil at 175 Newport Way Northwest in the stormwater detention pond area and on the western portion of the property where historical training exercises occurred (decision unit DU-6) (Geosyntec Consultants, Inc. 2016). The highest reported concentration of PFAS was 1,300 nanograms per gram in a soil sample collected from the training area on the western portion of the property. The lateral extent of PFAS in soil was not characterized as part of the investigation performed by the City of Issaquah at the 175 Newport Way Northwest property.

2.5 SUMMARY OF PREVIOUS STUDIES AND EXISTING DATA

Groundwater sampling for PFAS from City of Issaquah production well COI-PW04 began in 2013 under the EPA (2013) Unregulated Contaminant Monitoring Rule program. Additional characterization work has been performed since the initial EPA sampling by the City of Issaquah and Sammamish Plateau Water and Sewer District that included installation of monitoring wells COI-MW01 through COI-MW07 (Figure 2). A statewide sampling program for PFAS in drinking water was implemented by the Washington Department of Health in 2018. A detailed summary of previous characterization work will be provided as part of the Final PFAS Characterization Summary Report.

2.6 PARAMETERS OF INTEREST AND POTENTIAL SOURCES

Each area of interest has been identified as a potential source of PFAS to groundwater based on historical uses and/or previous investigation results. At areas of interest where direct contact with surficial soil (at depths less than 6 inches below ground surface [bgs]) is a potential exposure pathway, decision units have been identified for shallow soil based on historical uses in each area of interest, observed drainage patterns, and other features (i.e., areas capped by buildings, concrete sidewalks, or asphalt-paved parking lots or roads) that may have affected overall mass loading.

Borings to collect reconnaissance groundwater samples have been located to characterize potential PFAS impacts to shallow groundwater at each area of interest, and to assess the vertical distribution of PFAS in vadose (unsaturated) soil at depth. Analytical results for reconnaissance groundwater samples collected from borings down-gradient of areas of interest will further characterize the lateral extent of PFAS in shallow groundwater. The distribution of PFAS in groundwater at existing monitoring wells in the vicinity of Dodd Fields Park and the Rainier Trail Area, and analytical results for reconnaissance groundwater samples with detected concentrations of PFAS at all areas of interest, will be used to design a monitoring well network to monitor groundwater quality and flow direction associated with each confirmed source. Additional sampling will ultimately be necessary at confirmed sources to further refine the nature and extent of impacts to soil and groundwater.

For this characterization study, parameters of interest for soil and groundwater include the following PFAS:

- Perfluorobutyl sulfonate;

- Perfluorohexanoic acid;
- Perfluorohexane sulfonic acid;
- Perfluoroheptanoic acid;
- PFOA;
- PFOS;
- Perfluorononanoic acid;
- Perfluorodecanoic acid;
- Perfluoroundecanoic acid;
- Perfluorododecanoic acid;
- Perfluorotridecanoic acid; and
- Perfluorotetradecanoic acid.

2.7 REGULATORY CRITERIA

PFAS are not currently regulated as hazardous substances under MTCA. For this investigation, Ecology (2018a) has developed investigatory levels that include numerical criteria based on exposure scenarios for groundwater (drinking water scenario), residential and industrial soil contact, and analyte concentrations in soil for protection of groundwater. Investigatory levels for groundwater and soil are presented in Table 1.

The Washington State Department of Health is in the process of assessing toxicological data for PFAS in preparation for development of a state drinking water standard or health advisory, which will inform development of health-based cleanup levels by Ecology. As of April 2018, Ecology had begun the process of developing health-based cleanup levels with resources dedicated for an Ecology toxicologist to perform approximately 3 months of development work on cleanup standards.

3.0 PROJECT DESCRIPTION

This section identifies work elements to be performed in accordance with this Work Plan, project goals and objectives, tasks required, and Farallon's project organization and schedule. Data quality objectives for this project are identified in the QAPP provided in Appendix A.

3.1 PROJECT GOALS

The primary project goal is to assess potential PFAS sources in the Lower Issaquah Valley sufficiently to develop a conceptual site model of PFAS source(s), fate, and transport. Data will be collected to evaluate direct exposure pathways for surface soil, migration of PFAS from soil to groundwater, and the distribution of PFAS in groundwater emanating from confirmed sources identified in the Lower Issaquah Valley.

Complete project goals are summarized as follows:

- Assess areas of interest where historical operations included use of AFFF to identify potential points of release of PFAS to the environment in the Lower Issaquah Valley;
- Investigate the presence of PFAS in unsaturated soil at suspected source areas and assess whether groundwater quality of shallow water-bearing zones at and down-gradient of these areas of interest has been impacted by PFAS;
- Identify the occurrence of shallow water-bearing zones and local gradients and groundwater flow direction at areas of interest where reconnaissance groundwater analytical results, or the analytical results of groundwater samples collected from existing monitoring points, suggest that shallow water-bearing zone(s) have been impacted by PFAS;
- Collect synoptic area-wide groundwater quality data from monitoring and production wells screened in deeper water-bearing zones to better characterize the distribution of PFAS across the Lower Issaquah Valley; and
- Compare soil and groundwater analytical results to PFAS investigatory levels that were calculated by Ecology (2018a) to support the Lower Issaquah Valley PFAS characterization effort.

Data collected as part of the Lower Issaquah Valley PFAS characterization study are not anticipated to fully characterize the nature and extent of PFAS impacts to soil and groundwater. Therefore, data gaps will remain at the conclusion of the work to be performed.

3.2 PROJECT OBJECTIVES AND SCOPE OF WORK

Characterization of PFAS in the Lower Issaquah Valley will include multi-incremental sampling of shallow soil, soil sampling from borings, reconnaissance groundwater sampling from borings, and groundwater sampling from permanent monitoring wells. Specific project objectives for each area of interest are identified below. A summary of samples to be collected is presented by media in Table 2.

All samples will be analyzed by EPA Method 537 Modified[3]. Additional sample preparation steps to eliminate matrix interference for soil and groundwater performed as part of the method modification will be consistent with the U.S. Department of Defense (2017) guidance.

3.2.1 Issaquah Valley Elementary West Playfield and Dodd Fields Park

Work to be performed at the Issaquah Valley Elementary West Playfield and Dodd Fields Park areas of interest includes (Figure 3):

- Collecting multi-incremental soil samples from decision units DU-1A, DU-1B, DU-2A, and DU-2B at a depth interval of 0 to 6 inches bgs.
- Advancing a hand-auger boring (DF-R01) to collect a subsurface unsaturated (vadose) zone soil sample from decision unit DU-2A at a depth of 3 to 4 feet bgs, adjacent to monitoring well DF-MW02.
- Collecting groundwater samples from existing monitoring wells DF-MW02 and DF-MW03 at Dodd Fields Park and between the administrative buildings for the Issaquah School District northeast of Dodd Fields Park, respectively.
- Coordinating drilling investigation work, utility location, and other investigation preparation work.
- Advancing five borings to a maximum depth of approximately 35 feet bgs to collect soil and reconnaissance groundwater samples.
- Installing monitoring wells at locations where analytical results for reconnaissance groundwater and/or groundwater samples collected from permanent monitoring points indicate PFAS are present at concentrations exceeding the laboratory PQL. Final monitoring well placement will be based on reconnaissance groundwater analytical results and other considerations (e.g., the potential to assess the cross-gradient extent of confirmed groundwater impacts, relative magnitude of groundwater impacts compared to proximate wells, vertical stratification of analytical data, etc.). If analytical results for PFAS are reported non-detect at the laboratory PQL in groundwater, then no further groundwater assessment will be performed at the Issaquah Valley Elementary West Playfield or Dodd Fields Park.
- Developing the new monitoring wells, measuring groundwater levels, and collecting groundwater samples (if needed).

---

[3] EPA Method 537 is the EPA-approved method for determination of PFAS in drinking water by liquid chromatography/tandem mass spectrometry. There currently is no EPA-approved method for PFAS analysis in matrices other than drinking water; modified methods have been developed by individual analytical laboratories to analyze soil and groundwater.

- Surveying the existing geotechnical monitoring points and new monitoring wells using the Washington State Plane North coordinates system and measuring the top of casing elevations in North American Vertical Datum of 1988 with High Accuracy Reference Network (HARN) correction by a Washington State Professionally Licensed Land Surveyor (if needed).
- Disposing of investigation-derived waste (IDW), including soil cuttings and wastewater, within 60 days of generation.

3.2.2 Memorial Field and Rainier Trail Area

Work to be performed at the Memorial Field and Rainier Trail Area areas of interest includes (Figure 4):

- Collecting multi-incremental soil samples from decision units DU-3 and DU-4 at a depth interval of 0 to 6 inches bgs.
- Collecting groundwater samples from the existing monitoring wells north of the Rainier Trail Area.
- Coordinating drilling investigation work, utility location, and traffic control; procuring permits for work in rights-of-way with assistance from the City of Issaquah; and other investigation preparation.
- Advancing up to five borings to a maximum depth of approximately 35 feet bgs to collect soil and reconnaissance groundwater samples.
- Installing monitoring wells at locations where analytical results for reconnaissance groundwater and/or groundwater samples collected from permanent monitoring points indicate PFAS are present at concentrations exceeding the laboratory PQL. Final monitoring well placement will be based on reconnaissance groundwater analytical results and other considerations such as those as identified for the Issaquah Valley Elementary West Playfield and Dodd Fields Park. If analytical results for PFAS are reported non-detect at the laboratory PQL in groundwater, then no further groundwater assessment will be performed at Memorial Field or the Rainier Trail Area.
- Developing the new monitoring wells, measuring groundwater levels, and collecting groundwater samples.
- Surveying the existing and new monitoring wells using the Washington State Plane North coordinates system and measuring the top of casing elevations in North American Vertical Datum of 1988 with HARN correction by a Washington State Professionally Licensed Land Surveyor (if needed).
- Disposing of IDW, including soil cuttings and wastewater, within 60 days of generation.

3.2.3 175 Newport Way Northwest

Work to be performed at the 175 Newport Way Northwest area of interest includes:

- Collecting multi-incremental soil samples from at decision units DU-5 and DU-6 at a depth interval of 0 to 6 inches bgs.
- Coordinating drilling investigation work, utility location, and other investigation preparation work.
- Advancing three borings to a maximum depth of 35 feet bgs to collect reconnaissance groundwater samples.
- Advancing and installing four permanent monitoring wells, and collecting soil samples from three monitoring wells during installation. Final monitoring well placement may be adjusted based on reconnaissance groundwater analytical results and other considerations such as those as identified for the Issaquah Valley Elementary West Playfield and Dodd Fields Park.
- Developing the new monitoring wells, measuring groundwater levels, and collecting groundwater samples.
- Surveying the new monitoring wells using the Washington State Plane North coordinates system and measuring the top of casing elevations in North American Vertical Datum of 1988 with HARN correction by a Washington State Professionally Licensed Land Surveyor.
- Disposing of IDW, including soil cuttings and wastewater, within 60 days of generation.

3.2.4 Area-Wide Groundwater Monitoring

Following completion of reconnaissance groundwater sampling and, if applicable, installation of monitoring wells at selected areas of interest, EFR will conduct one groundwater monitoring event that includes sampling of any new groundwater monitoring wells in addition to those installed at 175 Newport Way Northwest, and existing monitoring wells COI-MW02 through COI-MW07.

3.3 TASKS REQUIRED

Characterization work has been organized into the following tasks:

- **Task 1:** Project Management and Communication;
- **Task 2:** Preparation of PFAS Characterization Work Plan;
- **Task 3**: Lower Issaquah Valley Elementary West Playfield and Dodd Fields Park Shallow Soil PFAS Characterization;
- **Task 4**: Dodd Fields Park and Rainier Trail Area Well Sampling;
- **Task 5**: Rainier Trail, Memorial Field, and 175 Newport Way Shallow Soil PFAS Characterization;

- **Task 6**: Reconnaissance Groundwater Sampling;
- **Task 7**: Monitoring Well Installation;
- **Task 8**: Area-Wide Groundwater Monitoring Event;
- **Task 9**: PFAS Characterization Summary Report; and
- **Task 10**: Investigation-Derived Waste Management.

3.4 ORGANIZATION AND SCHEDULE

Farallon’s Project Manager will be Mr. Eric Buer, a licensed Geologist and Hydrogeologist in Washington State. The Farallon Principal Reviewer for all work products and deliverables will be Mr. Clifford Schmitt, a licensed Geologist and Hydrogeologist in Washington State. Farallon’s Project QA/QC Officer will be Ms. Jeanette Mullin, a licensed Geologist in Washington State. Additional Farallon staff will perform work on the project under the direction and supervision of the Farallon Project Manager and Principal Reviewer.

3.5 PROJECT SCHEDULE

Key project dates and milestones are identified below. To minimize disruption at the Issaquah Valley Elementary School and Issaquah School District property, invasive field work has been scheduled to be completed by September 5, 2018, the start date for the school year, except for sampling groundwater at the new monitoring wells on the properties. Groundwater samples will be collected at these monitoring wells during a day when school is not in session (weekend day) in September 2018.

- July 31: Issue Final PFAS Characterization Study Work Plan.
- August 3: Collect groundwater samples from existing monitoring wells at Dodd Fields Park and the Rainier Trail Area (Task 4).
- August 6 through 9: Collect multi-incremental soil samples at decision units on Issaquah Valley Elementary West Playfield and Dodd Fields Park (Task 3).
- August 8 through 20: Conduct reconnaissance groundwater sampling from a total of 13 borings at the five areas of interest (Task 6).
- August 10 through August 15: Collect multi-incremental soil samples at decision units at Memorial Field, the Rainier Trail Area, and 175 Newport Way Northwest (Task 5).
- August 29 through September 10: Install a minimum of 4 monitoring wells at 175 Newport Way Northwest and up to 10 monitoring wells at the other areas of interest, dependent on reconnaissance groundwater sample analytical results (Task 7).
- September 12 through 15: Perform an area-wide groundwater sampling event at new and existing monitoring wells (Task 8). Coordinate sampling by others of production wells in

the Lower Issaquah Valley operated by the City of Issaquah and Sammamish Plateau Water and Sewer District.

- November 2: Issue Draft PFAS Characterization Summary Report to Ecology and the City of Issaquah.
- November 16: Comments on Draft PFAS Characterization Summary Report from Ecology and the City of Issaquah are due to Farallon.
- November 30: Issue Revised Draft PFAS Characterization Summary Report to Ecology and the City of Issaquah.
- December 7: Comments on Revised Draft PFAS Characterization Summary Report from Ecology and the City of Issaquah are due to Farallon.
- December 14: Issue Final PFAS Characterization Summary Report (Task 9).

4.0 FIELD PROCEDURES

This section summarizes the protocols and procedures that will be followed for the field data collection phase of PFAS characterization. Farallon SOPs for fieldwork, including detailed step-by-step protocols, are provided in Appendix B.

Every effort will be made to use sampling equipment free of PFAS. The following materials will not be allowed to come in contact with sample media: Teflon (polytetrafluoroethylene); Gore-tex and other waterproof coatings, unless shown to be free of PFAS; waterproof paper, unless shown to be free of PFAS ("Rite in the Rain" paper is acceptable); coated Tyvek (plain Tyvek is acceptable); fluorinated ethylene propylene; ethylene tetrafluoroethylene; low-density polyethylene; polyvinylidene fluoride; and anything with "fluoro" in the name. Sample containers will be certified by the laboratory as PFAS-free. The ingredients of detergents or soaps used in decontamination procedures will be reviewed to ensure that fluoro-surfactants are not listed as ingredients. The final rinse water will be laboratory-certified as PFAS-free.

4.1 SOIL SAMPLING

The field sampling procedures, drilling methods, and sample handling protocols for soil samples are discussed below. Field sampling data will be documented on Field Report forms, as described in Section 6, Field Documentation. An Inadvertent Discovery Plan (IDP) has been prepared in accordance with Ecology's requirements for all work that disturbs soil (Appendix C). In the event cultural resources are discovered, work will stop while the IDP procedures are followed and the IDP-listed contacts are notified.

4.1.1 Multi-Incremental Soil Sampling

Multi-incremental soil sampling will be performed for the decision units identified for the Issaquah Valley Elementary West Playfield, Dodd Fields Park, Memorial Field, Rainier Trail Area, and 175 Newport Way Northwest as specified in Section 2.4, Areas of Interest. A total of 30 subsampling locations will be identified at each decision unit prior to collection in accordance with Farallon SOP SL-03, marked in the field with pin flags, and have positions mapped with a differential global positioning system with external antenna. Subsampling locations will be selected by applying a regularly spaced grid within each decision unit that generates 30 grid cells. Subsamples will be collected from the center of each grid cell unless an obstruction is present, in which case the subsample will be repositioned within the grid cell and the offset recorded in the field records.

Subsamples will be collected with a hand-coring device with a diameter of 2.5 inches. Subsamples will be logged in a soil sample log sheet (Appendix D) and composited in accordance with Farallon SOP SL-03. Each composite sample will be labeled and handled in accordance with the requirements of Section 5, Sample Handling, and Section 6, Field Documentation. Individual sampling locations will be backfilled with topsoil and grass seed following completion of sampling.

4.1.2 Discrete-Interval Soil Sampling

Soil samples will be collected from discrete depth intervals during drilling to characterize the subsurface distribution of PFAS at select locations. Boring locations will be marked and measured in the field prior to drilling. Locations may be adjusted as necessary based on access and utilities. Farallon will use the one-call and private utility location services to confirm the location of subsurface utilities (Farallon SOP GN-02).

Borings will be drilled to depths of up to approximately 35 feet bgs using a sonic drill rig except for the location proximate to monitoring well DF-MW02, where a boring will be manually drilled with a hand auger to a depth of approximately 3.5 feet bgs. Soil samples will be collected at approximately 2- to 5-foot intervals for lithologic description and potential laboratory analysis depending on the sampling location and available soil and groundwater data from proximate locations. Discrete soil samples will be collected from borings at the top of fine-grained lithologic units proximate to or above water-bearing zones. If no fine-grained lithologic units are observed, discrete soil samples will be collected immediately above water-bearing zones.

Soil samples will be collected from borings and handled in accordance with the requirements of Farallon SOP SL-01 (Appendix B); Section 5, Sample Handling; and Section 7, Field Documentation. Completed borings will be abandoned in accordance with the requirements of WAC 173-160-460, chip sealed with bentonite to within 2 feet of the ground surface, and completed to grade with in-kind material (i.e., soil, cold patch asphalt, or concrete as appropriate).

4.2 GROUNDWATER SAMPLING

The field sampling procedures, well construction requirements, drilling methods, and sample handling protocols for reconnaissance groundwater and groundwater samples are discussed below. Field sampling data will be documented on Field Report forms, as described in Section 6, Field Documentation. Existing groundwater monitoring well construction details for wells at Issaquah Valley Elementary and the Rainier Trail Area are provided in Appendix E.

4.2.1 Monitoring Well Construction and Development

Monitoring well locations will be identified in advance and marked in the field. Locations may be adjusted as necessary based on access and utility locations. Farallon field staff will observe monitoring well drilling and installation and document observations as described in Section 7, Field Documentation. Monitoring well construction and development will be performed in accordance with Farallon SOPs GW-01 and GW-02 (Appendix B).

Groundwater monitoring wells will be constructed in accordance with WAC 173-160-400 and will meet Washington State requirements for resource protection well construction. Monitoring wells will be installed using 2-inch-diameter Schedule-40 polyvinyl chloride well casings with a 0.020-inch slotted well screen. Monitoring well screen intervals will be selected based on analytical results from the vadose soil and reconnaissance groundwater sampling and discussed with Ecology and the City of Issaquah prior to installation. Where PFAS are detected in vadose soil samples, screens will be set across the top of the first-encountered groundwater. Where PFAS are detected in the deeper water-bearing sand and gravel, monitoring wells will be screened across the top of the lower unit. Each monitoring well will extend a minimum of 5 feet into the water-bearing unit.

Each monitoring well filter pack will consist of 10/20 Colorado Silica Sand emplaced in the borehole annulus up to 1 foot above the top of the screen. The borehole will be sealed to within 2 feet of the surface with hydrated bentonite chips. The monitoring wells will be completed with flush-mounted steel monuments set in concrete and developed immediately following installation. Monitoring well development will consist of pumping with a whale-pump until the majority of the fine-grained sediment in the well and surrounding filter pack has been removed; purge water appears visually clear; pH has stabilized to within ± 0.1 unit; conductivity has stabilized to within ± 3 percent; and dissolved oxygen has stabilized to within ± 10 percent.

4.2.2 Reconnaissance Groundwater Sampling

Reconnaissance groundwater samples will be collected at first-encountered (shallowest) groundwater and from the deeper water-bearing sand and gravel that has previously been observed between depths of approximately 20 and 30 feet bgs. Reconnaissance groundwater sampling will be accomplished using either a peristaltic or bladder pump and temporary disposable well screen. Samples will be collected in accordance with EPA low-flow methodology from each boring, which will be purged until visually clear prior to sampling directly into laboratory-supplied containers.

4.2.3 Groundwater Sampling

Groundwater samples will be collected from permanent monitoring wells. Procedures for monitoring well purging and low-flow sampling are provided in Farallon SOP GW-04 (Appendix B). Farallon will record observations and field data on Field Report forms as described in Section 7, Field Documentation.

4.3 DECONTAMINATION PROCEDURES

Reusable equipment will be decontaminated in accordance with Farallon SOP EQ-01 (Appendix B).

5.0 SAMPLE HANDLING

This section discusses the sample designation and labeling and sample-handling methods to be used during PFAS characterization work. The protocols discussed include sample containers, preservation and holding times, sample documentation, collection of QA/QC samples, and sample packaging and shipment.

5.1 SAMPLE DOCUMENTATION

Sample documentation includes sample labels, Field Report forms, and Chain of Custody forms. Other sample documentation to be maintained by field personnel are provided in Appendix D.

Each sample container will be marked with a durable adhesive label and labeled with a unique identifier. The sample identifier for each sample will be constructed according to Section 5.2, Sample Designation and Labeling, and recorded in the Field Report forms and on the sample Chain of Custody form (Attachment D). Sample labels will include the client name, project name and number, date and time sampled, sample identifier, sampler’s initials, requested sample analysis, and analyte preservative(s), if any. The Chain of Custody form will include the sample identifier, date and time of sample collection, sampler’s initials, number of containers, and requested sample analysis. Entries for all samples will be made on the Chain of Custody form prior to the transfer of the samples off the area of interest.

5.2 SAMPLE DESIGNATION

Sample identification systems for soil and groundwater samples are presented below.

5.2.1 Soil Sample Identifiers

Soil samples will be assigned a unique sample identifier that will include the sample location (e.g., boring identification or decision unit), the sample date in the format YYMMDD (e.g., 180712), and the depth of the sample stated in feet bgs. Multi-incremental soil samples collected from decision units are all from a uniform depth of 0 to 6 inches; therefore, this information will be omitted for multi-incremental soil samples. All incremental values less than 10 will include a leading “0” (e.g., FB-01, FMW-08).

For example, a soil sample collected from boring FB-01 at a depth of 8 feet bgs on July 12, 2018 would be assigned the identifier FB-01-180712-8. A multi-incremental soil subsample collected from decision unit DU-1A grid C-1 on August 6, 2018 would be assigned the identifier DU-1A-C1-180806. The sample identifier will be recorded on the sample label, Field Report form, Soil Sample Data Log, and Chain of Custody form.

5.2.2 Groundwater Sample Identifiers

The water samples will be assigned a unique sample identifier that will include the sample location identifier (e.g., boring or well identifier) and the sample date in the format YYMMDD (e.g., 180401). All incremental values less than 10 will include a leading “0” (e.g., FB-01, FMW-08).

For example, the groundwater sample collected from monitoring well FMW-04 on September 1, 2018 would be numbered FMW-04-180901. The reconnaissance groundwater sample collected from boring FB-12 on August 29, 2018 would be numbered FB-12-180829. The sample identifier will be recorded on the sample label, Field Report form, and Chain of Custody form.

5.3 SAMPLE CONTAINERS, PRESERVATION PROCEDURES, AND HOLDING TIMES

Sample containers, preservation, and holding times for each medium are described below:

- **Multi-Incremental Soil Samples:** Multi-incremental soil samples will be collected in accordance with Farallon SOP SL-03 with a 0.75-inch-diameter hand-coring device driven to a depth of approximately 6 inches bgs, collecting a volume of 4.5 cubic inches (approximately 40 grams). Each subsample will be placed into a laboratory-supplied, 6-ounce, PFAS-free high-density polyethylene container with a screw-cap lid that will be composited to produce the final multi-incremental soil sample. Once sealed, the container will be stored in a cooler at approximately 4 degrees Celsius (ºC). The multi-incremental soil sample collected from each decision unit will be submitted to the laboratory for subsampling and analysis for PFAS by EPA Method 537 Modified within 24 to 48 hours of collection. The typical hold time for this type of preserved sample chilled to 4ºC is 14 days.
- **Discrete-Interval Soil Samples:** Soil samples will be collected in accordance with EPA Method 537 Modified. Soil will be placed into a laboratory-supplied, 8-ounce, PFAS-free high-density polyethylene container with a screw-cap lid. Once sealed, the container will be stored in a cooler at approximately 4ºC. The samples will be submitted to the laboratory for analysis for PFAS by EPA Method 537 Modified within 24 to 48 hours of collection. The typical hold time for this type of preserved sample chilled to 4ºC is 14 days.
- **Water Samples:** Water samples, including reconnaissance groundwater and groundwater samples collected from monitoring wells, will be collected directly into laboratory-supplied, standard 500-milliliter, PFAS-free high-density polyethylene threaded containers with screw-cap lids. Once sealed, the containers will be stored in a cooler at approximately 4ºC. The samples will be submitted to the laboratory for analysis for PFAS by EPA Method 537 Modified within 24 to 48 hours of collection. The typical hold time for this type of preserved sample chilled to 4ºC is 14 days.

5.4 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

QA/QC samples will be analyzed to review and validate analytical data as detailed in the QAPP (Appendix A). QA/QC samples will include field duplicate samples, equipment rinsate blanks, and trip blanks. Field duplicate samples will be used to evaluate the accuracy and precision of the field sampling techniques as described in the QAPP (Appendix A).

Field duplicate samples will be collected in the same manner and at the same location as the original sample. Equipment rinsate blanks will be collected by rinsing non-dedicated sampling equipment with laboratory-supplied deionized water following decontamination and collecting the rinsate for analysis to evaluate the integrity of the decontamination procedures. Laboratory-prepared trip blanks will be included in each sample cooler. Analysis of the trip blank may be performed to evaluate potential contamination or exposure of samples to PFAS during transit if the reported concentrations of PFAS or field observations suggest this analysis is warranted.

Field duplicates will be collected at a rate of 1 field duplicate per 10 samples collected. Duplicate soil samples will not be collected for multi-incremental soil samples.

5.5 SAMPLE PACKAGING AND SHIPMENT

The samples shipped for laboratory analysis will be packaged according to applicable regulations and the recommendations of the laboratory performing the analysis. Samples will be expeditiously transported to the analytical laboratory after being sealed in coolers.

The following procedures (representing the minimum shipping and handling requirements) will be used for sample packaging:

- A sample label will be affixed to the corresponding sample container at the time of sample collection.
- Bubble-wrap bags or an equivalent will be used to protect sample containers.
- Sample containers will be placed into a cooler and checked against the Chain of Custody form to ensure that all samples are listed and are placed into the correct cooler.
- One copy of the Chain of Custody form will be detached and retained by the Farallon Field Scientist.
- Remaining paperwork will be sealed in a resealable plastic bag and taped to the inside of the cooler lid.
- One to three resealable bags will be filled with ice and/or a chemical equivalent and included in the cooler. Ice will be double-bagged in heavy-duty bags.
- The cooler will be sealed with a chain-of-custody seal and taped shut using strapping tape.
- The laboratory address will be affixed to the cooler.
- Extraneous stickers will be removed from the cooler.
- The cooler will be examined to ensure that Farallon’s return address is affixed.

Upon transfer of the samples to laboratory personnel or arrival of the samples at the laboratory facility, the laboratory will assume responsibility for custody of the samples. Laboratory personnel will document the status of shipping and handling containers and will adhere to standard chain-of-custody procedures to track each sample through all of the stages of laboratory processing.

6.0 FIELD DOCUMENTATION

Documentation of field activities will be provided on Field Report forms, boring logs, Low-Flow Well Purging and Sampling Data forms, Soil Sample Data Logs, sample and waste material labels, Waste Inventory forms, and Chain of Custody forms. Documentation generated during the field program will be retained in the project files and included in the reports generated, as appropriate. Filled forms and records will be maintained in the Farallon project files. Example forms and labels are provided in Appendix D.

6.1 FIELD REPORT FORM

Field personnel will be required to keep a daily field log on a Field Report form. Field notes will be as descriptive and inclusive as possible, enabling independent parties to reconstruct the sampling situation from the recorded information. Language will be objective, factual, and free of inappropriate or ambiguous terms and/or opinions.

A summary of each day's events will be provided on the Field Report form. At a minimum, field documentation will include the date, job number, project identification and location, weather conditions, sample collection data, personnel present and responsibilities, field equipment used, and any activities performed in a manner other than as specified in this Work Plan. In addition, if other forms or documents such as well-head surveys or maps are completed or used, they will be cited in and attached to the Field Report form. Field personnel will sign the completed Field Report form.

6.2 BORING LOGS

Boring logs will be prepared by a Farallon Scientist for each boring and/or monitoring well drilled during the PFAS characterization work. The log includes hydrologic conditions, lithologic descriptions using the Unified Soil Classification System, and information on the potential presence of contamination.

6.3 LOW-FLOW WELL PURGING AND SAMPLING DATA FORM

A Low-Flow Well Purging and Sampling Data form will be used to record the depth to groundwater, well purging information, and other pertinent hydrologic measurements and supplementary information collected during reconnaissance groundwater sampling at each boring and groundwater sampling at each monitoring well. The form will be completed by the Field Scientist at the time of sample collection.

6.4 SOIL SAMPLE DATA LOG

A Soil Sample Data Log will be used to record information pertaining to soil samples collected. This log includes entries for the sample location, identification, and depth; the time sampled; field-screening results; the types and number of containers collected; and a brief lithologic description.

6.5 SAMPLE LABEL

Sample labels will be filled out and affixed to appropriate sample containers immediately prior to sample collection. The label will be filled out with indelible ink and includes the medium, date, time sampled, sample identifier (see Section 5.2, Sample Designation and Labeling), project name, project number, sampler's initials, and analyte preservative(s) if any.

6.6 WASTE MATERIAL LABEL

A waste material label is filled out and affixed to the appropriate waste container immediately upon filling. The label is filled out in indelible ink and includes the job number and name, address where the waste was generated, container contents, date, consultant's name and phone number, and sampler's initials.

6.7 WASTE INVENTORY FORM

A Waste Inventory form will be used to document and track the wastes generated during the characterization field work. The form will include information on the waste container, origin of the waste, type of waste, date generated, date removed from the Site, transporter, and disposal location. A copy of the Waste Inventory form is included in Appendix B.

6.8 CHAIN OF CUSTODY FORM

The Chain of Custody form provides an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and reporting of analytical values. The Chain of Custody form should be updated whenever samples are collected, transferred, stored, analyzed, or destroyed. The Chain of Custody form includes the client name, project name and number, date and time sampled, sample identifier, sampler's initials, and requested sample analysis.

7.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Soil cuttings, wastewater, and other products generated during characterization work may be impacted with PFAS and will be containerized and stored at the generating location pending receipt of analytical results for selection of a disposal method. The specific criteria for tracking the sampling and analysis of the wastes to identify appropriate disposal options for each of the expected waste streams are discussed below. Waste-related documentation will be maintained in Farallon's project files.

7.1 SOIL CUTTINGS

Waste soil will be generated by the following activities:

- Advancing borings; and
- Installing monitoring wells.

Soil cuttings will be temporarily stored in 55-gallon drums or a similar U.S. Department of Transportation–approved containers pending analytical results and profiling. Drums will be temporarily stored proximate to the administration buildings at Issaquah Valley Elementary, at the parking lot at 190 East Sunset, and on site at 175 Newport Way Northwest. The waste soil will be segregated based on the location(s) where the soil was generated. The soil cuttings container used for waste storage will be labeled according to content, date, and origin. Soil cuttings containers and locations will be tracked using a Waste Inventory form (Appendix D) and will be removed within 60 days.

7.2 WASTEWATER

Wastewater will be generated during monitoring well development, purging, and sampling and equipment decontamination. Wastewater will be segregated into 55-gallon drums or other U.S. Department of Transportation–approved containers for temporary storage at the same locations as soil drums. Wastewater containers will be labeled according to the content, date, and origin and/or generating activity. Wastewater containers will be tracked using a Waste Inventory form (Appendix D). Analytical results will be used to generate a profile for disposal. No wastewater will remain on site longer than 60 days.

7.3 DISPOSABLES

Disposable personal protective clothing (e.g., Tyvek suits, rubber gloves, boot covers) and sampling devices (e.g., plastic scoops, bailers) will be cleaned, placed into plastic garbage bags, and disposed of as nonhazardous waste.

8.0 LABORATORY ANALYSIS

8.1 SAMPLE PREPARATION METHODS

Multi-incremental samples will be collected in accordance with Farallon SOP SL-03 and subsampled in accordance with the *Draft Guidance on Multi Increment Soil Sampling* dated March 2009, prepared by the Alaska Department of Environmental Conservation (2009). PFAS samples will be prepared in accordance with the analytical laboratory PFAS Isotope Dilution Method. Multi-incremental soil samples will be submitted as a set of subsamples collected directly into laboratory-supplied containers to prevent cross-contamination and will be composited by the analytical laboratory.

8.2 SPECIAL METHOD REQUIREMENTS

Special method requirements will be addressed by the analytical laboratory. Farallon’s Project Manager will work closely with the analytical laboratory to ensure that the methods used meet project needs and reporting limits.

8.3 LABORATORY ACCREDITATION FOR METHODS

Farallon has selected Vista Analytical Laboratory of El Dorado Hills, California (Vista) to complete the required laboratory analyses during PFAS characterization work. Vista has the capability to provide laboratory services that will meet Ecology investigatory levels for PFAS using EPA Method 537 Modified.

Vista laboratory accreditation for PFAS analysis includes U.S. Department of Defense environmental laboratory accreditation for EPA Method 537 Modified, International Organization for Standardization ISO/IEC 17025:2005, and 2003 NELAC Chapter 5 Standards of the U.S. Department of Defense Quality System Manual (Appendix F). A copy of the laboratory Quality Assurance Manual for Vista that will be followed throughout PFAS characterization work will be kept on file at the Farallon office for review and reference (Appendix A).

9.0 REPORTING

Farallon will prepare technical memoranda and reports as identified in the Interagency Agreement dated July 10, 2018, executed between Ecology and EFR (Ecology 2018b) (IAA). Technical memoranda and reports will include appropriate background, a description of the work performed and rationale, a summary of data QA/QC, summary figures and tables, and attachments such as analytical laboratory reports, boring logs, and other records as appropriate. Technical memoranda and reports will be prepared by qualified personnel, reviewed and approved by a Farallon Principal Reviewer, and provided to Ecology and the City of Issaquah as specified under the IAA.

9.1 FREQUENCY AND DISTRIBUTION OF REPORTS

The schedule of delivery for analytical summaries and summary reports is addressed in Section 3.5, Project Schedule. Project progress reporting will be provided monthly to Ecology and the City of Issaquah.

9.2 RESPONSIBILITY FOR REPORTS

Reports will be prepared by Farallon project personnel, overseen by the Project Manager and reviewed by the Principal Reviewer. QA/QC review and reporting will be performed by the Project QA/QC Officer.

9.3 DATA ANALYSIS AND PRESENTATION

Reporting will include analysis of laboratory analytical data, including data reduction, and production of summary tables and figures. Preparation of summary tables and figures is discussed below.

9.3.1 Summary Tables

To ensure that data are accurately transferred during the reduction process, all summary tables will be checked by a second party, which will initial and date the reviewed data. Any incorrect transfer of data will be highlighted and corrected.

Analytical laboratory reports will be categorized according to various parameters to summarize the information for easier assimilation and presentation. Soil sampling and analysis data will be categorized several ways, including by sample point number, constituent, and date of sample collection. The parameters chosen for categorizing soil and groundwater data will be determined based on the most-appropriate format and the utility of the format in demonstrating the physical and chemical characteristics of interest.

9.3.2 Figures

Figures will be prepared to illustrate the results of the PFAS characterization work. Figures may include but are not limited to plan maps of the Lower Issaquah Valley and each area of interest depicting sampling locations and chemical concentrations for individual and groups of chemicals.

9.3.3 Documentation of Assessment

Reports will include a QA/QC section that summarizes data quality information. The summary will include:

- An assessment of precision, accuracy, representativeness, comparability, completeness, and sensitivity parameters;
- The results of performance and/or system audits; and
- Significant QA problems, if any, and their impact on the data quality objectives.

10.0 REFERENCES

Alaska Department of Environmental Conservation. 2009. *Draft Guidance on Multi Increment Soil Sampling*. March.

Associated Earth Sciences Inc. 2018. *Subsurface Exploration, Geologic Hazards, and Preliminary Geotechnical Engineering Report, Issaquah Middle School AT Admin Site, Issaquah, Washington*. Prepared for the Issaquah School District. June 12.

City of Issaquah Public Works Engineering (City of Issaquah). 2017. Memorandum Regarding Soil Sampling Results – East Sunset Way Sites. From Bob York. To Sheldon Lynne, City of Issaquah Public Works Engineering. January 31.

Farallon Consulting, L.L.C. (Farallon). 2016. Interview Regarding Firefighting Training Exercises Between a Representative of Farallon and Bob Butterfield and Kelly Revfem, Representatives of Eastside Fire & Rescue. November 13.

———. 2018. Interview Regarding Firefighting Training Exercises Between a Representative of Farallon and Bob Butterfield, Representative of Eastside Fire & Rescue. July 23.

Geosyntec Consultants, Inc. 2016. *Hydrogeological Characterization Report, Issaquah, Washington*. Prepared for the City of Issaquah. November.

Interstate Technology Regulatory Council (ITRC). 2017. *History and Use of Per- and Polyfluoroalkyl Substances (PFAS)*. November.

Lindstrom A.B., M.J. Styrnar, and E.L. Libelo. 2011. "Perfluorinated Compounds: Past, Present, and Future." *Environmental Science and Technology* 45 (19): 7,954-7,961.

Moody, C.A. and J. Field. 1999. "Determination of Perfluorocarboxylates in Groundwater Impacted by Fire-Fighting Activity." *Environmental Science and Technology* 33 (16): 2,800-2,806.

U.S. Climate Data. 2016. Climate Data for the Snoqualmie Falls, Washington Meteorological Station No. 457773. <https://www.usclimatedata.com/>. (July 16, 2018.)

U.S. Department of Defense. 2017. *Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories*. Version 5.1. Environmental Data Quality Workgroup.

U.S. Environmental Protection Agency (EPA). 2003. *Perfluorooctanoic Acid (PFOA), Fluorinated Telomers; Request for Comment, Solicitation of Interested Parties for Enforceable Consent Agreement Development and Notice of Public Meeting.* EPA Administrative Record OPPT-2003-0012-001. April 14.

———. 2013. *Revisions to the Unregulated Contaminant Monitoring Rule Regulation (UCMR 3) for Public Water Systems*. EPA Administrative Record EPA-HW-OW-2009-0090. May 2.

———. 2016a. *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)*. EPA No. 822-R-16-004. May.

———. 2016b. *Lifetime Health Advisories and Health Effects Support Documents for Perfluorooctanoic Acid and Perfluorooctane Sulfonate.* EPA Administrative Record EPA-HQ-OW-2014-0138. May 19.

Wang, Z., J.C. DeWitt, C.P. Higgins, and I.T. Cousins. 2017. “A Never-Ending Story of Per- and Poly-Fluoroalkyl Substances (PFASs)?” *Environmental Science and Technology* 51 (5): 2,508-2,518.

Washington Department of Ecology (Ecology). 2004. *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*. Publication No. 04-03-030. Revised December 2016. July.

———. 2018a. Investigatory Levels for Perfluoroalkyl Substances. February 9.

———. 2018b. *IAA No. C1800181, Interagency Agreement (IAA) Between the State of Washington Department of Ecology and Eastside Fire and Rescue*. July 10.

Western Regional Climate Center. 2016. Greater Seattle Area Climate Data. <https://wrcc.dri.edu/>. (July 16, 2018.)

FIGURES

PRE- AND POLY-FLUOROALKYL SUBSTANCES CHARACTERIZATION STUDY WORK PLAN
Lower Issaquah Valley
Issaquah, Washington

Farallon PN: 1754-002

LEGEND

— ISSAQUAH CREEK

– – LOWER ISSAQUAH VALLEY

N

0 2,500

SCALE IN FEET

FARALLON CONSULTING

Washington
Issaquah | Bellingham | Seattle

Oregon
Portland | Bend | Baker City

California
Oakland | Folsom | Irvine

Quality Service for Environmental Solutions | farallonconsulting.com

FIGURE 1

ISSAQUAH VALLEY AND VICINITY
PFAS CHARACTERIZATION
STUDY WORK PLAN
LOWER ISSAQUAH VALLEY
ISSAQUAH, WASHINGTON

FARALLON PN: 1754-002

Drawn By: ebuer
Checked By: CS
Date: 7/23/2018
Disc Reference:
Document Path: Q:\Projects\1754 EastsideFireRescue\Mapfiles\IAA_Work_Plan\FIGURE_01_Vicinity.mxd

LEGEND

▭ KING COUNTY PARCELS
◉ PROPOSED BORING
⊕ PROPOSED MONITORING WELL
⊕ EXISTING MONITORING WELL
⊕ EXISTING PRODUCTION WELL
⊕ EXISTING TEST WELL
▣ EXISTING GEOTECHNICAL PIEZOMETER

NOTES:
ALL LOCATIONS ARE APPROXIMATE

FIGURES WERE PRODUCED IN COLOR. GRAYSCALE COPIES MAY NOT REPRODUCE ALL ORIGINAL INFORMATION

MIS = MULTI INCREMENTAL SAMPLE
PFAS = POLYFLUOROALKYL SUBSTANCES

N

0 200
SCALE IN FEET

FARALLON
CONSULTING

Washington
Issaquah | Bellingham | Seattle

Oregon
Portland | Bend | Baker City

California
Oakland | Folsom | Irvine

Quality Service for Environmental Solutions | farallonconsulting.com

FIGURE 2

AREAS OF INTEREST
PFAS CHARACTERIZATION STUDY WORK PLAN
LOWER ISSAQUAH VALLEY
ISSAQUAH, WASHINGTON

FARALLON PN: 1754-002

Drawn By: ebuer
Checked By: CS
Date: 7/31/2018
Document Path: Q:\Projects\1754 EastsideFireRescue\Mapfiles\IAA_Work_Plan\IAA_Figures.aprx

LEGEND

☐	KING COUNTY PARCELS
🟧	MIS DECISION UNIT
⦿	PROPOSED BORING
▚	EXISTING GEOTECHNICAL PIEZOMETER
●	FIRE HYDRANT

NOTES:
ALL LOCATIONS ARE APPROXIMATE

FIGURES WERE PRODUCED IN COLOR. GRAYSCALE COPIES MAY NOT REPRODUCE ALL ORIGINAL INFORMATION

PERFORM MIS TO EVALUATE EXPOSURE PATHWAY FOR DIRECT CONTACT WITH SOIL

VADOSE SOIL SAMPLING AT RECONNAISSANCE BORING IES-R02

SHALLOW HAND-AUGER SOIL SAMPLE PROXIMATE TO EXISTING MONITORING WELL EB-5W

MIS = MULTI-INCREMENTAL SAMPLING

N

0 60
SCALE IN FEET

FARALLON
CONSULTING

Washington
Issaquah | Bellingham | Seattle

Oregon
Portland | Bend | Baker City

California
Oakland | Folsom | Irvine

Quality Service for Environmental Solutions | farallonconsulting.com

FIGURE 3

ISSAQUAH VALLEY ELEMENTARY SCHOOL WEST PLAYFIELD
AND DODD FIELDS PARK
PFAS CHARACTERIZATION STUDY WORK PLAN
LOWER ISSAQUAH VALLEY
ISSAQUAH, WASHINGTON

FARALLON PN: 1754-002

Drawn By: ebuer
Checked By: CS
Date: 7/31/2018
Disc Reference:
Document Path: Q:\Projects\1754 EastsideFireRescue\Mapfiles\IAA_Work_Plan\IAA_Figures.aprx

LEGEND

▭	KING COUNTY PARCELS
🟧	MIS DECISION UNIT
⊕	EXISTING MONITORING WELL
⊙	PROPOSED BORING
●	FIRE HYDRANT

MIS = MULTI-INCREMENTAL SAMPLING
PFAS = POLYFLUOROALKYL SUBSTANCES

NOTES:
ALL LOCATIONS ARE APPROXIMATE

FIGURES WERE PRODUCED IN COLOR. GRAYSCALE COPIES MAY NOT REPRODUCE ALL ORIGINAL INFORMATION

PERFORM RECONNAISSANCE GROUNDWATER AND SOIL SAMPLING AT PROPOSED BORINGS MR-R01 AND RT-R01.

COLLECT GROUNDWATER SAMPLES FROM EXISTING MONITORING WELLS RT-MW01, RT-MW02, RT-MW03.

N

0 40
SCALE IN FEET

FARALLON
CONSULTING

Washington
Issaquah | Bellingham | Seattle

Oregon
Portland | Bend | Baker City

California
Oakland | Folsom | Irvine

Quality Service for Environmental Solutions | farallonconsulting.com

FIGURE 4

MEMORIAL FIELD
AND RAINIER TRAIL AREA
PFAS CHARACTERIZATION STUDY WORK PLAN
LOWER ISSAQUAH VALLEY
ISSAQUAH, WASHINGTON

FARALLON PN: 1754-002

Drawn By: ebuer
Checked By: CS
Date: 7/31/2018
Disc Reference:
Document Path: Q:\Projects\1754 EastsideFireRescue\Mapfiles\IAA_Work_Plan\IAA_Figures.aprx

LEGEND

▭ KING COUNTY PARCELS

🟧 MIS DECISION UNIT

◉ PROPOSED BORING

⊕ PROPOSED MONITORING WELL

NOTES:
ALL LOCATIONS ARE APPROXIMATE

FIGURES WERE PRODUCED IN COLOR. GRAYSCALE COPIES MAY NOT REPRODUCE ALL ORIGINAL INFORMATION

PERFORM RECONNAISSANCE GROUNDWATER SAMPLING AT PROPOSED BORINGS

PERFORM VADOSE ZONE SOIL SAMPLING AT MONITORING WELLS NWN-MW02, NWN-MW03, AND NWN-MW04

SAMPLE GROUNDWATER AND CALCULATE GROUNDWATER FLOW DIRECTION USING PERMANENT SHALLOW WELLS

MIS = MULIT-INCREMENTAL SAMPLING
PFAS = POLYFLUOROALKYL SUBSTANCES

FARALLON
CONSULTING

Washington
Issaquah | Bellingham | Seattle

Oregon
Portland | Bend | Baker City

California
Oakland | Folsom | Irvine

Quality Service for Environmental Solutions | farallonconsulting.com

FIGURE 5

175 NEWPORT WAY NORTHWEST
PFAS CHARACTERIZATION STUDY WORK PLAN
LOWER ISSAQUAH VALLEY
ISSAQUAH, WASHINGTON

FARALLON PN: 1754-002

Drawn By: ebuer
Checked By: CS
Date: 7/23/2018
Disc Reference:
Q:\Projects\1754 EastsideFireRescue\Mapfiles\IAA_Work_Plan\IAA_Figures.aprx

TABLES

PRE- AND POLY-FLUOROALKYL SUBSTANCES CHARACTERIZATION STUDY WORK PLAN
Lower Issaquah Valley
Issaquah, Washington

Farallon PN: 1754-002

Table 1
Characterization Work Investigatory Levels
Lower Issaquah Valley
Issaquah, Washington
Farallon PN: 1754-002

Medium	Scenario	PFOS	PFOA	Units
Groundwater	Drinking water[1]	0.07		µg/l
	Typical reporting limits	0.001	0.0005	
Soil	Human contact – industrial	70		mg/kg
	Human contact – unrestricted	1.6		
	Leaching from unsaturated zone	0.0008	0.00044	
	Leaching from saturated zone	0.000046	0.000028	
	Typical reporting limits	0.00051	0.00033	

NOTES:

[1] Drinking water and human contact investigatory levels apply both to PFOS and PFOA individually, and the sum of both chemicals.

µg/l = micrograms per liter
mg/kg = milligrams per kilogram
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid

Table 2
Sampling Summary
Lower Issaquah Valley
Issaquah, Washington
Farallon PN: 1754-002

Area of Interest	Sampling Location	Surface Soil Samples (0 to 6 inches)	Subsurface Vadose Zone Soil Samples	Reconnaissance Groundwater Samples	Monitoring Well Groundwater Samples
Issaquah Valley Elementary West Playfield	DU-01A	1	--	--	--
	DU-01B	1	--	--	--
	IES-R01	--	--	2	--
	IES-R02	--	2	2	--
	IES-R03	--	--	2	--
	IES-R04	--	--	2	--
	IES-R05	--	--	2	--
	Optional Monitoring Wells	--	--	--	5*
Dodd Fields Park	DU-02A	1	--	--	--
	DU-02B	1	--	--	--
	DF-R01	--	1	--	--
	DF-MW01	--	--	--	1
	DF-MW02	--	--	--	1
Memorial Field	DU-03	1	--	--	--
	MF-R01	--	2	1	--
	MF-R02	--	--	1	--
	MF-R03	--	--	1	--
	MF-R04	--	--	1	--
	Optional Monitoring Wells	--	--	--	4*
Rainier Trail Area	RT-MW01	--	--	--	1
	RT-MW02	--	--	--	1
	RT-MW03	--	--	--	1
	DU-04	1	--	--	--
	RT-01	--	2	1	--
	Optional Monitoring Well	--	--	--	1*
175 Newport Way Northwest	DU-05	1	--	--	--
	DU-06	1	--	--	--
	NWN-R01	--	--	2	--
	NWN-R02	--	--	2	--
	NWN-R03	--	--	2	--
	NWN-MW01	--	--	--	1
	NWN-MW02	--	2	--	1
	NWN-MW03	--	2	--	1
	NWN-MW04	--	1	--	1
Existing Monitoring Well Network	COI-MW02	--	--	--	1
	COI-MW03	--	--	--	1
	COI-MW04	--	--	--	1
	COI-MW05	--	--	--	1
	COI-MW06	--	--	--	1
	COI-MW07	--	--	--	1
Total Samples Collected		**8**	**12**	**21**	**15**

NOTES:
Shaded cells indicate existing monitoring wells.
* Final number of wells and subsequent samples may change; maximum number of samples shown for each area.
-- denotes no samples of this type was collected for the location identified.
Monitoring well sample total does not include optional wells installed based on reconnaissance groundwater sampling results.

APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

PRE- AND POLY-FLUOROALKYL SUBSTANCES
CHARACTERIZATION STUDY WORK PLAN
Lower Issaquah Valley
Issaquah, Washington

Farallon PN: 1754-002

FARALLON
CONSULTING

Washington
Issaquah | Bellingham | Seattle
Oregon
Portland | Bend | Baker City
California
Oakland | Folsom | Irvine

DRAFT FINAL

QUALITY ASSURANCE PROJECT PLAN

APPENDIX A OF THE PER- AND POLY-FLUOROALKYL SUBSTANCES CHARACTERICATION STUDY WORK PLAN LOWER ISSAQUAH VALLEY ISSAQUAH, WASHINGTON

Submitted by:
Farallon Consulting, L.L.C.
975 5th Avenue Northwest
Issaquah, Washington 98027

Farallon PN: 1754-002

For:
Eastside Fire & Rescue
175 Newport Way Northwest
Issaquah, Washington 98027

August 1, 2018

Prepared by:

Eric F. Buer, L.G., L.H.G.
Associate Hydrogeologist

Reviewed by:

Clifford T. Schmitt, L.G., L.H.G.
Principal Hydrogeologist

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PROBLEM STATEMENT

This Quality Assurance Project Plan (QAPP) has been prepared by Farallon Consulting, L.L.C. (Farallon) on behalf of Eastside Fire & Rescue (EFR) to present the quality assurance (QA) and quality control (QC) criteria and procedures that will be applied to work described in the *Lower Issaquah Valley Per- and Poly-fluoroalkyl Substances Characterization Study Work Plan, Issaquah, Washington* dated August 1, 2018, prepared by Farallon (2018) (Work Plan). This document was prepared in accordance with *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* revised December 2016, prepared by the Washington Department of Ecology (Ecology) (2004) (Ecology Guidance).

QA/QC criteria and procedures described in this QAPP will ensure that data collected under the Work Plan are of sufficient quality to be scientifically defensible based on the current state of knowledge regarding per- and poly-fluoroalkyl substances (PFAS) and, to the extent possible, are appropriate for potential future use performing a cleanup action under the supervision of Ecology. Extensive research is underway on technical issues surrounding PFAS. It is possible that recommended sample collection protocols and analytical methods will change over time.

1.2 QAPP ORGANIZATION

The QAPP is organized into the following sections:

- **Section 1**, **Introduction**, defines the purpose of the QAPP, the problem statement, and organization of the QAPP;
- **Section 2**, **Data Quality Objectives**, provides data quality objectives (DQOs) for the project and measurement criteria for those objectives;
- **Section 3**, **Quality Control Procedures**, provides a description of field and laboratory QC procedures, data QC procedures, and corrective actions when QC criteria are not met;
- **Section 4**, **Management Procedures**, provides data recording and reporting procedures and practices, handling of laboratory data packages, transfer of files, and data management for upload to the Environmental Information Management System maintained by Ecology;
- **Section 5, Audits and Reports**, describes audit procedures and processes, responsible personnel, and the frequency and distribution of reports;
- **Section 6**, **Data Verification**, provides details regarding data verification, including field and laboratory verification;
- **Section 7**, **Data Quality Assessment**, summarizes data quality assessment procedures and reporting, including evaluating project objectives, treatment of non-detects, data reduction and presentation, and documentation of QA/QC assessment results; and
- **Section 8**, **References,** provides references cited in this document.

2.0 DATA QUALITY OBJECTIVES

The DQOs for PFAS characterization work will be used to develop and implement procedures to ensure that project data are of sufficient quality to be scientifically defensible based on the current state of knowledge regarding PFAS. Observations and measurements will be made and recorded in a manner that will yield results representative of the media of interest.

The quality of the field sampling methods and laboratory data will be assessed using the parameters of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). QC procedures for PARCCS are described in the following sections. Quantitative DQOs for applicable parameters (i.e., precision, accuracy, and completeness) are provided following their definition. Laboratory DQOs have been established by the analytical laboratories and are specified in the individual analytical laboratory Quality Assurance Manuals. The applicable analytical laboratory Quality Assurance Manual for the PFAS characterization work will be kept on file at the Farallon corporate office in Issaquah, Washington.

2.1 DATA QUALITY OBJECTIVES

DQOs for this project include the following:

- Collect eight multi-incremental surface soil samples from eight decision units at five areas of interest to evaluate the direct exposure pathway for soil;
- Collect 12 subsurface vadose zone soil samples from six borings to further evaluate the pathway for PFAS migration from soil to groundwater at five areas of interest;
- Collect 21 reconnaissance groundwater samples from 13 borings to evaluate potential impacts to groundwater quality from historical training and other operations at five areas of interest, and to inform and guide monitoring well installation and screen construction;
- Collect 1 groundwater sample each from the 11 existing and at least 4 new monitoring wells to evaluate groundwater quality and potential PFAS impacts;
- Perform synoptic measurement of groundwater levels at the Lower Issaquah Valley monitoring well network to evaluate groundwater gradient and flow direction;
- Achieve a practical quantitation limit (PQL) sufficient for direct comparison against Ecology (2018a) investigatory levels for all sample analyses.
- Implement QA/QC protocols described in this QAPP so that data collected are scientifically defensible and, to the extent possible, appropriate for future use performing a cleanup action under the supervision of Ecology.

2.2 MEASUREMENT OF QUALITY OBJECTIVES

Measurement quality objectives are described below using standard PARCCS criteria as specified in Ecology Guidance.

2.2.1 Precision

Precision measures the variability between results of replicate measurements under a given set of conditions due to random error. Precision is calculated from the results of duplicate sample analysis and matrix spike/matrix spike duplicate (MS/MSD) sample analyses, and is quantitatively expressed as the relative percent difference (RPD). Precision is calculated as follows:

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

Where:

RPD = relative percent difference

C_1 = the larger of the two duplicate results (i.e., the higher detected concentration)

C_2 = the smaller of the two duplicate results (i.e., the lower detected concentration)

Quantitative RPD criteria for laboratory duplicate results were developed by Ecology for the *Statewide Survey of Per- and Poly-Fluoroalkyl Substances in Washington State Rivers and Lakes* dated April 2016 (Ecology 2016) (Ecology PFAS Survey). RPD values for laboratory duplicate samples and field replicate samples should be less than 40 percent for results detected at 5 times the laboratory PQL.

2.2.2 Accuracy

Accuracy is a measure of the closeness (bias) of the measured value to the true value. The accuracy of analytical results is assessed by "spiking" samples in the laboratory with known standards (i.e., surrogates or matrix spikes of known concentration) and determining the percent recovery (%R). Accuracy is measured as the %R and is calculated as follows:

$$\% R = \frac{(M_{sa} - M_{ua})}{C_{sa}} x\ 100$$

Where:

%R = percent recovery

M_{sa} = measured concentration in spiked aliquot

M_{ua} = measured concentration in unspiked aliquot

C_{sa} = actual concentration of spike added

Target control limits for accuracy have been set at 70 to 130 %R in laboratory control samples. These limits were based on Ecology values in the Ecology PFAS Survey.

The accuracy of sample results can be affected by sample contamination (which can occur because of improperly cleaned sampling equipment), exposure of the samples to chemical concentrations in the field or during transport to the laboratory, or the presence of chemical concentrations in the laboratory. To confirm that the samples collected are not contaminated, blank samples will be collected and analyzed. The laboratory will run method blanks at a minimum frequency of one per sample digestion group to assess sample contamination in the laboratory.

Trip blanks will be used to check for procedural contamination, cross-contamination, and contamination during shipment and storage of solid and aqueous samples. One trip blank will be submitted to the laboratory for each cooler containing soil samples for analysis for PFAS. A trip blank filled with analyte-free deionized water will be included when a cooler contains reconnaissance groundwater, groundwater, or soil samples collected for analysis. After their preparation, the sample containers are not to be opened until they have been returned to the laboratory.

One field equipment rinsate blank will be used to evaluate whether the decontamination procedures were adequate to prevent cross-contamination between samples or introduction of PFAS into samples from the materials in the sampling equipment. One rinsate blank will be collected for each type of sampling equipment that comes in contact with sample material (e.g., hand-coring device, drill bit, hollo-stem-auger flight, peristaltic pump tubing, protective gloves).

2.2.3 Representativeness

Representativeness is a qualitative measure of how closely the measured results reflect the actual concentration or distribution of the constituent concentrations in the medium sampled. Sampling plan design, collection techniques, sample handling protocols, analytical methods, and data review procedures have been developed in the Work Plan and this QAPP to ensure that the results obtained are representative of conditions in the Lower Issaquah Valley study area.

Representative data will be obtained through adherence to the Work Plan. Goals for representativeness will be met by ensuring that sampling locations and procedures are properly selected and performed and that a sufficient number of samples are collected at the areas of interest to confirm whether there has been a release of PFAS to the environment at concentrations exceeding investigatory levels.

2.2.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The use of standard U.S. Environmental Protection Agency (EPA) and Ecology methods and procedures for both sample collection and laboratory analysis will ensure the data collected are comparable against other data collected using the same methods and procedures. EPA Method 537 is approved for drinking water. No EPA-approved method is available for soil or groundwater; the most appropriate method available at this time is EPA Method 537, modified by qualified analytical laboratories to extract and analyze soil and groundwater matrices. Additional sample preparation steps to eliminate matrix interference for soil and groundwater performed as part of the method modification will be consistent with the U.S. Department of Defense (DOD) (2017) guidance.

2.2.5 Completeness

Completeness is defined as the percentage of measurements judged to be valid. Results are considered valid if they are not rejected during data validation (see Section 3.3, Data Quality Control). Completeness is calculated as presented below.

The site-specific target completeness goal for the PFAS characterization work will be 95 percent for a given analysis.

$$Completeness = \frac{(Number\ of\ Valid\ Measurements)}{(Total\ Number\ of\ Measurements)}\ x\ 100$$

2.2.6 Sensitivity

Sensitivity has been defined as the PQL for EPA Method 537 Modified for soil and groundwater analyses. Analytical reporting limits are lower than Ecology’s investigatory levels for groundwater and for soil in the vadose zone, but not for soil in the saturated zone (Work Plan Table 1). Thus, the analytical method is sufficiently sensitive for groundwater and vadose soil.

2.3 ACCEPTANCE CRITERIA FOR QUALITY OF EXISTING DATA

Historical data generated by the City of Issaquah and Sammamish Plateau Water and Sewer District will be reviewed and evaluated based on the following criteria:

- Analytical results meet a laboratory PQL for EPA Method 537 Modified;
- Sampling locations can be verified and surveyed within ±0.1 foot using the Washington State Plane North coordinate system; and
- Sample collection practices can be verified to meet minimum requirements to prevent accidental or cross-contamination.

3.0 QUALITY CONTROL PROCEDURES

QC refers to the system of maintaining standards through testing against established standards or specifications. This section addresses QC procedures that will be applied to the PFAS characterization project sample collection and analysis work, including procedures for field and laboratory QC and analytical data QC.

3.1 FIELD QUALITY CONTROL

Field QC samples (e.g., duplicate samples, equipment rinsate blanks) to be collected during this project are described in Section 5.4, Field Quality Assurance/Quality Control Samples, of the Work Plan. The purpose of the field QC samples is discussed in Section 2, Data Quality Objectives, of this QAPP.

3.2 LABORATORY QUALITY CONTROL

Analytical laboratory QA/QC procedures are described in the laboratory Quality Assurance Manual, which will be kept on file at the Farallon corporate office in Issaquah, Washington.

Each lot of laboratory supplies will be verified as PFAS-free prior to use. Samples will not be filtered prior to analysis because PFAS can adsorb to the filters. When analyzing groundwater samples, the entire sample will be prepared and the sample container will be rinsed with the rinse water included in the analysis. The laboratory will use sample extraction and preparation methods consistent with DOD (2017) guidance to alleviate matrix interferences.

3.3 DATA QUALITY CONTROL

Data will undergo two levels of QA/QC evaluation: one by the laboratory and one by Farallon. Initial data reduction, evaluation, and reporting will be performed by the laboratory, as specified in the laboratory Quality Assurance Manual. The analytical data will then be validated by Farallon under the supervision of the Project QA/QC Officer. The following types of QC information will be reviewed, as appropriate:

- Method deviations;
- Sample extraction and hold times;
- Method reporting limits;
- Blank samples (e.g., equipment rinsate, trip, and laboratory method);
- Field duplicate samples;
- RPD (for precision);
- MS/MSD samples (for accuracy);
- Surrogate recoveries; and

- Percent completeness.

Farallon will review field records and the results of field observations and measurements to ensure that procedures were properly performed and documented. Field procedures will be reviewed for the following elements:

- Completeness and legibility of field logs;
- Preparation and frequency of field QC samples;
- Field equipment calibration and maintenance; and
- Chain of Custody forms.

3.4 CORRECTIVE ACTION

Corrective action will be the joint responsibility of the Project Manager and the Project QA/QC Officer. Corrective procedures may include:

- Identifying the source of deviation from the quality standards set forth in the Work Plan and its supporting documents;
- Re-analyzing soil and/or groundwater samples if hold-time criteria permit;
- Re-sampling and analyzing soil and/or groundwater if necessary to meet the quality standards set forth in this QAPP;
- Evaluating and amending sampling, analytical, and/or data transfer procedures; and/or
- Qualifying data to indicate the level of uncertainty.

During field operations and sampling procedures, field team members will be responsible for identifying and correcting equipment malfunctions and documenting sampling procedures in a manner that will enable the Project Manager or the Project QA/QC Officer to evaluate whether corrective action is warranted.

Equipment malfunctions, variances in sampling protocols, and corrective actions taken by field team members will be documented in the field notes. The Project Manager or the Project QA/QC Officer will evaluate the field notes upon submittal to determine whether the corrective action taken was adequate to meet project quality standards or whether additional corrective action is required.

4.0 MANAGEMENT PROCEDURES

Procedures for filing, storing, and retrieving project files are described below.

4.1 DATA RECORDING AND REPORTING REQUIREMENTS

The following sections address receipt and recording of incoming data and reports, and records for transmittal of outgoing data and reports.

4.1.1 Document Filing and Storage

Project files and raw data files will be maintained at the Farallon corporate office in Issaquah, Washington. Files will be organized by project number and document type, and maintained by the Document Control Clerk and the Project Manager. Electronic copies of final documents, email messages, boring logs, laboratory data, drafted project content, correspondence, and other project documentation will be maintained in Farallon's project files. Draft documents and data will be removed from Farallon project files once final versions have been completed and distributed.

4.1.2 Meeting, Telephone, and Field Notes

Notes from project meetings and telephone conversations will be maintained in the project files by the Project Manager. Field notes will be scanned on a daily basis and retained in PDF file format and maintained in Farallon project files.

4.1.3 Receipt of Data and Reports

Incoming documents will be date-stamped and filed in accordance with established procedures. Correspondence and transmittal letters for reports, maps, and data will be filed chronologically. Data packages such as those from field personnel, laboratories, and surveyors (e.g., soil analytical data, survey data, geologic observations) will be filed by project task, subject heading, and date. If distribution of a document is required, the required number of copies will be made and distributed to the appropriate persons or agencies. The original document will not be distributed to project personnel and will be retained in the Farallon project files.

4.1.4 Outgoing Data and Reports

A transmittal sheet will be attached to outgoing project data and reports. A copy of each transmittal sheet will be kept in the Farallon project files. Outgoing reports and maps will be reviewed by the Project Manager and the Project QA/QC Officer prior to being sent. Reports, data, and other documentation sent via email also will be tracked. Copies of emails will be maintained in the Farallon project files.

4.1.5 Access to Project Files

Access to Farallon project files will be controlled by and limited to authorized agents of Eastside Fire & Rescue, the City of Issaquah, Ecology, and Farallon personnel. Authorized agents may direct Farallon to provide project-related information to others as appropriate and agreed to by other authorized agents. Access to Farallon project files is restricted to Farallon personnel. Documents in Farallon project files cannot be altered or deleted by anyone but the Document Control Clerk.

4.2 LABORATORY DATA PACKAGE REQUIREMENTS

Laboratory data packages will consist of a laboratory report and electronic data deliverable. Laboratory reports will include the following elements:

- Case narrative;
- Analytical notes;
- QC narrative;
- Sample inventory report;
- Analytical results; and
- Data qualifiers and abbreviations.

The electronic data deliverable will include at a minimum:

- Sample identification information;
- Sample media;
- Sampling, laboratory receiving, extraction, and analysis dates;
- Analyte and Chemical Abstracts Service Reference No.;
- Reported concentrations and reporting units;
- Analytical method detection limits;
- Machine reporting limits and reporting units; and
- QA/QC results, including identification of MS/MSD and surrogate samples.

4.3 ELECTRONIC TRANSFER REQUIREMENTS

The final repository for sample analytical information will be an EQuIS environmental data management system database (EQuIS database). The electronic data deliverables received from the laboratories will be directly transferred into the EQuIS database, reducing the likelihood of data entry errors. The Project QA/QC Officer will manage and maintain the EQuIS database.

Emails associated with the project will be placed in Farallon project files. These mailings typically include routine correspondence, laboratory data, and transmissions of reports or other project documentation. Emails that include draft versions of any project document will be deleted once the document has been issued in final format. Electronic communications and documents provided to public entities will be retained in accordance with each entity's document retention policy.

4.4 ENVIRONMENTAL INFORMATION MANAGEMENT SYSTEM DATA UPLOAD PROCEDURES

Farallon will maintain laboratory and field data in a format appropriate for future transfer into the Ecology Environmental Information Management System. At the request of Ecology, Farallon will directly transfer the analytical data provided by the laboratory into the Environmental Information Management System, thus eliminating the likelihood of data entry errors inherent with manual data entry.

Field measurements and other data requiring manual entry will be reviewed by Farallon personnel other than the data entry staff prior to submission to the Environmental Information Management System. Ecology's confirmation of receipt of the data will be maintained in Farallon project files.

5.0 AUDITS AND REPORTS

5.1 FIELD, LABORATORY, AND OTHER AUDITS

Performance audits will be conducted for both sampling and analysis work. Field performance will be monitored through regular review of field notebooks, field measurements, and Chain of Custody forms. Periodic on-site review of work in progress will be performed by the Farallon Project Manager and/or the Project QA/QC Officer. Project staff and organization are provided in Section 3.3, Project Organization and Schedule, of the Work Plan.

U.S. Department of Defense accreditation for each of the analyses conducted by a laboratory demonstrates the laboratory's ability to properly perform requested methods. Therefore, a system audit of the analytical laboratory will not be conducted during the course of this project.

The Project Manager and/or the Project QA/QC Officer will oversee communication with the analytical laboratory on an ongoing basis during sample processing and analysis. This oversight will allow Farallon to assess progress toward achieving the DQOs and take corrective measures if problems are encountered. Corrective measures will be the joint responsibility of the Project Manager and the Project QA/QC Officer.

The analytical laboratory will be responsible for identifying any deviation from the performance standards described in the laboratory Quality Assurance Plan, and for taking appropriate corrective action. The laboratory will communicate to the Project Manager or the Project QA/QC Officer any deviation from the performance standards during sample analysis, and the corrective action taken. Corrective actions are discussed in Section 3.4, Corrective Action.

5.2 RESPONSIBLE PERSONNEL

Farallon staff responsible for field and reporting audits include the Project Manager, Principal Reviewer, and Project QA/QC Officer. Audits and reporting for analytical laboratories will be addressed by each laboratory's Project Manager or Project QA/QC Officer.

5.3 REPORTS

Farallon will prepare technical memoranda and reports as identified in the Interagency Agreement dated July 10, 2018, executed between Ecology and Eastside Fire & Rescue (Ecology 2018b) (IAA), including the Work Plan, a PFAS Characterization Summary Report, and monthly status memoranda. The PFAS Characterization Summary Report will include appropriate background, a description and the rationale of the work performed, a summary of data QA/QC, summary figures and tables, and attachments, including analytical laboratory reports, boring logs, and other records as appropriate.

Monthly status memoranda and the PFAS Characterization Summary Report will be prepared by qualified personnel, overseen by the Project Manager, reviewed by the Principal Reviewer, and provided to the Parties as specified under the IAA. QA/QC review and reporting will be performed by the Project QA/QC Officer. The QA/QC summary will include:

- A description of any changes or deviations from the sampling plan or QAPP;
- An assessment of PARCCS parameters;
- The results of performance and/or system audits; and
- Significant QA problems, if any, and their impact on the DQOs.

6.0 DATA VERIFICATION

6.1 FIELD DATA VERIFICATION, REQUIREMENTS AND RESPONSIBILITIES

Field data verification will be conducted by the Project Manager. Field data verification will consist of the tasks identified in Section 3.3, Data Quality Control, and Section 3.4, Corrective Action.

Field measurements and data requiring manual tabulation from field records will be reviewed by Farallon personnel other than the data entry staff and approved by the Project Manager. Any discrepancies will be corrected prior to use.

6.2 LABORATORY DATA VERIFICATION

Data verification involves examining the data for errors, omissions, and compliance with QC acceptance criteria. Each analytical laboratory will follow its on-file procedures for data reduction, review, and reporting, which meet the needs of the project.

Laboratory staff will provide as part of the laboratory data package a narrative that will include a discussion of whether PARCCS criteria were met and proper analytical methods and protocols were followed. The narrative will include a discussion of QA/QC, including whether control limits were met and data were consistent, correct, and complete, without errors or omissions. The Principal Reviewer is responsible for the final acceptance of the project data.

Electronic data deliverables will be provided by the laboratories and will be directly transferred into Farallon's EQuIS database, reducing the likelihood of data entry errors. Reportable data entered into the EQuIS database will be quality checked against the laboratory reports as the official laboratory record. Any discrepancies identified in the data during the QA/QC check against the laboratory reports will be corrected in the EQuIS database prior to reporting and use. The Principal Reviewer is responsible for the final acceptance of the project data.

6.3 DATA VALIDATION

Independent data validation will not be required for this project. The data are being used for general characterization of PFAS source(s) and distribution and not to assess cleanup performance or confirmation.

7.0 DATA QUALITY ASSESSMENT

This section outlines data types that will be generated by implementation of the Work Plan and the procedures to be followed for the inventory, control, storage, and retrieval of data collected during performance of the PFAS characterization work. The procedures described in the Work Plan are designed to ensure that the integrity of the collected data is maintained for subsequent use. In addition, project-tracking data (e.g., schedules, progress reports) will be maintained to monitor, manage, and document the progress of PFAS characterization work.

Farallon will maintain project files in accordance with Washington State Model Toxics Control Act Cleanup Regulation requirements and the procedures outlined in this QAPP. Data generated during field activities and laboratory analyses will be submitted directly to Farallon. Laboratory documentation from the analytical laboratories will be maintained in Farallon project files to validate analytical data collected during the cleanup action.

7.1 PROJECT OBJECTIVES EVALUATION

The Project Manager will assess the quality of data and verify that the DQOs presented in Section 2.1 were met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will be evaluated in terms of major impacts observed from data validation, data quality indicators (including an evaluation with respect to the PARCCS parameters specified in this QAPP), and performance criteria. Based on the results of these assessments, the usability of the data will be determined. Any limitations on the usability of the data will be described (e.g., whether data need to be qualified, whether data can be used in the technical analysis). The Principal Reviewer will determine whether the combined analyses for an objective are sufficient to meet project goals and whether any data gaps were identified.

7.2 SAMPLE DESIGN EVALUATION

The sampling program described in the Work Plan has been developed to address project goals, including:

- Further characterize areas of interest where historical operations included use of aqueous film-forming foam to identify potential points of release for PFAS to the environment;
- Assess the presence of PFAS in shallow soil and groundwater at areas of interest (potential points of release) in the Lower Issaquah Valley, and identify potential direct contact exposure to surface soil and migration pathways from soil to groundwater;
- Further characterize the nature and extent of PFAS in groundwater below the shallowest water-bearing zone at the Lower Issaquah Valley; and
- Collect data that can be directly compared against Ecology-specified investigatory levels for sampled media.

The following types of data are to be collected as described in Section 2.1, Data Quality Objectives:

- Analytical results for PFAS in eight multi-increment surface soil samples;
- Analytical results for PFAS in 12 subsurface vadose zone soil samples;
- Analytical results for PFAS in 21 reconnaissance groundwater samples;
- Analytical results for PFAS in 15 groundwater samples collected from monitoring wells;
- Groundwater geochemical parameters (e.g., pH, specific conductivity) collected during monitoring well purging and sampling;
- Lithology information collected during advancement of borings; and
- Synoptic measurements of groundwater levels in monitoring wells in the monitoring well network.

Evaluation of the analytical results will include data trending, comparison of data with historical and previously collected data, and comparison against Ecology investigatory levels. Data results will also be evaluated spatially and vertically to determine whether project goals were achieved. The data will be used to enhance the conceptual site model for the Lower Issaquah Valley.

Successful completion of the tasks and work elements outlined in the Work Plan will meet project goals.

7.3 TREATMENT OF NON-DETECTS

Non-detects will be reported at the PQL for a given analyte when reported in tables and as data on figures. Non-detects will be treated as zero values when used in preparing graphs (such as trend plots) and potentially for preparing isoconcentration contour maps. Analytical method detection limits will be included in laboratory electronic data deliverables and transferred into Farallon's EQuIS database for future upload to the Ecology Environmental Information Management System.

8.0 REFERENCES

Farallon Consulting, L.L.C. (Farallon). 2018. Draft Final *Lower Issaquah Valley Per- and Poly-Fluoroalkyl Substances Characterization Work Plan, Issaquah, Washington*. Prepared for Eastside Fire & Rescue. August 1.

U.S. Department of Defense (DOD). 2017. *Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories*. Version 5.1. Environmental Data Quality Workgroup.

Washington State Department of Ecology (Ecology). 2004. *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*. Publication Number 04-03-030. Revised December 2016. July.

———. 2016. *Quality Assurance Project Plan: Statewide Survey of Per- and Poly-Fluoroalkyl Substances in Washington State Rivers and Lakes*. Publication No. 16-03-110. April.

———. 2018a. Investigatory Levels for Perfluoroalkyl Substances. February 9.

———. 2018b. *IAA No. C1800181, Interagency Agreement (IAA) Between the State of Washington Department of Ecology and Eastside Fire and Rescue*. July 10.

APPENDIX B
FARALLON STANDARD OPERATING PROCEDURES

PRE- AND POLY-FLUOROALKYL SUBSTANCES
CHARACTERIZATION STUDY WORK PLAN
Lower Issaquah Valley
Issaquah, Washington

Farallon PN: 1754-002

STANDARD OPERATING PROCEDURE EQ-01

EQUIPMENT DECONTAMINATION PROCEDURES

PURPOSE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide field personnel with the methodology for decontaminating sampling equipment during various field activities. The step-by-step guidelines provided in this SOP are to be followed by the field crew during all site visits, as applicable.

EQUIPMENT AND SUPPLIES/REAGENTS

The following equipment is necessary to properly decontaminate field equipment during various field tasks:

- Rinse water or distilled water.
- Deionized water.
- Liquinox or other phosphate-free detergent.
- Paper towels.
- Labeled squirt bottles.
- Long-handled hard-bristle brushes (for sediment and soil).
- Cotton swabs.
- Plastic sheeting, garbage bags, and aluminum foil (for sediment and soil).
- Core liner caps or plastic wrap and rubber bands (for sediment and soil).
- Extension arm for cleaning core liners (for sediment and soil).
- Plastic 5-gallon bucket.
- U.S. Department of Transportation-approved drum(s) for decontamination water unless other water-handling arrangements have been made. Separate drums are needed for liquid and solid wastes (see Farallon SOP WM-01, Field-Handling of Investigation-Derived Waste). Liquid wastes should not be added to drums containing solid wastes.

Dilute Liquinox with distilled water in a squirt bottle in accordance with the instructions on the Liquinox package, and label the bottle. Fill another squirt bottle with distilled water, and label the bottle.

FIELD EQUIPMENT TO BE DECONTAMINATED AFTER USE

Decontaminate the following field equipment at the conclusion of field work each day, in accordance with the procedures outlined in this SOP:

- Water-level meter.
- Horiba/YSI multiparameter probe.
- Bladder pump.
- Submersible pump.
- Sediment and soil collection and processing equipment.

WATER-LEVEL METER DECONTAMINATION

Decontaminate the water-level meter after measuring the water level at a monitoring well before moving to a new monitoring well, using the following procedures:

- Spray the bottom half of a paper towel with the diluted Liquinox solution, and the upper half with deionized water.
- Grip the measuring tape of the water-level meter with the paper towel in one hand with the Liquinox side down toward the monitoring well casing.
- Begin slowly reeling up the water-level meter while maintaining firm contact between the measuring tape and the paper towel.
- Ensure that no debris or contamination remains on the measuring tape of the water-level meter once it has been reeled up.
- Use a clean new paper towel for each successive decontamination of the measuring tape of the water-level meter.

HORIBA/YSI MULTIPARAMETER PROBE DECONTAMINATION

Decontaminate the Horiba/YSI multiparameter probe at the end of each workday or after sampling a monitoring well with high concentrations of contamination, using the following procedures:

- Remove the multiparameter probe from the flow-through cell, and thoroughly spray each component with deionized water.
- Use a cotton swab to gently clean around each sensor probe, ensuring that all contaminated water and material has been washed away.
- Refill the protective dissolved oxygen and pH probe caps with deionized water, and replace prior to storage.
- Once the multiparameter probe has been adequately cleaned, replace the protective shield, and return the probe to the case. If the device appears to be overly wet, allow it to air-dry with the case open.

- Do not use Liquinox to clean any probes on the Horiba multiparameter probe, as it may damage the device.

BLADDER PUMP DECONTAMINATION

Decontaminate the bladder pump after sampling a well and at the end of each workday, using the following procedures:

- After extracting the bladder pump from the well, break down the pump, remove and dispose of the used bladder, and spray each component with the diluted Liquinox solution, followed by deionized water.
- Wipe away any visible contamination or debris with a paper towel.
- Capture cleaning water in a liquid waste drum for proper disposal in accordance with Farallon SOP WM-01, Field-Handling of Investigation-Derived Waste.
- Ensure that all contamination and Liquinox solution is washed off all components before reassembling the device, installing a new bladder, and moving to sample a new well.

SUBMERSIBLE PUMP DECONTAMINATION

Decontaminate the submersible pump after purging water from any well, using the following procedures:

- After extracting the submersible pump from the well, thoroughly spray down the pump with the diluted Liquinox solution, followed by deionized water.
- Wipe away any visible contamination or debris with a paper towel.
- Purge clean water through the pump and tubing to ensure that contaminated water has been cleared from all lines.
- Capture cleaning water in a liquid waste drum for proper disposal in accordance with Farallon SOP WM-01, Field-Handling of Investigation-Derived Waste.

SEDIMENT AND SOIL SAMPLING AND PROCESSING EQUIPMENT DECONTAMINATION

Decontaminate sampling equipment used to collect and process sediment and soil samples, using the following procedures:

- Place contaminated equipment and decontamination tools on plastic sheeting.
- Thoroughly rinse all used equipment with distilled water in a 5-gallon bucket to remove excess sediment or soil.
- Pour one capful of Liquinox solution into a 5-gallon bucket filled with tap water or distilled water.
- Using a long-handled hard-bristle brush, thoroughly scrub the equipment with the Liquinox solution until no sediment or soil particles remain.

- Holding the equipment over a 5-gallon bucket, double-rinse the equipment with distilled water until no Liquinox solution remains. Do not allow clean equipment to come into contact with a contaminated surface.
- Drain the equipment and place it in a clean, dry place to prevent recontamination.
- If decontaminated equipment will not be re-used immediately, wrap stainless steel equipment (e.g., bowls, spoons) in aluminum foil with the dull side facing the equipment. Seal polycarbonate core liners with core caps or cellophane plastic. Rubber-band ends to ensure a proper seal.
- After decontamination has been completed, place disposable items into a garbage bag, and store decontamination water in a drum in accordance with Farallon SOP WM-01, Field-Handling of Investigation-Derived Waste.

STANDARD OPERATING PROCEDURE GN-01

FIELD NOTE PROCEDURES

PURPOSE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide field personnel with the information needed to document site and sampling activities during field work. The step-by-step guidelines provided in this SOP are to be followed by the field personnel during field work.

GENERAL FIELD NOTE INSTRUCTIONS

- Use a blue or black pen.
- Always document time in military time.
- Record your full name and the names of other Farallon employees present. Initials of personnel can be used after the full names have been provided in the field notes.
- Don’t leave line spaces between field note entries.
- Keep handwriting neat.
- Be concise.

ITEMS TO INCLUDE IN FIELD NOTES

At Start of Workday:

- Document when and where you started the field day and when you arrived at the site.
- Note any stops along the way to the site.

Upon Arrival at Site:

- Note the reason for the site visit/site work.
- Document the weather on page 1, and throughout the day if the weather changes.
- Document the time personnel arrive at the site and the name of the company/agency they are affiliated with.
- Document the time subcontractors arrive, the tasks they are conducting, and the time they leave the Site.
- Conduct the Health and Safety (H&S) meeting, ensure all participants sign the H&S form, and include the signed H&S form in the field notes.
- Calibrate equipment: document equipment model number/serial number, calibration method, and results. Be specific (e.g., “Calibrated Horiba for pH using 4.0 standard.” “Calibrated PID using 100 ppm isobutylene span gas and ambient air as zero gas.”). Note whether the instrument is Farallon’s or a rental. If using a rental, include in the field notes the calibration sheet that should have come with the equipment. If using two sets of

equipment, note on the field forms which equipment was used for each location. For example, label “Horiba 1” and “Horiba 2” on the groundwater sampling sheets, and document the serial numbers of the instruments in the field notes. Make sure to document the calibration results for Farallon equipment in the Rite-in-the-Rain notebook kept in each field equipment case.

- Document when work starts at a specific task location (e.g., well or boring), and document what equipment Farallon or the subcontractors are using at that location.
- Measure out and record the sample locations (using a rolling wheel, or GPS if available), and mark utilities on a field map if applicable.
- If media samples will be collected, complete the appropriate documentation form, or record the information in the field notes. For example, record field sampling methods (e.g., grab, composite), the type of media (e.g., soil, groundwater, stormwater), the time the sample was collected, sample location and ID, analytical method(s), the laboratory conducting the analysis, the size of the sample container, the number of containers used, and the preservative included in the sample container. If a composite sample is collected, record how many composite points make up the sample, and document where the composite samples were collected.
- If multiple samples are collected using the same methods and the same type of sample containers, simply document that a sample was collected the same as previous samples.
- Document when work is complete at each location.
- If conducting groundwater monitoring, note the condition of monitoring well monuments (e.g., bolts missing, gasket needed).
- Throughout the workday, note any relevant information (e.g., QC-sampling discrepancies, unexpected conditions, abnormal sampling events).

At End of Workday:

- Decontaminate equipment and note the decontamination method (e.g., Alconox and towels).
- Review the field notes, and complete sketches of any relevant features and sample locations if necessary.
- Record whether wastes were generated. If so, record how much was generated, whether the waste was sampled, and where the waste is stored.
- Place an “Analysis Pending” label on drums of waste, and fill out the label completely.
- Complete a drum inventory sheet and note the drum/container sizes and how much waste was accumulated.
- Document when you left the site;

- Document when you returned to the office or when the field day ended.
- Note any additional work performed after returning to the office (e.g., finished field notes, downloaded field photos).

Make sure to include any of the following forms relevant for the type of field work conducted:

- Daily Field Notes
- Health and Safety Meeting form
- Water Level Summary form
- Low Flow Well Purging and Sampling Data form
- Boring and/or test pit logs
- Monitoring Well Construction Data form
- Soil Sample Data form
- SVE Monitoring form
- Any site-specific operation and maintenance or pilot test forms
- Elevation Survey Data form
- Utility Clearance Log
- Waste Inventory Tracking Sheet
- Copy of the laboratory Chain of Custody form for any samples collected
- Copies of subcontractor daily log sheets (e.g., utility locate, drilling)
- Copies of rental equipment calibration sheets
- Near Miss form (if applicable)
- Incident Report form (if applicable)

Assemble all field forms used each day, scan, save to the electronic project Field Notes folder, and give the hard copy of the forms to the Project Manager.

Refer to the Farallon Field Documentation Checklist and the *Doc Reqs by Field Task list.*

STANDARD OPERATING PROCEDURE GN-02

UTILITY LOCATE

PURPOSE

The purpose of this standard operating procedure (SOP) is to provide Farallon Consulting, L.L.C. (Farallon) personnel with the specific information needed to identify and locate utilities on sites where drilling or excavation activities will occur. Excavation is defined by Section 20 of Chapter 19.122 of the Revised Code of Washington (RCW 19.122.020) as “any operation, including the installation of signs, in which earth, rock, or other material on or below the ground is moved or otherwise displaced by any means.” For the purposes of this SOP, the excavation area refers to the area of an excavation or a perimeter around all proposed borings, test pits, soil gas sampling locations, and subslab soil gas sampling locations. Identifying utilities within the boundaries of a proposed excavation area prior to any digging is required by law and is necessary for the safety of Farallon personnel and contractors.

The guidelines provided in this SOP are to be followed by Farallon personnel who coordinate utility locating, mark locate boundaries, and/or observe field work that involves any type of excavation.

EQUIPMENT AND SUPPLIES

The following equipment and supplies are necessary to arrange and conduct utility locating:

- A map of the site with the proposed excavation area(s);
- Readable side sewer card figures, if applicable;
- Geographic information system (GIS) utility figures, if applicable;
- Readable American Land Title Association (ALTA) survey figures, if applicable;
- Any previous utility figures associated with the site;
- White marking products (e.g., paint, flags, stakes, grease marking pen, tape, chalk);
- Materials necessary to provide required documentation (e.g., Field Report form, camera, measuring wheel, global positioning system); and
- Personal protective equipment (PPE) as described in the site-specific Health and Safety Plan, or Level D PPE at a minimum.

PROCEDURES

The following utility locating procedures have been developed for use before excavation occurs on a site. The procedures are divided into the following five parts:

- Call Before You Dig System;
- Private Utility Locating Services;
- Hand-Clearing Proposed Excavation Areas;
- Maintaining Public Utility Locate Marks; and
- Utility Line Damage.

The Project Manager should discuss the scope of work, details of the project location, and any essential information with the project field team before any of the procedures described below commence. When practicable, an on-site kickoff meeting involving a member of the field team and the Project Manager should be conducted to discuss the work to be performed, mark the boundaries of the excavation area, and mark potential boring locations, if applicable.

Call Before You Dig System

According to RCW 19.122.030, excavators are required to mark the boundary of a proposed excavation area using white marking products. Marking products include paint, flags, and stakes. Boundary marks should conform to the following guidelines:

- A continuous line, hashed line, dots, or corner marks with arrows are acceptable ways to mark the boundary; and
- Flags and stakes can be used if paint is not adequate.

The location(s) of the proposed excavation area(s) must be reviewed to verify that no visible utilities that would interfere with the proposed excavation area(s) are present. If utilities are present, the Project Manager and field personnel should communicate the changes to the excavation that are area necessary before the boundaries are marked with white paint.

After marking the boundaries of the proposed excavation area, Farallon personnel must provide notice of the scheduled excavation to the owner/operators of buried utilities at least 2 but no more than 10 business days in advance by calling 811 or 1-800-424-5555, or using the online tool at www.callbeforeyoudig.org. Use of the online tool is preferred.

A map with the excavation area boundaries depicted and/or photos of the white paint marks is helpful in conveying the scope of work to the Call Before You Dig service.

The following information should be available to provide the Call Before You Dig service at the time of initial contact:

- Scope of work, including the start date and time;

- Contact information for the Project Manager and a field person able to answer questions from public utility locators regarding project details; and
- Site address, township/range/section quarter, and name of property owner.

Once the Call Before You Dig system has been notified of the upcoming work, the system provides a ticket number, which

- Should be referenced whenever the Call Before You Dig service is contacted about the job.
- Provides proof that the Call Before You Dig system was notified prior to excavation. Public utility locators, inspectors, and law enforcement personnel may ask for the ticket number.
- Should be supplied to any subcontractors doing work on the site for reference when contacting the system for their own ticket number.

Call Before You Dig personnel will provide a list of public utilities present on the site, and will notify public utility operators of the planned work.

Public utility operators have 2 full business days after the day notification was received to locate and mark their lines, or to provide reasonable information on lines that they are not able to locate. The day notice is given is not included as 1 of these 2 days. Therefore, if excavation work is planned to start on a Monday, for example, the Call Before You Dig system must be notified by Wednesday the week before.

Two full business days must elapse between Call Before You Dig notification and the start of excavation. No excavation is to take place until all known utilities are marked or otherwise accounted for with information provided by the facility operator.

Locators mark their lines with colored hash marks. The American Public Works Association determines the colors to be used to denote different kinds of lines:

Red:	Power Lines and Cable	Yellow:	Gas, Oil, Petroleum
Orange:	Telephone and Cable	Blue:	Drinking Water
Green:	Sewer (Storm and Sanitary)	Purple:	Non-Potable Water
Pink:	Survey Marks	White:	Excavator Marks

Public utility operators are required to mark their lines only to the meter. Utility lines located beyond the meter are the responsibility of the property owner. Public utility operators should indicate by marking if no public utilities are present.

Public utility locators are required to mark their lines with reasonable accuracy. According to RCW 19.122.020, "reasonable accuracy means location within twenty-four inches of the outside dimensions of both sides of an underground facility."

At this time, public utility companies are not required to mark abandoned or deactivated lines in Washington.

An individual not following the protocols established by the Call Before You Dig system can be held liable for up to three times the cost to repair a utility line damaged during excavation.

Records of ticket numbers and communications with the Call Before You Dig service should be stored in the project folder and supplied to on-site project personnel.

Before any excavation work is started, Farallon personnel should verify that all public utility marks are present on the site. The public utility company/ies listed on the Call Before You Dig system ticket should be contacted if marks for that utility/ies are not present.

Private Utility Locating Services

After the public utility companies have marked their lines and before excavation begins, it is standard practice to have a private utility locating service clear areas that will be excavated.

Private locates generally are scheduled for the day before or the morning of the start of excavation.

Areas where excavation will occur must be cleared for conductible utilities by a private locator. Depending on the nature of the site and the proximity of utility lines, the private locator may also mark non-conductible utilities.

If possible, the excavation contractor should be on the site during the private utility locating to verify with the private locator that all proposed excavation areas are accessible.

When working with private utility locators, Farallon personnel should:

- Study existing figures of the site, noting the locations of known utilities.
- Use available side sewer cards or geographic information system utility figures to verify utility locations at the site.
- Verify that all public utilities have been marked by physically verifying that colored paint marks are present for all of the public utility companies listed on the One Call Before You Dig ticket. If any public utilities have not been marked, the utility company must be contacted and requested to mark the area, or to provide confirmation that the area is clear of their utility.
- Discuss the scope of work/excavation areas with the private locator.
- Document the name of the locating company and the name of the locator.

- Observe the locator clear the excavation area(s).
- Document the locate marks with photos, and note any uncertainties in the Field Report form.
- Identify the locations of shut-off valves for utilities such as water and natural gas.
- Contact the Project Manager or Principal to discuss relocating the excavation area if a proposed excavation area is in conflict with a utility identified by the private locator.
- Sign the locator's paperwork, if necessary, and depart the site if no additional field work is to be performed that day.

Private location of conductible utilities should sweep the excavation area in two perpendicular directions.

Private location of non-conductible utilities (typically storm and sanitary sewer) can use either a probe or a camera for accessible lines. Appropriately colored paint marks are applied by the private locator based on a signal sent from the probe or camera. For inaccessible lines, a ground-penetrating radar or magnetometer can be used to approximate the line locations. Marks based on this method should be considered approximate.

Hand-Clearing Excavation Areas

Prior to conducting certain excavation activities, excavators will clear the proposed excavation area to verify that no utilities are present. This can be accomplished through use of an air knife/vacuum truck, post-hole digging, hand-augering, or use of other hand tools that allow the excavation location be explored sufficiently to verify that no utilities are present. Farallon Project Managers will confirm the method of clearing and depths with the field team before the excavation work is performed. Farallon Project Managers also need to discuss shallow soil sampling needs with the field team if clearing activities are being performed. Clearing activities should be conducted according to the following guidelines:

- Hollow-Stem Auger Drilling: Hand-clear to a minimum depth of 5 feet below ground surface (bgs) using an air knife/vacuum truck whenever possible. Alternative methods such as post-hole digging or hand-augering also may be used.
- Sonic Drilling: Hand-clear to a minimum depth of 5 feet bgs using an air knife/vacuum truck whenever possible. Alternative methods such as post-hole digging or hand-augering also may be used.
- Geoprobe Drilling: Clearing activity requirements are dependent on known utilities and results of the public and private utility location procedures completed above. Hand-clear using a post-hole digger or hand-auger to a maximum depth of 5 feet bgs is necessary. An air knife/vacuum truck may be used to hand clear each boring location to a maximum depth of 5 feet bgs, if available.

- Test Pit Excavation: No hand-clearing is necessary. Excavation contractors should be directed to dig cautiously in the upper 5 feet bgs in the event an unknown utility is present. A test pit excavation or regular excavation using machinery (e.g., track hoe, backhoe) should include using a spotter to watch for unidentified utility lines. Ideally, the spotter should be provided by the excavation contractor.
- Rotary Hammer for Soil Gas Sampling: No hand-clearing is necessary.
- Rotary Hammer for Subslab Soil Gas Sampling: No-hand clearing is necessary.

Some drilling contractors require that a utility line be exposed prior to drilling if the proposed drilling location is within a certain distance of the utility line. Farallon personnel should confirm drilling contractor requirements prior to conducting drilling activities.

If a utility line is encountered during clearing, excavators should verify that the utility has not been damaged, and Farallon personnel should document the encounter on the Field Report form with photos and details. RCW 19.122.020 states that “damage” includes the substantial weakening of structural or lateral support of an underground facility, penetration, impairment, or destruction of any underground protective coating, housing, or other protective device, or the severance, partial or complete, of any underground facility to the extent that the project owner of the affected facility operator determines that repairs are required. The Project Manager or Principal should be notified immediately if a utility line is encountered during hand-clearing, and an alternate location will be proposed. A hand-cleared area having an exposed utility line should be backfilled with a bentonite seal and finished to match existing grade.

Maintaining Public Utility Locate Marks

According to RCW 19.122.030, “public utility locate marks expire 45 days from the date the excavator provides notice,” and “it is the responsibility of the excavator to maintain the public utility marks for 45 days, or for the length of the project–whichever is shortest. In any case, the public utility locate marks expire after 45 days.”

Locate marks can be maintained digitally through both photos and figures drawn to scale.

Locate marks can be maintained in the field using white paint. White paint can be applied between original hash marks, on either side of the hash marks, or on both ends. Offset paint or staking can be used if placed a uniform distance from the original marks with a clear indication of the direction and distance from the original marks. The original marks should not be painted over, and white paint should never be applied over colored paint. White marks should include a letter identifying the type of buried line.

Utility Line Damage

A utility line does not need to be ruptured or severed to be considered damaged. Scratching or denting a utility line or its protective tape also is considered damage, as the integrity of the line may have damaged even if the damage does not appear to be significant. Before excavation work begins, shut-off valve locations for applicable utilities should be documented. If a utility is believed to be damaged, the utility should be shut down if practicable and safe to do so. According to RCW 19.122.053, “all facility operators and excavators who observe or cause damage to an underground facility must report the damage event to the Washington State Utilities and Transportation Commission.”

If a utility line is hit and public safety is a concern, 911 should be the first call made after the immediate area has been evacuated. If a utility line is hit and the public is not at risk, the field team should notify the Project Manager, who will notify the Principal and the corporate Health and Safety Coordinator immediately. The Project Manager should then contact the utility that owns the damaged line, and report to the field team any instructions issued by the utility owner, and an expected timeframe for arrival of a utility owner representative at the site. Repairs to a utility line will not be attempted by Farallon personnel or contractors.

Damage must be reported through the Common Ground Alliance Damage Information Reporting Tool website, hosted by the Washington State Utilities and Transportation Commission: http://www.utc.wa.gov/publicSafety/pipelineSafety/Pages/Damagereportingrequirements.aspx

Access to damaged utility lines should be maintained to allow inspection by the utility company. An exposed utility should not be backfilled or patched until instruction to do so has been provided by the Project Manager or Principal.

DOCUMENTATION

Farallon personnel should document in the Field Report form the work performed and methods used by private utility locators, and photos from multiple angles with good reference points for each utility line in the excavation area(s).

REFERENCES

Washington Utilities Coordinating Council. 2014. *Guide to Safe Digging, Washington State Law and Industry Best Practices.*

STANDARD OPERATING PROCEDURE GW-01
MONITORING WELL CONSTRUCTION

PURPOSE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide field personnel with the methodology for monitoring well construction and installation. Monitoring well construction ultimately is at the discretion of the Project Manager, and is based on the geology at the site and the use of the monitoring well.

Groundwater monitoring wells in the Puget Sound region, for example, typically are constructed using 2-inch-diameter Schedule 40 polyvinyl chloride well casing with 0.010-inch slotted screens because of the finer-grained materials prevalent in the region. Slot and sand sizes may be increased at the discretion of the Project Manager, depending on local geology. Monitoring wells must be installed and decommissioned by a licensed well driller, and constructed in general accordance with Chapter 173-360, Minimum Standards for Construction and Maintenance of Wells, of the Washington Administrative Code in Washington; with Rule 0410 of Division 240 of Chapter 690, Well Construction Standards – General, of the Oregon Administrative Rules in Oregon; with Bulletins 74-81 and 74-90, California Well Standards, from the California Department of Water Resources in California; and with the federal and/or state standards established for well construction specified in the project-specific field sampling plan in other states.

EQUIPMENT AND SUPPLIES/REAGENTS

The following equipment is necessary for the construction and installation of monitoring wells:

- Monitoring well construction equipment (e.g., water-level meter, photoionization detector, tape measure, camera, plastic sheeting), as applicable.
- Monitoring well construction materials (e.g., well casing [screened and blank], filter pack sand, bentonite and/or Volclay Grout annular seal material, concrete, locking casing cap, well-head monument [flush-mounted or stove-pipe monument, as appropriate] complete with locking top, bollards for placement around well-head monument as applicable), provided by the driller.
- Materials necessary to provide required documentation, including Boring Log, Monitoring Well Construction Data form, and Field Report form.
- Personal protective equipment as described in the site-specific Health and Safety Plan.
- Decontamination equipment as specified in Farallon SOP EQ-01, Equipment Decontamination Procedures.
- U.S. Department of Transportation-approved drum(s) for decontamination wastewater and excess soil cuttings. Separate drums are needed for liquid and solid wastes (refer to Farallon SOP WM-01, Field-Handling of Investigation-Derived Waste). Liquid wastes should not be added to drums containing solid wastes.

DECONTAMINATION

Before arrival at the site, upon relocation at the site, and upon demobilization from the site, decontaminate equipment that will come into contact with potentially contaminated soil and groundwater, in accordance with Farallon SOP EQ-01, Equipment Decontamination Procedures.

PROCEDURES

Follow the instructions below for monitoring well construction and installation:

- Don appropriate personal protective equipment as described in the site-specific Health and Safety Plan.
- Before installing the casing, discuss the geology and groundwater conditions at the site with the Project Manager to confirm the depth the monitoring well screen should be placed at, and the length of screen to be used.
- Measure the depth to the bottom of the borehole to calculate the appropriate placement and length of the screened interval, filter pack, annular seal, and concrete surface seal. Calculate the approximate volumes of the filter pack and the seal material required for the specific monitoring well bore annulus and monitoring well casing diameter. Ensure that the filter pack extends from the bottom of the monitoring well intake to approximately 2 to 5 feet above the top of the monitoring well intake, and is approximately 2 to 4 inches thick. The monitoring well casing should be centered in the borehole. Ensure that the annular seal is a minimum of 2 feet thick above the top of the filter pack, and that the concrete seal is a minimum of 2 feet in depth from the surface.
- Prior to installation, measure and check the lengths of the monitoring well screen and the blank casing, and confirm the slot size and the sand filter pack size, the type of bentonite seal and/or Volclay Grout seal, and the monitoring well-head monument. For boreholes completed to depths deeper than the planned installation depth of the monitoring well casing, backfill the borehole with bentonite, sand, or pea gravel. Record the type and brand of the monitoring well construction materials used on a Monitoring Well Construction Data form.
- Record on a Field Report form the start and completion times for the various stages of monitoring well construction such as installation of the monitoring well casing into the borehole, filter pack and seal emplacement, and well-head monument placement.
- Record on a Monitoring Well Construction Data form the volumes of filter pack, the bentonite seal, and the concrete used to construct the monitoring well, and check against calculated volumes to confirm proper placement and amount. During the construction process, record any irregularities such as bridging of the filter pack or seal material that could indicate construction problems.

- Upon completion of monitoring well installation, measure the total monitoring well depth and the depth to groundwater, and record the measurements on the Monitoring Well Construction Data form.
- Place a mark or notch on the northern side of the top of the monitoring well casing to provide a monument for the measurement of water levels.

DOCUMENTATION

Document monitoring well construction activities on the Monitoring Well Construction Data form and the Field Report form.

REFERENCES

U.S. Environmental Protection Agency. 1991. *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells*. EPA160014-891034. March.

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

STANDARD OPERATING PROCEDURE GW-02
MONITORING WELL DEVELOPMENT

PURPOSE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide field personnel with the methodology for monitoring well development. All monitoring wells should be developed to create an effective filter pack around the monitoring well screen, rectify damage to the formation caused by drilling, remove fine particulates from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the monitoring well. The step-by-step guidelines provided in this SOP are to be followed by the field crew performing or overseeing monitoring well development.

EQUIPMENT AND SUPPLIES/REAGENTS

The following equipment is necessary to properly develop a groundwater monitoring well:

- Monitoring well key, socket wrench or speed wrench, socket set, padlock key, or other monitoring well-access equipment.
- Electric water-level meter long enough to reach the bottom of the monitoring well, calibrated to 0.01 foot.
- Two-inch-diameter (or appropriately sized) surge block.
- Monitoring well-purging equipment (e.g., silicone line, polyvinyl chloride pipe, plug, submersible or non-submersible pump, tubing, power supply, extension cord), as applicable.
- U.S. Department of Transportation-approved drum(s) for decontamination wastewater unless other water-handling arrangements have been made. Separate drums are needed for liquid and solid wastes (see Farallon SOP WM-01, Field Handling of Investigation-Derived Waste). Liquid wastes should not be added to drums containing solid wastes.
- Materials necessary to provide required documentation (e.g., Field Report form, Monitoring Well Construction Data form, and Waste Inventory Tracking Sheet).
- Personal protective equipment as described in the site-specific Health and Safety Plan.
- Decontamination equipment as specified in Farallon SOP EQ-01, Equipment Decontamination Procedures.

DECONTAMINATION

Before arrival at the site, upon relocation at the site, and upon demobilization from the site, decontaminate equipment that will come into contact with groundwater, in accordance with SOP EQ-01, Equipment Decontamination Procedures.

PROCEDURES

Follow the instructions below for each monitoring well:

- Don appropriate personal protective equipment as described in the site-specific Health and Safety Plan.
- Brush away soil and vegetation, and pump standing water away from the monitoring well opening.
- Open the monitoring well cap.
- Measure the depth to water and the total depth of the monitoring well to the nearest 0.01 foot using a decontaminated water-level meter in accordance with Farallon SOP GW-03, Groundwater Level Measurements in Monitoring Wells. Record the measurements on the Monitoring Well Construction Data form.
- Calculate the unit purge volume using the formula and the input values from the table below:

$$V = [X(monitoring\ well\ depth - water\ level)] + [Y(monitoring\ well\ depth - bottom\ of\ seal\ or\ water\ level, whichever\ is\ lowest\ in\ depth)]$$

Where:
V = monitoring well volume, including annular space
X = internal casing volume per unit length (gallons per linear foot)
Y = annular volume per unit length (gallons per linear foot)

Borehole Diameter (inches)	Casing Diameter (inches)	Volume$_{casing}$ (X) (gallons per linear foot)	Volume$_{annulus}$ (Y) (gallons per linear foot)
7	2	0.17	0.68
8	2	0.17	0.98
10	4	0.65	1.34
12	4	0.65	2.07
12	6	1.47	1.70
14	8	2.61	1.98

Development Procedures – Existing and New Monitoring Wells

Existing wells in a monitoring well network may require redevelopment if an excessive amount of fines are present in the monitoring well casing that could interfere with stabilization of water-quality parameters or collection of representative water-quality samples.

The instructions below are to be followed for development of existing and new monitoring wells:

For existing monitoring wells only:

- Remove the pump and/or any dedicated tubing from the monitoring well.

For existing and new monitoring wells:

- Attach one length of twine to the decontaminated surge block (or use a drill rig or tripod) and lower the surge block to within 0.25 foot of the bottom of the monitoring well.
- Surge the monitoring well by vigorously moving the surge block up and down from 0.25 foot from the bottom of the monitoring well to 1 foot above the top of the screened interval for a minimum of 5 minutes to create a surging action across the screened interval, which will bring finer-grained material into suspension. Move the surge block up and down in 3-foot sections until the entire monitoring well screen length has been surged. Record on the Monitoring Well Construction Data form the number of times the surge block is raised and lowered, and total surge time.
- Remove the surge block.
- If a submersible pump is to be used for monitoring well development, gently lower the pump into the monitoring well to within 1 foot of the bottom of the screened interval. If a non-submersible pump is to be used, lower the tubing to within 1 foot of the bottom of the screened interval.
- Begin purging the monitoring well at a rate sufficient to remove fines without pumping the monitoring well dry. Record on the Monitoring Well Construction Data form the volume of water pumped from the monitoring well.
- Surge and pump the monitoring well, including saturated annular space, a minimum of three and a maximum of five monitoring well volumes. If the monitoring well runs dry, let the monitoring well recharge. Then commence purging until a minimum of three monitoring well volumes have been purged. If this event is the first time the monitoring well has been developed and water was added during the drilling process, remove the volume of water introduced during drilling and monitoring well construction. Purging has been completed when *one* of the following has occurred:
    - The minimum purge volume has been removed; OR
    - Five purge volumes and the drilling process water volume have been removed.
- Measure the total depth of the monitoring well after development, and record on the Monitoring Well Construction Data form the total volume of water pumped from the monitoring well.
- Record on the Monitoring Well Construction Data form a description of the suspended particle content, and additional information such as unique odor or water color.

- Containerize the purge water in a U.S. Department of Transportation-approved drum(s) unless other water-handling arrangements have been made. Separate drums are needed for liquid and solid wastes (refer to Farallon SOP WM-01, Field-Handling of Investigation-Derived Waste). Liquid wastes should not be added to drums containing solid wastes.
- Upon completion of monitoring well development, properly seal, secure, and label the drums in accordance with Farallon SOP WM-01, , Field-Handling of Investigation-Derived Waste. Record the number and contents of the drums on a Waste Inventory Tracking Sheet. At a minimum, the drum label(s) should include:
    - Boring/monitoring well ID.
    - Facility name.
    - Drum contents.
    - Date.
    - Drum number.
- Close the monitoring well and record any monitoring well-integrity concerns on the Field Report form and the Monitoring Well Construction Data form.
- Decontaminate all equipment in accordance with Farallon SOP EQ-01, Equipment Decontamination Procedures.

DOCUMENTATION

Document monitoring well development activities on the Monitoring Well Construction Data form. Record the number and contents of the drums on a Waste Inventory Tracking Sheet.

REFERENCE

U.S. Environmental Protection Agency. 1991. *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.* Document No. 160014-891034. March.

STANDARD OPERATING PROCEDURE GW-03

GROUNDWATER LEVEL MEASUREMENT IN MONITORING WELLS

PURPOSE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide field personnel with the methodology for measuring and documenting the depth to groundwater in monitoring wells. The step-by-step guidelines provided in this SOP are to be followed by the field crew to ensure consistent and representative measurements of depth to groundwater in monitoring wells. When multiple wells are present at a site, all water-level measurements typically are taken as quickly as possible to aid in the creation of potentiometric surface maps that are representative of a “single” point in time.

EQUIPMENT AND SUPPLIES/REAGENTS

The following equipment is necessary to properly measure the depth to groundwater in monitoring wells:

- Monitoring well key, hand drill, socket set, Allen wrench, speed handle, padlock key, or other monitoring well-access equipment specific to the monitoring well monument cover plate.
- Electronic water-level meter (Solinst or equivalent) narrow enough to fit in the monitoring well, calibrated to 0.01 foot, with sufficient line to reach the bottom of the monitoring well.
- Oil-water interface probe, if light nonaqueous-phase liquid (LNAPL) is known or suspected to be present.
- Disposable bailer if LNAPL is known or suspected to be present, and the Project Manager requests that LNAPL be bailed from the well.
- Tape measure.
- Materials necessary to provide required documentation, including Groundwater Level Measurement Summary Forms and Field Report forms.
- Personal protective equipment as described in the site-specific Health and Safety Plan.
- Decontamination equipment as specified in Farallon SOP EQ-01, Equipment Decontamination Procedures.

DECONTAMINATION

Before arrival at the site, upon relocation at the site, and upon demobilization from the site, decontaminate equipment that will come into contact with groundwater, in accordance with Farallon SOP EQ-01, Equipment Decontamination Procedures.

PROCEDURES

Follow the instructions below for measuring water levels at each monitoring well:

- Don appropriate personal protective equipment as described in the site-specific Health and Safety Plan.
- Check the operation of the water-level meter by turning on the indicator switch and pressing the test button.
- Remove soil or vegetation from the monitoring well site.
- Open the monitoring well-head enclosure, and use a bilge pump or cup to remove standing water inside the monitoring well monument before opening the monitoring well cap. Dispose of standing water to the ground surface.
- Open the monitoring well cap.
- Monitor air quality at the monitoring well-head if volatile contaminants are suspected to be present, or if it is unknown whether volatile contaminants are present.
- Repeat above procedure until all monitoring wells are open.
- Allow the water level to equilibrate with ambient atmospheric pressure for approximately 15 minutes before measuring.
- Before taking any measurements, carefully measure the length of the sonde to the nearest 0.01 foot. The additional 2 to 3 inches from the zero point of the sonde to the tip of the sonde **must be discounted** for **all** total depth measurements.
- Measure and record the depth to water using a water-level meter that has been decontaminated in accordance with Farallon SOP EQ-01, Equipment Decontamination Procedures. With the water-level meter turned on to a medium level of sensitivity, slowly lower the meter into the monitoring well casing until it reaches the groundwater table. The probe will beep when it reaches the interface of the groundwater table (when the electronic circuit is first completed). Stop lowering the probe, hold the graduated water-level cable to the notch or mark on the northern side of the top of the monitoring well casing, and note the length measurement. Repeat this process to collect a second water-level measurement. If the two readings differ by more than 0.01 foot, repeat the measurements until the readings stabilize. Repeat the process until three consecutive stabilized readings have been measured. Record the water-level measurement **only** in relation to the probe being lowered into the monitoring well, *not* as it is raised out of the monitoring well. If you cannot see the top of the monitoring well casing when the water level beeps, grasp the tape with your thumb and index finger exactly at the measuring point corresponding with the notch or mark at the top of the monitoring well casing. Slowly pull the cable out of the monitoring well and read the measurement. Repeat until readings stabilize.
- Remove the cable from the monitoring well, and record the stabilized depth-to-water measurement on the Groundwater Level Measurement Summary Form to the nearest 0.01 foot.

- Measure the total monitoring well depth. **NOTE:** If groundwater samples are to be collected, measure the total monitoring well depth **after** all groundwater samples have been collected, to avoid resuspension of settled solids in the monitoring well, impacting the samples. If the monitoring well does not have a dedicated pump, lower the water-level indicator probe to the bottom of the monitoring well to measure the total depth of the monitoring well. Gently bounce the probe on the monitoring well bottom, and pull the slack in the cord to read the total monitoring well depth. Repeat three times to ensure that the monitoring well depth measurement is reproducible, and is representative of the true depth. Note on the Groundwater Level Measurement Summary Form whether the bottom of the monitoring well is hard or soft.
- Remove the cable from the monitoring well, and record the monitoring well depth measurement on the Groundwater Level Measurement Summary Form to the nearest 0.01 foot.
- Decontaminate the water-level meter in accordance with Farallon SOP EQ-01, Equipment Decontamination Procedures.
- If the presence of LNAPL is suspected or if site conditions are unknown, check for the presence of LNAPL by one of two methods:
    - Use of a bailer: Use a new 3-foot-long disposable bailer attached to a nylon rope. Slowly lower the bailer until the bottom of the bailer is approximately 2 feet below the water surface. Slowly retrieve the bailer, and measure the product thickness using a tape measure. Record the information on the Groundwater Level Measurement Summary Form. Dispose of the bailer and product or wastewater in accordance with Farallon SOP WM-01, Field Handling of Investigation-Derived Waste.
    - Use of an oil-water interface probe: Decontaminate the oil-water interface probe in accordance with Farallon SOP EQ-01, Equipment Decontamination Procedures. With the oil-water interface probe meter turned on to a medium level of sensitivity, slowly lower the probe into the monitoring well casing until it reaches the top of the LNAPL. The probe will have a steady beep when it reaches the interface of the LNAPL (when the electronic circuit is first completed). Stop lowering the probe, hold the graduated oil-water interface cable to the notch or mark on the northern side of the top of the monitoring well casing, and note the length measurement. Repeat this process to collect a second LNAPL measurement. If the two readings differ by more than 0.01 foot, repeat the measurements until the readings stabilize. Repeat the process until three consecutive stabilized readings have been measured. Record the depth to LNAPL measurement **only** in relation to the probe being lowered into the monitoring well, *not* as it is raised out of the monitoring well. If you cannot see the top of the monitoring well casing when the oil-water interface probe beeps, grasp the tape with your thumb and index finger exactly at the measuring point corresponding with the notch or mark at the top of the monitoring well casing. Slowly pull the cable out of the monitoring well and read the

measurement. Repeat until readings stabilize. Once the depth to LNAPL has been recorded, collect the water-level measurement as described above using the oil-water interface probe. Once the depth to LNAPL and the depth to the groundwater table have been determined, subtract the depth to LNAPL from the depth to the groundwater table to determine LNAPL thickness.

- Close the monitoring well as appropriate based on monitoring well-head construction. Record any concerns about monitoring well integrity on the Groundwater Level Measurement Summary Form and on the Field Report form.

DOCUMENTATION

Document monitoring well water-level measurements on the Groundwater Level Measurement Summary Form. Document any additional information on the Field Report form.

REFERENCE

U.S. Environmental Protection Agency. 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance.* Office of Solid Waste. November.

STANDARD OPERATING PROCEDURE GW-04

LOW-FLOW GROUNDWATER SAMPLING PROCEDURES

PURPOSE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide field personnel with the methodology for collecting and documenting groundwater samples from monitoring wells using U.S. Environmental Protection Agency (EPA) low-flow groundwater sampling procedures (EPA 1996, 2017) for chemical analysis to ensure consistent and representative sampling. The step-by-step guidelines provided in this SOP are to be followed by the field crew conducting groundwater sampling.

EQUIPMENT AND SUPPLIES/REAGENTS

The following equipment is necessary to properly purge and sample a monitoring well:

- Monitoring well key, hand drill, socket set, padlock key, or other monitoring well-access equipment.
- Electronic water-level meter long enough to reach the bottom of the monitoring well, calibrated to 0.01 foot. Alternatively, to measure for light nonaqueous-phase liquid thickness in addition to groundwater, use an oil-water interface probe.
- Monitoring well purging and sampling equipment:
    - Submersible pump (bladder or Grundfos): the pump, control box, and power source (typically a portable generator or a 12-volt battery); or
    - Peristaltic pump: the pump with pump head, silicone tubing, tubing connectors (as needed), and power source (typically a 12-volt battery).
- Sample tubing of project- and site-specific type and length.
- Bailer, if a pump is not used, or if light nonaqueous-phase liquid requires removal.
- Sufficient number of 55-gallon drums, including lids, gaskets, and fasteners, to contain all purge water, unless other water-handling arrangements have been made.
- Flow-through water-quality meter(s) to measure temperature, pH, specific conductivity, dissolved oxygen, oxidation-reduction potential (ORP), and turbidity.
- Air-space monitoring equipment if required (photoionization detector or multi-gas meter).
- Decontamination equipment and supplies (e.g., buckets, scrub brushes, deionized or distilled water, potable water, Liquinox detergent).
- Materials necessary to provide required documentation, (e.g., sample labels, Field Report forms, Low-Flow Well Purging and Sampling Data form, Chain of Custody form, Waste Inventory Tracking Sheet).

- Sample containers with the chemical preservatives appropriate for the samples, as described in project-specific plans, or as required by the analytical laboratory at a minimum.
- Personal protective equipment as described in the site-specific Health and Safety Plan (HASP).
- Sampling-support equipment (e.g., sample coolers, ice, bubble wrap, clear tape, duct tape, resealable plastic bags, garbage bags, paper towels, distilled water, nitrile gloves, shipping supplies).
- U.S. Department of Transportation-approved drum(s) for purge water, unless other water-handling arrangements have been made. Separate drums are needed for liquid and solid wastes (Refer to Farallon SOP WM-01, Field Handling of Investigation-Derived Waste). Liquid wastes should not be added to drums containing solid wastes.

DECONTAMINATION

Before arrival at the site, upon relocation at the site, and upon demobilization from the site, decontaminate reusable equipment that will come into contact with the monitoring well(s) and/or be used to acquire samples, in accordance with Farallon SOP EQ-01, Equipment Decontamination Procedures.

PROCEDURES FOR LOW-FLOW GROUNDWATER SAMPLING

Low-flow groundwater sampling procedures have been developed for monitoring wells with a dedicated pump (dedicated monitoring wells) and for monitoring wells without a dedicated pump (non-dedicated monitoring wells). Setup, purging, sample collection, and post-sampling procedures for dedicated and non-dedicated monitoring wells are presented below.

Setup

Setup procedures differ slightly for dedicated versus non-dedicated monitoring wells. Follow the instructions below for the monitoring wells as indicated:

- Calibrate the water-quality meter for the field parameters specified in the project-specific plans. At a minimum, collect temperature, pH, and specific conductivity during purging and prior to sampling. Record on the Field Report form the equipment calibration and maintenance performed. Decontaminate the water-quality meter between monitoring wells by rinsing with distilled or deionized water. Manage the rinsate water used in collecting these measurements in the same manner as for purge water, as defined in project-specific plans, and in accordance with Farallon SOP WM-01, Field Handling of Investigation-Derived Waste.
- Don appropriate personal protective equipment as described in the site-specific HASP, including nitrile gloves for activities that might involve contact with groundwater or equipment. Change gloves between each monitoring well at a minimum, or when

contaminants could be introduced into a monitoring well or onto decontaminated equipment.

- Brush away soil and/or vegetation, and pump standing water away from the monitoring well opening. If necessary, place a plastic drop cloth around the monitoring well-head to prevent sampling equipment from contacting the ground surface.
- Inspect the condition of the monitoring well (e.g., locked monitoring well cap, tightness of monitoring well cap, well-marked measuring point on casing, disturbance of surface casing, straightness of monitoring well casing, condition of concrete pad). Indicate the monitoring well condition on the Low-Flow Well Purging and Sampling Data form.
- Open the monitoring well cap. If the site-specific HASP identifies organic compounds as potential contaminants of concern, screen the monitoring well headspace and the breathing zone headspace (if specified in the HASP) for organic vapors using the appropriate field monitoring instrument (e.g., photoionization detector, multi-gas meter).
- Measure and record the depth to water using a decontaminated water-level meter in accordance with Farallon SOP GW-03, Groundwater Level Measurements in Monitoring Wells.
- If light nonaqueous-phase liquid may be present (see site-specific plans), obtain a sample from the monitoring well using a bailer (if a dedicated pump is not in use), as specified in Farallon SOP GW-03, Groundwater Level Measurements in Monitoring Wells. Alternatively, measure free-floating product thickness using an oil-water interface probe.
- Calculate the monitoring well casing volume as follows:

  Monitoring well casing volume in gallons = $(\pi * r^2) * h$(7.48 gallons/cubic foot)

  Where:

  r = radius of the inside of the monitoring well casing in feet

  h = length of the water column in the monitoring well casing (i.e., the depth to the bottom of the monitoring well minus the depth to water, both measured from the mark at the top of the monitoring well casing), in feet

- **For monitoring wells with dedicated pumps and tubing**: Set up a flow-through cell in preparation for purging. Connect dedicated tubing from the monitoring well to the flow-through cell. Set tubing and/or pump to the correct water depth in accordance with the constituents being sampled for, as described in project-specific plans. **DO NOT IMMERSE water-quality probes or meters in purge water containing nonaqueous-phase liquids, which could damage the probes.** Turn the pump controller to its lowest setting, set the memory in the flow-through cell to record readings every 3 minutes, and turn on the pump. Begin purging slowly (i.e., less than 500 milliliters per minute [ml/min]) to prevent drawing down the water table.

- **For monitoring wells with non-dedicated pumps**: Connect dedicated silicon tubing to the peristaltic pump. Place the tubing intake at the midpoint of the screen, or at the depth pre-determined in the project-specific plans. If using a bladder pump, insert the bladder pump and attach the dedicated polyethylene tubing so the pump intake is at the approximate midpoint of the screened interval, or set the pump intake to the depth pre-determined in the project-specific plans.

Purging Procedures

The purging instructions below are to be followed for dedicated and non-dedicated monitoring wells:

- Begin purging, and initiate water-quality testing for temperature, pH, specific conductivity, dissolved oxygen, ORP, and turbidity. Purge monitoring wells using a peristaltic or bladder pump, and dedicated polyethylene and silicon tubing. Record water-quality parameters every 3 minutes.
- Record water levels every 3 minutes, as possible. It is imperative that the water level not drop by more than 0.33 foot during the low-flow purging process. If the water level drops more than 0.33 foot during purging, reduce the flow rate on the pump. Recommended purge rates generally are less than 500 ml/min. Actual purge rates will vary based on aquifer material and monitoring well construction. If the water level continues to drop by more than 0.33 foot during the low-flow purging at a rate less than 100 ml/min, notify and consult with the Project Manager on how to proceed.
- Record flow rates every 3 minutes. Ensure that the flow rate does not exceed 500 ml/min during the low-flow purging process.

Purging Requirements

Continue purging at a constant rate until the water-quality parameters have stabilized for three successive measurements according to the stability criteria provided in the table below. Before samples can be collected from each monitoring well, the groundwater must stabilize according to following criteria:

- Drawdown is no greater than 0.33 foot for low-flow sampling, and
- The water-quality parameters should stabilize according to the criteria specified below:

Water-Quality Parameter	Stability Criterion
Turbidity (if required)	10% for values greater than 5 NTU or three consecutive values < 5 NTU
Dissolved oxygen	10% for values greater than 0.5 mg/l, or three consecutive values <0.5 mg/l
Specific conductivity	3%
Oxidation-reduction potential	+/- 10 millivolts
pH	+/- 0.1 unit
Temperature	3%

Notes:
mg/l = milligrams per liter
NTU = nephelometric turbidity unit

Although under some circumstances, a monitoring well may not stabilize according to the above criteria, the monitoring well can still be sampled if the monitoring well does not meet stability criteria due to the instrument accuracy, or the water level drops below the minimum value using low-flow sampling procedures. For example, a fluctuation in ORP greater than 10 millivolts does not meet the stability criterion. However, because the accuracy range of the ORP instrument is ±20 millivolt, the stability criterion would be considered satisfied and within the range of instrument accuracy. Consult the manual for the instrument to determine the accuracy range.

Also, if the water level drops below the minimum value using low-flow sampling procedures (i.e., the pump intake, or the top of the screen if the aquifer is confined) during purging and one monitoring well volume of groundwater has been removed from the monitoring well, or the monitoring well runs dry during the purging procedure, sample the monitoring well as soon as the water level has recovered sufficiently to allow collection of the volume of groundwater necessary for all samples. Use the following equation to determine the minimum volume of groundwater to remove before sampling:

Minimum purge volume = 2*[500 milliliters + M*(length of tubing in feet)]

Where: M = volume (in milliliters) contained in a 1-foot length of tubing

The value of M is provided below for the inner diameters of tubing listed:

Inner Diameter (inches)	M (milliliters)
0.125	2.4
0.25	9.7
0.5	39

Record on the Field Report form and the Low-Flow Well Purging and Sampling Data form if any monitoring well did not meet the drawdown and stability criteria and explain the rationale for sampling the monitoring well at the time it was sampled. If stability criteria have not been achieved following completion of all entries in the Low-Flow Well Purging and Sampling Data form, notify and consult with the Project Manager whether to continue purging until stability criteria have been achieved or begin sample collection.

Sample Collection

During low-flow sampling, do not stop pumping once the purging requirements have been met. Turn down the flow rate on the pump so the water flow is minimal, but maintain sufficient pressure in the system to prevent water from the tubing or flow-through cell from flowing back into the monitoring well. Disconnect the pump discharge hose from the flow-through cell, or cut the tubing just before the connection to the flow-through cell. It is imperative not to lower the water table or disturb the water column. Fill pre-cleaned laboratory-supplied sample containers directly from the pump discharge tube into the proper sample container, and fill to capacity. Place a bucket beneath the sampling tube to catch any unsampled water between filling the sample jars. When collecting groundwater samples for multiple analyses, collect the samples in the order listed below per the EPA (1992) groundwater sampling technical guidance:

- Volatile organic compounds (VOCs);
- Dissolved gases and total organic carbon;
- Semivolatile organic compounds;
- Metals and cyanide;
- Major water quality cations and anions;
- Radionuclides; and
- Dissolved (filtered) inorganics (if required).

When collecting samples for VOCs, adjust the flow rate as low as possible without introducing air bubbles into the system. When filling the VOC containers, hold the cap in hand to minimize contamination, and direct the flow from the pump discharge tubing down the side of the sample container to minimize aeration. Fill all VOC sample containers to the top, ensuring a positive meniscus when the cap is screwed down on the container. Tap the filled VOC container, and invert several times to ensure no air bubbles are present in the sample container. If an air bubble is present, the VOC sample must be recollected using a fresh VOC sample container. If sampling for other analytes, the flow rate may be increased.

If dissolved inorganics are required, attach a new disposable 0.45-micrometer filter cartridge to the discharge line. Collect filtered samples last. Pre-rinse the disposable filter cartridges by running a minimum of 0.25 gallon of groundwater through them (collecting the groundwater into a waste bucket) prior to collecting the samples directly into the sample container. Alternate field filtration methods may be specified in the project-specific plans. Remove the pump and/or tubing from the monitoring well.

Post-Sampling

- Record the depth to water of well to determine whether the water level changed from the original reading.
- Close and lock the monitoring well or tap and record any monitoring well integrity concerns on the Field Report form and the Low-Flow Well Purging and Sampling Data form.
- Transfer purge, wash, and rinse water into a U.S. Department of Transportation-approved drum(s) and label. Separate drums are needed for liquid and solid wastes, in accordance with SOP WM-01, Field Handling of Investigation-Derived Waste. Do not add liquid wastes to drums containing solid wastes.

PROCEDURES FOR RECONNAISSANCE GROUNDWATER SAMPLING

Collect reconnaissance groundwater samples from borings using direct-push or hollow-stem auger drilling methods and 0.75- or 2-inch-inside-diameter temporary monitoring well casing and 0.010-inch slotted screen. In some cases, alternate well casing diameters or screen slot sizes may be appropriate based on the drilling equipment or project-specific requirements. Follow the instructions below for reconnaissance groundwater sample collection:

- Withdraw the drill casing when the desired sampling depth has been reached, so the temporary monitoring well screen is exposed to water-bearing material.
- Insert disposable polyethylene tubing to the approximate midpoint of the temporary monitoring well screen. Attach the appropriate length of pre-cleaned disposable silicon tubing from the polyethylene tubing to connect with the peristaltic or bladder pump.
- Set up the peristaltic or bladder pump in preparation for purging. Turn the pump to its lowest setting and turn on the pump. Begin purging slowly to prevent drawing down the water table.
- Purge each temporary monitoring well point using a peristaltic or bladder pump until visual turbidity is as low as possible, or until the temporary monitoring well is purged dry of water.
- Purge a minimum of 1 to 2 liters before sample collection, if possible. If the temporary monitoring well is completely dewatered during purging, collect samples when sufficient recharge has occurred to allow filling of the sample containers.
- Slow the pumping rate to less than 500 ml/min to reduce the potential for volatilization of chemicals during sample collection.
- Collect the sample as described above.
- If insufficient groundwater is available to collect a sample using a peristaltic or bladder pump (i.e., the boring pumps dry or cannot maintain a sufficient flow of less than 100 ml/min) or if the depth to groundwater exceeds the maximum practicable limit for sampling using a peristaltic or bladder pump, use a disposable polyethylene bailer lowered

into the monitoring well screen to collect a groundwater sample from the screened interval, if possible.

DOCUMENTATION

Document the monitoring well purging and sampling activities on the Low-Flow Well Purging and Sampling Data form and on the Field Report form. Track samples on a Chain of Custody form. Track waste generated during groundwater sampling on a Waste Inventory Tracking Sheet.

REFERENCES

U.S. Environmental Protection Agency. 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance.* Office of Solid Waste. November.

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

———. 2017. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.* EQASOP-GW4. September.

STANDARD OPERATING PROCEDURE SL-01

SOIL CORE SAMPLING

PURPOSE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide field personnel with the methodology for collecting and documenting soil core samples using a hollow-stem-auger drill rig, a direct-push drill rig, and a sonic drill rig. All drilling operations will be conducted by a licensed drilling subcontractor in accordance with subcontractor SOPs. This SOP presents the procedures that will be performed by Farallon field staff once the soil core has been collected by the drilling subcontractor. The step-by-step guidelines provided in this SOP are to be followed by the field crew conducting subsurface soil sampling.

EQUIPMENT AND SUPPLIES/REAGENTS

The following equipment is necessary to properly collect soil samples from borings:

- Personal protective equipment (PPE) as described in the site-specific Health and Safety Plan.
- Differential global positioning system, if required in project-specific plans. Discuss the methodology for recording the location of the sample point with the Project Manager before conducting the field work.
- Photoionization detector (PID) to monitor and record soil headspace readings.
- Applicable soil sampling equipment, including:
    - Stainless steel hand auger.
    - Wooden or steel stakes to stabilize cores on table while sampling.
    - Folding table.
    - Utility knife.
    - Stainless steel spoons or scoops.
    - Six-mil plastic sheeting.
    - Resealable plastic bags.
    - Duct tape.
    - Aluminum foil.
    - Tape measure.
    - Five-gallon buckets, and scrub brushes.
    - Alconox phosphate-free cleanser.
    - Laboratory-provided certified pre-cleaned sample containers.

  - Soil sample plunger and syringes for sampling volatile organic compounds (VOCs) using U.S. Environmental Protection Agency (EPA) Method 5035A.
- Materials necessary to provide required documentation, including:
  - Camera.
  - White board and dry-erase markers, if specified in project-specific plan.
  - Sample labels.
  - Field Report forms.
  - Boring Log forms.
  - Chain of Custody forms.
  - Chain-of-custody seals for the sample cooler(s).
- U.S. Department of Transportation-approved drum(s) for decontamination wastewater and excess soil cuttings. Separate drums are needed for liquid and solid wastes (refer to Farallon SOP WM-01, Field Handling of Investigation-Derived Waste). Liquid wastes should not be added to drums containing solid wastes.
- Decontamination equipment as specified in Farallon SOP EQ-01, Equipment Decontamination Procedures.
- Sampling support equipment (e.g., sample coolers, ice, bubble wrap, clear packing tape, heavy resealable plastic bags, razor knives, garbage bags, paper towels, distilled water, nitrile gloves).

DECONTAMINATION

Reusable equipment that will come into contact with soil boring samples or will be used to acquire soil samples is to be decontaminated before arrival at the site, between soil samples collected, upon relocation at the site, and upon demobilization from the site, in accordance with Farallon SOP EQ-01, Equipment Decontamination Procedures.

PROCEDURES

Prior to drilling, all underground utilities must be located, and cleared with an air-knife or other method approved by the Farallon Health and Safety Coordinator.

Collect soil samples from areas known or suspected to have the lowest concentrations of constituents of concern first, with areas of higher concentrations of constituents of concern sampled last, unless the Project Manager indicates a different project-specific sampling protocol. The procedures listed below may be modified, with approval from the field team lead and the Project Manager. Any modifications must be identified in the project-specific sampling plans or, at a minimum, details must be noted on the Field Report form.

Soil core collection methods differ for hollow-stem-auger, direct-push, and sonic drilling techniques, each summarized below:

- Hollow-stem-auger: Collect soil core samples using a standard 18-inch-length (6-inch waste barrel) Dames & Moore split-spoon sampler with a 2.5-inch inner diameter that can be used with or without brass or stainless steel liners.
- Direct-push: Collect soil core samples using 5-foot macrocore samplers with acetate sample liners.
- Sonic: Collect soil core samples using a standard 6-inch-diameter stainless steel sampling rod. Use a 2.5-, 5.0-, or 10-foot polyethylene liner inside the sampling rod for soil sample collection.

Record the specific drilling and soil sampling equipment used on the Boring Log form and on the Field Report form.

Setup

The instructions below are to be followed at each boring site:

- Don appropriate PPE as described in the site-specific Health and Safety Plan.
- Ensure that each borehole has been cleared to a minimum depth of 5 feet below ground surface using an air knife, per the Farallon health and safety policy.
- Set up a temporary sampling table adjacent to the drill rig to log and collect soil samples from the soil cores as they are recovered during drilling. During sunny conditions, consider using a portable canopy for protection from the sun. Lay plastic sheeting over the table to keep the surface clean and to prevent potential cross-contamination between borings and soil samples. Designate clean areas for decontaminated sampling equipment and laboratory-provided certified pre-cleaned soil sample containers.
- Set up 5-gallon buckets for decontaminating soil sampling equipment between samples. These decontamination buckets are separate from the buckets provided by the drillers for their split spoons and core barrels. (Refer to Farallon SOP EQ-01, Equipment Decontamination Procedures.)
- Calibrate the PID to monitor headspace for selected soil core samples in accordance with the equipment manual.

Sample Collection and Processing

The instructions listed below are to be followed for collecting samples using lined and unlined split-spoon and tube samplers:

- Don a new pair of nitrile sampling gloves for each individual soil sample collected, and prior to decontaminating sampling equipment to avoid potential cross-contamination.

- Ensure that the drillers have properly decontaminated all drill shoes and caps prior to initiating drilling operations. Drill shoes and caps must be decontaminated between sampling intervals and stations in accordance with Farallon SOP EQ-01, Equipment Decontamination Procedures. Replace dirty or ineffective decontamination water as needed throughout the workday.
- Ensure that the drillers position the sampling rig over the sample station and remove any surface material or debris that would interfere with sampling. Note on the Field Report form any surface material removed.
- Note on the Field Report form and the Boring Log forms any difficulties encountered during drilling operations. Include the number of blow counts (if applicable) or any resistance encountered during drilling operations.
- Place the core tube, core liner, or split spoon on a new piece of aluminum foil on the sample logging/processing table. If necessary, use wood or metal stakes as shims to stabilize the tube, liner, or split spoon on the sample logging/processing table.
- If a core liner is used, split the liner open with a decontaminated utility knife, taking care not to penetrate the soil in the liner with the blade or knife.
- Briefly examine the soil sample visually for obvious signs of contamination, and take PID readings.
- Take care to:
    - **Not** collect soil in contact with the sidewalls of the sampler or liner.
    - **Always** use decontaminated stainless-steel spoons or scoops to handle the soil within a given sample interval.
    - **Always** don a new pair of nitrile gloves before processing each sample interval in each soil core to prevent cross-contamination in the soil core.
- When sampling for VOCs, collect them as soon as possible after opening the core tube, split spoon, or core liner. Use a decontaminated stainless steel spoon to collect the VOC samples with minimal disturbance to soil by placing a representative amount of soil from the length and depth of the desired sample interval directly into the laboratory-provided VOC sample container with no headspace, and seal it tightly. Follow the sample collection guidelines provided by the manufacturer or the analytical laboratory when using a plunger-type sampling device in accordance with EPA Method 5035A.
- Retain approximately 100 grams of the soil sample in a heavy resealable plastic bag or glass sample container, shake the sealed bag to volatilize the contaminants in the soil, and wait approximately 5 minutes before measuring for headspace analysis using the PID (Washington State Department of Ecology 2011). Insert the PID probe tip into a small opening in the top of the bag, and record the PID units on the Boring Log form. Reseal the bag after taking the headspace reading in case further assessment of the sample is needed. Do not puncture the resealable plastic bag to obtain headspace readings.

- If specified in the project-specific plans, photograph each section of the boring, including in the photograph notations on a white board documenting sample location identifier, date, orientation, depth, and site markers.
- Describe the soil samples in accordance with ASTM International Standard D-2488-00, *Standard Practice for Description and Identification of Soils*.
- Record on the Field Report form any deviations from the project-specified sampling procedures or from this SOP, or any obstacle encountered.
- Examine the remaining soil core sample for lithology using the Unified Soil Classification System, and record the lithology on the Boring Log form.
- Discard excess soil cuttings in a labeled waste drum or a soil bin in accordance with Farallon SOP WM-01, Field Handling of Investigation-Derived Waste. Do not add soil to a liquid waste drum.
- Backfill the borehole, as appropriate.
- Upon completion of sampling at a boring, measure the boring’s location to an on-site permanent datum, collect the location using the differential global positioning system, or have the sample location surveyed by a licensed surveyor.
- Decontaminate the soil sampling equipment, and don a new pair of sampling gloves before collecting each new soil sample.

DOCUMENTATION

Document the soil sampling activities on the Boring Log form, the Chain of Custody form, and the Field Report form.

REFERENCE

American Society for Testing Materials. 1989. *Standard Method for Penetration Test and Split-Barrel Sampling of Soils.* Method D-1586-11.

U.S. Environmental Protection Agency. 1987. *A Compendium of Superfund Field Operation Methods.* EPA Document No. 540-P-87-001. December 1.

Washington State Department of Ecology. 2011. *Guidance for Remediation of Petroleum Contaminated Sites.* Ecology Publication No. 10-09-057. Toxics Cleanup Program. September.

STANDARD OPERATING PROCEDURE SL-03

MULTI-INCREMENT SAMPLING METHODOLOGY APPLICATION

PURPOSE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide field staff with the methodology for using the multi-increment (MI) sampling approach to reduce the random fluctuations in the distribution of contaminants of potential concern that occur when discrete soil samples are collected. The benefit of the MI sampling approach is the much-lower variability and higher reproducibility of the data it generates compared with data generated by discrete sampling, resulting in greater confidence in the data for decision-making.

The MI sampling approach entails collection of a large number of small equal-volume discrete soil increments in a targeted Decision Unit (DU). The collected discrete soil increments are combined into a single sample that is representative of the DU, referred to as a bulk MI sample. The bulk MI sample typically is air-dried and sieved at the analytical laboratory to remove particles larger than 2 millimeters in diameter. The laboratory then prepares each individual sample aliquot for each type of analysis by subsampling the bulk MI sample, using MI methodology, to increase homogeneity and reduce measurement error.

This SOP details the sampling design for the MI approach for soil, and is applicable also to sediment sampling. Specific details regarding equipment and methods for soil and sediment sampling are available in the project-specific sampling plans and/or applicable SOPs. It is assumed that the MI sampling approach was selected as the most-appropriate method to meet project-specific data quality objectives.

The MI methodology can be used for non-volatile contaminant testing in surface and subsurface soils and sediments. Although this methodology can be used also for volatile contaminant testing in soil and sediments, close coordination with the analytical laboratory is needed to ensure that sample collection methods minimize loss of volatile compounds (typically achieved by transferring the increments directly into methanol or freezing individual increments).

This SOP relies on information provided in Sections 3 through 5 of the *Technical Guidance Manual for the Implementation of the Hawai'i State Contingency Plan* dated August 2016, prepared by the Hawai'i State Department of Health (HI TGM).

This SOP is generic in nature, and may be modified to meet the handling and analytical requirements of the contaminants of potential concern, and any constraints presented by site conditions or equipment limitations. Modifications to this SOP will be approved by the Project Manager, and documented in a site or field logbook. Modifications will be discussed also in reports summarizing field activities.

EQUIPMENT AND SUPPLIES

See applicable SOPs for collection of surface and/or subsurface soil or sediment samples. Care must be taken to ensure that the sampling equipment used can reliably and consistently collect the representative volume over the desired depth interval required for each incremental sample in the DUs. Additional equipment needed for MI sampling is listed below:

- A rigid measuring tape;
- A flexible measuring tape;
- Wooden stakes and/or rebar to mark DU boundaries;
- Color-coded marker flags, for soil sampling, to assist with increment spacing. A sufficient number of flags should be available to separately mark each increment for at least three DUs, using a different color for each DU; and
- Floatable rope, for sediment sampling, to assist with increment spacing.

DECONTAMINATION

Reusable equipment that will come into contact with soil or sediment samples will consist of inert materials, and is to be decontaminated in accordance with Farallon SOP EQ-01 upon arrival at the site, between DU sample depths collected, upon relocation to a new DU at the site, and upon demobilization from the site. Equipment decontamination is not required between incremental samples collected from the same depth interval in a given DU.

PROCEDURES

Decision Unit Determination

The HI TGM states, “A DU is a well-defined area of a site where a decision is to be made regarding the potential for contaminants to pose an environmental hazard.” The processes identified in Sections 3.2 and 3.4 of the HI TGM should be followed when determining the type, location, size, shape, and depth of each DU. The example DUs provided in Section 3.5 of the HI TGM should be reviewed when determining the design of project-specific DUs. Most importantly, a thorough understanding of the historical, current, and future use of the site is critical in determining the appropriate type, size, shape, and number of DUs for each project.

The boundaries of the DUs must be carefully measured, with key boundaries and corners of the DUs georeferenced or surveyed. Note that Differential Global Positioning System measurements can be 1 to 2 meters off, and the accuracy of the equipment used (e.g., ground-truthing against a surveyed stationary feature) must be documented.

Minimum Number of Increments and Locations in Decision Units

Incremental sampling locations within a DU must be collected in an unbiased and precise manner. Bias is avoided by collecting the increment samples in systematic random or stratified random locations throughout the DU. Precision is maintained by collecting an appropriate number of increment samples in a DU, and a sufficient and consistent volume of soil from each discrete location in a DU. Sample data are most reproducible when the increment locations in each DU are distributed at evenly spaced locations (systematic random), as shown on Figure 4-9 from the HI TGM, reproduced below:

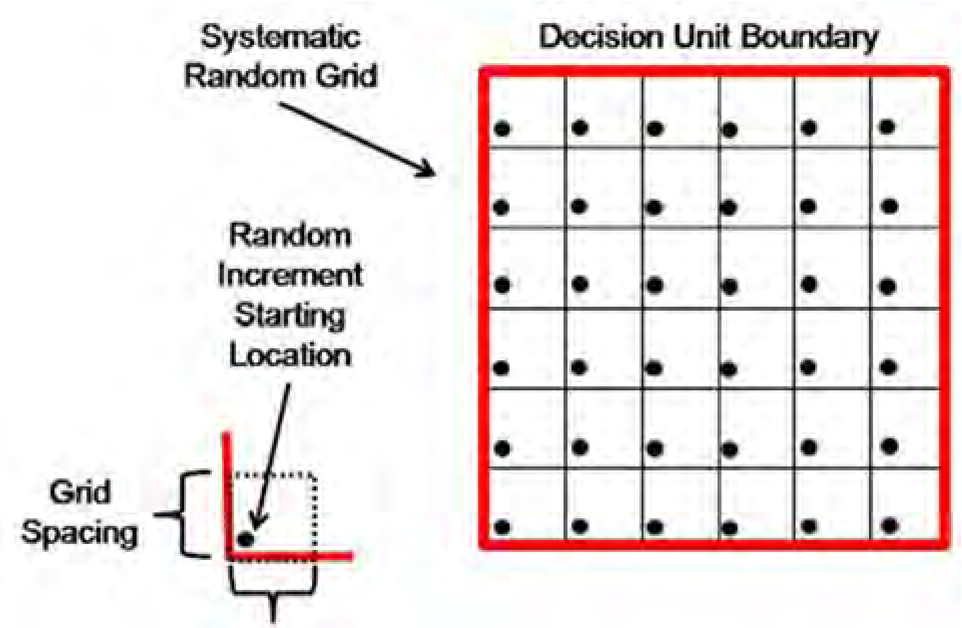


Figure 4-9 from HI TGM: Example Increment Collection Locations Based on a Systematic Random Grid Scheme

Grid spacing determined based on DU area and number of desired increments.
Initial increment location selected from random location; subsequent increments collected at uniform spacing within DU.

A minimum of 30 up to more than 75 increments per DU is recommended, depending on the type of release at the site. A minimum of 30 increments per DU is recommended for sites where releases are suspected to be relatively uniform, and small-scale variability (i.e., variability within an individual increment) is assumed to be relatively low (e.g., sites involving aerial fallout or liquids that release in a uniform manner). A minimum of 75 increments per DU is recommended for contaminants that do not release in a uniform manner (e.g., as in chips of paint, lead shot, munitions and explosives; some oil-based chemicals). A minimum of 50 increments per DU is recommended for all other release scenarios. Triplicate samples, described in the Field Quality Control section below, will help in evaluating whether the number of increments collected is representative of the DU, and whether the DU is of an appropriate size.

Increment spacing in the DU is calculated as the square root of the DU area divided by the targeted number of increments:

$$\textbf{\textit{Increment Spacing}} = \sqrt{\frac{DU\ Area}{\#\ Increments}}$$

Actual increment-collection locations in a DU are based on a random offset of the incremental spacing grid, with increments collected from the same relative location in each cell of the grid (see Figure 4-9 from the HI TGM). Increment spacing may need to be adjusted slightly (e.g., rounded to the nearest whole foot) to facilitate establishing the grid for DU sample collection.

Although increment spacing in each DU and increment-collection offsets must be documented in the field notes, individual increment locations do not need to be surveyed.

Increment Sample Mass

A bulk MI sample target mass of 1,000 to 2,500 grams is recommended for non-volatile contaminants of potential concern. The number of increments in a DU will determine the target mass to be collected from each individual increment to produce the bulk MI sample target mass of 1,000 to 2,500 grams. For example, a DU with 35 increments would require approximately 29 grams collected from each increment to meet the bulk MI sample target mass of 1,000 grams; and 71 grams collected from each increment to meet the bulk MI sample target mass of 2,500 grams. If the substrate contains vegetation such as root material, or sticks, rocks, and/or debris, the target mass for the DU may need to be increased to account for the loss of volume resulting from removal of non-soil material from the DU sample during processing at the analytical laboratory. Similarly, the target mass for the DU may need to be increased if the substrate contains a high percentage of moisture. **It is important to coordinate selection of the bulk MI sample target mass to be collected with the analytical laboratory, and to inform the laboratory of the physical characteristics of the samples (e.g., the presence of vegetation, large rocks, debris; estimated moisture content).**

It is easiest to collect the increment sample on a volume rather than weight basis, due to the logistical challenges associated with weighing samples in the field. The target volume for each increment is dependent on the type of sampling devise used, and the ease with which a consistent increment volume can be obtained from the sampling devise. For example, using a 4-inch-long 2-inch-diameter coring device to collect surface soil would yield approximately 12.6 cubic inches of soil per increment, totaling approximately 378 cubic inches (6.2 liters) of soil for a 30-increment DU. This amount of soil would be difficult logistically for the laboratory to process. However, using one-quarter of the soil-core length (approximately 3.2 cubic inches of soil) to represent each increment would yield a total volume of approximately 96 cubic inches (1.5 liters) for the bulk MI sample for a 30-increment DU.

A bulk MI sample target mass of 1,000 grams of soil is not practical for samples to be tested for volatile contaminants, due to the large amount of methanol that would be required, and the associated shipping restraints for methanol. A bulk MI sample target mass of 300 grams of soil with a 1:1 soil to methanol ratio would be more practical for volatile contaminants.

Sample Increment Collection

It is important to ensure that vegetation and debris have been cleared to the extent feasible prior to sampling in vegetated areas. Clearing vegetation and debris prior to sampling is a relatively minor cost to the project compared to the additional time required to maneuver around and clear individual increment sampling areas by hand. Care must be taken when removing vegetation and/or debris to ensure that targeted sampling depths are not disturbed. If subsurface sampling will be conducted, utility locations must be cleared before sampling is initiated.

Various methods for collecting individual soil and sediment increments are described in detail in Section 5 of the HI TGM. Sample collection methods for surface and subsurface MI samples generally are much the same as those used for collection of discrete samples of the same matrix. Differences in collection methods for increment samples are identified below:

- A smaller and consistent volume of sample is needed from each increment in a DU.
- Homogenization of samples in the field is not necessary, as this step is conducted by the analytical laboratory.
- One composite sample for each DU is submitted to the analytical laboratory.
- Decontamination of sample collection equipment between individual increments in a given DU is not necessary.
- Triplicate samples are recommended for at least 1 of every 10 DUs collected.

Refer to the applicable Farallon field SOP for soil or sediment sampling for collection of individual increments in the DUs. Section 5 of the HI TGM provides several sampling equipment options appropriate for MI sampling.

Field Quality Control

A minimum of 1 field replicate should be collected for every 10 DUs sampled. A field replicate consists of two additional independent bulk MI samples collected in one DU. Replicate samples are collected in the manner used for collection of the initial bulk MI sample, with each replicate collected from a completely independent offset from the original bulk MI sample increments. An example is provided on Figure 4-12 from the HI TGM, reproduced below:

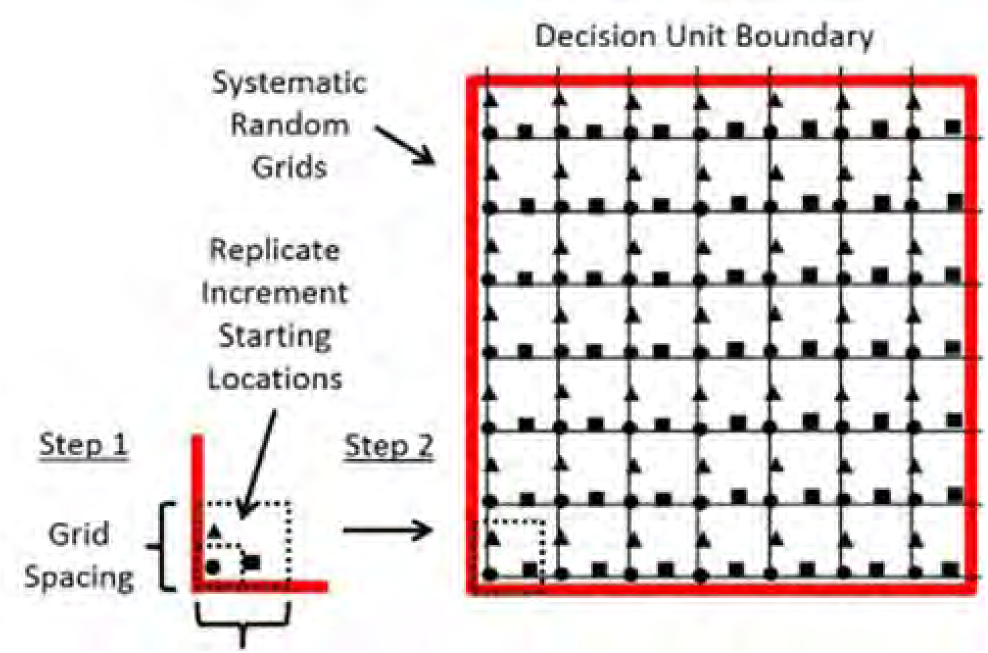


Figure 4-12 from HI TGM: Example Collection of Increment Location Points for Triplicate Multi-Increment Samples

Increments collected in a systematic random method.
Circles, triangles, and squares depict increment collection locations for three respective multi-increment samples (increments collected halfway between initial increment grid point locations).

Key factors to consider when identifying DUs for replicates are described below:

- Collection of one replicate for each type of DU is recommended for sites containing different types of DUs (e.g., an active playground, and an abandoned field with limited access), if possible.
- Replicate samples should be collected from the DU(s) with the highest anticipated contaminant concentrations.
- Replicate samples should be collected from the DU(s) with the highest likelihood of exposure to contaminants.

One of the replicate bulk MI samples should be selected in the field and identified on the laboratory Chain of Custody form for matrix spike/matrix spike duplicate analysis, as applicable to the analytical method(s). The replicate samples should be submitted to the analytical laboratory as "blind" samples, with unique sample identifiers that do not refer to the initial bulk MI sample for that DU.

Statistical evaluation of replicate samples will be conducted in accordance with Section 4.2.7.3 of the HI TGM.

DOCUMENTATION

Details of all relevant field activities must be accurately documented in writing, such that someone not present at the site could reconstruct the activity without relying on the memory of the field personnel. Documentation of the possession and handling of samples from the time of collection through analysis and final disposition also is required. Any deviations from project sampling plans or SOPs resulting from conditions encountered in the field must be identified in the field documentation. A Bulk Multi-Increment Sample Log form[1] should be completed for each DU depth interval sampled. If DUs are collected at multiple subsurface depths (e.g., deeper than 1 to 2 feet below ground surface), additional subsurface field logs may need to be prepared.

Demarcation of each DU, including shape, dimensions, adjoining DUs, landmarks, and north arrow, should be shown on a sketch map such that a to-scale map of each DU can be generated. Draft DU maps can be created from aerial photographs prior to sample collection, and adjusted in the field as needed to reflect actual conditions. Although the individual increments sampled in each DU do not need to be surveyed, increment offsets must be documented in the field notes and on the DU maps. Recording the increment spacing, or offset, is important to document that the bulk MI sample was collected using a systematic random approach.

LABORATORY MULTI-INCREMENT SUBSAMPLING

Bulk MI samples must be processed at the analytical laboratory using appropriate MI subsampling techniques. Care must be taken to select an analytical laboratory with experience in MI subsampling techniques, as described in Section 4.2.6 in the HI TGM. Laboratory processing of MI samples for analysis of non-volatile contaminants typically consists of the following steps, as listed in HI TGM Section 4.2.6:

- The entire bulk sample is spread evenly onto a tray made of or lined with material compatible with the contaminants of potential concern and the drying temperature.
- The bulk sample is allowed to air-dry to a constant weight, or until soil agglomerates are crushable, and a separate subsample can be used for moisture content and dry weight correction.
- The entire bulk sample is sieved to less than 2-millimeter-diameter particle size (generally considered "soil" for the purposes of environmental investigations).
- The entire sieved bulk sample is subsampled using MI sampling methods to collect appropriate mass for each targeted analysis.

For analysis of volatile contaminants, close coordination with the analytical laboratory and the regulatory agency is required to ensure that sample collection and processing methods minimize loss of volatile compounds.

---

[1] Patterned after the *Sample Information Sheet* provided in the HI TGM.

Laboratory Quality Control

Laboratory quality control for bulk MI samples consists of the standard analytical method requirements to monitor laboratory processing of samples (e.g., method blanks, laboratory control samples, matrix spikes, matrix spike duplicates, replicates). Bulk MI sample laboratory replicates consist of triplicate samples to evaluate the precision of the laboratory subsampling methods used. A minimum of 1 laboratory triplicate should be collected for every 10 to 20 samples submitted for analysis. Field personnel should select laboratory quality control samples and triplicates from the DUs anticipated to have the highest levels of contamination, and should designate them on the laboratory Chain of Custody forms.

REFERENCE

State of Hawai'i Department of Health. *Technical Guidance Manual for the Implementation of the Hawai'i State Contingency Plan*. Interim Final. August 2016. Office of Hazard Evaluation and Emergency Response. <http://www.hawaiidoh.org/tgm.aspx?p=0402a.aspx>. (July 26, 2017.)

STANDARD OPERATING PROCEDURE WM-01

FIELD HANDLING OF INVESTIGATION-DERIVED WASTE

PURPOSE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide field personnel with the methodology for containerizing, labeling, and tracking investigation-derived waste (IDW), and communicating information to the Project Manager. IDW may include soil cuttings, purge water, development water, and/or decontamination water. This SOP has been developed in compliance with Washington State Dangerous Waste Regulations (Chapter 173-303 of the Washington Administrative Code), Oregon Hazardous Waste Management Rules (Division 100 of Chapter 340 of the Oregon Administrative Rules), Environmental Health Standards for the Management of Hazardous Waste (Division 4.5 of Title 22 of the California Code of Regulations), and the U.S. Environmental Protection Agency Resource Conservation and Recovery Act (Parts 239 through 282 of Title 40 of the Code of Federal Regulations).

EQUIPMENT AND SUPPLIES/REAGENTS

The following equipment is necessary to properly containerize, label, and track IDW:

- U.S. Department of Transportation-approved drum(s) constructed of a material that does not react with the contaminants of concern for the project. Farallon typically uses lined open-top steel drums. Use a polyethylene drum for a material suspected to be corrosive.
- Labels appropriate to the characteristics of the IDW:
    - Non-Hazardous Waste Labels: For IDW known to be nonhazardous based on previous data and waste profiles.
    - Hazardous Waste or Washington State Dangerous Waste Labels: For IDW known to be hazardous/dangerous based on previous data and waste profiles.
    - On Hold Pending Analysis Labels: For waste not previously characterized, pending receipt of analytical results. On Hold Pending Analysis labels are temporary, and should be replaced with the applicable waste label once the waste has been characterized.
    - Another waste label as indicated by the Project Manager.
- Waste Inventory Tracking Sheet.
- Grease marking pencil or paint pen.
- Indelible ink pen.
- Crescent wrench, socket wrench, or other hand tool to seal the drum(s).
- Sampling supplies, if needed, including:
    - Stainless steel or plastic bowls and spoons for homogenizing soil and/or solids samples, depending on the analysis to be performed;

  - Glass or stainless steel container for homogenizing liquid samples, depending on the analysis to be performed; and
  - Stainless steel hand-auger or a glass tube, depending on the medium being sampled (i.e., soil/solids or liquid).

PROCEDURES

Follow the instructions below to inspect, label, and inventory IDW drums, and to containerize IDW:

- Inspect new drums brought to the site to ensure that they do not have dents or corrosion, and are in good condition. Lined or coated drums are preferred.
- Inspect drums remaining at the site from previous project work. Notify the Project Manager if a drum is leaking, damaged, or improperly labeled.
- Place soil and solids into separate drums from those containing liquids such as purge water, development water, and decontamination water. Do not add liquid IDW to drums containing soil or solids. Do not fill drums containing liquid IDW above 85 percent capacity, particularly in areas known to reach freezing temperatures.
- Discuss with the Project Manager whether chlorinated solvents or other contaminants of concern detected in areas of the site would cause IDW from that area to be characterized as hazardous/dangerous waste. Hazardous/dangerous waste should be drummed separate from non-hazardous/dangerous waste to minimize the amount of hazardous/dangerous waste generated.
- Use a grease pencil/paint pen and indelible ink to clearly mark the lid and the label of each drum with a unique identifier such as a number or a letter. Verify that no two drums have the same identifier marked on the lid or label, including drums remaining from previous project work.
- Inventory each Farallon-generated drum and its contents on a Waste Inventory Tracking Sheet.
- Track any waste added to an existing drum on a Waste Inventory Tracking Sheet.
- Prior to demobilizing from the site, label each drum with a complete Non-Hazardous Waste, Hazardous Waste/Washington State Dangerous Waste, On Hold Pending Analysis, or other appropriate waste label. List the client’s name as the Shipper or Generator, and the accumulation start date as the date when waste was first placed into the drum, or when the waste was first designated as hazardous or dangerous based on analytical data. Consult the Project Manager with questions about the correct start date.

Use care when drumming, labeling, and tracking IDW; mistakes in the disposal of waste can result in serious legal and financial repercussions for Farallon and the client.

DRUM SAMPLING

Sampling and analysis of wastes for hazardous/dangerous waste characterization purposes is to be conducted in accordance with U.S. Environmental Protection Agency Publication No. SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. Samples collected in California for hazardous waste characterization are to adhere to the requirements specified in California Code of Regulations Sections 66261.21 to 66261.24 of Title 22, Characteristics of Hazardous Waste. Discuss with the Project Manager the specific analyses to be performed prior to sample collection. The instructions below are to be followed for drum sampling, using composite sampling techniques to sample soil, solids, and liquid wastes:

- Collect soil/solids samples from various locations and depths in the drum using a hand auger or other decontaminated apparatus. Place all samples into a single decontaminated stainless steel bowl using decontaminated stainless steel tools, or into a plastic bowl using plastic spoons, depending on the analyses to be performed. Homogenize the samples in the bowl.
- Place samples of the homogenized soil/solids from the bowl into sample jars for analysis.
- Collect liquid samples from the drum using a glass sampling tube. Insert the tube to the base of the drum to fill the entire tube with liquid. Place the liquid into sample jars for analysis.

DRUM STORAGE

Follow the instructions below for drum storage:

- Label and store the drums in an area approved by the client.
- Store hazardous/dangerous waste drums in a secured area.
- Place hazardous/dangerous waste drums to be stored outside on secondary containment and under cover.

DOCUMENTATION

Document IDW drums on the Waste Inventory Tracking Sheet as described above. Provide the original Waste Inventory Tracking Sheet and the original field notes to the Project Manager. Provide a copy of the completed Waste Inventory Tracking Sheet to the Project Assistant for tracking.

REFERENCE

U.S. Environmental Protection Agency. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. Publication No. SW-846. Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), and V (2015).

APPENDIX C
INADVERTENT DISCOVERY PLAN

PRE- AND POLY-FLUOROALKYL SUBSTANCES
CHARACTERIZATION STUDY WORK PLAN
Lower Issaquah Valley
Issaquah, Washington

Farallon PN: 1754-002

DEPARTMENT OF
ECOLOGY
State of Washington

PLAN AND PROCEDURES FOR THE UNANTICIPATED DISCOVERY OF CULTURAL RESOURCES AND HUMAN SKELETAL REMAINS[1]

PROJECT TITLE: Lower Issaquah Valley Perfluoroalkyl Substances Investigation

COUNTY WASHINGTON: King

Section, Township, Range: Sections 27, 28, 33, and 31 in Township 24 North, Range 06 East, Washington Meridian.

1. INTRODUCTION

The following Inadvertent Discovery Plan (IDP) outlines procedures to perform in the event of discovering archaeological materials or human remains, in accordance with state and federal laws.

2. RECOGNIZING CULTURAL RESOURCES

A cultural resource discovery could be prehistoric or historic. Examples include:

a. An accumulation of shell, burned rocks, or other food related materials.

b. Bones or small pieces of bone.

c. An area of charcoal or very dark stained soil with artifacts.

d. Stone tools or waste flakes (i.e. an arrowhead. or stone chips).

e. Clusters of tin cans or bottles, logging or agricultural equipment that appears to be older than 50 years.

f. Buried railroad tracks, decking, or other industrial materials.

When in doubt, assume the material is a cultural resource.

3. ON-SITE RESPONSIBILITIES

STEP 1: *Stop Work*. If any employee, contractor or subcontractor believes that he or she has uncovered a cultural resource at any point in the project, all work must stop immediately. Notify the appropriate party(s). Leave the surrounding area untouched, and provide a demarcation adequate to provide the total security, protection, and integrity of the discovery. The discovery location must be secured at all times by a temporary fence or other onsite security.

STEP 2: *Notify Archaeological Monitor or Licensed Archaeologist*. If there is an Archaeological Monitor for the project, notify that person. If there is a monitoring plan in place, the monitor will follow the outlined procedure.

---

[1] If you need this document in a format for the visually impaired, call Water Quality Reception at Ecology, (360) 407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

STEP 3: *Notify the Project Manager* of this project and contact the Ecology Staff Project Manager, or other applicable contacts:

Project Manager: Farallon Consulting Name: Eric Buer Phone: (425) 394-4418 Email: ebuer@farallonconsulting.com	Ecology Staff Project Manager Name: Tamara Cardona Phone: (425)649-7058 Email: TACA461@ecy.wa.gov

Assigned Alternates:

Assigned Project Manager Alternate: Name: Clifford Schmitt Phone: (425)295-0800 Email:cschmitt@farallonconsulting.com	Ecology Cultural Resource Specialist (Alternate): Name: Priscilla Tomlinson Phone:(425)649-7135 email: ptom461@ecy.wa.gov

The Project Manager or applicable staff will make all calls and necessary notifications. **If human remains are encountered**, treat them with dignity and respect at all times. Cover the remains with a tarp or other materials (not soil or rocks) for temporary protection and to shield them from being photographed. **Do not call 911 or speak with the media. Do not take pictures unless directed to do so by DAHP. See Section 5.**

4. FURTHER CONTACTS AND CONSULTATION

A. **Project Manager's Responsibilities**:

- *Protect Find*: The Project Manager is responsible for taking appropriate steps to protect the discovery site. All work will stop immediately in a surrounding area adequate to provide for the complete security of location, protection, and integrity of the resource. Vehicles, equipment, and unauthorized personnel will not be permitted to traverse the discovery site. Work in the immediate area will not resume until treatment of the discovery has been completed following provisions for treating archaeological/cultural material as set forth in this document.

- *Direct Construction Elsewhere on-Site*: The Project Manager may direct construction away from cultural resources to work in other areas prior to contacting the concerned parties.

- *Contact Senior Staff*: If the Senior Staff person has not yet been contacted, the Project Manager must do so.

B. **Senior Staff Responsibilities**:

- *Identify Find*: The Senior Staff (or a delegated Cultural Resource Specialist), will ensure that a qualified professional archaeologist examines the area to determine if there is an archaeological find.

    - If it is determined not to be of archaeological, historical, or human remains, work may proceed with no further delay.
    - If it is determined to be an archaeological find, the Senior Staff or Cultural Resource Specialist will continue with all notifications.
    - If the find may be human remains or funerary objects, the Senior Staff or Cultural Resource Specialist will ensure that a qualified physical anthropologist examines the find. **If it is determined to be human remains, the procedure described in Section 5 will be followed.**

- *Notify DAHP*: The Senior Staff (or a delegated Cultural Resource Specialist) will contact the involved federal agencies (if any) and the Washington Department of Archaeology and Historic Preservation (DAHP).
- *Notify Tribes*: If the discovery may be of interest to Native American Tribes, the DAHP and Ecology Supervisor or Coordinator will coordinate with the interested and/or affected tribes.

General Contacts

State Agencies:

Washington State Department of Ecology
Northwest Regional Office
3190 – 160th Ave. SE
Bellevue, WA 98008-5452
Phone (425) 649-7000

Department of Archaeology and Historic Preservation:

Dr. Allyson Brooks State Historic Preservation Officer 360-586-3066	Rob Whitlam, Ph.D. Staff Archaeologist 360-586-3050

The DAHP or appropriate Ecology Staff will contact the interested and affected Tribes for a specific project.

Further Activities

- Archaeological discoveries will be documented as described in Section 6.
- Construction in the discovery area may resume as described in Section 7.

5. SPECIAL PROCEDURES FOR THE DISCOVERY OF HUMAN SKELETAL MATERIAL

Any human skeletal remains, regardless of antiquity or ethnic origin, will at all times be treated with dignity and respect. Do not take photographs by any means, unless you are pre-approved to do so.

If the project occurs on federal lands or receives federal funding (e.g., national forest or park, military reservation) the provisions of the Native American Graves Protection and Repatriation Act of 1990 apply, and the responsible federal agency will follow its provisions. Note that state highways that cross federal lands are on an easement and are not owned by the state.

If the project occurs on non-federal lands, the Project Manager will comply with applicable state and federal laws, and the following procedure:

A. **In all cases you must notify a law enforcement agency or Medical Examiner/Coroner's Office**:

In addition to the actions described in Sections 3 and 4, the Project Manager will immediately notify the local law enforcement agency or medical examiner/coroner's office.

The Medical Examiner/Coroner (with assistance of law enforcement personnel) will determine if the remains are human, whether the discovery site constitutes a crime scene, and will then notify DAHP.

Enter contact information below:

Issaquah Police Department
(425) 837-3200

B. **Participate in Consultation**:

Per RCW 27.44.055, RCW 68.50, and RCW 68.60, DAHP will have jurisdiction over non-forensic human remains. Ecology staff will participate in consultation.

C. **Further Activities**:

- Documentation of human skeletal remains and funerary objects will be agreed upon through the consultation process described in RCW 27.44.055, RCW 68.50, and RCW 68.60.
- When consultation and documentation activities are complete, construction in the discovery area may resume as described in Section 7.

6. DOCUMENTATION OF ARCHAEOLOGICAL MATERIALS

Archaeological deposits discovered during construction will be assumed eligible for inclusion in the National Register of Historic Places under Criterion D until a formal Determination of Eligibility is made.

Project staff will ensure the proper documentation and field assessment will be made of any discovered cultural resources in cooperation with all parties: the federal agencies (if any), DAHP, Ecology, affected tribes, and a contracted consultant (if any).

All prehistoric and historic cultural material discovered during project construction will be recorded by a professional archaeologist on a cultural resource site or isolate form using standard and approved techniques. Site overviews, features, and artifacts will be photographed; stratigraphic profiles and soil/sediment descriptions will be prepared for minimal subsurface exposures. Discovery locations will be documented on scaled site plans and site location maps.

Cultural features, horizons and artifacts detected in buried sediments may require further evaluation using hand-dug test units. Units may be dug in controlled fashion to expose features, collect samples from undisturbed contexts, or to interpret complex stratigraphy. A test excavation unit or small trench might also be used to determine if an intact occupation surface is present. Test units will be used only when necessary to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance. Excavations will be conducted using state-of-the-art techniques for controlling provenience, and the chronology of ownership, custody and location recorded with precision.

Spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil, regolith, or bedrock will be recorded for each probe on a standard form. Test excavation units will be recorded on unit-level forms, which include plan maps for each excavated level, and material type, number, and vertical provenience (depth below surface and stratum association where applicable) for all artifacts recovered from the level. A stratigraphic profile will be drawn for at least one wall of each test excavation unit.

Sediments excavated for purposes of cultural resources investigation will be screened through 1/8-inch mesh, unless soil conditions warrant ¼-inch mesh.

All prehistoric and historic artifacts collected from the surface and from probes and excavation units will be analyzed, catalogued, and temporarily curated. Ultimate disposition of cultural materials will be determined in consultation with the federal agencies (if any), DAHP, Ecology and the affected tribes.

Within 90 days of concluding fieldwork, a technical report describing any and all monitoring and resultant archaeological excavations will be provided to the Project Manager, who will forward the report for review and delivery to Ecology, the federal agencies (if any), DAHP, and the affected tribe(s).

If assessment activity exposes human remains (burials, isolated teeth, or bones), the process described in Section 5 will be followed.

7. PROCEEDING WITH WORK

Work outside the discovery location may continue while documentation and assessment of the cultural resources proceed. A professional archaeologist must determine the boundaries of the discovery location. In consultation with Ecology, DAHP and any affected tribes, the Project Manager will determine the appropriate level of documentation and treatment of the resource. If there is a federal nexus, Section 106 consultation and associated federal laws will make the final determinations about treatment and documentation.

Work may continue at the discovery location only after the process outlined in this plan is followed and the Project Manager, DAHP, any affected tribes, Ecology (and the federal agencies, if any) determine that compliance with state and federal law is complete.

8. RECIPIENT/PROJECT PARTNER RESPONSIBILITY

The Project Recipient/Project Partner is responsible for developing an IDP. The IDP must be immediately available onsite, be implemented to address any discovery, and be available by request by any party. The Project Manager and staff will review the IDP during a project kickoff or pre-construction meeting.

We recommend that you print images in color for accuracy.

Implement the IDP / UDP if …

You see chipped stone artifacts.

- Glass-like material
- Angular
- "Unusual" material for area
- "Unusual" shape
- Regularity of flaking
- Variability of size

Implement the IDP / UDP if …

You see ground or pecked stone artifacts.

- Striations or scratching
- Unusual or unnatural shapes
- Unusual stone
- Etching
- Perforations
- Pecking
- Regularity in modifications
- Variability of size, function, and complexity

Implement the IDP / UDP if …

You see bone or shell artifacts.

- Often smooth
- Unusual shape
- Carved
- Often pointed if used as a tool
- Often wedge shaped like a “shoehorn”

Bone Awls from Oregon and Bone Wedge from California

Implement the IDP / UDP if …

You see bone or shell artifacts.

- Often smooth
- Unusual shape
- Perforated
- Variability of size

Tooth Pendant and Bone Pendants from Oregon and Washington

Implement the IDP / UDP if …

You see fiber or wood artifacts.

- Wet environments needed for preservation
- Variability of size, function, and complexity
- Rare

Artifacts from Mud Bay, Olympia, Washington

Implement the IDP / UDP if …

You see historic period artifacts.

Artifacts from Downtown Seattle, Alaskan Way Viaduct (Upper Left and Lower) and Unknown Site (Upper Right)

Implement the IDP / UDP if …

You see strange, different or interesting looking dirt, rocks, or

- Human activities leave traces in the ground that may or may not have artifacts associated with them
- "Unusual" accumulations of rock (especially fire-cracked rock)
- "Unusual" shaped accumulations of rock (e.g., similar to a fire ring)
- Charcoal or charcoal-stained soils
- Oxidized or burnt-looking soils
- Accumulations of shell
- Accumulations of bones or artifacts
- Look for the "unusual" or out of place (e.g., rock piles or accumulations in areas with few rock)

Implement the IDP / UDP if …

You see strange, different or interesting looking dirt, rocks, or

- "Unusual" accumulations of rock (especially fire-cracked rock)
- "Unusual" shaped accumulations of rock (e.g., similar to a fire ring)
- Look for the "unusual" or out of place (e.g., rock piles or accumulations in areas with few rock)

Site on Muckleshoot Indian Reservation, near WSDOT ROW along SR 164

Implement the IDP / UDP if …

You see strange, different or interesting looking dirt, rocks, or

Layers of shell midden

Historic Debris

- Often have a layered or “layer cake” appearance
- Often associated with black or blackish soil
- Often have very crushed and compacted shells

Implement the IDP / UDP if …

You see historic foundations or buried structures.

45KI924, In WSDOT ROW for SR 99 Tunnel

APPENDIX D
FARALLON FIELD FORMS AND RECORDS

PRE- AND POLY-FLUOROALKYL SUBSTANCES
CHARACTERIZATION STUDY WORK PLAN
Lower Issaquah Valley
Issaquah, Washington

Farallon PN: 1754-002

FARALLON CONSULTING

Washington
Issaquah | Bellingham | Seattle

Oregon
Portland | Bend | Baker City

California
Oakland | Sacramento | Irvine

FIELD REPORT

Page __ of ___

Date: _____________ **Project #:** __________________________________ **Task #:**_______________

Project: _____________________________________ **Site Address:** _____________________________________

Client: _____________________________________ **Contractor:** _____________________________________

Weather: ____________________________________ **Temp:** ___________

Equipment Used: ____

Hours: ________ _________ **Mileage:** _________ **Project Manager:** ________________________________

Contractor *Staff*

Prepared By: ________________________________ **Reviewed By:** ____________________________________

Comments:

G:\Forms and Templates\Field Forms\Field Rpt Form.docx

FIELD REPORT (continued)

Page ___ of ___

Project: ______________________________ **Date:** ____________ **Project #:** _____________ **Task #:**_______

FARALLON CONSULTING

Log of Boring:

Page __ of __

Client:
Project:
Location:
Farallon PN:
Logged By:

Date/Time Started:
Date/Time Completed:
Equipment:
Drilling Company:
Drilling Foreman:
Drilling Method:

Sampler Type:
Drive Hammer (lbs.):
Depth of Water ATD (feet bgs):
Total Boring Depth (feet bgs):
Total Well Depth (feet bgs):

Depth (feet bgs)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (ppm*)	Sample ID	Sample Analyzed	Boring/Well Construction Details	
0											
_											
_											
_											
_											
5_											
_											
_											
_											
_											
10_											
_											
_											
_											
_											
15_											
_											
_											
_											
_											
20											

Well Construction Information

Monument Type:
Casing Diameter (inches):
Screen Slot Size (inches):
Screened Interval (ft bgs):

Filter Pack:
Surface Seal:
Annular Seal:

Ground Surface Elevation (ft):
Top of Casing Elevation (ft):
Boring Abandonment:
Surveyed Location: X: Y:

LOW-FLOW WELL PURGING AND SAMPLING DATA

WELL NO:

DATE: PROJECT NAME: PROJECT NO:

WEATHER CONDITIONS:

WELL DIAMETER (IN.) ☐ 1 ☐ 2 ☐ 4 ☐ 6 ☐ OTHER ________________

SAMPLE TYPE: ☐ GROUNDWATER ☐ WASTEWATER ☐ SURFACE WATER ☐ OTHER

WELL DEPTH (TOC) FT.

DEPTH TO WATER BEFORE PURGING (TOC) FT.

LENGTH OF WATER FT.

CALCULATED ONE WELL VOLUME[1]: __ GAL.

DEPTH OF SAMPLE POINT FT.

ESTIMATED VOLUME PURGED GAL.

EQUIP. DECON. ☐ ALCONOX WASH ☐ LIQUINOX WASH ☐ DIST/DEION 1 RINSE ☐ DIST/DEION 2 RINSE ☐ OTHER

CONTAINER PRESERVATION: ☐ LAB PRESERVED ☐ FIELD PRESERVED

WATER ANALYZER: PUMP TYPE: TUBING:

ACTUAL TIME (min)	FLOW RATE (ml/min)	DEPTH TO WATER (feet)	TEMP ☐ ºF ☐ ºC 3%	SPECIFIC CONDUCT. (mS/cm) 3%	pH +/- 0.1	DISS. OXYGEN (mg/l) <0.5 mg/L or 10% for > 0.5 mg/L	TURBIDITY (NTU) <5 NTU or 10% for > 5 NTU	ORP (mV) +/- 10 mV	REMARKS (EVIDENT ODOR, COLOR, PID)
	INITIAL		--	--	--	--	--	--	

DEPTH TO WATER AFTER PURGING (TOC) FT.

SAMPLE FILTERED ☐ YES ☐ NO SIZE ______

NOTES:

SAMPLE TIME: ID#

DUPLICATE ☐ TIME: ID#:

EQUIP. BLANK: ☐ TIME: ID#:

PREPARED BY:

---

[1] A 1 FOOT LENGTH OF WATER = 0.05 GAL IN 1" DIA. PIPE 0.17 GAL IN 2" DIA PIPE 0.65 GAL IN 4" DIA PIPE 1.5 GAL IN 6" DIA PIPE

FARALLON CONSULTING

Sheet_____of _____

Soil Sample Data Log

Date: _______________ **Project Name:** ____ **Farallon P/N:** ____

PID Model & Serial No: ____ **Calibration Date/Standard:** ___________________________________

Headspace Container: ☐ 16 oz glass ☐ 8 oz glass ☐ Zip-loc ☐ Other

Sample Method: ☐ Hand auger ☐ Direct push ☐ Split spoon ☐ Corer ☐ Other

Equip Decon: ☐ Tap water wash ☐ DIST/DEION 1 Rinse ☐ Isopropanol ☐ Analyte-free final rinse ☐ Tap water final rinse

☐ Alconox wash ☐ Liquinox Wash ☐ DIST/DEION 2 rinse ☐ Other solvent ☐ DIST/DEION final rinse ☐Air Dry

Test Pit/Boring Location	Sample ID	Time	Depth	PID	Odor	Sheen Tare Weight	Staining Field Weight	Containers	Lithological Description Remarks

2 oz = two-ounce jars

4 oz = four-ounce jars

THIS CONTAINER ON HOLD PENDING ANALYSIS

CONTENTS Soil from borings FB01 and FB02

ORIGIN OF MATERIALS Subsurface Investigation

ADDRESS 1234 Site Address

CONTACT Farallon Consulting - (425) 295-0800

DO NOT TAMPER WITH CONTAINER
AUTHORIZED PERSONNEL ONLY

BRADY® BRADYID.COM

NON-HAZARDOUS WASTE

OPTIONAL INFORMATION

Client Name
SHIPPER

1234 Site Address
ADDRESS

Seattle, Washington 98101
CITY STATE, ZIP

Purge Water (FMW-2)
CONTENTS

HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

ACCUMULATION START DATE First Day Waste Added

E.P.A. WASTE NO. WAD00000000

D.O.T. PROPER SHIPPING NAME Added by transporter

AND

U.N. OR N.A. NO. Added by transporter

GENERATOR NAME Client Name

ADDRESS 1234 Site Address

CITY Seattle

STATE Washington

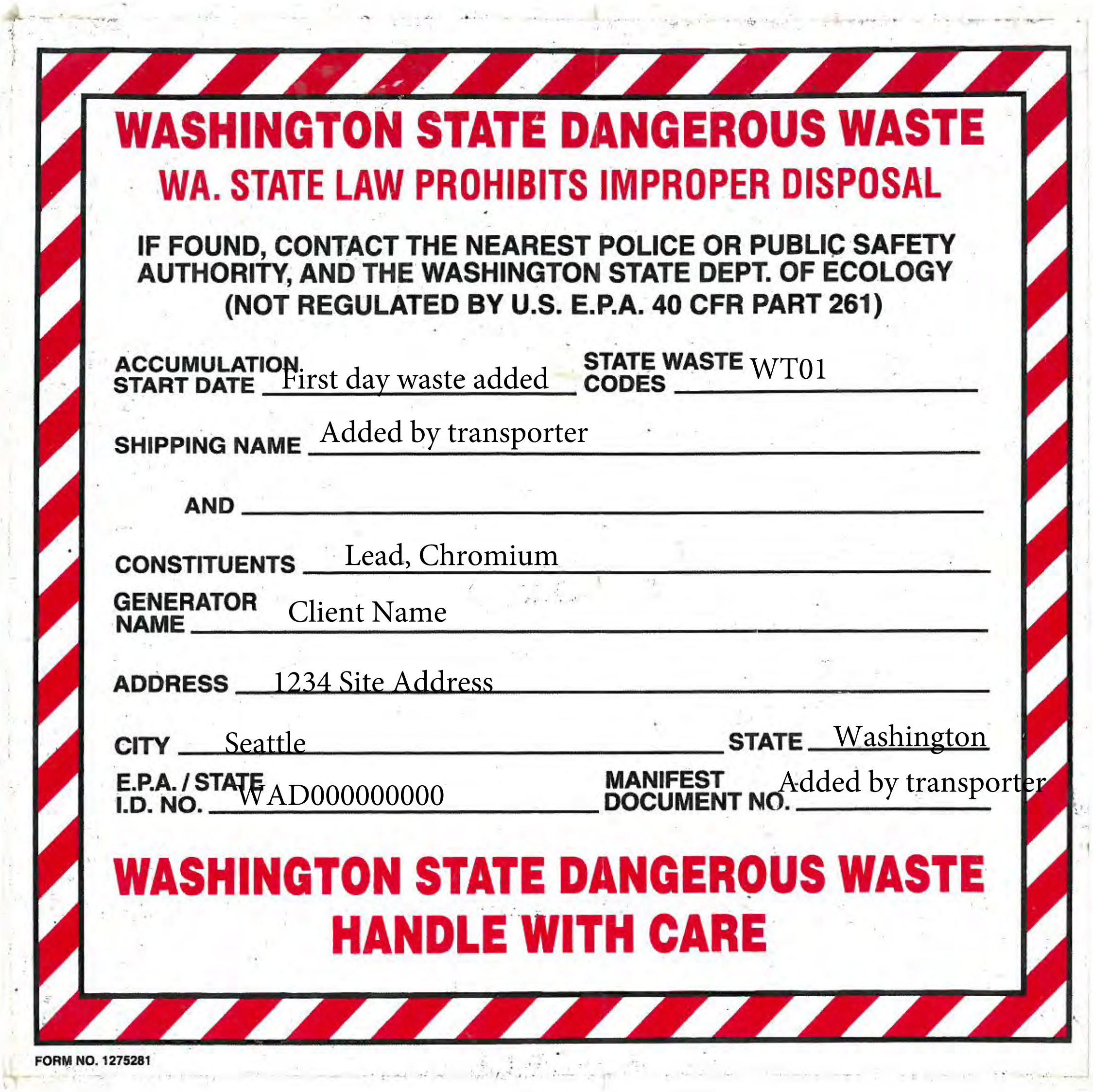
E.P.A. I.D. NO. WAD000000000

MANIFEST DOCUMENT NO. Added by transporter

HAZARDOUS WASTE HANDLE WITH CARE

29-HML-S (Rev. 10/96)

Published by J. J. KELLER & ASSOCIATES, INC., Neenah, WI • USA • (800) 327-6868



WASHINGTON STATE DANGEROUS WASTE

WA. STATE LAW PROHIBITS IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY, AND THE WASHINGTON STATE DEPT. OF ECOLOGY

(NOT REGULATED BY U.S. E.P.A. 40 CFR PART 261)

ACCUMULATION START DATE First day waste added **STATE WASTE CODES** WT01

SHIPPING NAME Added by transporter

AND ________________

CONSTITUENTS Lead, Chromium

GENERATOR NAME Client Name

ADDRESS 1234 Site Address

CITY Seattle **STATE** Washington

E.P.A. / STATE I.D. NO. WAD000000000 **MANIFEST DOCUMENT NO.** Added by transporter

WASHINGTON STATE DANGEROUS WASTE

HANDLE WITH CARE

FORM NO. 1275281

WASTE INVENTORY TRACKING SHEET

Project Number:

Project Name:

Project Address:

Field Work Description:

Project Manager:

Page: of

Generation Date:

Prepared By:

Date Waste Removed:

Waste Transporter:

Waste Disposal Location:

Unique Container ID	Container Size	% Capacity Used	Contents (Soil/GW/Decon Water)/ Origin (Boring or Well ID)	Date(s) Accumulated	Labeling (Contents Under Test/ Haz/Non-Haz/Other-Specify)	Sampled (Y/N)	Comments

NOTES: Contents should be specified and include identification of well/boring, media, source, depth of soil (if applicable), and any other helpful information.

Container ID should be unique when compared against other nearby containers. Special waste labels may include flammable, corrosive, dangerous when wet, and/or oxidizer.

Location of Drums (sketch or describe):

FARALLON
CONSULTING

☐ ALS Environmental
1317 South 13th Ave
Kelso, WA 98626
(Tel) 360.577.7222
(Fax) 360.636.1068

Chain of Custody Form

Page ______ of _______

ALS Project Manager:		**ALS Work Order #:**	

Customer Information		**Project Information**		**Parameter/Method Request for Analysis**	
Purchase Order		**Project Name**		**A**	
Work Order		**Project Number**		**B**	
Company Name		**Bill To Company**		**C**	
Send Report To		**Invoice Attn.**		**D**	
Address		**Address**		**E**	
				F	
City/State/Zip		**City/State/Zip**		**G**	
Phone		**Phone**		**H**	
Fax		**Fax**		**I**	
e-Mail Address				**J**	

No.	**Sample Description**	**Date**	**Time**	**Matrix**	**Pres. Key Numbers**	**# Bottles**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**Hold**
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Sampler(s): Please Print & Sign

Shipment Method:

Required Turnaround Time: (Check Box) ☑ Other ___________
☐ 10 Wk Days ☐ 5 Wk Days ☐ 3 Wk Days ☐ 2 Wk Days ☐ 24 Hour

Results Due Date:

Relinquished by:	**Date:**	**Time:**	**Received by:**	**Date:**	**Time:**	**Notes:**
Relinquished by:	**Date:**	**Time:**	**Received by (Laboratory):**	**Date:**	**Time:**	
Logged by (Laboratory):	**Date:**	**Time:**	**Checked by (Laboratory):**			

ALS Cooler ID	**Cooler Temp**

QC Package: (Check Box Below)
☐ Level II: Standard QC
☐ Level III: Raw Data
☐ TRRP LRC
☐ TRRP Level IV
☐ Level IV: SW846 Methods/CLP like
☐ Other: ______________________

Preservative Key: **1-**HCl **2-**HNO_3 **3-**H_2SO_4 **4-**NaOH **5-**$Na_2S_2O_3$ **6-**$NaHSO_4$ **7-**Other **8-**4^oC

Note: Any changes must be made in writing once samples and COC Form have been submitted to ALS.

APPENDIX E
BORING LOGS

PRE- AND POLY-FLUOROALKYL SUBSTANCES
CHARACTERIZATION STUDY WORK PLAN
Lower Issaquah Valley
Issaquah, Washington

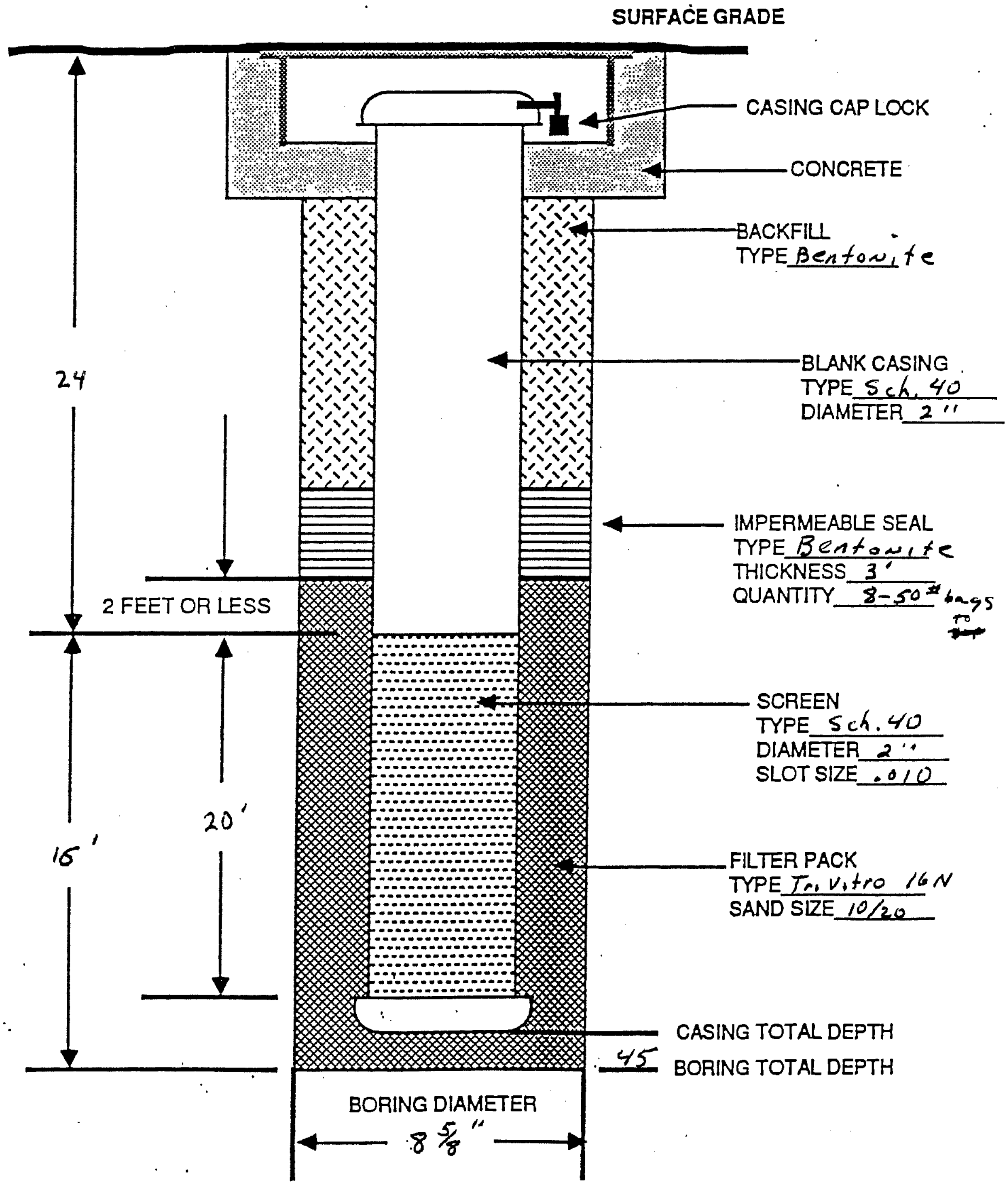
Farallon PN: 1754-002

MONITORING WELL INSTALLATION REPORT

WELL NUMBER: MW-1
PROJECT NAME: IPD RF/FS
ADDRESS: 132 E. Sunset Way
Issaquah, WA

TYPE OF WELL: GW MONITORING
INSTALLATION CONTRACTOR: HOLT DRILLING

INSTALLATION DATE: 5/27/97
SURFACE ELEV: (FT ABOVE MSL)
TOP OF CASING: (FT ABOVE MSL)
SURVEYED
WELL LOCATION: Library Parking area
SITE MANAGER: GARY GALLOWAY



BACKFILL
TYPE Bentonite

BLANK CASING
TYPE Sch. 40
DIAMETER 2"

IMPERMEABLE SEAL
TYPE Bentonite
THICKNESS 3'
QUANTITY 8-50# bags
to

SCREEN
TYPE Sch. 40
DIAMETER 2"
SLOT SIZE .010

FILTER PACK
TYPE Tri Vitro 16N
SAND SIZE 10/20

MONITORING WELL INSTALLATION REPORT

WELL NUMBER: MW- 2

PROJECT NAME: IPD RI/FS

ADDRESS: 132 E. Sunset Way
Issaquah, WA

TYPE OF WELL: GW MONITORING

INSTALLATION CONTRACTOR: HOLT DRILLING

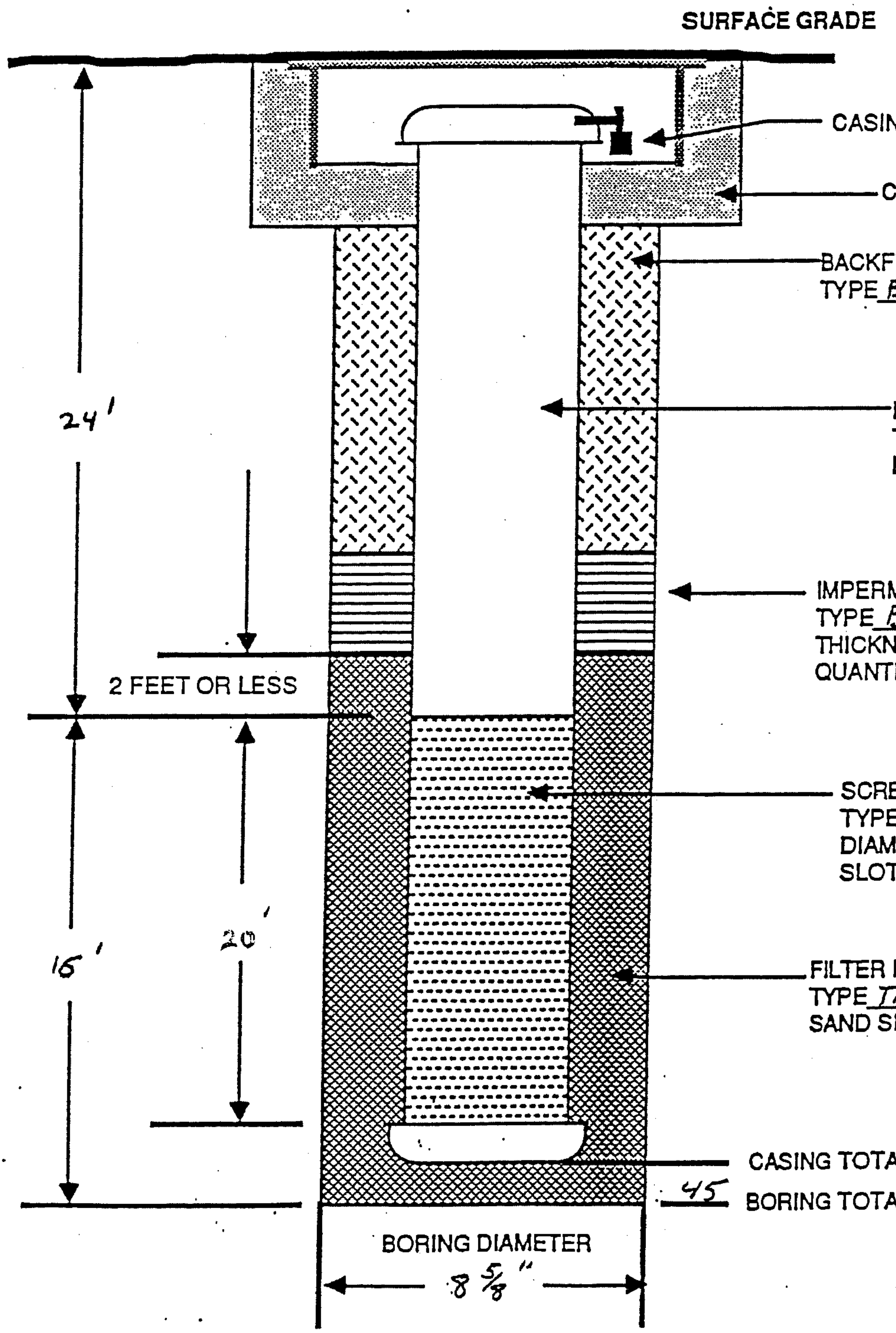
INSTALLATION DATE: 5/27/97

SURFACE ELEV: (FT ABOVE MSL)

TOP OF CASING: (FT ABOVE MSL)

SURVEYED WELL LOCATION: Iss. PARK PLAY AREA

SITE MANAGER: GARY GALLOWAY



CASING CAP LOCK

CONCRETE

BACKFILL
TYPE Bentonite

BLANK CASING
TYPE Sch. 40
DIAMETER 2"

IMPERMEABLE SEAL
TYPE Bentonite
THICKNESS 3'
QUANTITY 8-50# bags

SCREEN
TYPE Sch. 40
DIAMETER 2"
SLOT SIZE .010

FILTER PACK
TYPE Tri Vitro 16N
SAND SIZE 10/20

CASING TOTAL DEPTH

45 BORING TOTAL DEPTH

BORING DIAMETER 8 5/8"

MONITORING WELL INSTALLATION REPORT

WELL NUMBER: MW-

PROJECT NAME: IPD RI/FS

ADDRESS: 132 E. Sunset Way
Issaquah, WA

TYPE OF WELL: GW MONITORING

INSTALLATION CONTRACTOR: HOLT DRILLING

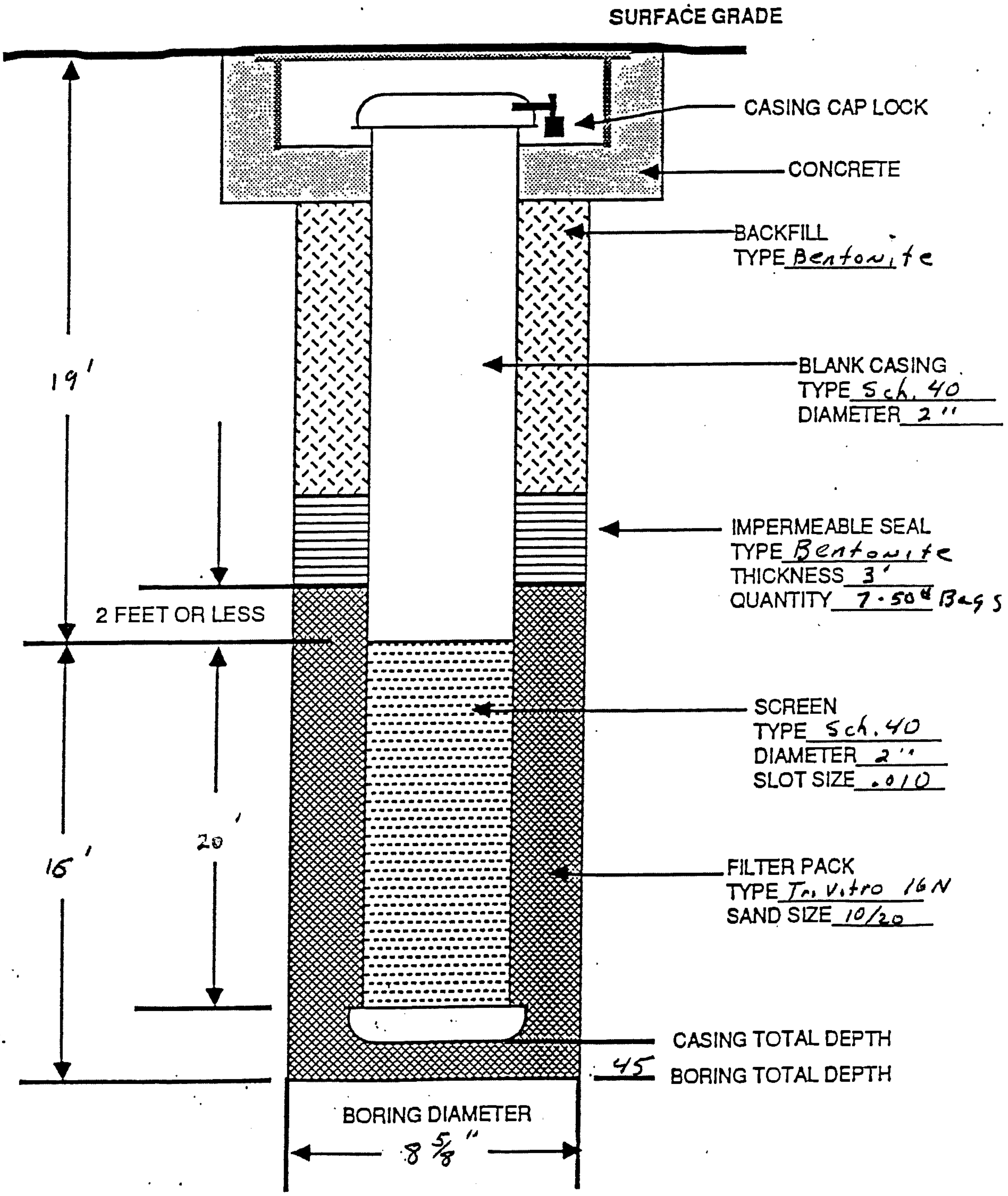
INSTALLATION DATE: 5/28/97

SURFACE ELEV: (FT ABOVE MSL)

TOP OF CASING: (FT ABOVE MSL)

SURVEYED WELL LOCATION: SUNSET WAY

SITE MANAGER: GARY GALLOWAY



BACKFILL
TYPE Bentonite

BLANK CASING
TYPE Sch. 40
DIAMETER 2"

IMPERMEABLE SEAL
TYPE Bentonite
THICKNESS 3'
QUANTITY 7 · 50# Bags

SCREEN
TYPE Sch. 40
DIAMETER 2"
SLOT SIZE .010

FILTER PACK
TYPE Tri Vitro 16N
SAND SIZE 10/20

PROJECT NO. 19721

BORING LOG

SHEET 1 OF 3

PROJECT NAME: IPD RI/FS
LOCATION: Library Parking
Police Demo Project
CLIENT NAME: ISSAQUAH
SITE MANAGER: G. GALLOWAY
LOGGED BY: G. GALLOWAY

BORING NUMBER: MW-1
BORING LOCATION: Library Parking
DRILLING CONTRACTOR: Holt
DRILLING METHOD: HSA
BIT SZ/HAMMER/WT/DROP: 6"/140#/30"
SAMPLE RETRIEVAL SYS: Split Spoon

DATE/TIME STARTED: 5/29/97 (0805)
DATE/TIME COMPLETED: 5/27/97 (11:15)
TOTAL DEPTH: 45'
SURFACE ELEVATION:
WATER DEPTH: 28.5'
CLOSURE METHOD: MW

DEPTH (Feet)	GRAPHIC LOG										SAMPLE DATA									DESCRIPTION
	Sample Intervals	Boulders	Cobbles	Pebbles	Gravel	Crs. Sand	Med. Sand	Fine Sand	Silt	Clay	Sample #	Blows / 6"	OVA (ppm)	CGI (% LEL)	Odor	Color	Moisture	Porosity (%)	USCS Symbols	
5																				0-3" Asphalt 3"-12" Crushed aggregate @12" Brn, damp silty sand (SM) with gravel @3' Reddish-brn, damp, med. dense (MD) clayey-silty sand (SM)
10												4 4 6								@5'-6.5' sample - brn., damp, MD silty sd with clay (SM), NO odor/discoloration.
15												50/6"								@10'-11.5' Brn, damp, dense, gravelly cobbly sand (SW), poor sample recovery, (NO ODOR etc.)
20												32 50/5"								@15'-16.5' Same as above
25												36 50/3"								@20'-21.5' " " "
30												50/6"								@25'-26.5' " " "
35												50/3"								@30'-31.5' tan to brn, wet, dense gravelly sd (SW), water @ 29', NO HC evident, sample submitted for chem. analysis.
40												50/3"								@35'-36.5' tan pebbly/cobbly sd., wet dense (photo) No HC
45												32 50/5"								@40-41.5' tan, wet, dense crs. gr. sd with pebbles (SW)
																				@ 45'-46.5' SAME AS ABOVE

Legend - see back

FIELD BORING LOG

Signature Gary Galloway

Date 5/27/97 (field)

PROJECT NO. 19721

BORING LOG

SHEET 2 OF 3

PROJECT NAME: IPD - MWS
BORING NUMBER: MW-2
DATE/TIME STARTED: 5/27/97 14:30
LOCATION: IPD DEMO
BORING LOCATION: Play Area
DATE/TIME COMPLETED: 5/27/97 18:20
DRILLING CONTRACTOR: HOLT
TOTAL DEPTH: 45'
CLIENT NAME: ISSAQUAH
DRILLING METHOD: HSA
SURFACE ELEVATION:
SITE MANAGER: G. GALLOWAY
BIT SZ/HAMMER/WT/DROP: 6"/140#/30"
WATER DEPTH: 31'
LOGGED BY: G. GALLOWAY
SAMPLE RETRIEVAL SYS: Split Spoon
CLOSURE METHOD: MW

DEPTH (Feet)	SAMPLE DATA	DESCRIPTION
		@ surface grass brn silty top soil
		@ 5' brn, clayey silt (sm), soft No indication of contamination
5	1 2 2	
0	22 32 49	@ 10' same as above @ 11' Gravelly, pebbly, brn, MD to Dense sd (SW), damp, NO odors etc.
5	50/1"	@ 15' No sample recovered - same description as above.
0	50/3"	@ 20' Grey-brn, Gravelly-cobbly crs. gr. sd (SW), Dense, NO HC cont. poor sample recovery.
5	50/1"	@ 25' NO sample recovered - same as above, re-took rig for sampling @ 28.5'
∇	41 39 50/5½"	@ 28.5' Reddish-brn, cobbly-gravelly crs. gr. sd, wet, dense NO HC contamination
5	50/5"	@ 31' Grey-brn clay (cl), stiff NO contamination @ 32' Grey, fine gr. sd. (sm) wet NO HC (contamination)
0	50/4"	@ 33.5 Grey-brn, gravelly-cobbly crs gr. sd (SW) NO HC @ 38.5 same as above @ 43.5 " " "
5		

Legend - see back

FIELD BORING LOG

Signature Gary Galloway

Date 5/27/97 (field)

PROJECT NO. 19714

BORING LOG

SHEET 3 OF 3

PROJECT NAME: IPD-MW
BORING NUMBER: MW-3
DATE/TIME STARTED: 5/28/97 11:45
LOCATION: 732 E. Sunset Way
BORING LOCATION: Sunset Way
DATE/TIME COMPLETED: 5/28/97 14:45
DRILLING CONTRACTOR: HOLT
TOTAL DEPTH: 45'
CLIENT NAME: ISSAQUAH
DRILLING METHOD: HSA
SURFACE ELEVATION:
SITE MANAGER: G. GALLOWAY
BIT SZ/HAMMER/WT/DROP: 6"/140#/30"
WATER DEPTH: 32'
LOGGED BY: G. GALLOWAY
SAMPLE RETRIEVAL SYS: Split Spoon
CLOSURE METHOD: MW

DEPTH (Feet)	GRAPHIC LOG									SAMPLE DATA									DESCRIPTION
	Boulders	Cobbles	Pebbles	Gravel	Crs. Sand	Med. Sand	Fine Sand	Silt	Clay	Sample #	Blows / 6"	OVA (ppm)	CGI (% LEL)	Odor	Color	Moisture	Porosity (%)	USCS Symbols	
5																			0-3" Asphalt 3"-12" crushed aggregate @3" to 3' Brn, clayey-silty sd (SM) MD, damp (topsoil) @3'-3.6' fine-med gr sd (SM), tan damp, MD
10											2 2 3								@3.6' brn, MD, Silty SD (SM), damp No HC cont.
15											17 36 50(3")								@8.5' Tan-brn, gravelly med. gr. sd. SM, damp, No HC cont.
20											28 32 50(2")								@13.5 brn-tan, gravelly-cobbly med. gr. sd (SW), Dense, Damp., NO HC cont.
25											50(6")								@18.5 SAME
30											45 50(2")								@23.5 tan-brn, damp to moist, gravelly-pebbly sd (SW) dense, NO HC
35											50(4")		Submit sample						@28.5 SAME
40											30 35 42								@33.5 SAME (Submit SAMPLE)
45											35 23 25								@38.5 SAME
																			@43.5 SAME

45, 38, 29

Legend - see back

FIELD BORING LOG

Signature Gary Galloway

Date 5/28/97 (field)

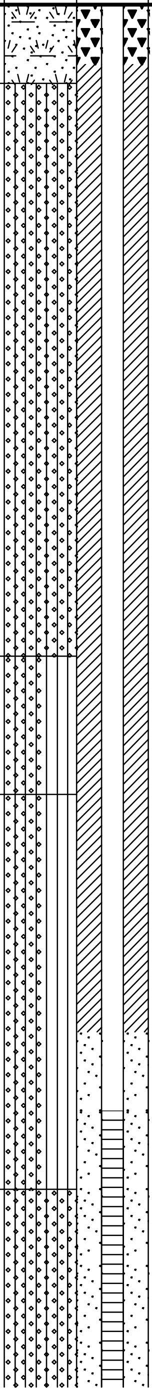
Geosyntec consultants

621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW01 **SHEET** 1 **OF** 3
START DATE 5/26/2016 **Elevation** 58.36 FT. MSL
FINISH DATE 5/26/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Grass, topsoil	Surface completion: 8" Morris monument					TOPSOIL	
	Brown (7.5YR 4/3), loose, dry, silty SAND; well graded, some rounded gravel					0.1	SM	
			55					
5								
			50			0.1		
10		2" sch 40 PVC well casing			40			
			45					
15								
	Brown (7.5YR 4/3), medium dense, moist to dry, sandy SILT; some gray mottling, trace fine gravel						SM-ML	
		Halliburton Hole-plug, 3/8" bentonite chips	40					
20	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT				35		SM-ML	
			35					
	6" fine sand							
25						0.1		
	trace organics/wood fragments							no oxidation noted
			30					
30	Gray (Gley 2 4/5B dark bluish gray), loose, wet, fine to medium SAND; well sorted, poorly graded, trace rounded gravel	2" sch 40 PVC 0.01" slotted well screen			100		SM	First encountered groundwater: 29'
			25	MW01_30to40_20160526 @1215				DTW: 18' Screen: 30-40'
35								

CONTRACTOR	Holt Services	**NORTHING**	201387.690
EQUIPMENT	Terra Sonic, track	**EASTING**	1338963.340
DRILL MTHD	Sonic	**ANGLE**	Vertical
DIAMETER	8"	**BEARING**	------

LOGGER J Dahl **REVIEWER** C Bartlett **PRINTED** 07/08/16

REMARKS: Site: park bench. Well Tag ID: BJX-185

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BORING LOG W/WELL SONIC (PORTLAND) PNG0714 ISSAQUAH.GPJ EED DEFAULT GINT LIBRARY.GLB 7/8/16

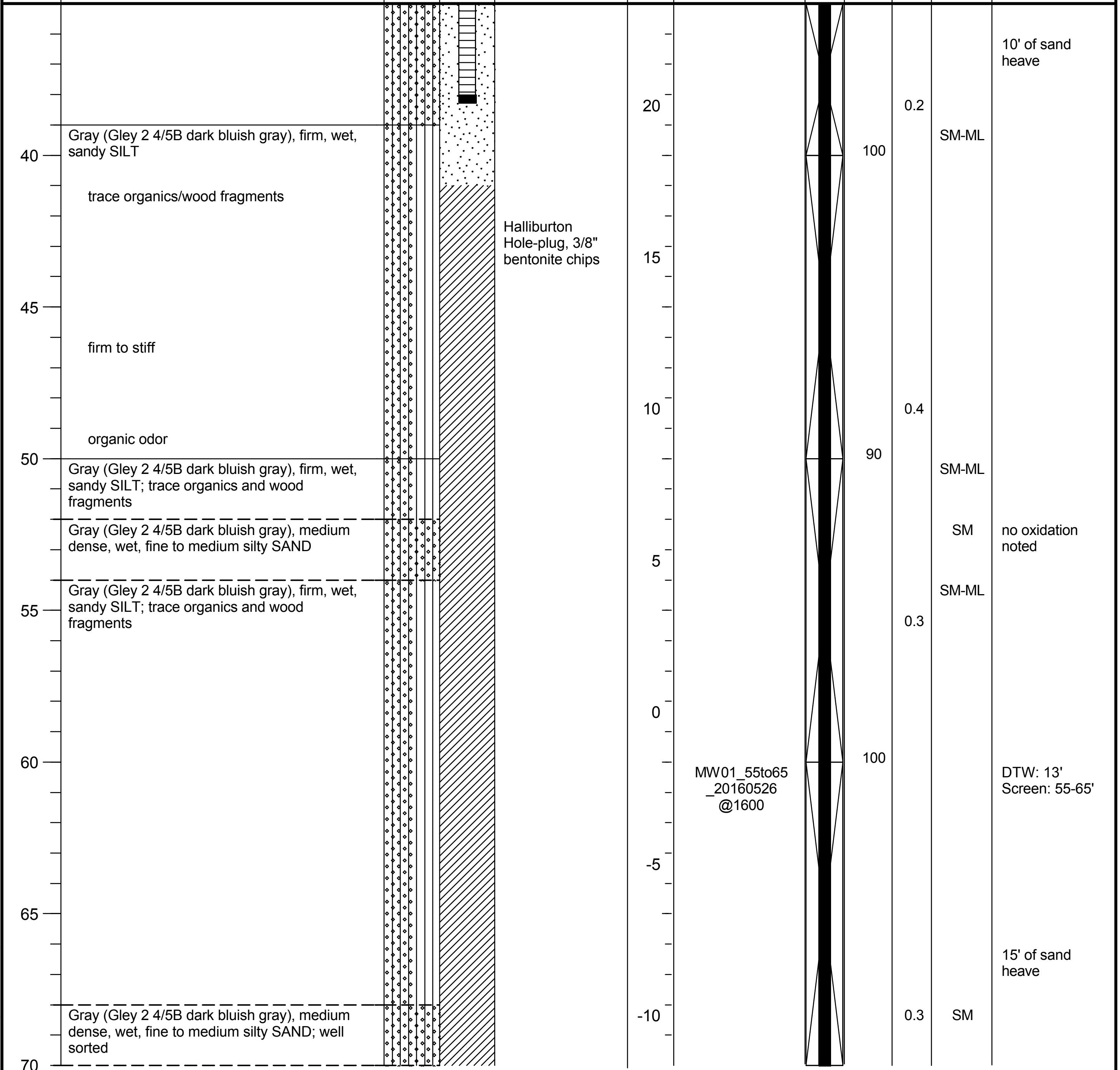
Geosyntec consultants

621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW01 **SHEET** 2 **OF** 3
START DATE 5/26/2016 **Elevation** 58.36 FT. MSL
FINISH DATE 5/26/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
											10' of sand heave
					20				0.2		
	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT									SM-ML	
40								100			
	trace organics/wood fragments										
				Halliburton Hole-plug, 3/8" bentonite chips	15						
45											
	firm to stiff										
					10				0.4		
	organic odor										
								90			
50	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT; trace organics and wood fragments									SM-ML	
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium silty SAND									SM	no oxidation noted
					5						
	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT; trace organics and wood fragments									SM-ML	
55									0.3		
					0						
60								100			
						MW01_55to65 _20160526 @1600					DTW: 13' Screen: 55-65'
					-5						
65											
											15' of sand heave
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium silty SAND; well sorted				-10				0.3	SM	
70											

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 201387.690
EASTING 1338963.340
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: park bench. Well Tag ID: BJX-185

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW01 **SHEET** 3 **OF** 3
START DATE 5/26/2016 **Elevation** 58.36 FT. MSL
FINISH DATE 5/26/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES				USCS Classification	COMMENTS
						SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)		
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium SAND; trace gravel, well sorted							90		SW	
	Gray (Gley 2 4/5B dark bluish gray), firm, moist, SILT; non-plastic				-15				0.4	ML	
75	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium silty SAND; well sorted									SM	
					-20			100			
80	End of boring, install monitoring well.										

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 201387.690
EASTING 1338963.340
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: park bench. Well Tag ID: BJX-185

COORDINATE SYSTEM:

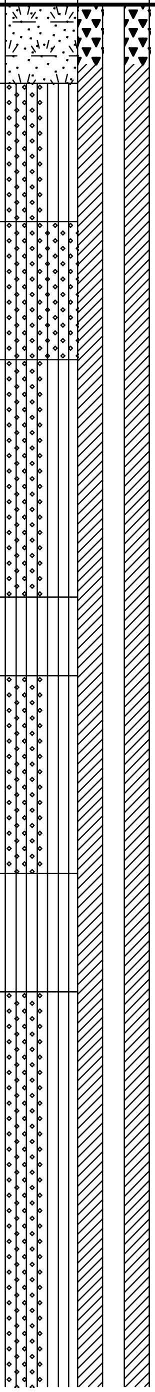
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW02 **SHEET** 1 **OF** 3
START DATE 5/31/2016 **Elevation** 59.70 FT. MSL
FINISH DATE 6/2/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	Topsoil	Above ground completion (+3.5 feet), steel monument, 3 bollards installed around monument					TOPSOIL	
	Brown (10YR 6/6 brownish yellow), medium stiff, dry, sandy SILT; trace oxidation						SM-ML	
	becomes moist							
5			55					
	Brown (10YR 6/6 brownish yellow), medium dense, wet, silty fine SAND; well graded, poorly sorted, some oxidation						SM	
	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT; trace wood fragments						SM-ML	
10			50		70			
	3" lens of gray, loose, wet, medium sand							
15	Gray (Gley 2 4/5B dark bluish gray), stiff, dry, SILT; slightly mottled		45				ML	
	Gray (Gley 2 4/5B dark bluish gray), firm, moist, sandy SILT						SM-ML	
	3" lens of gray, loose, wet, medium sand							
20	becomes wet	2" sch 40 PVC well casing	40		100			
	Gray green (Gley 1 4/5G dark greenish gray), stiff, dry, SILT						ML	
25	Gray (Gley 2 4/5B dark bluish gray), firm, moist, sandy SILT		35				SM-ML	
	trace wood fragments							
30			30					
35			25					

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 201354.260
EASTING 1340787.500
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Pickering Trail. Well Tag ID: BJX-187

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

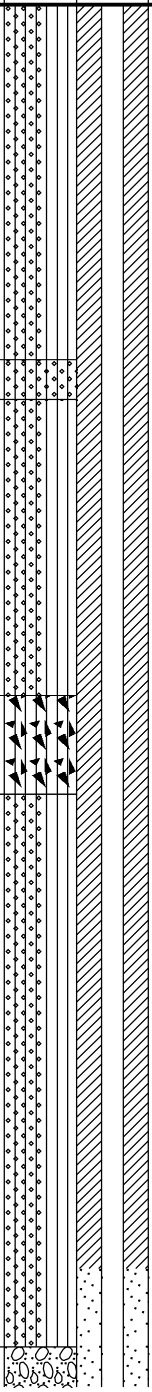
Geosyntec consultants

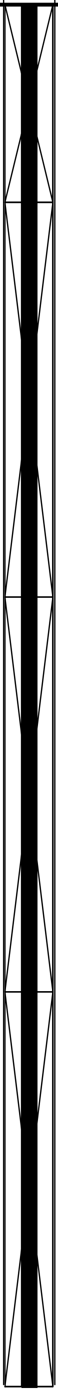
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW02 **SHEET** 2 **OF** 3
START DATE 5/31/2016 **Elevation** 59.70 FT. MSL
FINISH DATE 6/2/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714





DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	becomes wet							
40		Halliburton Hole-plug, 3/8" bentonite chips	20		100			First encountered groundwater: 39'
	becomes moist							
	becomes wet							
	Gray, medium dense, wet, SAND						SM	
45	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT		15	MW02_40to50 _20160531 @1730			SM-ML	DTW: 2.0' Screen: 40-50'
	becomes moist							
	6" lens gray, medium dense, sand							
	becomes moist to dry, trace wood fragments							
50	becomes wet		10		100			End of drilling 05/31/2016; continue on 06/01/2016
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to medium sandy GRAVEL; poorly sorted, well graded, trace organics and mottling						GM	
55	Gray (Gley 2 4/5B dark bluish gray), firm to soft, wet, sandy SILT; trace wood fragments		5				SM-ML	
60			0		100			
65			-5					
	2-6" lens wet, fine to medium sand							
70	Gray (Gley 2 4/5B dark bluish gray), loose, dry,		-10				SW	

CONTRACTOR	Holt Services	**NORTHING**	201354.260
EQUIPMENT	Terra Sonic, track	**EASTING**	1340787.500
DRILL MTHD	Sonic	**ANGLE**	Vertical
DIAMETER	8"	**BEARING**	------
LOGGER J Dahl	**REVIEWER** C Bartlett	**PRINTED**	07/08/16

REMARKS: Site: Pickering Trail. Well Tag ID: BJX-187

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

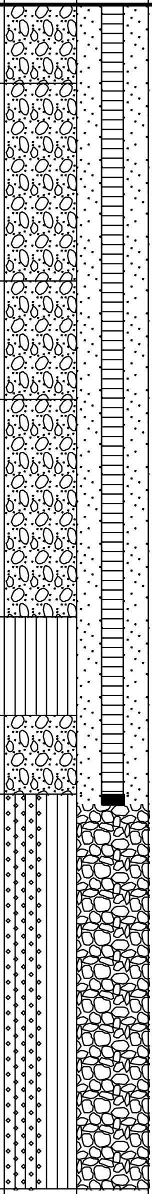
Geosyntec consultants

621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING	**MW02**	**SHEET**	**3 OF 3**
START DATE	**5/31/2016**	**Elevation**	**59.70 FT. MSL**
FINISH DATE	**6/2/2016**		
PROJECT	**Phase 2 Hydrogeologic Investigation**		
LOCATION	**Issaquah, Washington**		
PROJECT NUMBER	**PNG0714**		



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	medium to coarse SAND; well graded, poorly sorted, some gravel					100			
75	Brown (10YR 5/1 gray), loose, dry, medium to coarse SAND; well graded, poorly sorted, some gravel 6" lens gray, firm, silt	pre-pack screen	-15					SW	
	Gray (Gley 2 4/5B dark bluish gray), loose, dry, medium to coarse SAND; well graded, poorly sorted, some gravel							SW	
80	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, medium to coarse SAND; poorly graded, no fines, trace coarse gravels 6" lens firm, wet, silt		-20			100		SW	
85			-25						
	Gray (Gley 2 4/5B dark bluish gray), firm, moist, SILT							ML	
	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, fine to coarse SAND; well graded							SW	10-15' of sand heave
90	Gray (Gley 2 4/5B dark bluish gray), medium dense, wet, silty fine SAND; poorly graded, well sorted	Slough	-30			100		SM-ML	
95			-35						
100	End of boring, install monitoring well.		-40						

CONTRACTOR	**Holt Services**	**NORTHING**	**201354.260**
EQUIPMENT	**Terra Sonic, track**	**EASTING**	**1340787.500**
DRILL MTHD	**Sonic**	**ANGLE**	**Vertical**
DIAMETER	**8"**	**BEARING**	**------**
LOGGER J Dahl	**REVIEWER** C Bartlett	**PRINTED**	**07/08/16**

REMARKS: Site: Pickering Trail. Well Tag ID: BJX-187

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

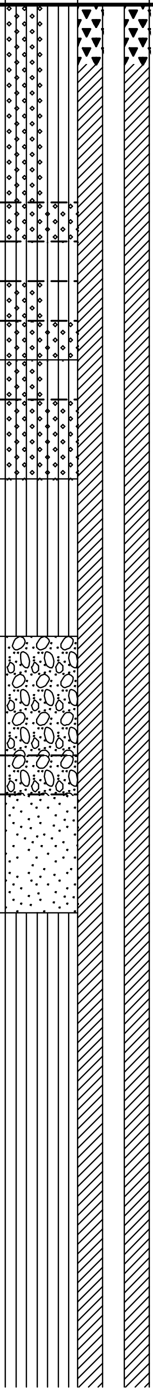
BORING LOG W/WELL SONIC (PORTLAND) PNG0714 ISSAQUAH.GPJ EED DEFAULT GINT LIBRARY.GLB 7/8/16

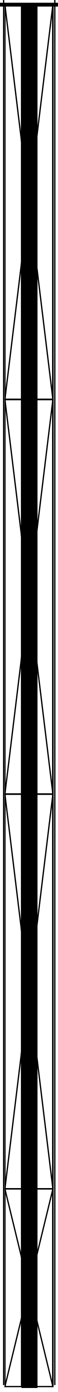
Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW03 **SHEET** 1 **OF** 3
START DATE 5/24/2016 **Elevation** 63.16 FT. MSL
FINISH DATE 5/25/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714





DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Brown (2.5YR 5/2 weak red), firm, dry, sandy SILT						SM-ML	
		Surface completion: 8" Morris monument						
						0.2		
			60					
5								
	Brown (7.5YR 4/6 strong brown) with trace red oxidation, loose, wet, fine to medium SAND; trace silt					0.2	SM	
							ML	
	Brown (7.5YR 4/6 strong brown) with trace red oxidation, very stiff, moist, SILT						SM-ML	
	Brown (2.5YR 5/2 weak red) with some gray mottles, medium dense, moist, sandy SILT; some oxidation		55				SM	
						0.2	SM-ML	
					90			
10	Brown (2.5YR 5/2 weak red), loose, wet, medium to fine SAND; some oxidation, well graded, poorly sorted						SM	
	Gray (Gley 2 5/5BG greenish gray), firm, moist, silty SAND; poorly graded, well sorted, trace organics						ML	
			50					
	Gray (Gley 2 5/5BG greenish gray), medium dense, wet, silty SAND							
15	Gray (Gley 2 5/5BG greenish gray), very stiff, wet, SILT			MW03_10to20 _20160524 @1545		0.2		DTW: 8.27' Screen: 10-20'
	Gray (Gley 2 4/10B dark bluish gray), medium dense, wet, fine to medium SAND; poorly sorted, well graded						SW	
			45					
	Gray (Gley 2 4/5BG dark greenish gray), medium dense, wet, fine to coarse SAND; poorly sorted, well graded					0.2	SW	
					90			
20						0.1	SP	
	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, gravelly coarse SAND; no fines							
	Gray (Gley 2 4/5BG dark greenish gray), very stiff, wet, SILT; slightly plastic, trace fine sand		40			0.2	ML	
25		2" sch 40 PVC well casing						
			35			0.1		
					100			
30								Driller using water to drill, heaving conditions
			30					
35								

CONTRACTOR Holt Services **NORTHING** 200673.280
EQUIPMENT Terra Sonic, track **EASTING** 1341038.950
DRILL MTHD Sonic **ANGLE** Vertical
DIAMETER 8" **BEARING** ------
LOGGER J Dahl **REVIEWER** C Bartlett **PRINTED** 07/08/16

REMARKS: Site: Dental lab. Well Tag ID: BJX-184

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants

621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW03 **SHEET** 2 **OF** 3
START DATE 5/24/2016 **Elevation** 63.16 FT. MSL
FINISH DATE 5/25/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, fine to coarse SAND; with gravel interbeds									SM	
					25						
40	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, gravelly fine to coarse SAND; fine to coarse gravel			Halliburton Hole-plug, 3/8" bentonite chips (12-50lb bags)				100		SP	
					20						
45						MW03_40to50 _20160524 @1730					DTW: 0.0' Screen: 40-50'
	Gray (Gley 2 4/5BG dark greenish gray), stiff, wet, sandy SILT; trace organics				15			100		ML	
50								100			possible heave
									0		
					10						
55											
					5				0		
60								100			
					0						
65	Gray (Gley 2 4/5B dark bluish gray), dense, wet, silty fine to coarse SAND; trace organics, well graded, poorly sorted									SM	
					-5						
70											

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 200673.280
EASTING 1341038.950
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

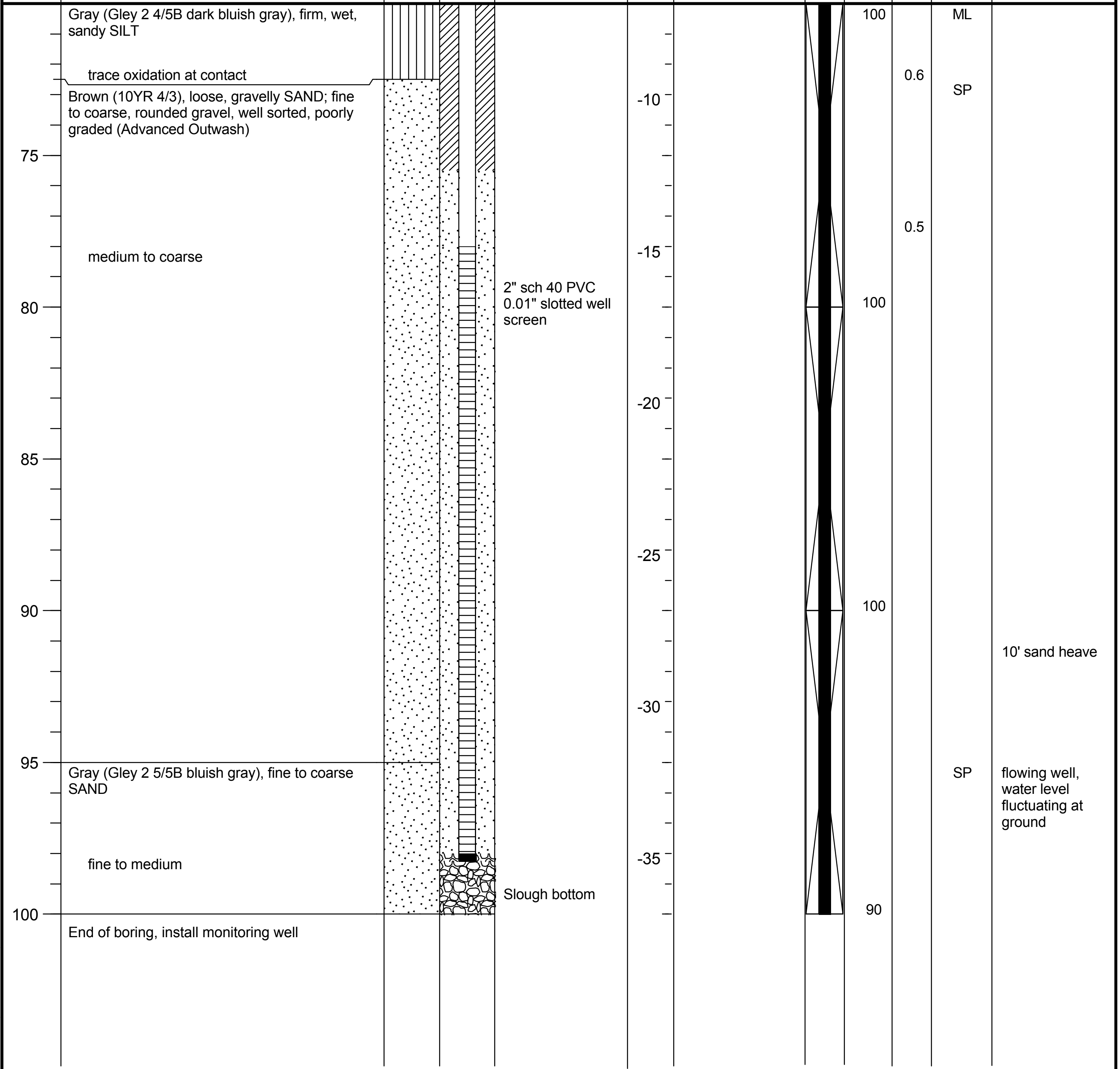
REMARKS: Site: Dental lab. Well Tag ID: BJX-184

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BOREHOLE LOG

BORING MW03 **SHEET** 3 **OF** 3
START DATE 5/24/2016 **Elevation** 63.16 FT. MSL
FINISH DATE 5/25/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	Gray (Gley 2 4/5B dark bluish gray), firm, wet, sandy SILT					100		ML	
	trace oxidation at contact						0.6		
	Brown (10YR 4/3), loose, gravelly SAND; fine to coarse, rounded gravel, well sorted, poorly graded (Advanced Outwash)		-10					SP	
75									
							0.5		
	medium to coarse		-15						
80		2" sch 40 PVC 0.01" slotted well screen				100			
			-20						
85									
			-25						
90						100			
									10' sand heave
			-30						
95	Gray (Gley 2 5/5B bluish gray), fine to coarse SAND							SP	flowing well, water level fluctuating at ground
	fine to medium		-35						
		Slough bottom							
100						90			
	End of boring, install monitoring well								

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 200673.280
EASTING 1341038.950
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Dental lab. Well Tag ID: BJX-184

COORDINATE SYSTEM:

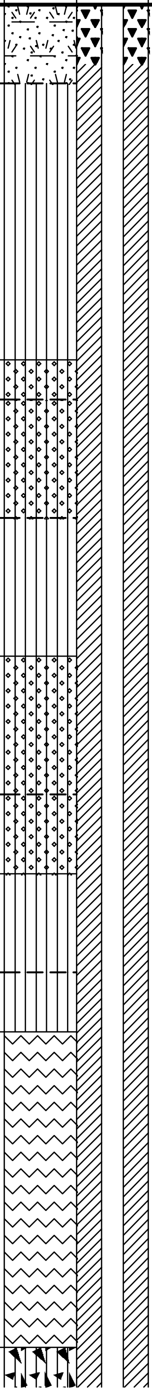
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING	**MW04**	**SHEET**	**1 OF 3**
START DATE	**5/27/2016**	**Elevation**	**73.30 FT. MSL**
FINISH DATE	**5/31/2016**		
PROJECT	**Phase 2 Hydrogeologic Investigation**		
LOCATION	**Issaquah, Washington**		
PROJECT NUMBER	**PNG0714**		



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	Grass, topsoil	Surface completion: 8" Morris monument					TOPSOIL	
	Brown, medium stiff, dry, sandy SILT; some rounded gravel		70				ML	
5								
			65			0.2		
	Gray, medium dense, dry, medium to fine SAND; poorly graded, trace gravel						SM	
10	Gray with some brown, medium dense, dry, silty SAND; poorly graded, trace gravel				60		SM	
						0		
	Brown, firm, wet, SILT; oxidation		60				ML	
15								
	Gray (Gley 2 4/5BG dark greenish gray), medium dense, moist, fine silty SAND; poorly graded, trace gravel, oxidation at 16.5-17.0		55				SM	
20	Gray (Gley 2 4/5BG dark greenish gray), medium dense, fine silty SAND; poorly graded	2" sch 40 PVC well casing			70		SM	
	Gray (Gley 2 4/5BG dark greenish gray), firm, moist, SILT		50				ML	
25	Gray (Gley 2 4/5BG dark greenish gray), firm, dry, SILT; some oxidation						ML	
	Black, dry, PEAT; some wood pieces, blocky structure		45				PT	
30					100			
	6" gray, firm, wet, silt		40	MW04_29to39 _20160527 @1245				DTW: 11' Screen: 29-39' First encountered groundwater:
35	Gray (Gley 2 4/5BG dark greenish gray), loose,						GM	

CONTRACTOR	**Holt Services**	**NORTHING**	**199858.780**
EQUIPMENT	**Terra Sonic, track**	**EASTING**	**1341896.090**
DRILL MTHD	**Sonic**	**ANGLE**	**Vertical**
DIAMETER	**8"**	**BEARING**	**------**
LOGGER J Dahl	**REVIEWER** C Bartlett	**PRINTED**	**07/08/16**

REMARKS: Site: Post office. Well Tag ID: BJX-186. Complete drilling on 05/27/2016, casing remained in the borehole 05/28-05/30, constructed monitoring well 05/31/2016.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

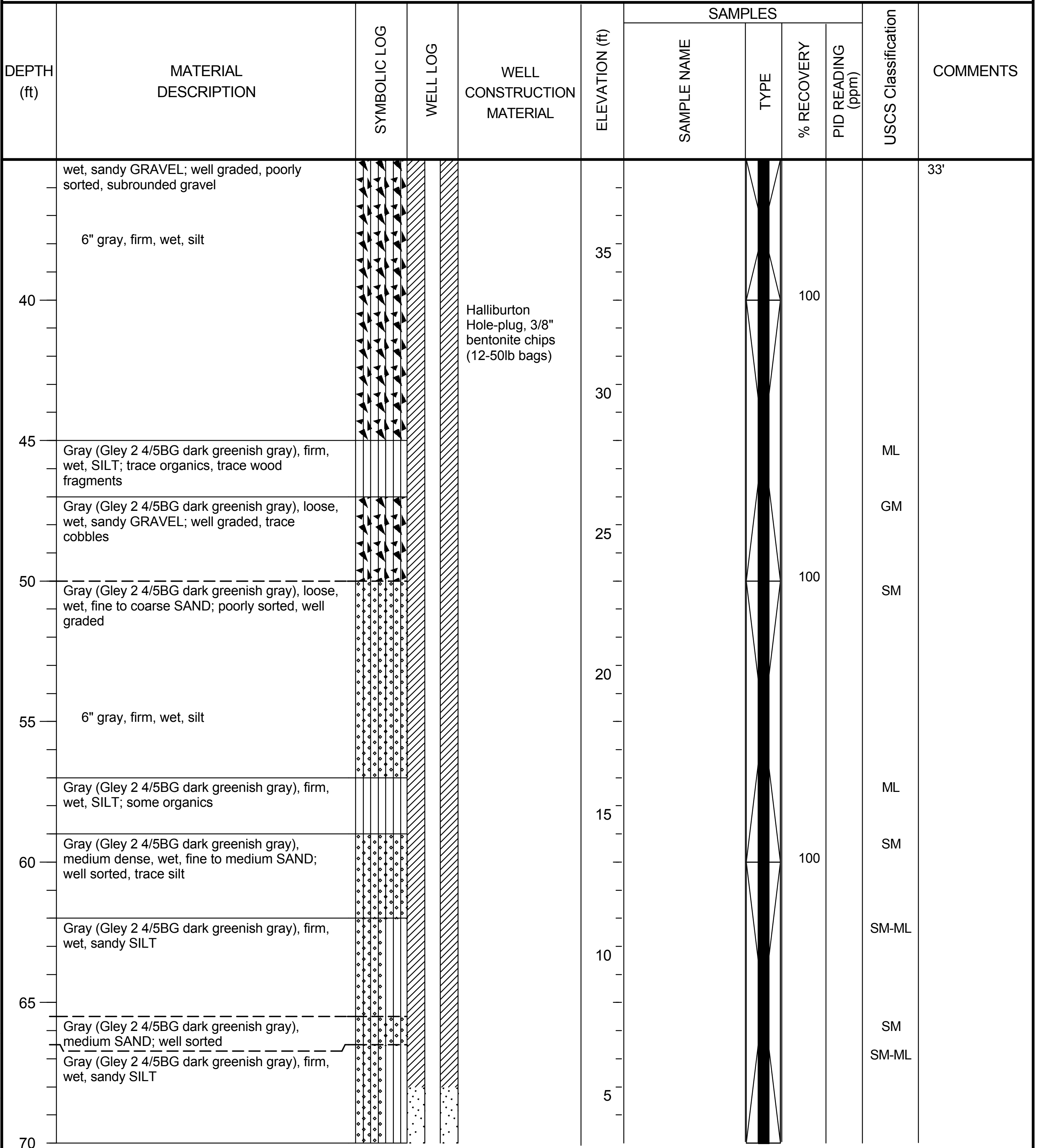
Geosyntec consultants

621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW04 **SHEET 2 OF 3**
START DATE 5/27/2016 **Elevation** 73.30 FT. MSL
FINISH DATE 5/31/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	wet, sandy GRAVEL; well graded, poorly sorted, subrounded gravel 6" gray, firm, wet, silt		35						33'
40		Halliburton Hole-plug, 3/8" bentonite chips (12-50lb bags)				100			
			30						
45	Gray (Gley 2 4/5BG dark greenish gray), firm, wet, SILT; trace organics, trace wood fragments							ML	
	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, sandy GRAVEL; well graded, trace cobbles		25					GM	
50	Gray (Gley 2 4/5BG dark greenish gray), loose, wet, fine to coarse SAND; poorly sorted, well graded 6" gray, firm, wet, silt		20			100		SM	
55									
	Gray (Gley 2 4/5BG dark greenish gray), firm, wet, SILT; some organics		15					ML	
60	Gray (Gley 2 4/5BG dark greenish gray), medium dense, wet, fine to medium SAND; well sorted, trace silt					100		SM	
	Gray (Gley 2 4/5BG dark greenish gray), firm, wet, sandy SILT		10					SM-ML	
65	Gray (Gley 2 4/5BG dark greenish gray), medium SAND; well sorted							SM	
	Gray (Gley 2 4/5BG dark greenish gray), firm, wet, sandy SILT		5					SM-ML	
70									

CONTRACTOR	Holt Services	**NORTHING**	199858.780
EQUIPMENT	Terra Sonic, track	**EASTING**	1341896.090
DRILL MTHD	Sonic	**ANGLE**	Vertical
DIAMETER	8"	**BEARING**	------
LOGGER J Dahl	**REVIEWER** C Bartlett	**PRINTED**	07/08/16

REMARKS: Site: Post office. Well Tag ID: BJX-186. Complete drilling on 05/27/2016, casing remained in the borehole 05/28-05/30, constructed monitoring well 05/31/2016.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BORING LOG W/WELL SONIC (PORTLAND) PNG0714 ISSAQUAH.GPJ EED DEFAULT GINT LIBRARY.GLB 7/8/16

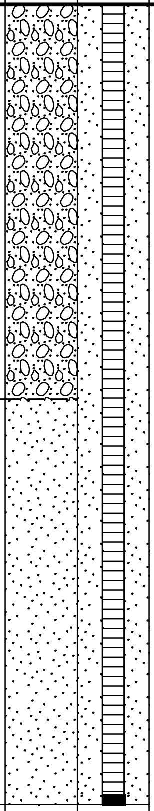
Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW04 **SHEET** 3 **OF** 3
START DATE 5/27/2016 **Elevation** 73.30 FT. MSL
FINISH DATE 5/31/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

				SAMPLES					
DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	Brown, medium dense, fine to coarse SAND; well graded, some rounded gravel (Advanced Outwash)					100		SW	
		2" sch 40 PVC 0.01" slotted well screen	0						
75									
			-5						
80	Brown, medium dense, wet, gravelly fine to coarse SAND					100		SP	
			-10						
85									
			-15						
90						100			
	End of boring, install monitoring well								



CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 199858.780
EASTING 1341896.090
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Post office. Well Tag ID: BJX-186. Complete drilling on 05/27/2016, casing remained in the borehole 05/28-05/30, constructed monitoring well 05/31/2016.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

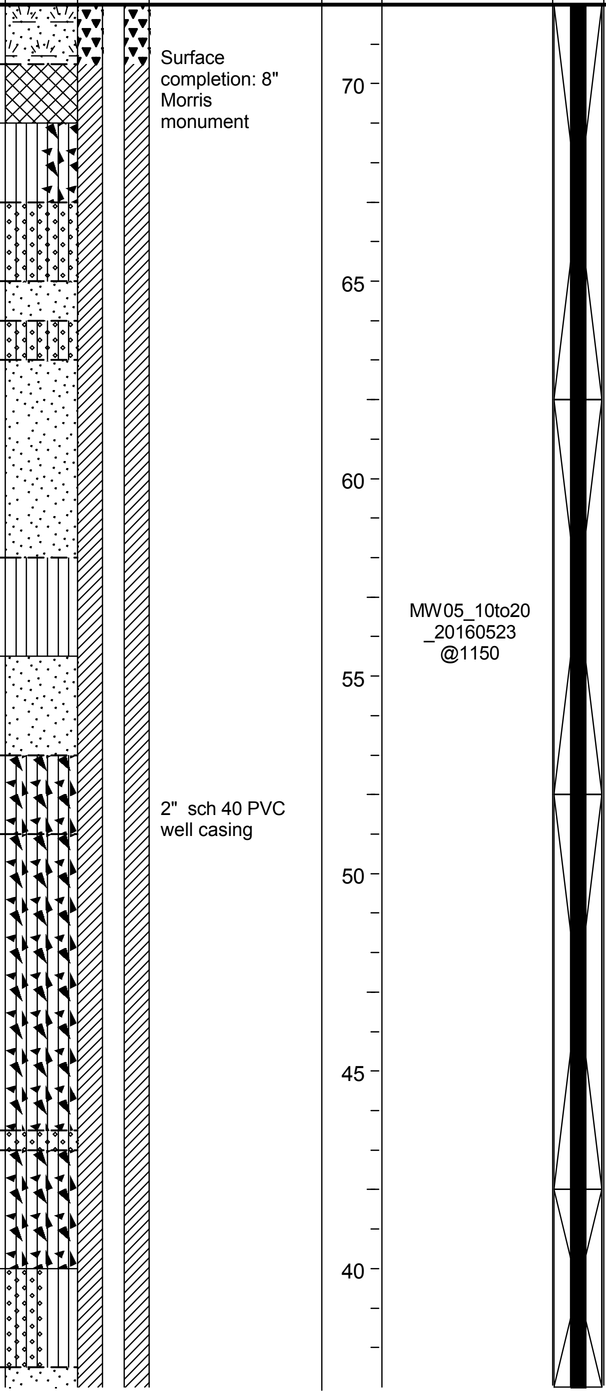
Geosyntec consultants

621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW05 **SHEET** 1 **OF** 3
START DATE 5/23/2016 **Elevation** 72.05 FT. MSL
FINISH DATE 5/23/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	Grass and Topsoil	Surface completion: 8" Morris monument	70			0	TOPSOIL	easy drilling
	FILL (Light brown, loose, moist, silty sandy GRAVEL; round coarse gravel)						FILL	
	Dark gray, medium dense, moist, silty GRAVEL/gravelly SILT; trace fine sand, subangular gravel, trace rounded gravel					0	ML-GM	
5	Dark and light gray mottled (Gley 1 3/5GY very dark greenish gray), medium dense, moist, silty fine SAND					0	SM	
	Gray (Gley 1 3/N very dark gray) fine SAND interbed with trace firewood pieces		65				SP	
	Dark and light gray mottled (Gley 1 3/5GY very dark greenish gray), medium dense, moist, silty fine SAND					0	SM SP	
10	Very dark gray (Gley 1 3/N), loose, moist, coarse SAND with some fine gravels grades to gravelly SAND, wet, well graded, round coarse gravels		60		100	0		First groundwater: 10', rising
15	Dark gray (Gley 1 2.5/5GY greenish black), moist, SILT with some clay; slight plasticity, fine sand interbeds (<1")			MW05_10to20 _20160523 @1150		0	ML	DTW: 7.7' Screen: 10-20'
	Brown (10YR 4/2 dark grayish brown), loose, medium SAND; poorly graded, trace coarse angular sand and fine subangular gravels		55			0	SP	
20	Dark gray, medium dense, wet, sandy GRAVEL	2" sch 40 PVC well casing			100		GM	5' heave
25	Medium brown (10YR 5/2 grayish brown), medium dense, wet, sandy GRAVEL; rounded/subrounded gravels, coarse sand, trace silt, well sorted gravels of volcanics, quartzite, basalt, and granodiorite		50 45			0 0	GM	
	medium to fine SAND, trace rounded gravel						SM	
30	Medium brown (10YR 5/2 grayish brown), medium dense, wet, sandy GRAVEL; round/subround gravels, coarse sand, trace silt, well sorted gravels of volcanics, quartzite, basalt, and granodiorite						GM	Continued heave
35	Dark gray, medium dense, wet, silty SAND to dark gray, medium stiff, wet, sandy SILT (Gley 1 4/N)		40			0.1	SM-ML	

CONTRACTOR	Holt Services	**NORTHING**	199057.680
EQUIPMENT	Terra Sonic, track	**EASTING**	1341394.920
DRILL MTHD	Sonic	**ANGLE**	Vertical
DIAMETER	8"	**BEARING**	------

LOGGER J Dahl **REVIEWER** C Bartlett **PRINTED** 07/08/16

REMARKS: Site: Salmon Run Park. Well Tag ID: BJX-183

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW05 **SHEET** 2 **OF** 3
START DATE 5/23/2016 **Elevation** 72.05 FT. MSL
FINISH DATE 5/23/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES				USCS Classification	COMMENTS
						SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)		
	Brown (10YR 4/3), medium dense, wet, fine to medium SAND; trace fine rounded gravels									SP	
	Medium brown/orange oxidation, medium dense, wet, coarse sandy GRAVEL; fine rounded gravel, trace coarse rounded gravel				35					GP	
									0.1		
	Medium brown/orange (7.5YR 4/6 strong brown), medium dense, wet, fine SAND; trace fine rounded gravel									SP	
								100			
40	Medium brown/orange (10YR 4/3 brown), loose, wet, gravelly SAND/sandy GRAVEL; coarse sand, coarse rounded well graded gravel			Halliburton Hole-plug, 3/8" bentonite chips (14-50lb bags)						GP	
									0.2		
					30						
	Dark gray (Gley 2 4/5B dark bluish gray), medium stiff, wet, sandy SILT; trace wood fragments, slight sulfur odor									SM-ML	
									0		
45											
					25						
									0		
								75			
50	Dark gray (Gley 2 4/5B dark bluish gray), medium stiff, wet, sandy SILT; trace organics									ML	
									0.1		
					20						
	Brown (10YR 4/3), medium dense, wet, fine to medium SAND; trace gravel									SM	
	Dark gray (Gley 2 4/5B dark bluish gray), medium stiff, wet, sandy SILT									SM-ML	
									0.1		
55	Brown (10YR 4/3), medium dense, wet, silty SAND; well graded, poorly sorted, trace gravel									SM	
					15						
									0		
								100			
60											
	Brown (2.5Y 3/2 very dark grayish brown), wet, fine to medium SAND; trace gravel, poorly graded, well sorted				10					SM	
	Brown, medium dense, wet, silty SAND; oxidation at contact								0	SM	
65											
									0		
	Brown (10YR 5/4 yellowish brown), stiff, wet, sandy SILT, some wood fragments									SM-ML	
					5						
	Brown (10YR 5/4 yellowish brown), medium dense, wet, silty coarse rounded GRAVELS									GP	
										SM-ML	
	Gray (Gley 2 4/5B dark bluish gray), soft, wet, sandy SILT								0	GM	
70											

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 199057.680
EASTING 1341394.920
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Salmon Run Park. Well Tag ID: BJX-183

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

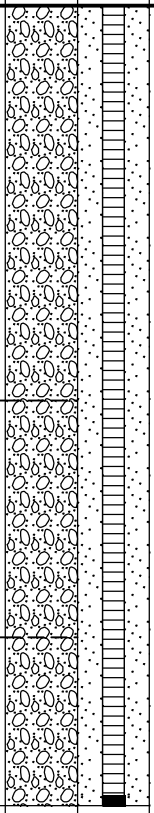
Geosyntec consultants

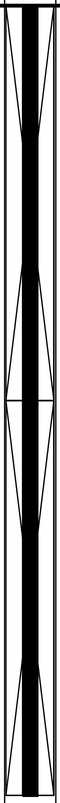
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW05 **SHEET** 3 **OF** 3
START DATE 5/23/2016 **Elevation** 72.05 FT. MSL
FINISH DATE 5/23/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714





DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Brown (10YR 4/4 dark yellowish brown), medium dense, wet, silty sandy GRAVEL; well graded, poorly sorted					75		SW	
	Brown (10YR 4/3), loose, wet, gravelly SAND; trace cobbles, no fines, well sorted, poorly graded, rounded (Advance Outwash)	2" sch 40 PVC 0.01" slotted well screen	0						
75									
			-5						
80	Brown (10YR 4/3), loose, wet, gravelly SAND; well graded, poorly sorted, no fines, rounded gravels						0	SW	
			-10						
85									
	Brown (10YR 4/3), medium dense, wet, fine to medium SAND; trace gravels, rounded, well sorted, poorly graded, no fines							SW	
			-15				0		
90	End of boring, installed monitoring well								

CONTRACTOR Holt Services
EQUIPMENT Terra Sonic, track
DRILL MTHD Sonic
DIAMETER 8"
LOGGER J Dahl **REVIEWER** C Bartlett

NORTHING 199057.680
EASTING 1341394.920
ANGLE Vertical
BEARING ------
PRINTED 07/08/16

REMARKS: Site: Salmon Run Park. Well Tag ID: BJX-183

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BORING LOG W/WELL SONIC (PORTLAND) PNG0714 ISSAQUAH.GPJ EED DEFAULT GINT LIBRARY.GLB 7/8/16

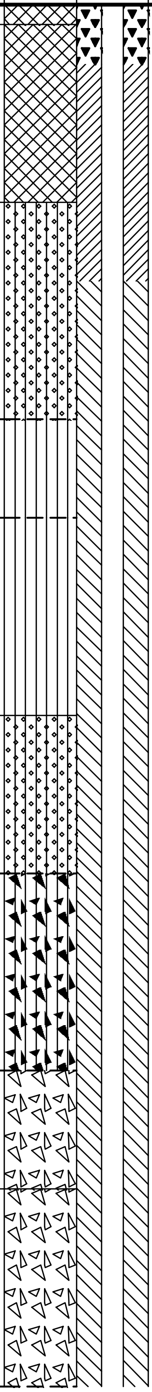
Geosyntec consultants

621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW06 **SHEET** 1 **OF** 3
START DATE 10/5/2016 **Elevation** FT. MSL
FINISH DATE 10/6/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	FILL (Barkdust, geotextile at 0.5')							FILL	
	FILL (Medium brown, loose, dry, silty SAND; topsoil)	Surface completion: 8" Morris monument, 2'x2' concrete pad Halliburton Hole-Plug, 3/8" bentonite chips (4-50lb bags)				100	0.3	FILL	
5	Light olive brown (2.5Y 5/3), loose, dry, fine SAND; trace silt					10 75	0.0	SM	Very soft drilling, compressing samples, poor recovery
10	Medium gray brown, soft, moist, SILT; some fine sand, trace clay (slightly plastic)					50 100	0.1	ML	
15	Dark bluish gray (2 gley 4/5 PB), soft, moist, medium gravelly SILT; less sand, more water, mottled gray and brown, trace clay, slightly plastic, oxidized at lower contact					100	0.1	ML	
20	Light brown gray, loose, moist, fine SAND; large wood piece at 19-19.5' (fresh), slight sulfur odor, trace silt, grading to coarse sand with depth					100	0.3 1.0	SM	
25	Medium brown, loose, wet, fine GRAVEL; some fine to coarse sand, trace silt, poorly sorted, occasional coarse subrounded gravel, grades to coarse gravel with depth			CO1-MW06 -20161005 -19.5-24.5 @1530		100	0.1 0.0	GM	DTW: 20' Screen: 19.5-24.5'
	Brown (7.5YR 4/4), loose, wet, sandy coarse GRAVEL; poorly sorted subrounded to subangular, trace silt						0.2	GW	
30 35	Dark yellow brown (10YR 4/6), loose, wet, GRAVEL; some cobbles, coarse sand to coarse subangular to subrounded gravel, trace fine sand	2" sch 40 PVC well casing				100	0.0 0.2 0.3	GW	Hit metal at 30', move over 2' Second hole on 10/06/2016, metal at 32.5?

CONTRACTOR Cascade Drilling
EQUIPMENT Geoprobe 8140LS, track
DRILL MTHD Sonic
DIAMETER 6"
LOGGER C Bartlett **REVIEWER** C Bartlett

NORTHING
EASTING
ANGLE Vertical
BEARING ------
PRINTED 11/07/16

REMARKS: Site: Dogwood/Newport. Well Tag ID: BJH-349

COORDINATE SYSTEM:

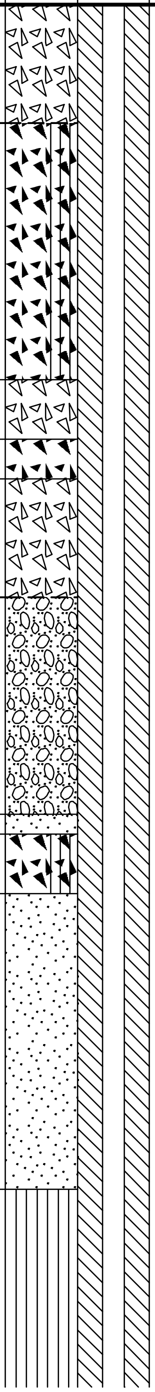
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW06 **SHEET** 2 **OF** 3
START DATE 10/5/2016 **Elevation** FT. MSL
FINISH DATE 10/6/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	SAMPLE NAME	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
				100	0.4	GW	
	- color change to dark brown (7.5YR 3/3), increased silt		CO1-MW06 -20161006 -34.5-39.5 @1015			GP-GM	DTW: 30' Screen: 34.5-39.5'
					0.1		
40				100			
					0.1		
45	Dark brown, loose, wet, sandy GRAVEL; trace fine sand, trace subrounded cobbles			100	0.0	GW	
	Brown (7.5YR 4/3), loose, wet, silty sandy GRAVEL					GP	
	Dark brown, loose, wet, sandy GRAVEL; trace fine sand, trace subrounded cobbles				0.0	GW	
					0.0		
50	Dark brown, loose, wet, coarse subrounded to subangular SAND; some fine gravel, occasional subangular cobble			100		SW	
					0.0		
			CO1-MW06 -20161006 -51-56 @1235				DTW: 29' Screen: 51-56'
55					0.0		
	Brown, loose, gravelly SAND					SP	
	Dark brown, loose, wet, cobbly subangular GRAVEL; trace silt, trace fine sand					GP-GM	
					0.0		
	Dark grayish brown (10YR 4/2), loose, wet, fine to medium SAND; trace fine gravel (no silt)					SP	
					0.0		
60		Halliburton Quik-Grout (4-50lb bags, 140 gal of water)		100			
							10' heave
					0.0		
65	Dark bluish gray (2 Gley 4/1 5PB), medium stiff, moist, fine sandy SILT; occasional fine rounded gravel				0.0	ML	
					0.0		
70							

CONTRACTOR Cascade Drilling
EQUIPMENT Geoprobe 8140LS, track
DRILL MTHD Sonic
DIAMETER 6"
LOGGER C Bartlett **REVIEWER** C Bartlett

NORTHING
EASTING
ANGLE Vertical
BEARING ------
PRINTED 11/07/16

REMARKS: Site: Dogwood/Newport. Well Tag ID: BJH-349

COORDINATE SYSTEM:

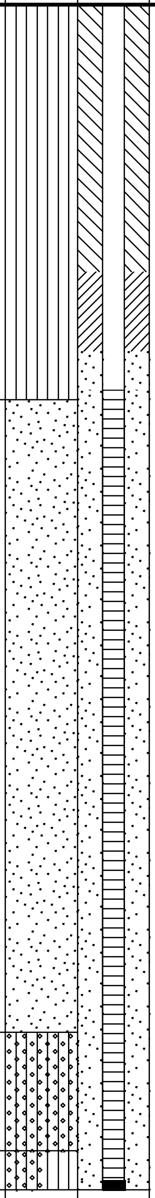
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

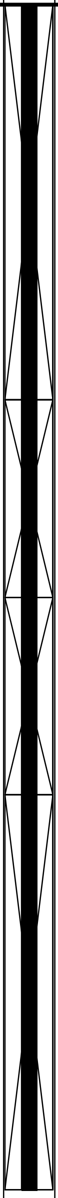
Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW06 **SHEET** 3 **OF** 3
START DATE 10/5/2016 **Elevation** FT. MSL
FINISH DATE 10/6/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714





DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
						100			
							0.0		
75	- increased fine sand, becomes finely interbedded, fine sand and silt						0.0		
		Halliburton Hole-Plug, 3/8" bentonite chips (1-50lb bag)					0.0		
80	Brown (10YR 4/3), loose, wet, SAND; well sorted, trace fine subrounded gravel, trace silt					75	0.0	SP	Heave, flush out with water
							0.0		
85						100	0.0		
							0.0		
90		2" sch 40 PVC 0.01" slotted well screen with 10/20 silica sand filter pack (8-50lb bags)				100			
							0.0		Using water to drill
95									
	Gray (1 Gley N4), loose, wet, silty very fine to fine SAND						0.0	SM	
	Gray, soft, wet, very fine sandy SILT						0.0	SM-ML	Sample compressed
100	End of boring, install monitoring well					75			

CONTRACTOR Cascade Drilling
EQUIPMENT Geoprobe 8140LS, track
DRILL MTHD Sonic
DIAMETER 6"
LOGGER C Bartlett **REVIEWER** C Bartlett

NORTHING
EASTING
ANGLE Vertical
BEARING ------
PRINTED 11/07/16

REMARKS: Site: Dogwood/Newport. Well Tag ID: BJH-349

COORDINATE SYSTEM:

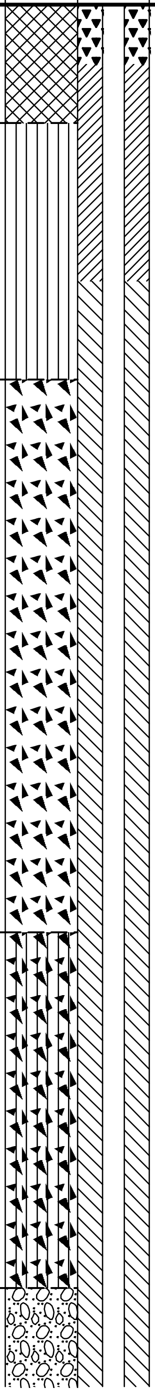
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW07 **SHEET** 1 **OF** 4
START DATE 10/7/2016 **Elevation** FT. MSL
FINISH DATE 10/10/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLE NAME	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
	FILL (Light brown gray, loose, dry, fine SAND)	Surface completion: 8" Morris monument, 2'x2' concrete pad					FILL	
	Yellowish brown (10YR 5/4), medium stiff, dry, SILT	Halliburton Hole-Plug, 3/8" bentonite chips (3-50lb bags)					ML	
5					75			
						0		
					100			
							GP	
10	Light brown gray, loose, dry, sandy coarse GRAVEL; subrounded to subangular, some subrounded cobbles							
						0		
15								
	- increased silt (<10%)							
20					80			
					100			
	- large boulder			CO1-MW07 -20161007 -20-25 @1450			GM	Hard drilling DTW: 26' Screen: 20-25'
25	Yellow brown (10YR 5/4), medium dense, moist, sandy coarse GRAVEL; subrounded, trace silt, some cobbles							
		2" sch 40 PVC well casing						
								Hole caved-in
30								30-32' washed out
							SW	
	Olive brown (2.5Y 4/3), loose, wet, fine to coarse SAND; some coarse subangular gravel							
35								

CONTRACTOR	Cascade Drilling	**NORTHING**	
EQUIPMENT	Geoprobe 8140LS, track	**EASTING**	
DRILL MTHD	Sonic	**ANGLE**	Vertical
DIAMETER	6"	**BEARING**	------
LOGGER C Bartlett	**REVIEWER** C Bartlett	**PRINTED**	11/07/16

REMARKS: Site: Alder Court. Well Tag ID: BJH-348

COORDINATE SYSTEM:

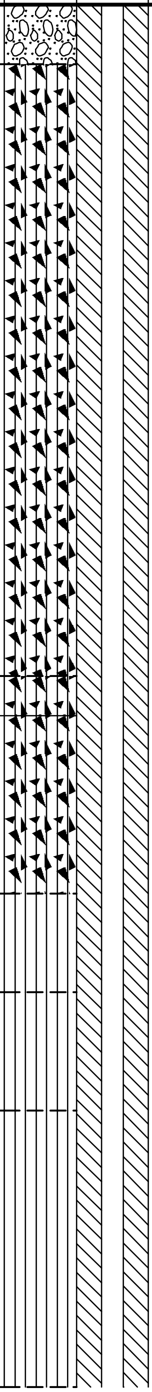
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW07 **SHEET** 2 **OF** 4
START DATE 10/7/2016 **Elevation** FT. MSL
FINISH DATE 10/10/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES				USCS Classification	COMMENTS
						SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)		
	Brown, loose, wet, silty fine to coarse subrounded GRAVEL to fine to coarse sandy GRAVEL, with silt, occasional cobble									GM	
						CO1-MW07 -20161007 -35-40 @1535					DTW: 22' Screen: 35-40'
40								75			
45											
50											
	Light olive brown (2.5Y 5/2), loose, wet, sandy GRAVEL; with silt			Halliburton Quik-Grout (4-50lb bags, 30 gal of water)						GM	
	Brown, loose, wet, silty fine to coarse subrounded GRAVEL to fine to coarse sandy GRAVEL, with silt, occasional cobble									GM	7' of heave, very soft, pushing out, poor recovery (depths recovered uncertain)
55											
	Olive brown, very soft, wet, SILT									ML	
60	Dark gray, soft, wet, clayey SILT; low to medium plasticity							25		ML	change to flapper bit
	Dark gray (N4), medium stiff, moist, SILT; low plasticity, trace very fine to fine sand									ML	very soft, fighting heave at 60', good recovery
65											
						C01-MW07 -20161007 -65-70 @1800					DTW: 52' Screen: 65-70'
70											

CONTRACTOR Cascade Drilling
EQUIPMENT Geoprobe 8140LS, track
DRILL MTHD Sonic
DIAMETER 6"
LOGGER C Bartlett **REVIEWER** C Bartlett

NORTHING
EASTING
ANGLE Vertical
BEARING ------
PRINTED 11/07/16

REMARKS: Site: Alder Court. Well Tag ID: BJH-348

COORDINATE SYSTEM:

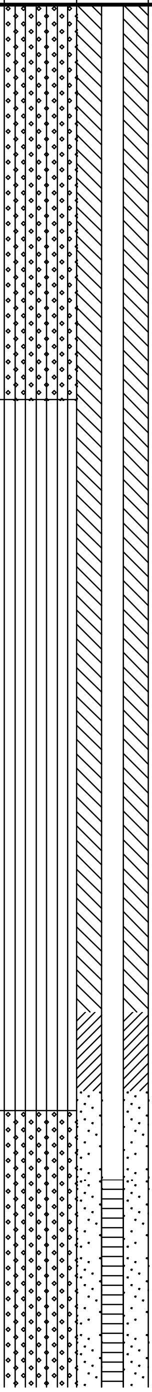
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING MW07 **SHEET** 3 **OF** 4
START DATE 10/7/2016 **Elevation** FT. MSL
FINISH DATE 10/10/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714



DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
	Dark gray, loose, wet, silty very fine to medium SAND; some finely interbedded silt							100		SM	
75								100			
80	Dark gray, medium stiff, moist, sandy SILT; trace clay							80		ML	End of day (10/07/16) Begin next day (10/08/16)
								100			
85											
90								100			
95				Halliburton Hole-Plug, 3/8" bentonite chips (1-50lb bag)							
	Dark gray, loose, moist, fine to medium SAND; trace fine gravel and silt									SM	
100								75			
105											

CONTRACTOR Cascade Drilling
EQUIPMENT Geoprobe 8140LS, track
DRILL MTHD Sonic
DIAMETER 6"
LOGGER C Bartlett **REVIEWER** C Bartlett

NORTHING
EASTING
ANGLE Vertical
BEARING ------
PRINTED 11/07/16

REMARKS: Site: Alder Court. Well Tag ID: BJH-348

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BORING LOG W/WELL SONIC (PORTLAND) PNG0714 ISSAQUAH.GPJ EED DEFAULT GINT LIBRARY.GLB 11/7/16

Geosyntec consultants

621 SW Morrison Street, Suite 600
Portland, Oregon 97205
Phone: 503.222.9518

GS FORM:
CORE3 10/00

BOREHOLE LOG

BORING MW07 **SHEET** 4 **OF** 4
START DATE 10/7/2016 **Elevation** FT. MSL
FINISH DATE 10/10/2016
PROJECT Phase 2 Hydrogeologic Investigation
LOCATION Issaquah, Washington
PROJECT NUMBER PNG0714

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES				USCS Classification	COMMENTS
						SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)		
				2" sch 40 PVC 0.01" slotted well screen with 10/20 silica sand filter pack (4.5-50lb bags)				100			
110	End of boring, install monitoring well										

CONTRACTOR Cascade Drilling
EQUIPMENT Geoprobe 8140LS, track
DRILL MTHD Sonic
DIAMETER 6"
LOGGER C Bartlett **REVIEWER** C Bartlett

NORTHING
EASTING
ANGLE Vertical
BEARING ------
PRINTED 11/07/16

REMARKS: Site: Alder Court. Well Tag ID: BJH-348

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Coarse-Grained Soils - More than 50%(1) Retained on No. 200 Sieve	Gravels - More than 50%(1) of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines (5)	**GW**	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥12% Fines (5)	**GM**	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50%(1) or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines (5)	**SW**	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥12% Fines (5)	**SM**	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50% (1) or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		**ML**	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		**MH**	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			**PT**	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT(2) blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50
	Consistency	**SPT(2) blows/foot**
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

(3) Estimated Percentage

Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch

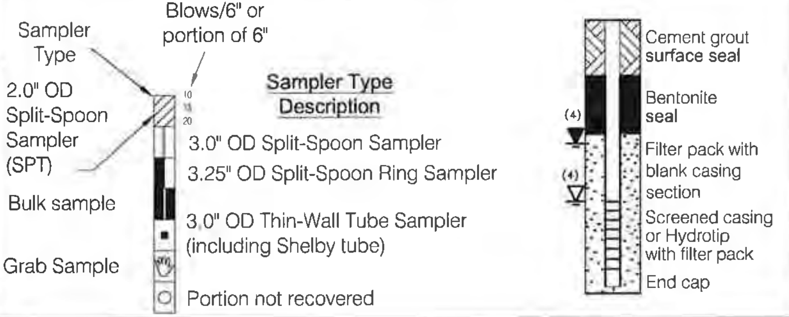
Slightly Moist - Perceptible moisture

Moist - Damp but no visible water

Very Moist - Water visible but not free draining

Wet - Visible free water, usually from below water table

Symbols



(1) Percentage by dry weight

(2) (SPT) Standard Penetration Test (ASTM D-1586)

(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

(4) Depth of ground water

▼ ATD = At time of drilling

▽ Static water level (date)

(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

associated
earth sciences
incorporated

EXPLORATION LOG KEY

FIGURE A1

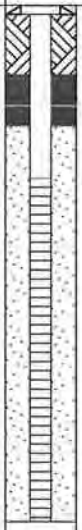
blocks \ dwg \ log_key.dwg LAYOUT: Layout 4 -2014 Qty Chng

associated earth sciences incorporated

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
180066E001	EB-1W	1 of 1

Project Name: Issaquah Middle School
Elevation (Top of Well Casing): -0.292 ft below ground surface
Water Level Elevation:
Drilling/Equipment: Boretec / EC95 Rubber Track Drill
Hammer Weight/Drop: 140# / 30"
Location: Issaquah, WA
Surface Elevation (ft):
Date Start/Finish: 4/30/18,4/30/18
Hole Diameter (in): 8 inches



Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	DESCRIPTION
		Flush mount monument Concrete 0 to 2 feet			**Lawn** **Fill** Gravelly drilling.
		Bentonite chips (Pure Gold, medium) 2 to 3.5 feet 2-inch I.D. Sch 40 PVC casing 0 to 5 feet		27 12 8	Very moist, brown, slightly silty, fine SAND, some gravel (SM).
5		Sand Pack (Colorado whole grain silica sand) 3.5 to 15 feet		3 4 5	Very moist, brown, slightly gravelly, fine SAND, trace silt, trace organics (SP).
					Younger Alluvium Drill chatter, grinding at 7.5 feet.
10		2-inch I.D. Sch 40 PVC well screen 0.020-inch slot width 5 to 15 feet		11 14 10	Very moist, orange and gray, slightly silty, fine SAND, some gravel; seam (1 inch thick) of gray, SILT; seam (1/2 inch thick) of wet, orange, silty, SAND; exterior of spoon wet (SM).
15	▼			10 11 19	Wet, orangish brown, medium SAND, some silt, some gravel; seam (3 inches thick) of larger gravel (SP).
		ECY Well tag # BKH-190			Boring terminated at 16.5 feet. Well completed at 15 feet on 4/30/18. Groundwater encountered at 15 feet.
20					
25					
30					
35					

Sampler Type (ST):

▯	2" OD Split Spoon Sampler (SPT)	▯	No Recovery	M -	Moisture
▯	3" OD Split Spoon Sampler (D & M)	▮	Ring Sample	▽	Water Level ()
▣	Grab Sample	▨	Shelby Tube Sample	▼	Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
180066E001	EB-2	1 of 2

Project Name: Issaquah Middle School
Location: Issaquah, WA
Driller/Equipment: Boretec / EC95 Rubber Track Drill
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft):
Datum: N/A
Date Start/Finish: 4/30/18,4/30/18
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
0			**Gravel**					
			Fill					
	◫	S-1	Very moist, grayish brown, fine SAND, some silt, some gravel (SP).			2 1 2	3	
5	◫	S-2	Moist, gray, fine sandy, SILT; faintly laminated with rust colored laminae (ML).			7 6 5	11	
			Younger Alluvium					
			Moist, orangish brown, medium SAND, some silt, some gravel (SP).					
10					▼			
	◫	S-3	Wet, brown, silty, fine SAND, some gravel (SM). Wet, orangish brown, slightly sandy, GRAVEL, some silt (GP). Free water in spoon. Some drill chatter.			12 13 12	25	
15	◫	S-4	Wet, brown, fine SAND (SP). Wet, brownish gray, coarse SAND, some gravel (SP). Wet, brownish gray, silty, gravelly, fine SAND (SM).			14 13 13	26	
			Fraser Undifferentiated					
			Heavy drill chatter, bouncing. Difficult drilling.					
20	◫	S-5	Wet, brownish gray with trace iron oxide staining, very gravelly, slightly silty, medium SAND; occasional large gravel in spoon; interbeds (<1 inch thick) of coarse sand or silt (SP). Difficult drilling continues.			14 21 27	48	
25	◫	S-6	Wet, brownish gray, very gravelly, medium SAND, some silt; thin beds (1/2 to 1 inch thick) of coarse sand and silt (SP).			20 26 22	48	
			Smoother drilling.					
30	◫	S-7	Wet, gray, fine SAND; massive; grades to medium SAND with gravel at shoe (SP). Difficult drilling.			7 7 7	14	
35	◫	S-8	Wet, gray, fine SAND; massive (SP). Wet, brownish gray, sandy, GRAVEL, some silt; clasts of gray silt and brown silt (GP).			11 20 23	43	
			Smoother drilling.					

Sampler Type (ST):

◫ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
◫ 3" OD Split Spoon Sampler (D & M)	▮ Ring Sample	▽ Water Level ()
▨ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
180066E001	EB-2	2 of 2

Project Name Issaquah Middle School
Location Issaquah, WA
Driller/Equipment Boretec / EC95 Rubber Track Drill
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft)
Datum N/A
Date Start/Finish 4/30/18,4/30/18
Hole Diameter (in) 8 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
		S-9		Wet, gray, fine SAND; massive (SP). Wet, gray, slightly gravelly, fine SAND, some medium and coarse sand, some silt; occasional large gravel (SP). Some drill chatter but generally smooth drilling.			25 29 43	▲74	
45		S-10		Wet, gray, fine SAND to medium SAND (SP). Difficult drilling. Wet, brownish gray, gravelly, silty, fine SAND; unsorted (SM). Smoother drilling.			32 50/6"	▲50/6"	
50		S-11		Wet, gray, very fine, SAND; bed (3 inches thick) of fine sand, fine gravel, in shoe (SP).			29 24 20	▲44	
				Bottom of exploration boring at 51.5 feet Groundwater encountered at 10 feet.					
55									
60									
65									
70									
75									

Blows/Foot scale: 10 20 30 40

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ☒ Grab Sample
- ☐ No Recovery
- ▮ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

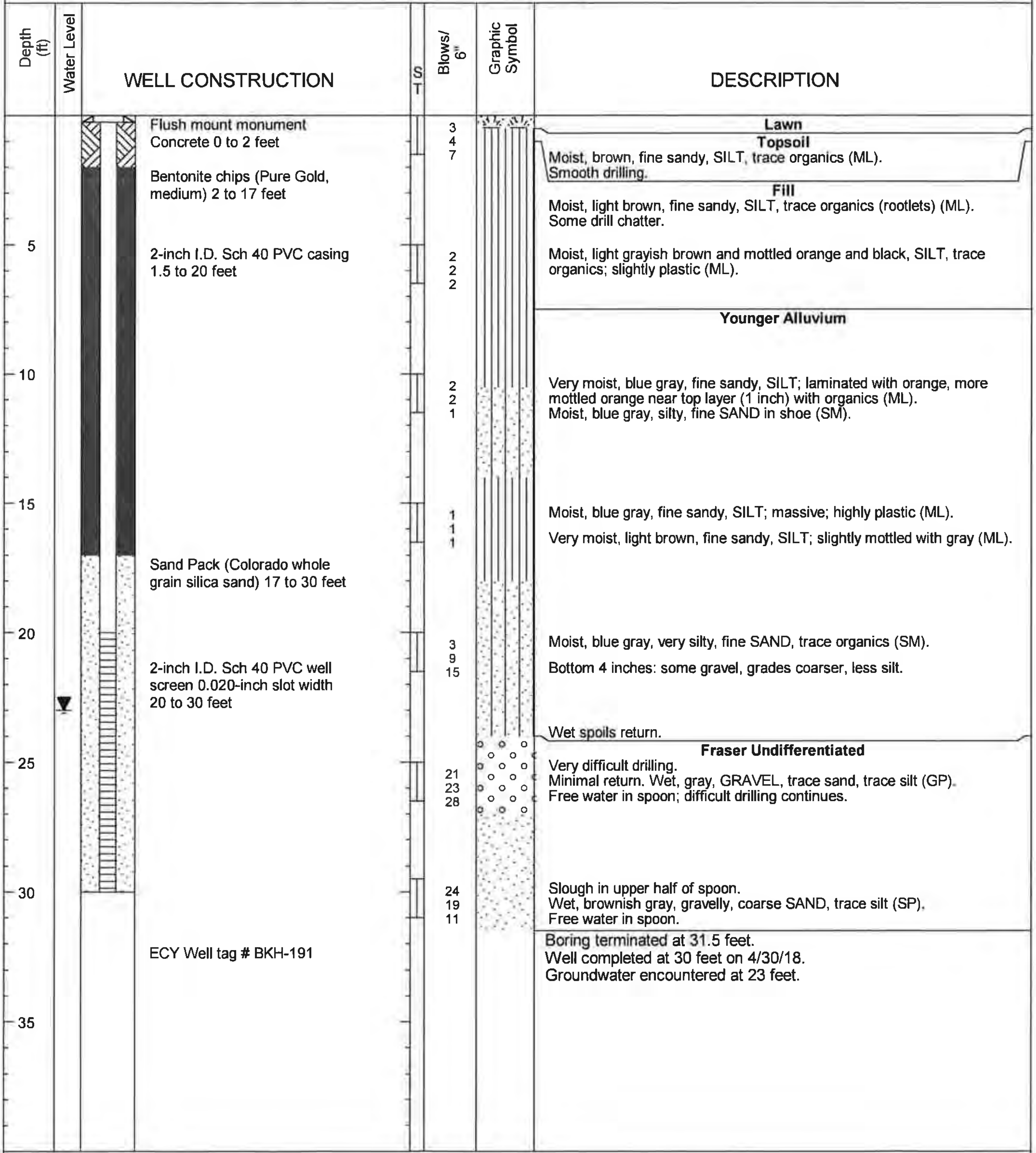
Logged by: NS
Approved by: CJK

associated earth sciences incorporated

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
180066E001	EB-3W	1 of 1

Project Name: Issaquah Middle School
Location: Issaquah, WA
Elevation (Top of Well Casing): -0.365 ft below ground surface
Surface Elevation (ft):
Water Level Elevation:
Date Start/Finish: 4/30/18,4/30/18
Drilling/Equipment: Boretec / EC95 Rubber Track Drill
Hole Diameter (in): 8 inches
Hammer Weight/Drop: 140# / 30"



Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
0		Flush mount monument Concrete 0 to 2 feet		3 4 7		**Lawn** **Topsoil** Moist, brown, fine sandy, SILT, trace organics (ML). Smooth drilling.
		Bentonite chips (Pure Gold, medium) 2 to 17 feet				**Fill** Moist, light brown, fine sandy, SILT, trace organics (rootlets) (ML). Some drill chatter.
5		2-inch I.D. Sch 40 PVC casing 1.5 to 20 feet		2 2 2		Moist, light grayish brown and mottled orange and black, SILT, trace organics; slightly plastic (ML).
						Younger Alluvium
10				2 2 1		Very moist, blue gray, fine sandy, SILT; laminated with orange, more mottled orange near top layer (1 inch) with organics (ML). Moist, blue gray, silty, fine SAND in shoe (SM).
15				1 1 1		Moist, blue gray, fine sandy, SILT; massive; highly plastic (ML). Very moist, light brown, fine sandy, SILT; slightly mottled with gray (ML).
		Sand Pack (Colorado whole grain silica sand) 17 to 30 feet				
20		2-inch I.D. Sch 40 PVC well screen 0.020-inch slot width 20 to 30 feet		3 9 15		Moist, blue gray, very silty, fine SAND, trace organics (SM). Bottom 4 inches: some gravel, grades coarser, less silt.
	▼					Wet spoils return.
25				21 23 28		**Fraser Undifferentiated** Very difficult drilling. Minimal return. Wet, gray, GRAVEL, trace sand, trace silt (GP). Free water in spoon; difficult drilling continues.
30				24 19 11		Slough in upper half of spoon. Wet, brownish gray, gravelly, coarse SAND, trace silt (SP). Free water in spoon.
		ECY Well tag # BKH-191				Boring terminated at 31.5 feet. Well completed at 30 feet on 4/30/18. Groundwater encountered at 23 feet.
35						

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ▣ Grab Sample
- ▯ No Recovery
- ▮ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
180066E001	EB-4	1 of 2

Project Name Issaquah Middle School
Location Issaquah, WA
Driller/Equipment Boretec / EC95 Rubber Track Drill
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft)
Datum N/A
Date Start/Finish 4/30/18,4/30/18
Hole Diameter (in) 8 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Lawn					
				Fill					
		S-1		Moist, light grayish brown with mottled iron oxide, SILT, some fine and, trace organics; rootlets and black specks; slightly plastic (ML).			3 4 3	▲7	
5				**Younger Alluvium**					
		S-2		Very moist, reddish brown with mottled iron oxide, silty, fine SAND, trace organics (SM). Moist, mottled orange, brown and gray, fine sandy, SILT (ML). Bottom of 12 inches of spoon wet. Bed (3 inches thick) of very moist, brown, silty, fine SAND.		▼	3 2 3	▲5	
10		S-3		Wet, brown, silty, fine SAND (SM). Wet, gray, silty, fine SAND, trace organics; occasional faint laminae; root (1 inch in diameter) (SM).			2 2 2	▲4	
15		S-4		Wet, gray, medium SAND; occasional thin bed (1/4 inch thick) of coarse sand (SP).			4 3 4	▲7	
20		S-5		Wet, gray, medium SAND; massive (SP). Free water. Bottom 4 inches: Wet, brown and gray, coarse SAND, some gravel, trace silt (SP).			3 6 9	▲15	
				Fraser Undifferentiated					
25		S-6		Wet, brownish gray, medium SAND; one coarse sand interbed (1/2 inch thick) (SP). Heavy drill chatter and difficult drilling. Bottom 8 inches: Wet, light orangish brown, gravelly, medium SAND, trace silt, trace coarse sand (SP).			25 17 10	▲27	
30		S-7		Fairly smooth drilling. Wet, gray, fine SAND grading to medium; bed (5 inches thick) of wet, orangish brown, slightly silty, medium SAND; laminated (SP). Bottom 5 inches: Wet, silty, gravelly, fine SAND (SM).			7 22 21	▲43	
35		S-8		Wet, gray, medium SAND grading to a thin bed of coarse sand (SP). Orangish brown, fine SAND, some silt (SP). Thin layer (1/8 inch thick) of blue gray, SILT at tip of shoe.			7 9 13	▲22	

Sampler Type (ST):

◫ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
◫ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
☒ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
180066E001	EB-4	2 of 2

Project Name: Issaquah Middle School
Location: Issaquah, WA
Driller/Equipment: Boretec / EC95 Rubber Track Drill
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft):
Datum: N/A
Date Start/Finish: 4/30/18,4/30/18
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	DESCRIPTION	Blows/6"	Blows/Foot
		S-9	Very moist, gray, very silty, fine SAND, trace organics; thin black laminae at ~1 inch spacing (SM). Bed (5 inches thick) of wet, gray, silty, coarse, SAND, some gravel; vertical rust colored streak (SM).	8 6 10	16
45		S-10	Wet, gray, silty, fine SAND, trace gravel; massive (SM). Wet, orangish brown, fine SAND, trace silt; grades to coarse SAND (SP). Bed (2 inches thick) of orangish brown, silty, fine SAND; laminated (SM). Difficult drilling.	7 10 15	25
50		S-11	Wet, gray, brown, silty, fine SAND, some gravel; unsorted; large rock near shoe (SM). Smoother drilling. Drill chatter.	50/6"	50/6"
55		S-12	Wet, brownish gray, gravelly, coarse SAND, some silt (SP). Interbeds (1 inch thick) of orange, silty, medium SAND (ML).	50/6"	50/6"
			Bottom of exploration boring at 55.5 feet Groundwater encountered at 5.5 feet.		
60					
65					
70					
75					

Sampler Type (ST):
- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ▨ Grab Sample
- ☐ No Recovery
- ▮ Ring Sample
- ▧ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

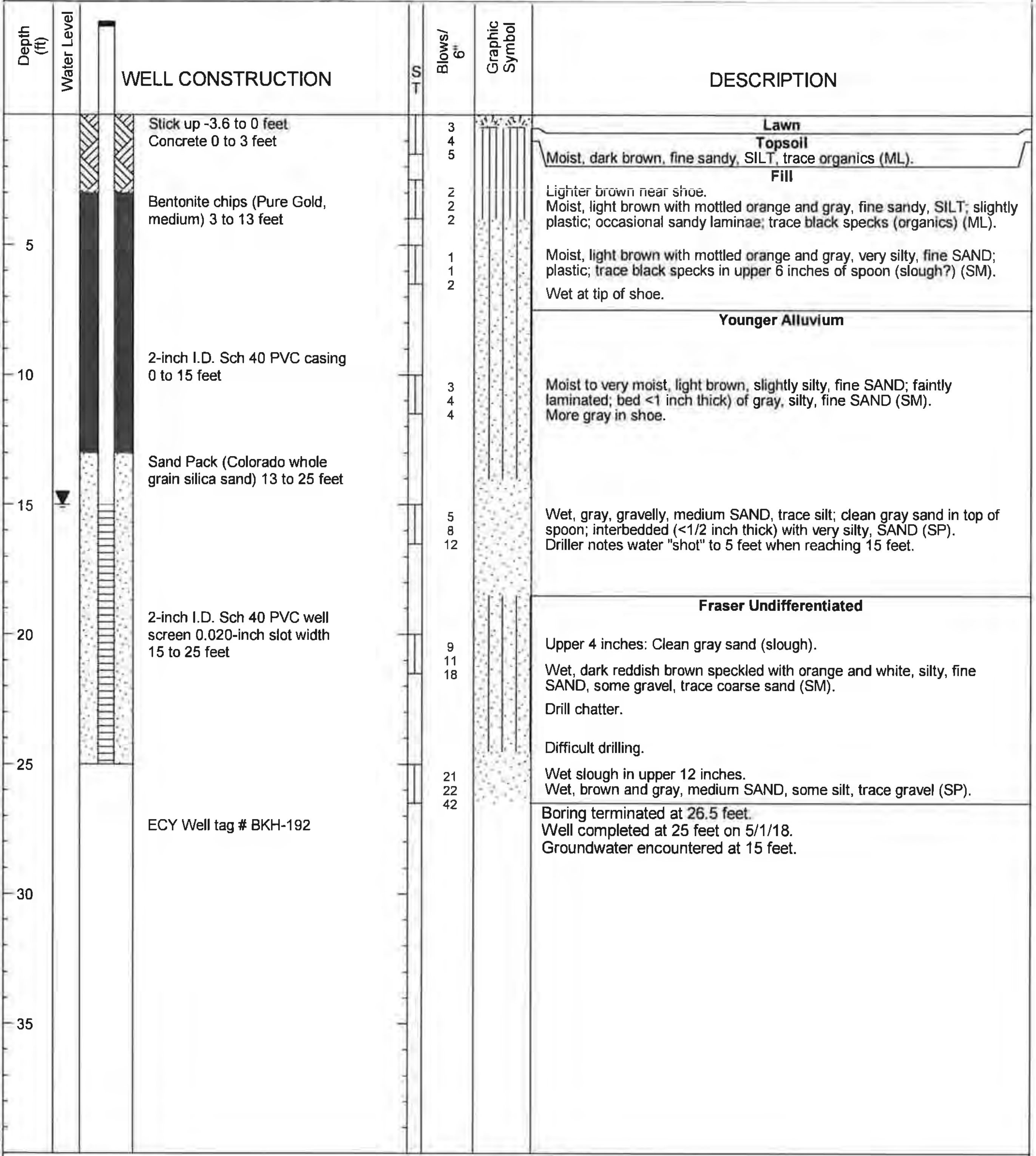
Logged by: NS
Approved by: CJK

associated earth sciences incorporated

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
180066E001	EB-5W	1 of 1

Project Name: Issaquah Middle School
Elevation (Top of Well Casing):
Water Level Elevation:
Drilling/Equipment: Boretec / EC95 Rubber Track Drill
Hammer Weight/Drop: 140# / 30"
Location: Issaquah, WA
Surface Elevation (ft):
Date Start/Finish: 5/1/18,5/1/18
Hole Diameter (in): 8 inches



WELL CONSTRUCTION

Stick up -3.6 to 0 feet
Concrete 0 to 3 feet

Bentonite chips (Pure Gold, medium) 3 to 13 feet

2-inch I.D. Sch 40 PVC casing 0 to 15 feet

Sand Pack (Colorado whole grain silica sand) 13 to 25 feet

2-inch I.D. Sch 40 PVC well screen 0.020-inch slot width 15 to 25 feet

ECY Well tag # BKH-192

Blows/6"

3, 4, 5
2, 2, 2
1, 1, 2
3, 4, 4
5, 8, 12
9, 11, 18
21, 22, 42

DESCRIPTION

Lawn

Topsoil

Moist, dark brown, fine sandy, SILT, trace organics (ML).

Fill

Lighter brown near shoe.

Moist, light brown with mottled orange and gray, fine sandy, SILT; slightly plastic; occasional sandy laminae; trace black specks (organics) (ML).

Moist, light brown with mottled orange and gray, very silty, fine SAND; plastic; trace black specks in upper 6 inches of spoon (slough?) (SM).

Wet at tip of shoe.

Younger Alluvium

Moist to very moist, light brown, slightly silty, fine SAND; faintly laminated; bed <1 inch thick) of gray, silty, fine SAND (SM).
More gray in shoe.

Wet, gray, gravelly, medium SAND, trace silt; clean gray sand in top of spoon; interbedded (<1/2 inch thick) with very silty, SAND (SP).
Driller notes water "shot" to 5 feet when reaching 15 feet.

Fraser Undifferentiated

Upper 4 inches: Clean gray sand (slough).

Wet, dark reddish brown speckled with orange and white, silty, fine SAND, some gravel, trace coarse sand (SM).

Drill chatter.

Difficult drilling.

Wet slough in upper 12 inches.
Wet, brown and gray, medium SAND, some silt, trace gravel (SP).

Boring terminated at 26.5 feet.
Well completed at 25 feet on 5/1/18.
Groundwater encountered at 15 feet.

Sampler Type (ST):

◫ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
◫ 3" OD Split Spoon Sampler (D & M)	▮ Ring Sample	▽ Water Level ()
▣ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
180066E001	EB-6	1 of 1

Project Name	Issaquah Middle School	Ground Surface Elevation (ft)	
Location	Issaquah, WA	Datum	N/A
Driller/Equipment	Boretec / EC95 Rubber Track Drill	Date Start/Finish	5/1/18,5/1/18
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	8 inches

Depth (ft)	Samples	DESCRIPTION	Water Level	Blows/6"	Blows/Foot
		Lawn			
	S-1	**Topsoil / Fill** Moist, dark brown, SILT, some fine sand, trace organics; slightly plastic (ML).		2 4 4	8
	S-2	Moist, light brown with mottled orange and gray, very sandy, SILT, trace organics; black specks, rootlets (ML).		1 2 1	3
5	S-3	**Younger Alluvium** Very moist, light brown with mottled orange and gray, slightly silty, fine SAND, trace organics (SM). Bed (1 inch thick) of brown, SAND, some silt near shoe with sandy silt in shoe.		1 1 3	4
10	S-4	Wet, brown with some gray mottling, fine SAND, some silt; occasional orange laminae (SP). Laminae (3 inches thick) of alternating light brown and gray, fine sandy, SILT. Wet, blue gray, fine sandy, SILT interbedded with clean medium SAND and SILT (<1/2 inch thick) (ML).	▼	4 3 3	6
15	S-5	Upper 6 inches: Wet, brown, slough, free water in spoon. Wet, blue gray, slightly silty, fine SAND, trace organics (small roots); trace white specks (SM).		2 1 2	3
20	S-6	Upper 6 inches: Wet, gray, medium SAND; occasional bed (<1 inch thick) of coarse sand; free water in spoon (SP). **Fraser Undifferentiated** Wet, gray, coarse SAND, some silt, some gravel; interbeds (1/2 to 1 inch thick) of gravel, silty, fine SAND, orange silty, fine sand (SP).		10 18 17	35
25	S-7	Wet, brownish gray, very gravelly, coarse SAND, trace to some silt; grades coarser to shoe (SP). Difficult drilling.		50/6"	50/6"
30	S-8	Wet, brownish gray, medium SAND, trace silt; massive (SP).		28 24 23	47
		Bottom of exploration boring at 31.5 feet Groundwater encountered at 13 feet.			
35					

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	▮ Ring Sample	▽ Water Level ()
☒ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: NS
Approved by: CJK

APPENDIX F
LABORATORY ACCREDITATION

PRE- AND POLY-FLUOROALKYL SUBSTANCES
CHARACTERIZATION STUDY WORK PLAN
Lower Issaquah Valley
Issaquah, Washington

Farallon PN: 1754-002

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the DoD Quality Systems Manual for Environmental Laboratories Version 5.1 January 2017 and is accredited is accordance with the:

United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP)

This accreditation demonstrates technical competence for the defined scope:

Chemical and Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Initial Accreditation Date:	*Issue Date:*	*Expiration Date:*
July 19, 2011	March 8, 2018	June 30, 2020

Accreditation No.:	*Certificate No.:*
65188	L18-128

Tracy Szerszen
President/Operations Manager

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 1631E	CVAFS	Mercury (Low level)
Aqueous	EPA 1664A	Gravimetry	Hexane Extractable Material (HEM)
Aqueous	EPA 1664A	Gravimetry	Total Petroleum Hydrocarbons (TPH)
Aqueous	EPA 180.1	Turbidimetry	Turbidity
Aqueous	EPA 2340B	Calculation by 6010	Hardness as CaCO3)
Aqueous	EPA 245.1	CVAA	Mercury
Aqueous	EPA 300.0	IC	Bromide
Aqueous	EPA 300.0	IC	Chloride
Aqueous	EPA 300.0	IC	Fluoride
Aqueous	EPA 300.0	IC	Nitrate
Aqueous	EPA 300.0	IC	Nitrite as N
Aqueous	EPA 300.0	IC	Sulfate
Aqueous	EPA 353.2	Colorimetry	Nitrate + Nitrite as N
Aqueous	EPA 7196A	Colorimetry	Chromium VI
Aqueous	EPA 7470A	CVAA	Mercury
Aqueous	EPA 8260C SIM	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,1,2-Trichloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,1-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	1,2-Dibromoethane
Aqueous	EPA 8260C SIM	GC-MS	1,2-Dichloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,3 Butadine
Aqueous	EPA 8260C SIM	GC-MS	1,4-Dichlorobenzene
Aqueous	EPA 8260C SIM	GC-MS	Bromodichloromethane
Aqueous	EPA 8260C SIM	GC-MS	Carbon Tetrachloride
Aqueous	EPA 8260C SIM	GC-MS	Chlorodibromomethane
Aqueous	EPA 8260C SIM	GC-MS	Chloroform
Aqueous	EPA 8260C SIM	GC-MS	Chloromethane
Aqueous	EPA 8260C SIM	GC-MS	cis-1,2-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	Dichloromethane (Methylene Chloride)
Aqueous	EPA 8260C SIM	GC-MS	Tetrachloroethene
Aqueous	EPA 8260C SIM	GC-MS	trans-1,2-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	Trichloroethene
Aqueous	EPA 8260C SIM	GC-MS	Vinyl chloride
Aqueous	EPA 9020B	Titrimetry	Total Organic Halides (TOX)
Aqueous	EPA 9040C	Potentiometry	pH

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	SM 2130B	Turbidimetry	Turbidity
Aqueous	SM 2320B	Titrimetry	Total Alkalinity (as CaCO3)
Aqueous	SM 2510B	Potentiometry	Specific Conductance
Aqueous	SM 2540B	Gravimetry	Solids, Total
Aqueous	SM 2540C	Gravimetry	Solids, Total Dissolved
Aqueous	SM 2540D	Gravimetry	Solids, Total Suspended
Aqueous	SM 4500-CN- G	Colorimetry	Cyanide, Amenable
Aqueous	SM 4500-P-E	Colorimetry	ortho-phosphorous
Aqueous	SM 4500-S2 D	Titrimetry	Sulfide
Aqueous	SM 4500-CN E	Colorimetry	Total Cyanide
Aqueous	SM4500-NH3 G	Colorimetry	Ammonia
Aqueous	SM5220C	Titrimetry	Chemical Oxygen Demand (COD)
Aqueous	SM5310C	UV-VIS Spectrophotometry	Total Organic Carbons (TOC)
Drinking Water	EPA 504.1	GC-ECD	1,2-Dibromo-3-chloropropane (DBCP)
Drinking Water	EPA 504.1	GC-ECD	1,2-Dibromoethane (EDB)
Drinking Water	EPA 524.2	GC-MS	1,1,1,2-Tetrachloroethane
Drinking Water	EPA 524.2	GC-MS	1,1,1-Trichloroethane
Drinking Water	EPA 524.2	GC-MS	1,1,2,2-Tetrachloroethane
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloroethane
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	1,2,3-Trichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2,3-Trichloropropane
Drinking Water	EPA 524.2	GC-MS	1,2,4-Trichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2,4-Trimethylbenzene
Drinking Water	EPA 524.2	GC-MS	1,2-Dibromoethane (EDB)
Drinking Water	EPA 524.2	GC-MS	1,2-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2-Dichloroethane
Drinking Water	EPA 524.2	GC-MS	1,2-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	1,3,5-Trimethylbenzene
Drinking Water	EPA 524.2	GC-MS	1,3-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,3-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	1,4-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	2,2-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	2-Chlorotoluene

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 524.2	GC-MS	4-Chlorotoluene
Drinking Water	EPA 524.2	GC-MS	4-Isopropyltoluene
Drinking Water	EPA 524.2	GC-MS	Benzene
Drinking Water	EPA 524.2	GC-MS	Bromobenzene
Drinking Water	EPA 524.2	GC-MS	Bromochloromethane
Drinking Water	EPA 524.2	GC-MS	Bromodichloromethane
Drinking Water	EPA 524.2	GC-MS	Bromoform
Drinking Water	EPA 524.2	GC-MS	Bromomethane
Drinking Water	EPA 524.2	GC-MS	Carbon Tetrachloride
Drinking Water	EPA 524.2	GC-MS	Chlorobenzene
Drinking Water	EPA 524.2	GC-MS	Chlorodibromomethane
Drinking Water	EPA 524.2	GC-MS	Chloroethane
Drinking Water	EPA 524.2	GC-MS	Chloroform
Drinking Water	EPA 524.2	GC-MS	Chloromethane
Drinking Water	EPA 524.2	GC-MS	cis-1,2-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	cis-1,3-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	Dibromomethane
Drinking Water	EPA 524.2	GC-MS	Dichlorodifluoromethane
Drinking Water	EPA 524.2	GC-MS	Dichloromethane (Methylene Chloride)
Drinking Water	EPA 524.2	GC-MS	Ethylbenzene
Drinking Water	EPA 524.2	GC-MS	Hexachlorobutadiene
Drinking Water	EPA 524.2	GC-MS	Isopropylbenzene
Drinking Water	EPA 524.2	GC-MS	m+p-Xylene
Drinking Water	EPA 524.2	GC-MS	Naphthalene
Drinking Water	EPA 524.2	GC-MS	n-Butylbenzene
Drinking Water	EPA 524.2	GC-MS	n-Propylbenzene
Drinking Water	EPA 524.2	GC-MS	o-Xylene
Drinking Water	EPA 524.2	GC-MS	sec-Butylbenzene
Drinking Water	EPA 524.2	GC-MS	Styrene
Drinking Water	EPA 524.2	GC-MS	tert-butylbenzene
Drinking Water	EPA 524.2	GC-MS	Tetrachloroethene
Drinking Water	EPA 524.2	GC-MS	Toluene
Drinking Water	EPA 524.2	GC-MS	trans-1,2-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	trans-1,3-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	Trichloroethene
Drinking Water	EPA 524.2	GC-MS	Trichlorofluoromethane (Freon 11)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 524.2	GC-MS	Vinyl chloride
Drinking Water	EPA 524.2	GC-MS	Xylenes, total
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluorobutanesulfonic Acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluorodecanoic acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluorododecanoic acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluoroheptanoic Acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluorohexanesulfonic Acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perflurorohexanoic acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluorononanoic Acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluorooctanesulfonic Acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluorooctanoic Acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluorotetradecanoic acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluorotridecanoic acid
Drinking Water	EPA 537.1	HPLC/MS/MS	Perfluoroundecanoic acid
Drinking Water	EPA 537.1	HPLC/MS/MS	N-Ethylperfluoro-1-octanesulfonamidoacetic acid
Drinking Water	EPA 537.1	HPLC/MS/MS	N-Methylperfluoro-1-octanesulfonamidoacetic acid
Solid	ASTM D4129-05M, Lloyd Kahn	Coulmetry	Total Organic Carbons (TOC)
Solid	EPA 160.3M	Gravimetry	Solids, Total
Solid	EPA 1631E	CVFAS	Mercury (low level)
Solid	EPA 7471A, B	CVAA	Mercury
Solid	EPA 9045D	Potentiometry	pH
Solid	EPA 9056A	IC	Nitrate as N
Solid	EPA 9071A	Gravimetry	Hexane Extractable Material (HEM)
Solid	PSEP	Gravimetry	Particle Size
Solid	SOP-GEN-AVS	Colorimetry	Acid Volatile Sulfides
Aqueous/Solid	ASTM D 1426-93B	Potentiometry	Nitrogen, Total Kjeldahl (TKN)
Aqueous/Solid	EPA 1020A	Physical Property	Ignitability
Aqueous/Solid	EPA 350.1	Colorimetry	Ammonia
Aqueous/Solid	EPA 365.3	Colorimetry	Total Phosphorus
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Aluminum
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Antimony
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Arsenic
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Barium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Beryllium

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Boron
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Cadmium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Calcium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Chromium, total
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Cobalt
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Copper
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Iron
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Lead
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Magnesium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Manganese
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Molybdenum
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Nickel
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Potassium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Selenium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Silver
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Sodium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Strontium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Thallium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Tin
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Titanium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Vanadium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Zinc
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Aluminum
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Antimony
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Arsenic
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Barium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Beryllium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Boron
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Cadmium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Chromium, total
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Cobalt
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Copper
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Iron
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Lead
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Manganese

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Molybdenum
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Nickel
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Selenium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Silver
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Strontium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Thallium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Tin
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Titanium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Vanadium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Zinc
Aqueous/Solid	EPA 6850	HPLC/MS/MS	Perchlorate
Aqueous/Solid	EPA 7742	AA, Borohydride Reduction; GFAA	Selenium
Aqueous/Solid	EPA 8011	GC-ECD	Ethylene Dibromide
Aqueous/Solid	EPA 8011	GC-ECD	1,2-Dibrom-3-chloropropane
Aqueous/Solid	EPA 8015C/AK103-RRO-NWTPH-Rx	GC-FID	Residual Range Organics (RRO)
Aqueous/Solid	EPA 8015C; AK101-GRO; NWTPH-Gx	GC-FID	Gasoline Range Organics (GRO)
Aqueous/Solid	EPA 8015C; AK102-DRO; NWTPH-Dx	GC-FID	Diesel Range Organics (DRO)
Aqueous/Solid	EPA 8081A, B	GC-ECD	Aldrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Alpha-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	alpha-Chlordane
Aqueous/Solid	EPA 8081A, B	GC-ECD	Chlordane (total)
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDD (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDE (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDT (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	delta-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	Dieldrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan I
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan II
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan sulfate
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin aldehyde
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin ketone

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8081A, B	GC-ECD	gamma-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	gamma-Chlordane
Aqueous/Solid	EPA 8081A, B	GC-ECD	Heptachlor
Aqueous/Solid	EPA 8081A, B	GC-ECD	Heptachlor Epoxide (beta)
Aqueous/Solid	EPA 8081A, B	GC-ECD	Methoxychlor
Aqueous/Solid	EPA 8081A, B	GC-ECD	Toxaphene (total)
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDD
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDE
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDT
Aqueous/Solid	EPA 8081B	GC-ECD	Chlorpyrifos
Aqueous/Solid	EPA 8081B	GC-ECD	cis-Nonachlor
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachlorobenzene
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachlorobutadiene
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachloroethane
Aqueous/Solid	EPA 8081B	GC-ECD	Isodrin
Aqueous/Solid	EPA 8081B	GC-ECD	Mirex
Aqueous/Solid	EPA 8081B	GC-ECD	Oxychlordane
Aqueous/Solid	EPA 8081B	GC-ECD	trans-Nonachlor
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,3’,4,4’,5,5’,6-Nonachlorobiphenyl (PCB 206)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,3’,4,4’,5,6-Octachlorobiphenyl (PCB 195)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2',3,3',4,4',5,5',6,6' Decachlorobiphenyl (PCB 209)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,3’,4,4’,5-Heptachlorobiphenyl (PCB 170)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,3’,4,4’-Hexachlorobiphenyl (PCB 128)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,4,4’,5,5’-Heptachlorobiphenyl (PCB 180)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,4,4’,5’,6-Heptachlorobiphenyl (PCB 183)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,4,4’,5’-Hexachlorobiphenyl (PCB 138)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,4,4’,6,6’-Heptachlorobiphenyl (PCB 184)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,4’,5,5’,6-Heptachlorobiphenyl (PCB 187)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,4,5’-Pentachlorobiphenyl (PCB 87)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,4’,5-Pentachlorobiphenyl (PCB 90)

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,3,5’-Tetrachlorobiphenyl (PCB 44)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,4,4’,5,5’-Hexachlorobiphenyl (PCB 153)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,4,5,5’-Pentachlorobiphenyl (PCB 101)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,5,6’-Tetrachlorbiphenyl (PCB 53)
Aqueous/Solid	EPA 8082A	GC-ECD	2,2’,5-Trichlorobiphenyl (PCB 18)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3’,4,4’,5,5’-Heptachlorobiphenyl (PCB 189)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3’,4,4’,5-Hexachlorobiphenyl (PCB 156)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3’,4,4’,5’-Hexachlorobiphenyl (PCB 157)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3’,4,4’,6-Hexachlorobiphenyl (PCB 158)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,3’,4,4’-Pentachlorobiphenyl (PCB 105)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3’,4,4’,5,5’ Hexachlorobiphenyl (PCB 167)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3’,4,4’,5’,6-Hexachlorobiphenyl (PCB 168)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,4,4’,5-Pentachlorobiphenyl (PCB 114)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3’,4,4’,5-Pentachlorobiphenyl (PCB 118)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3’,4,4’,5-Pentachlorobiphenyl (PCB 123)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3,4,4’-Tetrachlorobiphenyl (PCB 60)
Aqueous/Solid	EPA 8082A	GC-ECD	2,3’,4,4’-Tetrachlorobiphenyl (PCB 66)
Aqueous/Solid	EPA 8082A	GC-ECD	2,4,4’-Trichlorobiphenyl (PCB 28)
Aqueous/Solid	EPA 8082A	GC-ECD	2,4’-Dichlorobiphenyl (PCB 8)
Aqueous/Solid	EPA 8082A	GC-ECD	3,3’,4,4’,5,5’-Hexachlorobiphenyl (PCB 169)
Aqueous/Solid	EPA 8082A	GC-ECD	3,3’,4,4’,5-Pentachlorobiphenyl (PCB 126)
Aqueous/Solid	EPA 8082A	GC-ECD	3,3’,4,4’-Tetrachlorobiphenyl (PCB 77)
Aqueous/Solid	EPA 8082A	GC-ECD	3,4,4’,5-Tetrachlorobiphenyl (PCB 81)
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1016
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1221
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1232
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1242
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1248
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1254
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1260
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1262
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1268
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,1-Trichloroethane

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,2-Trichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dibromoethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1-phenylpropane
Aqueous/Solid	EPA 8260B, C	GC-MS	2,2-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Butanone (MEK)
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Chloroethylvinylether
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Chlorotoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Hexanone
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Chlorotoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Isopropyltoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solid	EPA 8260B, C	GC-MS	Acetone
Aqueous/Solid	EPA 8260B, C	GC-MS	Acetonitrile
Aqueous/Solid	EPA 8260B, C	GC-MS	Acrolein
Aqueous/Solid	EPA 8260B, C	GC-MS	Acrylonitrile
Aqueous/Solid	EPA 8260B, C	GC-MS	Benzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromochloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromodichloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromoform
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Carbon disulfide
Aqueous/Solid	EPA 8260B, C	GC-MS	Carbon Tetrachloride
Aqueous/Solid	EPA 8260B, C	GC-MS	Chlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Chlorodibromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloroethane

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloroform
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	cis-1,3-Dichloropropene
Aqueous/Solid	EPA 8260B, C	GC-MS	Dibromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Dichlorodifluoromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Dichloromethane (Methylene Chloride)
Aqueous/Solid	EPA 8260B, C	GC-MS	Di-isopropylether (DIPE)
Aqueous/Solid	EPA 8260B, C	GC-MS	ETBE
Aqueous/Solid	EPA 8260B, C	GC-MS	Ethylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Freon 11
Aqueous/Solid	EPA 8260B, C	GC-MS	Freon 113
Aqueous/Solid	EPA 8260B, C	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8260B, C	GC-MS	Isopropylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Methyl-tert-butylether (MTBE)
Aqueous/Solid	EPA 8260B, C	GC-MS	Naphthalene
Aqueous/Solid	EPA 8260B, C	GC-MS	n-Butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	n-Propylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	sec-Butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Styrene
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-amylmethylether (TAME)
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-Butyl alcohol
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Tetrachloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	Toluene
Aqueous/Solid	EPA 8260B, C	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	trans-1,3-Dichloropropene
Aqueous/Solid	EPA 8260B, C	GC-MS	Trichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	Trichlorofluoromethane (Freon 11)
Aqueous/Solid	EPA 8260B, C	GC-MS	Vinyl acetate
Aqueous/Solid	EPA 8260B, C	GC-MS	Vinyl chloride
Aqueous/Solid	EPA 8260B, C	GC-MS	Xylene, total
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloroethene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner   Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloropropene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,3-Trichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,2-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,3-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dimethylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dinitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dinitrotoluene
Aqueous/Solid	EPA 8270C, D	GC-MS	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Chloronaphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Chlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Nitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	3,3-Dichlorobenzidine
Aqueous/Solid	EPA 8270C, D	GC-MS	3-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chloroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chlorophenyl-phenylether
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Nitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270C, D	GC-MS	Aniline

Certificate of Accreditation: Supplement
ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso
1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270C, D	GC-MS	Anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzidine
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzoic acid
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzyl alcohol
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroethoxy)methane
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroethyl)ether
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroisopropyl)ether
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-ethylhexy)phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Butyl benzyl phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Carbazole
Aqueous/Solid	EPA 8270C, D	GC-MS	Chrysene
Aqueous/Solid	EPA 8270C, D	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Dibenzofuran
Aqueous/Solid	EPA 8270C, D	GC-MS	Diethyl phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Dimethylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	di-n-butylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Di-n-octylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Fluorene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorocyclopentadiene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachloroethane
Aqueous/Solid	EPA 8270C, D	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Isophorone
Aqueous/Solid	EPA 8270C, D	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	Nitrobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodimethylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitroso-di-n-propylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodiphenylamine

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270C, D	GC-MS	Pentachlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	Pentachlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Phenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Pyridine
Aqueous/Solid	EPA 8270C, D	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1- Methylnaphthalene
Aqueous/Solid	EPA 8270 SIM	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Anthracene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Chrysene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Fluorene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270 SIM	GC-MS	p-Dioxane
Aqueous/Solid	EPA 8270 SIM	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270 SIM	GC-MS	Pyrene
Aqueous/Solid	EPA 9012B	Colorimetry	Total Cyanide
Aqueous/Solid	EPA 9030B	Distillation	Sulfide
Aqueous/Solid	EPA 9056A	IC	Bromide
Aqueous/Solid	EPA 9056A	IC	Chloride
Aqueous/Solid	EPA 9056A	IC	Fluoride
Aqueous/Solid	EPA 9056A	IC	Sulfate
Aqueous/Solid	EPA 9060A	UV-VIS Spectrophotometry	Total Organic Carbons (TOC)

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy) propanoic acid (HFPA-DA)
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	4:2 Fluorotelomersulfonate
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	6:2 Fluorotelomersulfonate
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	8:2 Fluorotelomersulfonate
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	N-Ethylperfluorooctanesulfonamide
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	N-Ethylperfluorooctanesulfonamidoethanol
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	N-Methylperfluorooctanesulfonamide
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	N-Methylperfluorooctanesulfonamidoethanol
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluoroheptanesulfonate
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorooctane Sulfonamide
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorotetradecanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorotridecanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorobutane sulfonate
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorobutanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorodecane Sulfonate

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorodecanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorododecanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluoroheptanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorohexane sulfonate
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorohexanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorononanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorooctane sulfonate
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorooctanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluoropentanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluoroundecanoic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	N-Ethylperfluroroctanesulfonamidoacetic acid
Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	N-Methylperfluorooctanesulfonamidoacetic acid
Aqueous/Solid	SOC-Butyl	GC-FPD	Di-n-butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	n-Butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	Tetra-n-butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	Tri-n-butyltin

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

ALS Environmental-Kelso

1317 South 13th Avenue, Kelso, WA 98626
Contact Name: Carl Degner Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 1640	Reductive Metals Precipitation	Prep Method
Aqueous	EPA 3010A	Acid Digestion	Metals Digestion
Aqueous	EPA 3020A	Acid Digestion	Metals Digestion
Aqueous	EPA 3511	Microextraction	Extractable Prep
Aqueous	EPA 3520C	Continuous Liquid-Liquid Extraction	Extractable Prep
Aqueous	EPA 3535A	Solid Phase Extraction	Prep Method
Aqueous	EPA 5030B	Purge and Trap	Volatile Prep
Aqueous	SOP-MET-DIG	Acid Digestion	Metals Digestion
Solid	EPA 3050B	Acid Digestion	Metals Digestion
Solid	EPA 3060	Alkaline Digestion	Alkaline Digestion for Cr(VI) only
Solid	EPA 3541	Automated Soxhlet Extraction	Extractable Prep
Solid	EPA 3546	Microwave Extraction	Extractable Prep
Solid	EPA 3550B	Ultrasonic Extraction	Extractable Prep
Solid	EPA 5035A	Purge and Trap	Voc Organics
Solid	EPA 5050	Bomb Digestion	Prep Method
Solid	EPA 9013	Midi-Distillation	Cyanides
Solid	SOP-GEN-AVS	Acid Digestion	Simultaneously Extracted Metals
Aqueous/Solids	ASTM D3590-89	Digestion	TKN
Aqueous/Solids	EPA 1311	TCLP Extraction	Physical Extraction
Aqueous/Solids	EPA 3620C	Florisil Clean Up	Extractable Cleanup
Aqueous/Solids	EPA 3630C	Silica Gel Clean Up	Extractable Prep
Aqueous/Solids	EPA 3640A	Gel-Permeation Clean Up	Extractable Cleanup
Aqueous/Solids	EPA 3660	Sulfur Clean Up	Extractable Prep
Aqueous/Solids	EPA 3665A	Acid Clean Up	Extractable Cleanup