PREPARED FOR:

Earle M. Jorgensen
Company
10650 S. Alameda Street
Lynwood, CA 90262

BY:

Shannon & Wilson
400 N. 34th Street, Suite 100
Seattle, WA 98103

(206) 632-8080
www.shannonwilson.com

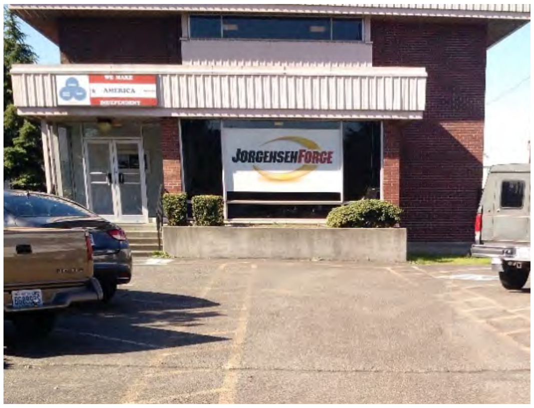
REMEDIAL INVESTIGATION WORK PLAN

Jorgensen Forge Corporation Property

TUKWILA, WASHINGTON

This work plan has been broken into two parts. Parts 1 and 2 form a whole and should be read in conjunction with each other.

Part 2 of 2
Appendices E, F, G, and H
Important Information



April 15, 2020

Shannon & Wilson No: 21-1-12596-013

Text, tables, figures, and appendices A, B, C, and D are provided within a separate PDF (Part 1).

APPENDIX E: SAMPLING AND ANALYSIS PLAN – REMEDIAL INVESTIGATION

Appendix E

Sampling and Analysis Plan – Remedial Investigation

Jorgensen Forge Corporation Property, Tukwila, Washington

PREPARED FOR:
Earle M. Jorgensen Company
10650 S. Alameda Street
Lynwood, CA 90262

BY:
Shannon & Wilson
400 N. 34th Street, Suite 100
Seattle, WA 98103

(206) 632-8020
www.shannonwilson.com

SAMPLING AND ANALYSIS PLAN – REMEDIAL INVESTIGATION

Jorgensen Forge Corporation Property

TUKWILA, WASHINGTON

SHANNON & WILSON

April 15, 2020

Shannon & Wilson No: 21-1-12596-013

CONTENTS

Tables

Figures

Attachments

ACRONYMS

1,1-DCE	1,1-dichloroethene
AFFF	aqueous film forming foam
ARI	Analytical Resources, Inc.
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
cis-1,2-DCE	cis-1,2-dichloroethene
COC	chain-of-custody
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
HASP	Health and Safety Plan
HSA	hollow-stem auger
HVOC	halogenated volatile organic compound
IDP	Inadvertent Discovery Plan
IDW	investigation-derived waste
JFC	Jorgensen Forge Corporation
L/min	liters per minute
LIF	laser-induced fluorescence
LL	low-level
LNAPL	light non-aqueous phase liquid
mg/L	milligrams per liter
mL/min	milliliters per minute
MS/MSD	matrix spike/matrix spike duplicate
NELAP	National Environmental Laboratories Accreditation Program
NSZD	natural source zone depletion
NTU	nephelometric turbidity unit
NWTPH-Dx	Northwest Total Petroleum Hydrocarbons-Diesel Extended
NWTPH-Gx	Northwest Total Petroleum Hydrocarbons-Gasoline Extended
ORP	oxidation reduction potential
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid

PID	photoionization detector
PPE	personal protective equipment
QA/QC	quality assurance and quality control
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
SIM	selected ion monitoring
Site	8231 East Marginal Way South
SVOCs	semi-volatile organic compounds
TCE	trichloroethene
TDS	total dissolved solids
TPH-D	total petroleum hydrocarbons diesel
TPH-G	total petroleum hydrocarbons as gasoline-range organics
TPH-O	total petroleum hydrocarbons oil
trans-1,2-DEC	trans-1,2-dichloroethene
UCMR 3	EPA's third Unregulated Contaminant Monitoring rule
VOA	volatile organic analyte
work plan	Remedial Investigation Work Plan
°C	degrees Celsius
±	plus or minus

1 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared to detail field and laboratory procedures for the proposed activities outlined within the Remedial Investigation (RI) Work Plan (the work plan). This SAP and the associated Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP) are included as appendices to the work plan.

This SAP has been revised in response to Washington State Department of Ecology (Ecology) comments dated December 20, 2019 (Ecology, 2019), on the submitted draft RI work plan dated January 31, 2019 (Shannon & Wilson, 2019).

The proposed activities are to be conducted at the Jorgensen Forge Corporation (JFC) facility located at 8531 East Marginal Way South, Tukwila, Washington (the Site). A Site location map is provided as Figure 1. Investigation locations are presented in Figure 2. Current monitoring well status and construction details are provided in Table 1.

1.1 Objectives and Scope of Work

The scope of work, as outlined in Section 10 of the work plan, consists of the following tasks and objectives:

- Light Non-Aqueous Phase Liquid (LNAPL) Investigation
  - Vertical and horizontal LNAPL plume delineation (including residual soil contamination) using direct-push borings, laser-induced fluorescence (LIF) technology, and a step-in/step-out approach.
  - LNAPL transmissivity testing to estimate the rate at which LNAPL flows laterally through the aquifer and to support the evaluation of future remedial design options.
  - Natural source zone depletion (NSZD) evaluation within the saturated zone. This will include groundwater monitoring and the collection and analysis of groundwater samples to evaluate if NSZD is occurring through dissolution and biodegradation. Monitoring and sampling will be completed along with groundwater investigation activities (discussed below).
- Soil Investigation
  - Completion of 49 soil borings (including 4 to be completed to support the LNAPL plume delineation) and collection of soil samples to address data gaps identified within Section 9 of the work plan.
  - Soil sampling and analysis from up to 27 borings to be completed as monitoring wells as part of the groundwater investigation activities (discussed below).

- Groundwater Investigation
    - Installation of up to 27 groundwater monitoring wells to address data gaps identified within Section 9 of the work plan.
    - Groundwater monitoring and sampling.
    - Hydraulic conductivity testing to support the evaluation of potential future remedial design options.

The LNAPL plume delineation within Areas 1 and 2 will be completed prior to other activities so that the findings from the delineation can be used to inform and adjust the subsequent activities.

The Site lies within an area that is designated as very highly likely to yield cultural materials by the Department of Archaeology and Historic Places. To support compliance with state cultural resource protection laws, an archeological company (Stell) prepared an Inadvertent Discovery Plan (IDP) to support the RI activities (Attachment 1).

1.2 Project Contact Information

Key contact information for the proposed scope of work includes:

- Project Manager: Shoshana Howard, (206) 695-6811
- Project Coordinator: Meg Strong, (206) 695-6787
- Quality Assurance Manager: David Randall, (206)-695-6918
- Facility Representative (JFC): Matteo Sanesi, (253) 878-6415
- Health and Safety Manager: Joe Laprade, (206) 695-6713
- Site Safety Officer: Christian Canfield, (206) 714-7637

As described in the work plan, it is our understanding that the property will be sold. When the sale occurs, the facility representative will change.

Analytical Resources, Inc. (ARI) of Tukwila, Washington and (an Ecology- and National Environmental Laboratories Accreditation Program [NELAP]-certified laboratory) and Eurofins TestAmerica of Sacramento, California (a NELAP-certified laboratory), will provide analytical testing services for the project.

Ms. Amanda Volgardsen – ARI
4611 S. 134th Place, Suite 100
Tukwila, WA 981168-3240
Telephone: (206) 695-6200

Eurofins TestAmerica
880 Riverside Parkway
West Sacramento, CA 95605
Telephone: (916) 373-5600

Select soil samples will also be submitted to the Shannon & Wilson Seattle Soils Laboratory, an American Association of State Highway and Transportation Accreditation Program-accredited laboratory, for grain-size analysis.

Mr. Joe Laprade – Shannon & Wilson Seattle Soils Laboratory
400 N. 34th Street, Suite 100
Seattle, WA 98103
Telephone: (206) 695-6713

1.3 Organization

The remainder of this SAP is broken into eight sections. Section 2 outlines preparation activities to be completed prior to field sampling events. LNAPL investigation activities including LNAPL plume and residual soil contamination delineation and LNAPL transmissivity testing are discussed in Section 3. Soil investigation activities are outlined within Section 4. Section 5 describes groundwater investigation activities, including well installation and development, groundwater monitoring and sampling, and hydraulic conductivity testing. Section 6 describes the field quality assurance and quality control (QA/QC) procedures, including sample handling, QA/QC samples, and equipment decontamination. Investigation-derived waste (IDW) management is discussed within Section 7, and health and safety considerations are provided in Section 8. The IDP is provided in Attachment 1. Relevant field forms are provided in Attachment 2. Available boring logs from previous investigations are provided in Attachment 3. Attachment 4 includes a reference document for per- and polyfluoroalkyl substances (PFAS) that contains procedures and protocols for collecting PFAS samples.

2 PREPARATION

2.1 Site Access Requirements and Notifications

In accordance with Agreed Order number DE 14143, Ecology will be provided at least seven days' notice prior to the initiation of any sampling or work activities at the Site.

In accordance with the access agreement (recorded in the real property records of King County on April 24, 2017, under instrument number 20170424000779) between Star Forge, LLC (the property owner) and Earle M. Jorgensen Company, at least 24 hours' notice will be provided to the facility representative prior to entering the Site, unless an emergency occurs. In emergency situations, as much notice as practical under the circumstances will be provided to the facility representative.

2.2 Utility Clearance

Exploration locations will be placed to avoid known utilities. The locations will be marked in advance of the drilling activities and the public One-Call utility check system will be notified. Applied Professional Services, Inc., a private utility clearance contractor, will clear each location and area if flexibility on location is required (for example during LNAPL plume delineation). Vacuum excavation will be performed at each location in areas that cannot be cleared (such as below the areas where the slab is very thick or has rebar). When performed, vacuum excavation will be completed within the top 5 feet below ground surface (bgs). In locations where samples for volatile analyses will be collected within the top 5 feet bgs, hand augers will be used in lieu of vacuum excavation to clear the top 5 feet bgs and collect samples.

2.3 Equipment Preparation

Necessary field equipment and documentation materials will be prepared. A checklist of equipment required during sampling activities will be prepared and checked each morning. Laboratory-supplied sample containers will be inspected for the proper preservative and inventoried to ensure adequate containers are available.

Meters will be calibrated at the start of each work period or prior to arrival on the Site. Calibration will be valid for field conditions and will be completed in accordance with manufacturer recommendations. Calibration measurements will be documented in the field activity log for the project. Calibrations will be checked approximately every four hours thereafter, and will be recalibrated, as necessary, during the work period. At the end of each day, all meters will be checked against their last calibration to document any drift that may have occurred. Instrument and equipment inspection, maintenance, and calibration is further discussed within the QAPP (Appendix F of the work plan).

A field sampling tablet, in conjunction with a field label printer, will be used during the groundwater sampling activities. The tablet will be charged and setup prior to the start of each work period. Tablet setup will include pre-loading the tablet with the wells to be sampled, the analyses to be performed, and the bottles (quantity, type, size, and preservation information) needed for each sample.

3 LIGHT NON-AQUEOUS PHASE LIQUID (LNAPL) INVESTIGATION

Within Area 1, cutting oil is present within soil and groundwater and as an LNAPL plume on groundwater. Elevated concentrations of total petroleum hydrocarbons oil (TPH-O) have been detected within borings located within the Hollowbore Area of the main building and within outside areas to the north. Within the main building, borings have contained elevated TPH-O within soil samples taken from the upper 2 feet. In outside areas, the contamination has been more prevalent within soil at depths greater than approximately 5 feet bgs. The data suggest that sources are shallow within the main building in Area 1, such as piping running to and from the lathes from the vaults. LNAPL has been observed within Area 1 groundwater monitoring wells MW-16 through MW-22 and MW-26 through MW-29 at thicknesses up to 12.6 feet.

Within Area 2, hydraulic oil and diesel are present within soil and groundwater and as an LNAPL plume on groundwater. Investigations within the area have identified elevated concentrations of TPH-O and total petroleum hydrocarbons diesel (TPH-D) in soil, primarily between depths of 7 and 10 feet bgs. A silt layer, encountered at approximately 10 feet in this area, may prevent downward migration of LNAPL. Though well investigated in outside areas to the north and south, greater LNAPL plume delineation is needed in the main building and to the east. In Area 2, LNAPL has been observed within existing groundwater monitoring wells MW-34 and MW-35 and within previous monitoring wells MW-2, MW-12, MW-13, and MW-33 at thicknesses up 9.15 feet.

3.1 Plume Delineation

Figure 2 shows the approximate extent of the Area 1 and Area 2 LNAPL plumes based on the observation of LNAPL within existing groundwater monitoring wells. The vertical and horizontal extent of LNAPL and residual soil contamination within the subsurface will be further delineated using a direct-push hydraulic probe rig and LIF technology.

Because facility equipment and tanks will have been removed for some time prior to the investigation, LNAPL-containing monitoring wells will be monitored prior to commencing with the LIF investigation to assess whether the removal of these features have significantly altered LNAPL thicknesses. Results from the monitoring will be used to adjust the investigation strategy, if needed. Procedures for monitoring LNAPL-containing monitoring wells are outlined in Sections 5.3.1.1 and 5.3.1.3.

LIF allows for rapid delineation of the vertical and horizontal extent of LNAPL and for the generation of three-dimensional LNAPL maps. The technology relies on the fact that polycyclic aromatic hydrocarbons (PAHs), present within LNAPL, fluoresce. An in situ LIF survey is conducted using a windowed probe equipped with fiber optics. The probe is advanced at a continuous rate by a direct-push hydraulic probe rig. As the equipment is advanced, the fiber optics emit laser light onto the passing soil. Any responding fluorescence (due to the presence of LNAPL) is returned to the surface and processed in real time.

A Shannon & Wilson representative will be on site to observe the LIF surveys. Because the results are processed in real time, each LIF location will be selected based on the results from preceding points. The surveys will target horizontal and vertical delineation of the LNAPL plume and residual soil contamination.

The LNAPL plume delineation investigation will include the completion of plume-center borings and plume-perimeter borings. Proposed boring locations are shown in Figure 2. Borings within the Area 1 and Area 2 LNAPL plumes will be designated as A1- and A2-borings, respectively. The actual locations and number of borings will be determined in the field as required to avoid utilities and in response to findings from previous borings.

Plume-center borings (A1-1, A1-2, A2-1, and A2-2 in Figure 2) will be completed within the anticipated central portion of each LNAPL plume with the objective of identifying the vertical extent of LNAPL and residual soil contamination. Plume-perimeter borings (A1-3 through A1-14 and A2-3 through A2-10 in Figure 2) will be completed to identify the edge of each LNAPL plume within multiple directions. A step-in/step-out approach will be utilized to identify the LNAPL plume edge with the objective of completing at least one boring within and one outside of the plume extents such that the plume edge can be inferred as being located between the two borings (with a target boring separation of 10 feet).

Plume-center borings will be completed to depths of up to 15 feet bgs or 5 feet deeper than observed petroleum-saturated soil, whichever is greater. Plume-perimeter borings will be completed to 5 feet deeper than observed petroleum-saturated soil or to depths of 5 feet deeper than observed groundwater (if no LNAPL is observed). Boring locations will be documented using a handheld global positioning system unit.

LIF investigations do not recover material for laboratory analysis. During the soil investigation (discussed in Section 4), direct-push borings will be completed at the locations of A1-1, A1-2, A2-1, and A2-2 (LNAPL plume-center borings) for the purposes of collecting soil samples. From each of these borings, one soil sample will be collected from the depth with the highest LIF response. This sample is intended to provide an understanding of the relationship between LIF response and concentration. A second sample will be collected from the base of each of these borings to demonstrate that impacted soil has been delineated vertically. The samples will be analyzed for TPH-D and TPH-O by Method Northwest Total Petroleum Hydrocarbons-Diesel Extended (NWTPH-Dx) and for PAHs by U.S. Environmental Protection Agency (EPA) Method 8270D selected ion monitoring (SIM).

3.2 Transmissivity Testing

Rising head slug testing will be completed at three Area 1 and Area 2 wells (two within Area 1) in accordance with ASTM E2865-13 to estimate LNAPL transmissivity. Rising head slug tests involve rapidly (as close to instantaneous as possible) dropping the LNAPL level within the well and recording the recovery as the well returns to equilibrium. Testing will include the following:

1. Prior to slug removal, a pressure transducer will be installed in the well below the LNAPL-groundwater interface. The initial depth to LNAPL and depth to groundwater will be measured with an interface probe (procedures described within Section 5.3.1.3).
2. A disposable polyethylene bailer or peristaltic pump will be used to remove LNAPL within the well to reduce the LNAPL layer thickness as low as practically achievable without removing water. Product will be poured into a graduated 5-gallon bucket and the volume will be recorded.
3. The pressure transducer will be allowed to record until equilibrium conditions have returned; days or weeks may be required to obtain equilibrium.

Depth to LNAPL and groundwater will be periodically measured using the interface probe during recovery. Estimated transmissivity will be calculated using the initial volume of drawdown and the volumetric response derived from the LNAPL layer thickness.

4 SOIL INVESTIGATION

Soil samples will be collected from a total of 48 borings completed using a direct-push hydraulic probe rig (including the 4 plume-center borings mentioned in Section 3.1) and from up to 27 borings (to be installed as monitoring wells) completed using hollow-stem auger (HSA) drilling methods. Investigation activities will be sequenced with deeper borings completed (and samples analyzed) prior to shallow borings. This will allow for the shallow boring depths to be adjusted based on the initial findings to target vertical delineation. If apparent contamination is observed at the base of a boring, the boring depth may be increased in the field.

Direct-push borings will be completed to depths ranging from 8 to 30 feet bgs. Depths have been selected based on the location and intended purpose of each boring. HSA borings, with the exception of the borings for wells MW-64 and MW-70, will be advanced to 20 feet bgs for well installation. The borings for MW-64 and MW-70 will be advanced into the deeper ("B") water-bearing zone to a total depth of approximately 60 feet bgs. Boring logs from previous investigations are provided in Attachment 3.

A Shannon & Wilson representative will be on site to locate the explorations, observe utility locating activities, observe drilling activities, screen for potential contamination, collect soil samples, and prepare descriptive logs of the materials encountered. Direct-push and HSA logs will present an interpretation of the materials encountered at each exploration and the depths of material changes. Soil screening methods will involve the use of a calibrated photoionization detector (PID), observation of discoloration and/or notation of odors, and sheen testing (Ecology, 2016). Sample collection points and depths, observations of the presence of potential contamination, and depths to saturated zones will be noted on the logs (Field Log of Boring or Field Log of Geoprobe, provided in Attachment 2).

Soil sampling will target potential contamination based on field screening and changes in lithology. In the absence of apparent contamination or lithology changes, the following sampling approach will be employed:

- Three borings (SB-2020-042 through SB-2020-044) will be completed adjacent to the decommissioned 24-inch property line pipe. The borings will be completed to just past the fill material (up to 8 feet bgs). One sample will be collected from each boring from within one foot of the bottom depth of the pipe.
- Borings SB-2020-001, SB-2020-002, SB-2020-028, SB-2020-029, and SB-2020-045 will be completed to 10 feet bgs to evaluate specific features within the main building. Samples will be taken from 5 feet and 10 feet bgs.
- Borings SB-2020-018 through SB-2020-025 will be completed adjacent to Boeing OA-11 to depths of 12 feet bgs. Six soil samples, including depth-discrete samples taken from between 0 to 2, 2 to 4, 4 to 6, 6 to 8, 8 to 10, and 10 to 12 feet bgs, will be collected at each boring. The samples taken from between 8 to 10 and 10 to 12 feet bgs will be held for potential analysis.
- Borings SB-2020-030 through SB-2020-037 will be completed to evaluate the former Area 3 Underground Storage Tanks, the Decommissioned Oil Storage Area vault, and the Decommissioned Diesel Storage Area vault and fill ports. The borings will be completed to depths of up to 15 feet bgs. Up to two soil samples will be collected from each of these borings. Fill material placed following tank removal activities will not be targeted. Samples will be taken from the first 2 feet below this material and from 15 feet bgs.
- At other 15-foot borings, up to three samples will be collected including samples taken from within the top 2 feet below surface or below subbase if present, from between 2 and 7 feet bgs, and from just above the water table.

- Up to five samples will be collected from 25-foot borings, including the same intervals sampled at 15-foot borings and samples taken from 20 and 25 feet bgs. The 20- and 25-foot samples will be held for potential analysis.
- Boring SB-2020-004 will be completed to 30 feet bgs due to the depth of the adjacent vault. Six samples will be collected including from the same intervals as the 25-foot borings and an additional 30 feet bgs sample. All samples from boring SB-2020-004 will be analyzed.
- At HSA borings, samples will be taken from within the top 2 feet below surface or below subbase if present, from between 2 and 7 feet bgs, and from just above the water table. Within the deeper HSA borings, soil samples will be collected from 20 feet bgs and from greater depths and will be held for potential follow-up analysis.

Additional soil samples may be collected if warranted, based on field screening. At select groundwater monitoring well locations, cores extracted during drilling will be archived for potential use during future bench scale testing.

If slag or swarf are noted within a boring, the soil surrounding the material will be sampled and will be analyzed for TPH-D, TPH-O, metals, and compounds detected at elevated concentrations within groundwater samples collected within the vicinity of the boring in which the slag or swarf was observed.

4.1 Direct-Push Soil Sampling

At direct-push locations, a hydraulic probe rig will use the static weight of the rig combined with percussive energy to advance a series of hollow rods. A 2-inch-diameter, 5-foot-long probe sampler fitted with removable plastic sampling (sleeve) tubes will be driven into undisturbed soil continuously from the ground surface to the desired depth of the boring. Upon retrieval of the sample sleeve, the plastic tube will be sliced open and the soil will be field-screened for contaminants and samples collected and logged.

4.2 Hollow-Stem Auger (HSA) Soil Sampling

Soil samples from the HSA borings will be collected using a standard 2-inch-outside-diameter, split-spoon sampler used in conjunction with the Standard Penetration Test. At each sample depth, the drill bit will be removed from the hole and the sampler will be attached to the end of the drill rods. The sampler will then be lowered down to the bottom of the hole. The sampler will typically be driven 1.5 feet or less into the soil at the bottom of the borehole, depending upon density. A second sampler will be driven at about the same interval if not enough soil was initially retrieved. After each sampler is removed from the borehole, a Shannon & Wilson field representative will open the sampler and screen the soil for potential contamination.

4.3 Soil Sample Collection

Field personnel will collect soil samples by first donning a new pair of disposable nitrile gloves. New disposable steel spoons will be used to transfer soil from the sample sleeve or the split-spoon sampler to the appropriate laboratory-supplied sample containers. Samples for volatile analyses will be collected using disposable syringes into methanol-preserved vials or pre-tared vials in accordance with EPA Method 5035. Once filled, the sample containers will be placed in a cooler with blue ice to maintain the samples within the acceptable temperature range of between 0 degree Celsius (°C) and 6°C. The samples will be transported under standard chain-of-custody (COC) procedures to ARI. Sample handling and field QA sample collection procedures are outlined within Section 6.

The following analyses will be completed in accordance with the sample schedule (Table 2A):

- Total petroleum hydrocarbons as gasoline (TPH-G) by Method Northwest Total Petroleum Hydrocarbon-Gasoline Extended (NWTPH-Gx) and benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA 8260C;
- TPH-D and TPH-O by Method NWTPH-Dx;
- Halogenated volatile organic compounds (HVOCs) including 1,1-dichloroethene (1,1-DCE), cis-1,2-dichchloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride by EPA Method 8260C;
- PAHs by EPA Method 8270D SIM;
- Full list semi-volatile organic compounds (SVOCs) by EPA Method 8720D SIM;
- Polychlorinated biphenyls (PCBs) as aroclors by EPA Method 8082A;
- Metals, including arsenic, barium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, vanadium, and zinc, by EPA Method 200.8;
- Mercury by EPA Method 7471B;
- Hexavalent chromium by EPA Standard Method 7196A; and
- Total organic carbon by EPA Method 9060A.

In addition to the analyses listed above, select samples will be submitted to the Shannon & Wilson Seattle Soils Laboratory for grain size and porosity analyses.

5 GROUNDWATER INVESTIGATION

5.1 Monitoring Well Installation

A total of up to 27 monitoring wells will be installed using HSA drilling methods. Soil sampling will be conducted at each location in accordance with Section 3. Monitoring wells will be screened across the water table at depth intervals ranging from 5 to 20 feet bgs with the exception of wells MW-64 and MW-70, which will be screened between approximate depths of 45 and 60 feet bgs. Screen interval depths may be adjusted based on field conditions. Wells will be surged during sandpack placement to optimize the well and prevent bridging of the sandpack during later redevelopment. A Shannon & Wilson representative will be on site to observe drilling activities, collect soil samples, log soil, and select screened intervals for the monitoring wells. Well construction logs will be completed for each well (Attachment 2).

5.2 Monitoring Well Development

Newly installed monitoring wells will be developed by Holt Services, Inc. under the supervision of Shannon & Wilson. Development will be completed using a pump-and-surge method with a surge block and submersible pump. Groundwater quality parameters, including conductivity, pH, turbidity, and temperature, will be measured periodically during development. Development will be considered complete when the measured turbidity is below 5 nephelometric turbidity units (NTUs) and the water becomes clear or at a maximum of four hours. Water levels, amount of water removed, observations of the discharge water, and turbidity measurements will be recorded on a Well Development Log (Attachment 2).

5.3 Groundwater Monitoring and Sampling

Four quarterly groundwater monitoring and sampling events will be completed. Groundwater monitoring and sampling will include collecting depth to water measurements at all locations, collecting depth to LNAPL and depth to LNAPL-groundwater interface measurements where applicable, measuring field parameters, and collecting groundwater samples for laboratory analysis. Well and chemical selection criteria are discussed in the RI work plan. Sampling schedules for the first two events are provided in Tables 2A and 2B. The sampling schedule for the second two events will be developed following receipt of analytical results from the first two events and will primarily include monitoring/sampling of new wells.

5.3.1 Groundwater Level Measurements

The collection of depth to water, depth to LNAPL, and depth to LNAPL-groundwater interface measurements will be completed at all Site wells prior to groundwater monitoring and sampling. To account for potential tidal influence at the Site, groundwater level measurements (at wells without LNAPL) will be completed within a two-hour timeframe by multiple teams working concurrently from west to east (toward East Marginal Way). If possible, the events will be scheduled to coincide with periods of minimal tidal exchange.

Wells that do not contain LNAPL will be monitored within the two-hour timeframe, followed by collection of measurements at the remaining LNAPL-containing wells. The event will be coordinated such that only a subset of well lids will be open at any given time. The following sections outline the procedures for collecting depth to water and depth to LNAPL measurements at each well. Measurements collected at the Site since 2009 are presented in Table 3.

5.3.1.1 Well Venting

Steps 1, 2, and 3, below, will be completed for all monitoring wells included in the study. Each well will be allowed to equilibrate for at least 15 minutes prior to proceeding to the appropriate step 4. Steps 1, 2, and 3 may be completed the day prior to beginning step 4.

1. The well monument lid will be opened. A PID will be used to screen the space within the monument for volatiles. Standing water and debris (i.e., sediment, vegetation, or refuse) will be cleaned out of the monument prior to removing the well cap. PID readings will be written on the Water Level Measurements Form (Attachment 2).
2. The cap will be removed carefully and any pressure or vacuum allowed to vent. The time that the well cap is removed and the initial conditions (i.e., well over-pressurized or under-pressurized relative to the atmosphere) will be recorded on the Water Level Measurements Form. A PID will be used to screen the space within the casing for volatiles.
3. The well cap will be left ajar and the lid will be replaced. If warranted (based on location), a cone will be placed on each location to prevent the well from being blocked.

5.3.1.2 Wells Without Light Non-Aqueous Phase Liquid (LNAPL)

4. The initial water level will be measured to the nearest 0.01 foot from the surveyed location (typically the north side of the top of well casing) using an electronic water level probe.
5. The water level measurement in each well will be duplicated to ensure that the reading is accurate. The results will be recorded (times, measured values, etc.) on the Water

Level Measurements Form. The duplicate depth to water measurement will be recorded if it is different than the original measurement.

6. The probe will be inspected to determine if LNAPL is present in the well before it is decontaminated in accordance with procedures discussed in Section 6.3.
7. The well cap will be replaced and the monument lid will be sealed tightly upon completing the water level measurement.

5.3.1.3 Wells with Light Non-Aqueous Phase Liquid (LNAPL)

In 2018, LNAPL was observed in wells MW-16 through MW-21, MW-26 through MW-29, and MW-35.

4. The initial depth to LNAPL will be measured to the nearest 0.01 foot from the surveyed location (typically the north side of the top of well casing) using an electronic oil-water interface probe. The probe will emit an audible alarm when product is encountered.
5. The measurement will be duplicated by lifting the probe from the surface until the alarm is silenced and re-lowering the probe to verify the depth to LNAPL. The results will be recorded on the Water Level Measurements Form. Duplicate measurements will be recorded if they differ from the original measurement.
6. The depth to the LNAPL-groundwater interface will be measured by lowering the probe to the LNAPL (audible alarm will sound) and then continuing to lower the probe. At the interface, the alarm will change to a second indicator sound. The probe will be slowly lifted and lowered to identify the point at which the alarm changes and this depth will be measured to the nearest 0.01 foot from the surveyed location (typically the north of the top of well casing).
7. The measurement will be duplicated to verify the reading. The results will be recorded on the Water Level Measurements Form. Duplicate measurements will be recorded if they are different from the original measurement.
8. The probe tip and the length of probe wire that was in contact with the LNAPL will be decontaminated in accordance with procedures discussed within Section 6.3.
9. The well cap will be replaced and the monument lid will be sealed tightly upon completing the measurements.

5.3.2 Groundwater Sampling

Groundwater sampling will take place over several days and will include purging the well while collecting field parameter readings followed by the collection of samples into laboratory-supplied and appropriately preserved containers.

Sampling of wells within the likely zone of tidal influence near the shoreline (MW-6, MW-39, MW-42, MW-43, MW-44, MW-47, MW-50, MW-51, MW-52, MW-53, MW-54, MW-65, MW-68, MW-69, and MW-70) will be scheduled such that sample collection time will occur within one hour before low tide and no later than three hours after low tide.

Due to the use of aqueous film forming foam (AFFF) fire suppression systems at the Site, during one groundwater sampling event, select wells will be sampled for PFAS, an emerging contaminant. PFAS specific sampling and handling techniques, necessary to prevent cross-contamination, are provided within Attachment 4.

5.3.2.1 Low-Flow Purging

At wells without LNAPL, a peristaltic sampling pump fitted with disposable polyethylene and silicon (at the pump head and water quality instrument connections) tubing will be used to sample each monitoring well. At wells deeper than 25 feet, a peristaltic sampling pump will not be used; an in-well submersible pump fitted with disposable sample hose will be used to collect samples. At each location:

1. Dedicated tubing will be slowly lowered into the well until the intake is placed mid-screen. At wells within and downgradient of the Area 1 and Area 2 LNAPL plumes, the intake will be placed 2 to 3 feet below the water table or mid-screen (for B zone wells). The time will be recorded on the field tablet and the pump will be started.
2. Pumping rates will be measured with a stopwatch and container of known volume to adjust the flow rate to between 150 milliliters per minute (mL/min) and 1 liter per minute (L/min). The water level will be measured and field parameters will be recorded every three to five minutes. The pumping rate will be adjusted to maintain a steady water level. If possible, a drawdown of 0.3 foot or less will be maintained in the well and the water level will be maintained above the intake. The pumping rate will be lowered to a minimum of 150 mL/min, if necessary, to maintain the desired drawdown.
3. Field parameters, including pH, specific conductivity, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP), turbidity (NTU), salinity, and total dissolved solids (TDS), will be measured approximately every three to five minutes during purging. Measurements will be recorded to the following standards:
   - pH to plus or minus (±)0.01 pH units,
   - Specific conductivity to ±0.01 mmhos per centimeter,
   - Temperature to ±0.1˚C,
   - DO to ±0.01 milligrams per liter (mg/L),
   - ORP to ±0.1 millivolt,
   - Turbidity to ±0.01 NTU,

- Salinity to ±0.01%, and
- TDS to ±0.001 gram per liter.

4. Samples will be collected following parameter stabilization. Stabilization occurs when three consecutive readings are within a specified tolerance from each other. The following criteria will be monitored for stabilization:
   - pH to ±0.1 pH units,
   - Specific conductivity to ±3% (readings within 3% of each other),
   - Temperature to ±3%,
   - DO to ±10%, and
   - Turbidity to ±10% or within 10% of 0.2 mg/L, whichever is greater.
5. If field parameters do not stabilize after one hour of pumping, the sample will be collected. Well purging data (including a notation when stabilization did not occur) will be recorded on the field tablet.
6. If the well yield is poor and the water level drops to the level of the intake, the pump will be stopped until the water level recovers to near the pre-pumping level. The process will then be repeated until the field parameters have stabilized. All measured water levels and pumping rate changes will be recorded on the field tablet.

5.3.2.2 Groundwater Sample Collection

Upon completion of purging and parameter stabilization, samples will be collected from the discharge end of the pump tubing into the laboratory-supplied containers. If the pump rate at the end of well purging is at or below 0.5 L/min, the same pump rate will be used during sample collection. If the pump rate at the end of well purging is greater than 0.5 L/min, the pump rate will be reduced to 0.5 L/min during sample collection.

Sample containers will be filled in order from most to least volatile in accordance with the sample schedule presented in Tables 2A and 2B. Sample handling and field QA sample collection procedures are outlined within Section 6.1.

Volatile organic analyte (VOA) vials will be filled by allowing the sample water to pour down the inside wall of the vials without splashing onto the base. VOAs will be filled to eliminate headspace and the seal/lid will be secured. Samples for dissolved metals analysis will not be field-filtered or preserved. Upon receipt, the laboratory will filter and preserve the samples with nitric acid. We will request laboratory filtering on the COC.

After sample collection is complete, the tubing/hose will be removed, the well cap will be replaced, and the monument lid will be secured. The following analyses will be completed in accordance with the sample schedule (Tables 2A and 2B):

- TPH-G by NWTPH-Gx and BTEX by EPA Method 8260C;
- TPH-D and TPH-O by Method NWTPH-Dx with the silica-gel cleanup preparation method;
- HVOCs, including 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, PCE, TCE, and vinyl chloride and methyl tert-butyl ether by EPA Method 8260C;
- PAHs by EPA Method 8270D;
- Full list SVOCs by EPA Method 8720D;
- Limited SVOCs, including bis(2-ethylhexyl phthalate), dibutyl phthalate, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dimethyphenol, benzoic acid, butyl benzyl phthalate, n-nitrosodiphenylamine, and pentachlorophenol by EPA Method 8270D;
- PCBs as aroclors by EPA Method 8082A;
- Total and dissolved, metals including arsenic, barium, cadmium, total chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, silver, vanadium, and zinc by EPA Method 200.8;
- Total and dissolved mercury by EPA Method 7470A;
- Dissolved hexavalent chromium by EPA Standard Method 3500;
- PFAS, including EPA’s third Unregulated Contaminant Monitoring rule [UCMR 3] list of six perfluorinated compounds (perfluorooctanesulfonic acid [PFOS], perfluorooctanoic acid [PFOA], perfluorobutanesulfonic acid [PFBS], perfluorohexanesulfonic acid [PFHxS], perfluoroheptanoic acid [PFHpA], and perfluorononanoic acid [PFNA]) by Method 537 (modified);
- Ferrous iron by EPA Standard Method 3500;
- Nitrate and nitrite as nitrogen by EPA Method 300.0;
- Sulfate by EPA Method 300.0;
- Sulfite by EPA Standard Method 4500;
- Manganese ion by EPA Method 200.8; and
- Methane by RSK-175.

SVOCs and PAHs are analyzed using EPA Method 8270D. Method 8270D includes the standard method, a low-level (LL) version, and SIM. SIM, which provides the lowest detection limits, is not available for the full suite of analytes on the EPA 8270D analyte list; the available SIM analyte list mainly includes PAHs. Similarly, the LL method does not include the full suite of analytes on the EPA 8270D analyte list. For the included analytes, the LL method provides lower detection limits than the standard method but less stringent than the SIM method. The standard method has been selected when the reporting limits are sufficient to meet the screening level requirements or if the analyte is not included within the SIM or LL methods. The LL method has been selected when it is required to achieve the screening level requirements, or when it can get closer to the screening levels and SIM is not available. SIM has been selected when it is available and required to achieve or get closer to the screening levels.

As stated in Section 5.3.2, PFAS is an emerging contaminant. The regulatory environment is rapidly changing. While Method 537 (modified) is listed above, an alternative analytical method may be used if one is approved prior to the field event. The UCMR 3 list has been selected for analysis because PFOS and PFOA are the largest component of historical AFFF; because PFOS, PFOA, PFBS, PFHxS, PFHpA, and PFNA are the most frequently detected compounds observed in groundwater at AFFF-affected sites; and because PFOS and PFOA are the compounds for which the EPA has set a lifetime Health Advisory Level for drinking water.

5.4 Hydraulic Conductivity Testing

Falling head/rising head slug testing will be performed by a two-person crew at up to six monitoring wells to evaluate hydraulic conductivity. The results of the hydraulic conductivity testing will be used to support the evaluation of remedial design options.

Falling head slug tests involve rapidly (as close to instantaneous as possible) raising the water level within the well and recording the water level as the well returns to equilibrium. Rising head slug tests involve rapidly (as close to instantaneous as possible) dropping the water level within the well and recording the recovery as the well returns to equilibrium. These tests can be accomplished by adding an object of known size to the well to raise the water level. Once equilibrium has returned, the object can be removed to drop the water level.

The slug tests will include the following steps:

1. A pressure transducer will be placed within the well and set at a sufficient depth to avoid interference with the slug once it is placed. The depth to water will be recorded. The datalogger will be set to record several readings per second for the first two minutes with gradually increasing reading intervals over time.
2. The falling head test will be initiated by rapidly lowering a slug consisting of a solid polyvinyl chloride pipe into the well and placing below the water table. The water level will rise as a result of this placement and the transducer will be allowed to record as the slug comes into equilibrium with the water table.
3. Readings will be collected until the water level has returned to equilibrium.

4. After a period of at least 24 hours, the datalogger will be reset to record several readings per second for first two minutes with gradually increasing reading intervals over time. The slug will then be pulled from the well, initiating the rising head test.
5. Readings will be collected until the water level has returned to equilibrium.

At least two tests will be performed within each well. The resulting data will be analyzed using a standard method such as Bouwer and Rice to estimate the hydraulic conductivity.

6 FIELD QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) REQUIREMENTS

Laboratory QA/QC protocols are discussed within the QAPP (Appendix F of the work plan). Field QA/QC procedures, discussed below, have been established to ensure that samples can be tracked from collection through analysis, evaluate the efficiency and reproducibility of sampling procedures; and ensure that sampling activities do not result in cross-contamination.

6.1 Sample Handling, Chain-of-Custody (COC), and Transportation Procedures

All environmental samples collected during the project will be labeled, stored, and transported using standard Shannon & Wilson protocols. These protocols are summarized below.

6.1.1 Sample Labeling

Sample container labels will be completed immediately before or immediately following sample collection. Labels will be completed using indelible ink. At a minimum, container labels will include the following information:

- Date and time of collection,
- Location of the sample,
- Name or initials of sample collector,
- Unique sample identification,
- Analysis requested, and
- Chemical preservative used.

The established nomenclature for soil samples will be:

Boring Name:Sample Depth-Date

For example, a soil sample collected from 5.5 feet bgs from boring SB-2020-001 on February 1, 2020, would be identified as:

SB-2020-001:5.5-02012020

The established nomenclature for groundwater samples will be:

Well Name-Date

For example, a groundwater sample from well MW-53 collected on February 1, 2020, would be identified as:

MW-53-02012020

Duplicate samples will be labeled with a discrete well/boring name commencing at numeral 100. For example:

MW-100-02012020 or SB-2020-100:5.5-02012020

Equipment blanks will have the initials EB, will be numbered sequentially, and dated:

EB-1-02012020

Trip blanks will have the initials TB, will be numbered sequentially, and dated:

TB-1-02012020

Matrix spike/matrix spike duplicate (MS/MSD) samples will be identified with the initials MS/MSD, with the identification of the well or boring from which it was collected, and dated. For example, an MS/MSD sample collected from MW-43 on February 1, 2020, would be labeled:

MS/MSD-MW-43-02012020

6.1.2 Chain-of-Custody (COC)

Once a sample is collected, it will be placed within a cooler with blue ice and will remain in the custody of the sampler until shipment, pick-up, or delivery to the laboratory, or until the sample possession is transferred to another party. Sample information will be entered onto a COC form along with the requested analyses. COC procedures are discussed in detail within the QAPP (Appendix F of the work plan).

Upon transfer of sample possession to subsequent parties, the COC form will be signed and time stamped by the person(s) transferring and receiving custody of the sample container. Upon receipt of samples at the laboratory, the condition of the samples will be recorded by the receiver. COC records will be included in the analytical report prepared by the laboratory.

Upon receipt of samples (which will be accompanied by a completed COC record detailing requested analyses), the Laboratory Coordinator(s) or his/her delegate will:

- Verify all paperwork, COC records, and similar documentation;
- Log in samples, assign unique laboratory sample numbers, and attach the numbers to the sample container(s);
- Perform any requested laboratory filtration and preservation;
- Open a project file and enter data into the file;
- Store samples in a refrigerated sample bank; and
- Email a record of the sample receipt and log-in form to the Shannon & Wilson Project Manager noting any problems with the samples.

6.1.3 Sample Transportation

Samples will be transported to the analytical laboratory within a cooler containing blue ice to ensure that samples are maintained within the appropriate temperature range (between 0°C and 6°C). Samples will be dropped at the laboratory by field personnel, picked up by the laboratory (or courier) at the Shannon & Wilson office, picked-up by the laboratory (or courier) at the Site, or shipped directly to the laboratory from the Shannon & Wilson office. Carriers who are only involved in the transport of sealed coolers are not required to sign the COC. However, shipping documents will be included in the project files if a carrier is used to transport the project samples.

6.2 Quality Assurance/Quality Control (QA/QC) Samples

QA/QC samples will be collected during the event to evaluate the reproducibility of the sampling technique and the subsequent laboratory analysis. These will include field duplicate samples, trip blank samples, equipment blank samples, MS/MSD samples, and temperature blank samples. Evaluation of QA/QC samples is discussed within the QAPP (Appendix F of the work plan).

6.2.1 Field Duplicate Samples

Field duplicate samples are a second sample collected from a location. This sample is submitted to the laboratory with a "dummy" sample number and time as a regular sample. It is analyzed for the same suite as the original sample to allow for evaluation of the reproducibility of the sampling technique and the subsequent laboratory analysis. One field duplicate sample will be collected for every 20 groundwater and 20 soil samples. The field team will note in the field log where each duplicate sample was collected. During the event during which PFAS sampling is to occur, one of the field duplicates will be collected from a location that is undergoing PFAS analysis.

6.2.2 Trip Blank Samples

One trip blank will be submitted with each cooler containing samples for volatile analytes (HVOCs or TPH-G/BTEX). Samples for volatile analyses will be grouped into as few coolers as possible to minimize trip blanks. The trip blank sample will be analyzed for the same set of volatile constituents that is contained within the cooler.

6.2.3 Equipment Blank Samples

Because some of the screening levels for this project are significantly lower than drinking water standards, an additional equipment blank sample will be collected from the water source used to perform equipment decontamination. This sample will be collected in advance of the field activities to evaluate its adequacy for use.

During the field activities, equipment blank samples will be collected from the peristaltic pump tubing and from the hose used to collect the samples at MW-64 and MW-70. Two equipment blank samples will be taken to evaluate potential contributions from the tubing. Two equipment blank samples will be collected to evaluate the potential contributions from the hose. The samples will be collected by running laboratory-distilled water through equipment tubing into laboratory-supplied containers.

A pair of equipment blank samples will be collected during decontamination of a reusable piece of equipment (such as a water level probe). The first will be collected following the first distilled water rinse and the second will be collected following the final distilled water rinse. The purpose of the pair is to determine if there is an ongoing need to perform two rinses with distilled water.

6.2.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples

MS/MSD samples are used by the laboratory to evaluate potential matrix interferences and evaluate analytical accuracy. One soil MS/MSD sample will be collected for every week of soil sampling and one groundwater MS/MSD sample will be collected during each groundwater sampling event.

6.2.5 Temperature Blank Samples

Temperature blank samples are used to determine whether the samples have been maintained within the appropriate temperature range. The samples are provided by the laboratory and are not analyzed for chemical constituents.

6.3 Equipment Decontamination

All non-disposable and non-dedicated sampling and monitoring equipment will be decontaminated prior to initial use, between sampling locations, and at the completion of the Site-specific sampling. The procedure will include:

- Tap water initial rinse (if needed),
- Tap water and non-phosphate detergent (Alconox™) mixture wash,
- Tap water rinse,
- Distilled water rinse, and
- Distilled water final rinse.

Additional decontamination steps may be incorporated as needed (such as during PFAS sampling). Oil absorbent pads may be used to aid in wiping product from equipment. Decontamination of personnel involved in sampling activities will be accomplished as described in a Site-specific HASP.

7 INVESTIGATION-DERIVED WASTE (IDW) MANAGEMENT

IDW is waste generated during Site activities. IDW generated during this effort will include soil cuttings, groundwater, and LNAPL purged from wells during development and sampling, and decontamination water generated during probing and drilling activities. Soil, water, and LNAPL will be placed into separate drums, sealed, labeled, and temporarily stored on site.

If possible, the diesel fueling and used oil storage building located in the northwest corner of the Site will be used to store IDW drums generated during this investigation. If the potential property sale or redevelopment prevent this building from being used, an alternative location will be selected with the input of the property owner. If necessary, a bermed containment area will be created such that the bermed area can contain at least 10% of the volume of free liquids within the area or 100% of the volume of the largest container. Following receipt of analytical results and disposal facility acceptance, the IDW will be picked up by an appropriately licensed waste transporter and disposed of offsite at the appropriate accepting disposal facility.

Miscellaneous IDW consists of used personal protective equipment (PPE), disposable sampling equipment (spoons, tubing, etc.), and other wastes that originated from Site activities. This IDW will be placed in doubled, heavy-duty plastic bags. The waste PPE and disposable sampling equipment will be disposed of in a dumpster at the Shannon & Wilson office.

8 HEALTH AND SAFETY

A Site-specific HASP is provided in Appendix G of the work plan. The HASP was prepared consistent with the requirements of the Washington State Division of Occupational Safety and Health Hazardous Waste Operations Regulation (Washington Administrative Code 296 843). The HASP includes a description of the project team, the scope of work, Site control, Site hazard information, Site hazard control, air monitoring, and emergency response. Information about the nearest hospital, including a map, is also provided.

9 REFERENCES

Shannon & Wilson, 2019, Draft remedial investigation work plan, Jorgensen Forge Corporation Property, Tukwila, Washington: Report prepared by Shannon & Wilson, Seattle, Wash., 21-1-12596-010, for Earle M. Jorgensen Company, Lynwood, Calif., January 31.

Washington State Department of Ecology (Ecology), Revised 2016, Guidance for remediation of petroleum contaminated sites: Toxics Cleanup Program, Olympia, Wash., Washington State Department of Ecology Publication No. 10-09-57, June.

Washington State Department of Ecology (Ecology), 2019, Ecology comments on the draft remedial investigation work plan, Jorgensen Forge Corporation property, Tukwila, Washington, dated January 31, 2019 for: Name: Jorgensen Forge Corp Site, Address: 8531 East Marginal Way South, Tukwila, WA 98106, Facility/Site No.: 2382, Cleanup Site ID No.: 3689, Agreed Order No.: 14143: Comments prepared by Ecology, Bellevue, Wash., for Shannon & Wilson, Seattle, Wash., December 20.

Table 1 - Monitoring Well Status and Construction Details - Sorted by Status

Monitoring Well Identification	Date Installed	Installed By	Hydro-Stratigraphic Unit	Screened Interval (feet bgs)[1]	Top of Casing Elevation (feet NAVD88)[2]	Status[3]
MW-3	05/21/91	SEACOR	A	4.5-19.75	17.327	Active
MW-4	05/21/91	SEACOR	A	4.75-20	17.449	Active
MW-6 (orig MW-2)	02/28/90	D&M	A	10-20	20.59	Active
MW-7 (orig MW-3)	02/28/90	D&M	A	10-20	20.813	Active
MW-8	10/10/91	SEACOR	A	5-20	17.662	Active
MW-9	03/19/92	SEACOR	A	5-20	17.774	Active
MW-11	03/19/92	SEACOR	A	5-20	17.649	Active
MW-14	08/27/92	SEACOR	A	5-20	17.603	Active
MW-15	08/27/92	SEACOR	A	5-20	17.608	Active
MW-16	08/29/92	SEACOR	A	6-16	17.695	Active, LNAPL
MW-17	03/04/93	SEACOR	A	8-23	17.566	Active, LNAPL
MW-18	08/29/92	SEACOR	A	6-15.75	17.466	Active, LNAPL
MW-19	08/28/92	SEACOR	A	6-16	17.916	Active, LNAPL
MW-20	08/28/92	SEACOR	A	6-16	18.22	Active, LNAPL
MW-21	08/28/92	SEACOR	A	6-16	17.881	Active, LNAPL
MW-23	08/31/92	SEACOR	A	6-15.75	17.779	Active
MW-24	09/14/92	SEACOR	A	6-19.75	17.792	Active
MW-25	09/14/92	SEACOR	A	6-19.75	17.652	Active
MW-26	11/03/93	SEACOR	A	7-22	18.278	Active, LNAPL
MW-27	11/03/93	SEACOR	A	7-22	18.081	Active, LNAPL
MW-28	12/03/93	SEACOR	A	5-20	18.277	Active, LNAPL
MW-29	12/03/93	SEACOR	A	7-22	18.151	Active, LNAPL
MW-30	01/30/94	SEACOR	A	5-19.5	17.449	Active
MW-31	01/30/94	SEACOR	A	5-20	17.471	Active
MW-32	01/30/94	SEACOR	A	5-20	13.62	Active
MW-34	08/04/93	SEACOR	A	5-15	17.061	Active
MW-35	08/04/93	SEACOR	A	5-20	17.438	Active, LNAPL
MW-36	Unknown	Unknown	A	Unknown	17.383	Active
MW-37	09/02/09	Farallon	A	10-25	17.498	Active
MW-38	09/02/09	Farallon	A	5-20	17.384	Active
MW-39	11/02/09	Farallon	A	5-20	20.8	Active
MW-40	07/19/08	Farallon	A	10-25	17.148	Active
MW-41	07/19/08	Farallon	B	30-40	17.329	Active
MW-42	10/02/09	Farallon	A	5-20	17.484	Active
MW-43	10/02/09	Farallon	B	30-40	17.443	Active
MW-44	05/02/09	Farallon	B	50-60	17.072	Active
MW-45	05/02/09	Farallon	B	30-40	17.043	Active
MW-46	11/02/09	Farallon	A	5-20	17.67	Active
MW-47	11/02/09	Farallon	A	5-20	20.778	Active
MW-48	12/02/09	Farallon	A	5-17	17.241	Active
MW-49	02/13/09	Farallon	A	5-17	17.235	Active
MW-50	12/02/09	Farallon	A	23-27	17.635	Active
MW-51	12/02/09	Farallon	A	23-27	17.395	Active

Table 1 - Monitoring Well Status and Construction Details - Sorted by Status

Monitoring Well Identification	Date Installed	Installed By	Hydro-Stratigraphic Unit	Screened Interval (feet bgs)[1]	Top of Casing Elevation (feet NAVD88)[2]	Status[3]
MW-52	12/02/09	Farallon	A	23-27	17.594	Active
MW-22	08/28/92	SEACOR	A	6-15.75	16.98	Inaccessible, LNAPL
MW-1	07/02/91	SEACOR	A	5-15	Unknown	Decommissioned (1991)
MW-2	07/02/91	SEACOR	A	5-15	Unknown	Decommissioned (unknown)
MW-5 (orig MW-1)	02/28/90	D&M	A	10-20	17.03	Decommissioned (2013)
MW-10	03/19/92	SEACOR	A	5-20	17.57	Decommissioned (2017)
MW-12	08/27/92	SEACOR	A	5-20	17.19	Decommissioned (2017)
MW-13	08/27/92	SEACOR	A	5-20	17.44	Decommissioned (2017)
MW-33	08/04/93	SEACOR	A	5-15	17.23	Decommissioned (2017)
PL2-JF01A	Unknown	Unknown	A	Unknown	Unknown	Decommissioned (unknown)
PL2-JF01AR	09/05/01	Weston	A	23-27	16.88	Decommissioned (2013)
PL2-JF01B	03/21/95	Weston	B	40-50	16.97	Decommissioned (2013)
PL2-JF01C	09/05/01	Weston	C	74-78	17.08	Decommissioned (2013)
PL2-JF02A	09/21/95	Weston	A	8-23	17.81	Decommissioned (2013)
PL2-JF03A	09/21/95	Weston	A	8-23	17.95	Decommissioned (unknown)
PL2-JF04A	02/16/05	Weston	A	8-18	Unknown	Decommissioned (unknown)

NOTES:

1 Screened interval of monitoring well in feet below ground surface (bgs).

2 Elevation of top of casing in feet relative to the North American Vertical Datum of 1988 (NAVD88), surveyed by True North Land Surveying, Inc., Seattle, Washington, August 2017, Bench Mark: 2" Brass Disc City of Seattle "3773-5101", located at the northeast corner of South 87th Street and East Marginal Way, Elevation 18.499 feet.

2017 survey did not include decommissioned or inaccessible wells (MW-1, MW-2, MW-5, MW-10, MW-12, MW-13, MW-22, MW-33, PL2-JF01A, PL2-JF01AR, PL2-JF01B, PL2-JF01C, PL2-JF02A, PL2-JF03A, and PLW-JF04A); MW-20; and MW-32. Elevations for these locations surveyed by PLS, Inc., Issaquah, Washington, August 2003 and March 2009, City of Seattle Benchmark No. SNV-5293.

3 Well status = status of monitoring well viability for monitoring and sampling:

Active: Monitoring well is currently viable for monitoring and sampling.

Decommissioned: Monitoring well has been decommissioned or abandoned and is no longer viable for monitoring and sampling. If known, year of decommissioning is shown in parenthesis.

Inaccessible: Monitoring well is believed to have been paved over during recent paving activities.

LNAPL: Monitoring well contains measurable petroleum as LNAPL.

Shading indicates LNAPL observed in the well.

D&M = Dames & Moore; Farallon = Farallon Consulting, Inc.; LNAPL = light nonaqueous phase liquid; orig. = originally

Table 2A - Proposed Investigation Locations and Sampling Schedule

								Soil Analyses												Groundwater Analyses												
LIF Boring	Groundwater Monitoring Well	Probe Boring	Location Name	Location Description	Rationale	Depth or Screen Interval (ft bgs)	Number[1] of Soil Samples	TPH-G	TPH-Dx	BTEX	HVOCs[2]	PAHs	Full List SVOCs	PCB aroclors	Metals[3]	Hexavalent Chromium	Total Organic Carbon	Porosity	Grain-Size Analysis	TPH-G	TPH-Dx	BTEX	HVOCs	MTBE	PAHs	Full List SVOCs	Limited SVOCs[4]	PCB aroclors	PFAS[5]	Metals[6]	Hexavalent Chromium	Attenuation Indicators[7]
Area 1																																
x		x	A1-1 and A1-2	Area 1 LNAPL plume-center borings	Provide vertical delineation of LNAPL extent and residual soil contamination.	15	2/boring[8]		x			x																				
x			A1-3 through A1-14	Area 1 LNAPL plume-perimeter borings	Identify edge of LNAPL extents. Provide vertical delineation of LNAPL at each location.	15	0																									
	x		MW-55	Outside and NW of Hollowbore Area	Monitor Area 1 LNAPL plume to the NW.[9]	5-20	4		x			x			x	x			x		x	x	x		x					x	x	
	x		MW-56	Outside and SW of Hollowbore Area	Monitor Area 1 LNAPL plume to the SW.[9]	5-20	4		x			x			x						x	x	x		x					x		x
	x		MW-57	S of Hollowbore Area	Monitor Area 1 LNAPL plume to the SE.[9]	5-20	4		x			x			x						x	x	x		x					x		
	x		MW-58	E of Hollowbore Area	Monitor Area 1 LNAPL plume to the E.[9] Evaluate Shipping Area.	5-20	4		x	x	x	x			x				x		x	x	x		x					x		x
	x		MW-59	Outside and N of Hollowbore Area	Monitor Area 1 LNAPL plume to the N.[9]	5-20	4		x			x			x						x	x	x		x					x		
	x		MW-22R	Outside and SW of Hollowbore Area	Optional well to be installed to replace lost well MW-22 (installed if MW-22 cannot be located).	5-20	4		x[10]			x[10]			x[10]																	
Area 1/9																																
		x	SB-2020-042	24-Inch JFOS Pipe	Evaluate decommissioned 24-inch pipe.	8	1		x			x		x																		
		x	SB-2020-043	24-Inch JFOS Pipe	Evaluate decommissioned 24-inch pipe.	8	1		x			x		x																		
		x	SB-2020-044	24-Inch JFOS Pipe	Evaluate decommissioned 24-inch pipe.	8	1		x			x		x																		
Area 2																																
x			A2-1 and A2-2	Area 2 LNAPL plume-center borings	Provide vertical delineation of LNAPL extent and residual soil contamination.	15	2/boring[8]		x			x																				
x			A2-3 through A2-10	Area 2 LNAPL plume-perimeter borings	Identify edge of LNAPL extent. Provide vertical delineation of LNAPL at each location.	15	0																									
	x		MW-60	Forge Shop Area	Monitor Area 2 LNAPL plume to the W.[9]	5-20	4	x	x	x	x	x		x	x		x		x	x	x	x	x		x			x	x	x		x
	x		MW-61	Forge Shop Area	Monitor Area 2 LNAPL plume to the SW.[9]	5-20	4	x	x			x		x	x		x		x	x	x	x	x		x					x		
	x		MW-72	E of Decommissioned Diesel Storage Area	Provide monitoring well upgradient of the Decommissioned Diesel Storage Area.	5-20	4		x				x		x						x	x[11]	x		x[11]	x			x	x		
	x		MW-73	Within aluminum heat treat building	Monitor Area 2 LNAPL plume to the E.[9]	5-20	4	x	x	x	x	x		x	x					x	x	x	x		x					x		
	x		MW-13R	W of aluminum heat treat building	Optional well to replace monitoring wells within Area 2 LNAPL plume.	5-20	4																									
	x		MW-74	W of ring expander vault	Evaluate ring expander vault and hydraulic oil tank.	5-20	4		x			x		x	x					x	x	x	x		x					x		
		x	SB-2020-030	Decommissioned Diesel Storage Area Vault	Evaluate Decommissioned Diesel Storage Area.	15	2		x			x			x																	
		x	SB-2020-031	Decommissioned Diesel Storage Area Vault	Evaluate Decommissioned Diesel Storage Area.	15	2		x			x			x																	
		x	SB-2020-032	Decommissioned Diesel Storage Area Fill Ports	Evaluate Decommissioned Diesel Storage Area.	15	2		x			x			x																	

Table 2A - Proposed Investigation Locations and Sampling Schedule

								Soil Analyses												Groundwater Analyses												
LIF Boring	Groundwater Monitoring Well	Probe Boring	Location Name	Location Description	Rationale	Depth or Screen Interval (ft bgs)	Number[1] of Soil Samples	TPH-G	TPH-Dx	BTEX	HVOCs[2]	PAHs	Full List SVOCs	PCB aroclors	Metals[3]	Hexavalent Chromium	Total Organic Carbon	Porosity	Grain-Size Analysis	TPH-G	TPH-Dx	BTEX	HVOCs	MTBE	PAHs	Full List SVOCs	Limited SVOCs[4]	PCB aroclors	PFAS[5]	Metals[6]	Hexavalent Chromium	Attenuation Indicators[7]
Area 3																																
		x	SB-2020-033	Former unregistered 2,000-gallon UST	Evaluate for compliance at location of former UST.	15	2	x	x	x	x[12]																					
		x	SB-2020-034	Former unregistered 1,000-gallon UST	Evaluate for compliance at location of former UST.	15	2	x	x	x	x[12]																					
		x	SB-2020-035	Former registered 8,000-gallon UST	Evaluate for compliance at location of former UST.	15	2	x	x	x	x[12]																					
Area 4																																
	x		MW-10R	W of Decommissioned Oil Storage Area	Replace decommissioned well MW-10.	5-20	4		x	x	x	x			x						x	x	x		x			x		x		
		x	SB-2020-036	Decommissioned Oil Storage Area Vault	Evaluate Decommissioned Oil Storage Area.	15	2		x			x			x																	
		x	SB-2020-037	Decommissioned Oil Storage Area Vault	Evaluate Decommissioned Oil Storage Area.	15	2		x			x			x																	
			SB-2020-045	Machine Shop Area	Investigate Large Bullard.	10	2	x[13]	x		x[14]	x		x	x																	
Area 5																																
	x		MW-62	W of MW-10R	Monitor downgradient of MW-10R.	5-20	4		x			x			x	x					x	x	x		x			x		x		
	x		MW-63	W of MW-40/MW-41	Monitor downgradient of MW-40 and MW-41.	5-20	4		x				x		x	x					x	x	x			x		x	x	x		
	x		MW-64	W of MW-40/MW-41	Monitor deeper zone downgradient of MW-40 and MW-41.	45-60	3		x			x			x						x	x	x		x			x	x	x		
	x		MW-75	Machine Shop Area	Evaluate Machine Shop Area	5-20	4		x	x			x		x						x	x	x			x		x		x		
		x	SB-2020-001	N of bar peeler	Evaluate in vicinity of FB-3 TPH-O detection.	10	2		x			x			x																	
		x	SB-2020-002	S of bar peeler	Evaluate in vicinity of FB-3 TPH-O detection.	10	2		x			x		x	x																	
		x	SB-2020-028	E of bar peeler	Evaluate in vicinity of FB-3 TPH-O detection.	10	2		x			x			x																	
		x	SB-2020-003	Heat Treat Area	Complete coverage within center of main building. Investigate West and East Craven Vaults.	15	3		x	x	x	x			x																	
		x	SB-2020-004	Heat Treat Area	Complete coverage within center of main building. Investigate Quench Tanks 1, 2, and 3 vault.	30	5		x	x	x	x		x	x		x		x													
		x	SB-2020-006	Forge Shop Area	Complete coverage within Forge Shop Area.	15	3		x			x			x																	
		x	SB-2020-027	Machine Shop Area	Evaluate Machine Shop Area. Investigate Tacchi Lathe vault.	15	3		x			x			x																	
		x	SB-2020-029	Machine Shop Area	Evaluate Machine Shop Area. Investigate Large Bullard.	10	2	x[13]	x			x			x																	
		x	SB-2020-038	Heat Treat Area	Complete coverage within center of main building. Investigate West and East Craven Vaults.	15	3		x			x		x	x																	

Table 2A - Proposed Investigation Locations and Sampling Schedule

								Soil Analyses												Groundwater Analyses												
LIF Boring	Groundwater Monitoring Well	Probe Boring	Location Name	Location Description	Rationale	Depth or Screen Interval (ft bgs)	Number[1] of Soil Samples	TPH-G	TPH-Dx	BTEX	HVOCs[2]	PAHs	Full List SVOCs	PCB aroclors	Metals[3]	Hexavalent Chromium	Total Organic Carbon	Porosity	Grain-Size Analysis	TPH-G	TPH-Dx	BTEX	HVOCs	MTBE	PAHs	Full List SVOCs	Limited SVOCs[4]	PCB aroclors	PFAS[5]	Metals[6]	Hexavalent Chromium	Attenuation Indicators[7]
Area 6																																
	x		MW-66	N end of property west of Truck Scale	Monitor N property boundary. Assess former Bethlehem Steel galvanizing plant.	5-20	4		x	x	x	x			x		x		x		x	x	x		x			x		x		
	x		MW-76	SE of Truck Scale	Complete coverage within Former BSF footprint.	5-20	4		x				x		x						x	x	x		x	x				x		
		x	SB-2020-005	W of Melt Bag House	Complete coverage within Former BSF footprint.	25	5		x	x	x	x			x																	
		x	SB-2020-009	SW of Former Steam Clean Area	Complete coverage within Former BSF footprint. Evaluate Former Steam Clean Area.	15	3	x	x	x	x	x			x																	
		x	SB-2020-039	N of Former Steam Clean Area	Complete coverage within Former BSF footprint. Evaluate Former Steam Clean Area.	15	3	x	x	x	x	x			x																	
Area 6/8																																
	x		MW-65	NW of stormwater treatment system	Monitor Former Bethlehem Steel Facility footprint with former embayment.	5-20	4		x	x	x	x		x	x	x	x		x	x	x	x	x		x		x	x		x		
		x	SB-2020-007	E of Melt Bag House	Complete coverage within Former BSF footprint.	25	5		x			x		x	x																	
		x	SB-2020-008	E MW-6	Complete coverage within Former BSF footprint.	25	5		x	x	x	x		x	x																	
Area 7																																
	x		MW-67	SW of Former Metals Storage Area bins	Monitor within the Former Metals Storage Area and unpaved slag storage area.	5-20[15]	4		x		x		x		x	x	x		x		x	x	x			x		x		x		
		x	SB-2020-010	E of Arc Furnace Vault	Complete coverage within Former Melt Shop.	15	3		x			x			x																	
		x	SB-2020-012	N of Swarf Stockpile Area	Evaluate NE portion of Former Metals Storage Area.	15	3		x			x			x																	
		x	SB-2020-040	W of Arc Furnace Vault	Complete coverage within Former Melt Shop.	15	3		x			x			x																	
Area 7/8																																
	x		MW-68	W of Former Metals Storage Area	Monitor downgradient of Former Metals Storage Area.	5-20	4		x	x	x		x	x	x						x	x	x			x		x	x	x		
		x	SB-2020-011	E of Former Metals Storage Area	Complete coverage E of Former Metals Storage Area and within unpaved slag storage area.	15[15]	3		x			x			x																	
Area 8																																
	x		MW-53	Shoreline W of Melt Bag House	Monitor shoreline.	5-20	4		x	x	x	x		x	x						x	x	x		x		x	x		x		
	x		MW-54	Shoreline S of Liquid Cooling Gas Storage	Monitor shoreline.	5-20	4		x	x	x	x		x	x			x			x	x	x		x		x	x		x		
		x	SB-2020-013	W of Former Acid Pit	Evaluate metals and PCBs along shoreline.	25	5		x			x		x	x		x		x													

Table 2A - Proposed Investigation Locations and Sampling Schedule

								Soil Analyses												Groundwater Analyses												
LIF Boring	Groundwater Monitoring Well	Probe Boring	Location Name	Location Description	Rationale	Depth or Screen Interval (ft bgs)	Number[1] of Soil Samples	TPH-G	TPH-Dx	BTEX	HVOCs[2]	PAHs	Full List SVOCs	PCB aroclors	Metals[3]	Hexavalent Chromium	Total Organic Carbon	Porosity	Grain-Size Analysis	TPH-G	TPH-Dx	BTEX	HVOCs	MTBE	PAHs	Full List SVOCs	Limited SVOCs[4]	PCB aroclors	PFAS[5]	Metals[6]	Hexavalent Chromium	Attenuation Indicators[7]
Area 9																																
	x		MW-69	NW of Black Shack Motor Storage	Monitor NW corner of property.	5-20	4		x	x	x	x		x	x		x	x		x	x	x	x				x	x		x		
	x		MW-70	NW of Black Shack Motor Storage	Monitoring deeper zone in NW corner of property.	45-60	3													x	x	x	x		x			x		x		
	x		MW-71	N property boundary east of Truck Scale	Monitor N property boundary.	5-20	4		x	x	x	x			x					x	x	x	x		x			x	x	x		
		x	SB-2020-014	W of Black Shack Motor Storage	Evaluate TPH and PCBs in NW corner.	25	5	x	x	x	x	x		x	x																	
		x	SB-2020-015	E of Black Shack Motor Storage	Evaluate TPH and metals in NW corner.	25	5	x	x	x	x	x		x	x																	
		x	SB-2020-016	S of Black Shack Motor Storage	Evaluate TPH and PCBs in NW corner.	25	5	x	x	x	x	x		x	x																	
		x	SB-2020-017	W of Truck Scale	Complete coverage.	15	3	x	x	x	x	x		x	x																	
		x	SB-2020-041	E of Diesel Fueling and Used Oil Storage Building	Evaluate Diesel Fueling and Used Oil Storage Building.	15	3	x	x	x	x	x		x	x																	
		x	SB-2020-018 through SB-2020-026	S of OA-11	Provide further delineation of PCBs from Boeing OA-11.	12	6/boring		x					x																		

NOTES:

1 Indicates number of soil samples to be collected; some (deeper) samples to be held for potential analysis. Additional samples may be collected based on field screening

2 HVOCs include 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, tetrachloroethene, trichloroethene, and vinyl chloride

3 Metals include arsenic, barium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, vanadium, and zinc

4 Limited SVOCs include bis(2)ethylhexyl phthalate, dibutyl phthalate, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dimethyphenol, benzoic acid, butyl benzyl phthalate, n-nitrosodiphenylamine, and pentachlorophen

5 To be analyzed during one event for EPA's third UCMR list of six perfluorinated compounds (perfluorobutanesulfonic acid, perfluorohexanesulfonic acid, perfluoroheptanoic acid, perfluorooctanoic acid, perfluorooctanesulfonic acid, and perfluorononanoic aci

6 Metals include total and dissolved metals, including arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc

7 Natural attenuation parameters include dissolved oxygen (field reading), nitrate, nitrite, sulfate, sulfite, ferrous iron, manganese, and methane

8 Soil samples to be collected from probe boring completed following LIF investigation. Soil samples to be collected from depth with highest LIF response and from below residual soil contaminatio

9 To be located outside of LNAPL plume footprint; position may be adjusted following plume delineation.

10 Analyze if visible LNAPL is not observed.

11 To be analyzed if TPH is detected within the sample.

12 Analyze the two soil samples with highest contamination within Area 3 (from two different borings) for HVOCs.

13 Analyze one sample (with highest contamination) for TPH-G

14 Analyze one sample for HVOCs.

15 Sample depths to include a near-surface soil sample

Investigation locations are shown in Figures 2A and 2B. Locations may be adjusted in the field as required to avoid utilities and in response to findings from previous points

BSF = Bethlehem Steel Facility; BTEX = benzene, toluene, ethylbenzene, and xylenes; E = east; ft bgs = feet below ground surface; EPA = U.S. Environmental Protection Agency; HVOCs = halogenated volatile organic compounds; LNAPL = light nonaqueous phase liquid; N = north; NE = northeast; NSZD = natural source zone depletion; NW = northwest; OA-11 = Boeing Other Area 11; PAHs = polycyclic aromatic hydrocarbons; PCBs = polychlorinated biphenyls; PFAS = per- and polyfluoroalkyl substances; S = south; SE = southeast; SVOCs = semi-volatile organic compounds; SW = southwest; TPH-Dx = total petroleum hydrocarbons diesel extended; TPH-G = gasoline-range petroleum hydrocarbons; TPH-O = oil-range petroleum hydrocarbons; UCMR = Unregulated Contaminant Monitoring Rule; W = west.

Table 2B - Proposed Sampling Schedule for Existing Monitoring Wells

Well Identification	Location on Site	TPH-G	TPH-Dx	BTEX	HVOCs[a]	MTBE	PAHs	Full List SVOCs	Limited SVOCs[b]	PCBs (Aroclors)	PFAS[c]	Arsenic	Chromium	Manganese	Nickel	Cadmium	Cobalt	Copper	Lead	Mercury	Selenium	Silver	Zinc	Hexavalent Chromium	Attenuation Indicators[d]
Area 1																									
MW-9	East of shipping area	x	x	x								x		x		x		x							
MW-25	West of hollowbore area				x		x					x													
MW-30	South of hollowbore area	x	x		x									x											x
MW-48	West of hollowbore area			x																					
Area 1/9																									
MW-23	North of shipping area		x		x					x		x	x	x										x	x
MW-24	West of main office				x				x	x		x													
MW-49	North of main office			x	x							x		x	x	x		x	x	x	x	x	x		
Area 2																									
MW-7	Southeast corner of site												x											x	
MW-14	North of aluminum heat treat area	x	x	x	x	x			x			x	x	x	x	x	x	x	x	x	x	x	x		x
MW-15	Northeast of aluminum heat treat	x	x		x												x								x
MW-32	East of forge shop area	x	x				x		x			x													
MW-34	West of aluminum heat treat area	x	x																						
MW-36	East portion of forge shop area	x	x	x	x							x	x	x	x	x	x	x	x	x	x	x	x		x
MW-37	South of forge shop area	x	x	x	x		x					x		x	x			x			x		x		
Area 3																									
MW-3	South of front gate	x	x	x	x	x													x						
MW-4	Near front gate	x	x	x		x						x		x	x	x		x	x	x	x	x	x		
MW-8	Southwest of front gate	x	x	x		x					x	x			x					x	x	x	x		
Area 4																									
MW-11	East of human resources office	x	x			x						x		x											
Area 5																									
MW-40	West of 5,000-ton press		x		x		x		x			x		x	x	x		x	x	x	x	x	x		
MW-41	West of 5,000-ton press		x		x		x		x			x		x	x	x		x	x	x	x	x	x		
Area 6																									
MW-31	West of machine shop		x		x		x		x																
MW-45	West of heat treat area		x	x	x					x				x											
MW-46	West of laboratory	x	x	x	x		x		x			x	x	x	x			x	x	x	x	x	x	x	
Area 6/8																									
MW-6	Northwest of former melt shop	x	x	x	x					x		x						x							
Area 7																									
MW-38	Southwest of forge shop area	x	x	x										x											
Area 7/8																									
MW-39	Southwest of former melt shop	x	x	x	x					x		x	x	x	x								x	x	
MW-42	West of former melt shop area[1]		x	x	x					x			x	x						x					
MW-43	West of former melt shop area[1]		x	x	x					x	x			x											
MW-44	West of former melt shop area[1]		x	x	x					x				x						x					
Area 8																									
MW-47	Southwest of baghouse[1]				x			x		x			x											x	

Table 2B - Proposed Sampling Schedule for Existing Monitoring Wells

Well Identification	Location on Site	TPH-G	TPH-Dx	BTEX	HVOCs[a]	MTBE	PAHs	Full List SVOCs	Limited SVOCs[b]	PCBs (Aroclors)	PFAS[c]	Arsenic	Chromium	Manganese	Nickel	Cadmium	Cobalt	Copper	Lead	Mercury	Selenium	Silver	Zinc	Hexavalent Chromium	Attenuation Indicators[d]
Area 9																									
MW-50	East of black shack motor storage[1]			x	x					x				x											
MW-51	North of black shack motor storage[1]	x			x				x	x															
MW-52	South of black shack motor	x		x	x		x			x				x											

NOTES:

1 Located near shoreline; sample collection to occur within one hour before low tide and no later than three hours after low tide.

a HVOCs to include 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, tetrachloroethene, trichloroethene, and vinyl chloride.

b Limited SVOCs to include bis(2-ethylhexyl phthalate), dibutyl phthalate, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dimethyphenol, benzoic acid, butyl benzyl phthalate, n-nitrosodiphenylamine, and pentachlorophenol.

c To be analyzed during one event for EPA's third UCMR list of six perfluorinated compounds (perfluorobutanesulfonic acid, perfluorohexanesulfonic acid, perfluoroheptanoic acid, perfluorooctanoic acid, perfluorooctanesulfonic acid, and perfluorononanoic acid).

d Natural attenuation parameters include dissolved oxygen (field reading), nitrate, nitrite, sulfate, sulfite, ferrous iron, manganese, and methane.

Quality Assurance/Quality Control (QA/QC) samples to be collected in accordance with Sampling and Analysis Plan and Quality Assurance Project Plan. Samples will include field duplicates, matrix spike/matrix spike dilution (MS/MSD) samples, equipment blanks, trip blanks, and temperature blanks. Field duplicates will be assigned a "dummy" name and time and will be analyzed for the same suite as the original well. MS/MSD samples will be labeled with "MS/MSD" and the source well identification. Two equipment blanks will be collected during the event by running distilled water through new (unused) sample tubing. One trip blank will be included within each cooler with volatile samples (grouped into as few coolers as possible). A temperature blank will be included in each cooler.

BTEX = benzene, toluene, ethylbenzene, and total xylenes; EPA = U.S. Environmental Protection Agency; HVOCs = halogenated volatile organic compounds; MTBE = methyl tert butyl ether; PAHs = polycyclic aromatic hydrocarbons; PCBs = polychlorinated biphenyls; PFAS = per- and polyfluoroalkyl substances; SVOCs = semivolatile organic compounds; TPH-Dx = total petroleum hydrocarbons as diesel extended; TPH-G = total petroleum hydrocarbons as gasoline; UCMR = Unregulated Contaminant Monitoring rule; x = analysis to be performed.

Table 3 - Summary of Recent Water Level Measurements, LNAPL Thickness, and Groundwater Elevation Data

Monitoring Well ID	Date	Collected By	Top of Casing Elevation (feet NAVD88)[1]	Depth to Water (feet)[2]	Depth to LNAPL (feet)	LNAPL Thickness (feet)	Potentiometric Surface Elevation (feet NAVD88)[3]
MW-3	02/23/09	Farallon	14.05	11.56	—	0	2.49
MW-3	05/19/09	Farallon	14.05	11.34	—	0	2.71
MW-3	08/25/09	Farallon	14.05	12.02	—	0	2.03
MW-3	12/09/09	Farallon	14.05	11.15	—	0	2.90
MW-3	09/29/15	PES	—	11.51	—	—	—
MW-3	08/15/17	S&W	17.33	11.21	—	0	6.12
MW-3	02/05/18	S&W	17.33	9.36	—	0	7.97
MW-4	02/23/09	Farallon	17.48	11.65	—	0	5.83
MW-4	05/19/09	Farallon	17.48	11.42	—	0	6.06
MW-4	08/25/09	Farallon	17.48	12.12	—	0	5.36
MW-4	12/09/09	Farallon	17.48	11.23	—	0	6.25
MW-4	09/29/15	PES	—	11.58	—	—	—
MW-4	08/15/17	S&W	17.45	11.27	—	0	6.18
MW-4	02/05/18	S&W	17.45	9.48	—	0	7.97
MW-5	02/23/09	Farallon	17.03	—	—	—	—
MW-5	05/19/09	Farallon	17.03	14.01	—	0	3.02
MW-5	08/25/09	Farallon	17.03	10.99	—	0	6.04
MW-5	12/09/09	Farallon	17.03	9.15	—	0	7.88
MW-5	—	PES	—	—	—	—	—
MW-6	02/23/09	Farallon	20.61	14.19	—	0	6.42
MW-6	05/19/09	Farallon	20.61	14.15	—	0	6.46
MW-6	05/21/09	Farallon	20.61	14.14	—	0	6.47
MW-6	08/25/09	Farallon	20.61	15.18	—	0	5.43
MW-6	12/09/09	Farallon	20.61	13.56	—	0	7.05
MW-6	09/29/15	PES	—	14.74	—	—	—
MW-6	08/15/17	S&W	20.59	14.8	—	0	5.79
MW-6	02/05/18	S&W	20.59	12.88	—	0	7.71
MW-7	02/23/09	Farallon	20.84	15.18	—	0	5.66
MW-7	05/19/09	Farallon	20.84	14.98	—	0	5.86
MW-7	08/25/09	Farallon	20.84	15.65	—	0	5.19
MW-7	12/09/09	Farallon	20.84	14.78	—	0	6.06
MW-7	09/30/15	PES	—	15.09	—	—	—
MW-7	08/15/17	S&W	20.81	14.77	—	0	6.04
MW-7	02/05/18	S&W	20.81	12.99	—	0	7.82
MW-8	02/23/09	Farallon	17.70	11.29	—	0	6.41
MW-8	05/19/09	Farallon	17.70	—	—	—	—
MW-8	08/25/09	Farallon	17.70	12.35	—	0	5.35
MW-8	12/09/09	Farallon	17.70	11.49	—	0	6.21
MW-8	09/29/15	PES	—	11.85	—	—	—
MW-8	08/15/17	S&W	17.66	11.52	—	0	6.14
MW-8	02/05/18	S&W	17.66	9.75	—	0	7.91
MW-9	02/23/09	Farallon	17.79	—	—	—	—
MW-9	05/19/09	Farallon	17.79	11.71	—	0	6.08
MW-9	08/25/09	Farallon	17.79	12.78	—	0	5.01
MW-9	12/09/09	Farallon	17.79	11.5	—	0	6.29
MW-9	09/29/15	PES	—	11.86	—	—	—
MW-9	08/15/17	S&W	17.77	11.64	—	0	6.13
MW-9	02/05/18	S&W	17.77	9.84	—	0	7.93

Table 3 - Summary of Recent Water Level Measurements, LNAPL Thickness, and Groundwater Elevation Data

Monitoring Well ID	Date	Collected By	Top of Casing Elevation (feet NAVD88)[1]	Depth to Water (feet)[2]	Depth to LNAPL (feet)	LNAPL Thickness (feet)	Potentiometric Surface Elevation (feet NAVD88)[3]
MW-10	02/23/09	Farallon	17.57	—	—	—	—
MW-10	05/19/09	Farallon	17.57	10.05	—	0	7.52
MW-10	08/25/09	Farallon	17.57	12.22	—	0	5.35
MW-10	12/09/09	Farallon	17.57	10.35	—	0	7.22
MW-10	—	PES	—	—	—	—	—
MW-11	02/23/09	Farallon	17.70	—	—	—	—
MW-11	05/19/09	Farallon	17.70	11.66	—	0	6.04
MW-11	08/25/09	Farallon	17.70	12.39	—	0	5.31
MW-11	12/09/09	Farallon	17.70	11.57	—	0	6.13
MW-11	09/29/15	PES	—	11.86	—	—	—
MW-11	08/15/17	S&W	17.65	11.58	—	0	6.07
MW-11	02/05/18	S&W	17.65	9.78	—	0	7.87
MW-12	02/23/09	Farallon	17.19	5.12	—	0	12.07
MW-12	05/19/09	Farallon	17.19	—	—	—	—
MW-12	08/25/09	Farallon	17.19	—	—	—	—
MW-12	12/09/09	Farallon	17.19	—	—	—	—
MW-13	02/23/09	Farallon	17.44	1.64	—	—	—
MW-13	05/19/09	Farallon	17.44	—	—	—	—
MW-13	08/25/09	Farallon	17.44	—	—	—	—
MW-13	12/09/09	Farallon	17.44	—	—	—	—
MW-14	02/23/09	Farallon	17.64	—	—	—	—
MW-14	05/19/09	Farallon	17.64	11.74	—	0	5.90
MW-14	08/25/09	Farallon	17.64	12.39	—	0	5.25
MW-14	12/09/09	Farallon	17.64	11.5	—	0	6.14
MW-14	09/29/15	PES	—	11.83	—	—	—
MW-14	08/15/17	S&W	17.60	11.58	—	0	6.02
MW-14	02/05/18	S&W	17.60	9.82	—	0	7.78
MW-15	02/23/09	Farallon	17.65	11.9	—	0	5.75
MW-15	05/19/09	Farallon	17.65	11.7	—	0	5.95
MW-15	08/25/09	Farallon	17.65	12.39	—	0	5.26
MW-15	12/09/09	Farallon	17.65	11.5	—	0	6.15
MW-15	09/29/15	PES	—	11.82	—	—	—
MW-15	08/15/17	S&W	17.61	11.55	—	0	6.06
MW-15	02/05/18	S&W	17.61	9.46	—	0	8.15
MW-16	02/23/09	Farallon	17.72	—	10.98	5	—
MW-16	05/19/09	Farallon	17.72	11.9	10.86	1.04	—
MW-16	08/25/09	Farallon	17.72	—	11.51	3.88	—
MW-16	12/09/09	Farallon	17.72	—	10.49	4.9	—
MW-16	09/30/15	PES	—	—	10.94	> 4.45	—
MW-16	08/11/17	S&W	17.70	15.25	10.92	4.33	6.47
MW-16	02/08/18	S&W	17.70	—	9.34	> 6.09	—
MW-17	02/23/09	Farallon	17.61	13.9	10.6	3.3	—
MW-17	05/19/09	Farallon	17.61	13.8	10.52	3.28	—
MW-17	08/25/09	Farallon	17.61	18.11	11.35	6.76	—
MW-17	12/09/09	Farallon	17.61	16.84	10.59	6.25	—
MW-17	09/30/15	PES	—	18.84	10.94	7.9	—
MW-17	08/11/17	S&W	17.57	15.64	10.61	5.03	6.60
MW-17	02/08/18	S&W	17.57	13.59	8.68	4.91	8.55

Table 3 - Summary of Recent Water Level Measurements, LNAPL Thickness, and Groundwater Elevation Data

Monitoring Well ID	Date	Collected By	Top of Casing Elevation (feet NAVD88)[1]	Depth to Water (feet)[2]	Depth to LNAPL (feet)	LNAPL Thickness (feet)	Potentiometric Surface Elevation (feet NAVD88)[3]
MW-18	02/23/09	Farallon	17.51	11.66	10.51	1.15	—
MW-18	05/19/09	Farallon	17.51	13.8	10.62	3.18	—
MW-18	08/25/09	Farallon	17.51	12.09	11.65	0.44	—
MW-18	12/09/09	Farallon	17.51	11.01	10.12	0.89	—
MW-18	09/30/15	PES	—	11.98	11.09	0.89	—
MW-18	08/11/17	S&W	17.47	11.79	9.95	1.84	7.39
MW-18	02/08/18	S&W	17.47	10.58	7.97	2.61	9.31
MW-19	02/23/09	Farallon	17.47	12.34	11.34	1	—
MW-19	05/19/09	Farallon	17.47	—	—	—	—
MW-19	08/25/09	Farallon	17.47	11.25	11.16	0.09	—
MW-19	12/09/09	Farallon	17.47	12.34	9.88	2.46	—
MW-19	09/30/15	PES	—	11.47	—	—	—
MW-19	08/10/17	S&W	17.92	11.3	11.2	0.1	6.71
MW-19	02/08/18	S&W	17.92	9.82	9.2	0.62	8.67
MW-20	02/23/09	Farallon	18.22	14.52	9.51	5.01	—
MW-20	05/19/09	Farallon	18.22	14.6	9.34	5.26	—
MW-20	08/25/09	Farallon	18.22	14.82	10.24	4.58	—
MW-20	12/09/09	Farallon	18.22	14.68	9.4	5.28	—
MW-20	09/29/15	PES	—	—	—	—	—
MW-20	02/08/18	S&W	—	12.1	7.98	4.12	—
MW-21	02/23/09	Farallon	13.90	12.56	7.08	5.48	—
MW-21	05/19/09	Farallon	13.90	13.75	6.7	7.05	—
MW-21	08/25/09	Farallon	13.90	12.56	7.97	4.59	—
MW-21	12/09/09	Farallon	13.90	10.23	6.77	3.46	—
MW-21	09/29/15	PES	—	9.35	8.88	0.47	—
MW-21	08/11/17	S&W	17.88	9.74	8.25	1.49	9.53
MW-21	02/08/18	S&W	17.88	7.35	6.49	0.86	11.33
MW-22	02/23/09	Farallon	16.98	10.21	7.23	2.98	—
MW-22	05/19/09	Farallon	16.98	11.05	6.95	4.1	—
MW-22	08/25/09	Farallon	16.98	14.13	8.03	6.1	—
MW-22	12/09/09	Farallon	16.98	8.48	7.1	1.38	—
MW-22	—	PES	—	—	—	—	—
MW-23	02/23/09	Farallon	17.84	11.88	—	0	5.96
MW-23	05/19/09	Farallon	17.84	11.7	—	0	6.14
MW-23	08/25/09	Farallon	17.84	12.36	—	0	5.48
MW-23	12/09/09	Farallon	17.84	11.5	—	0	6.34
MW-23	09/29/15	PES	—	11.89	—	—	—
MW-23	08/11/17	S&W	17.78	11.64	—	0	6.14
MW-23	02/05/18	S&W	17.78	9.87	—	0	7.91
MW-24	02/23/09	Farallon	17.88	11.9	—	0	5.98
MW-24	05/19/09	Farallon	17.88	11.87	—	0	6.01
MW-24	08/25/09	Farallon	17.88	12.46	—	0	5.42
MW-24	12/09/09	Farallon	17.88	11.58	—	0	6.30
MW-24	09/29/15	PES	—	11.99	—	—	—
MW-24	08/11/17	S&W	17.79	11.8	—	0	5.99
MW-24	02/05/18	S&W	17.79	10.27	—	0	7.52
MW-25	02/23/09	Farallon	17.64	11.7	—	0	5.94
MW-25	05/19/09	Farallon	17.64	11.8	—	0	5.84

Table 3 - Summary of Recent Water Level Measurements, LNAPL Thickness, and Groundwater Elevation Data

Monitoring Well ID	Date	Collected By	Top of Casing Elevation (feet NAVD88)[1]	Depth to Water (feet)[2]	Depth to LNAPL (feet)	LNAPL Thickness (feet)	Potentiometric Surface Elevation (feet NAVD88)[3]
MW-25	05/21/09	Farallon	17.64	12	—	0	5.64
MW-25	08/25/09	Farallon	17.64	12.32	—	0	5.32
MW-25	12/09/09	Farallon	17.64	11.36	—	0	6.28
MW-25	09/29/15	PES	—	9.44	—	—	—
MW-25	08/11/17	S&W	17.65	11.7	—	0	5.95
MW-25	02/05/18	S&W	17.65	7.4	—	0	10.25
MW-26	02/23/09	Farallon	18.36	NE	10.26	3.3	—
MW-26	05/19/09	Farallon	18.36	NE	10.23	3.33	—
MW-26	08/25/09	Farallon	18.36	—	—	—	—
MW-26	12/09/09	Farallon	18.36	—	—	—	—
MW-26	09/29/15	PES	—	—	10.64	> 2.66	—
MW-26	08/11/17	S&W	18.28	16.45	10.05	6.4	7.78
MW-26	02/08/18	S&W	18.28	16.22	8.62	7.6	9.13
MW-27	02/23/09	Farallon	18.15	21.21	11.16	10.05	—
MW-27	05/19/09	Farallon	18.15	18.5	11.27	7.23	—
MW-27	08/25/09	Farallon	18.15	19.65	11.96	7.69	—
MW-27	12/09/09	Farallon	18.15	18.36	10.96	7.4	—
MW-27	09/29/15	PES	—	19.84	11.5	8.34	—
MW-27	08/11/17	S&W	18.08	20.37	10.83	9.54	6.58
MW-27	02/08/18	S&W	18.08	21.8	9.18	12.62	8.02
MW-28	02/23/09	Farallon	18.35	13.06	6.02	7.04	—
MW-28	05/19/09	Farallon	18.35	16.5	11.15	5.35	—
MW-28	08/25/09	Farallon	18.35	16.68	12.15	4.53	—
MW-28	12/09/09	Farallon	18.35	15.44	10.95	4.49	—
MW-28	09/29/15	PES	—	14.28	11.95	2.33	—
MW-28	08/11/17	S&W	18.28	12.55	11.04	1.51	7.13
MW-28	02/08/18	S&W	18.28	14.4	9.25	5.15	8.67
MW-29	02/23/09	Farallon	18.24	18.28	11.42	6.86	—
MW-29	05/19/09	Farallon	18.24	21.95	11	10.95	—
MW-29	08/25/09	Farallon	18.24	21.1	11.75	9.35	—
MW-29	12/09/09	Farallon	18.24	21.02	10.7	10.32	—
MW-29	09/29/15	PES	—	—	11.32	> 1.03	—
MW-29	08/11/17	S&W	18.15	18.18	11.06	7.12	6.59
MW-29	02/08/18	S&W	18.15	18.02	9.42	8.6	8.13
MW-30	02/23/09	Farallon	17.48	11.62	—	0	5.86
MW-30	05/19/09	Farallon	17.48	11.65	—	0	5.83
MW-30	08/25/09	Farallon	17.48	12.23	—	0	5.25
MW-30	12/09/09	Farallon	17.48	11.37	—	0	6.11
MW-30	09/30/15	PES	—	11.39	—	—	—
MW-30	08/11/17	S&W	17.45	11.5	—	0	5.95
MW-30	02/05/18	S&W	17.45	9.04	—	0	8.41
MW-31	02/23/09	Farallon	17.50	11.63	—	0	5.87
MW-31	05/19/09	Farallon	17.50	11.7	—	0	5.80
MW-31	05/20/09	Farallon	17.50	11.85	—	0	5.65
MW-31	08/25/09	Farallon	17.50	12.24	—	0	5.26
MW-31	12/09/09	Farallon	17.50	11.42	—	0	6.08
MW-31	09/29/15	PES	—	11.87	—	—	—
MW-31	08/11/17	S&W	17.47	11.58	—	0	5.89

Table 3 - Summary of Recent Water Level Measurements, LNAPL Thickness, and Groundwater Elevation Data

Monitoring Well ID	Date	Collected By	Top of Casing Elevation (feet NAVD88)[1]	Depth to Water (feet)[2]	Depth to LNAPL (feet)	LNAPL Thickness (feet)	Potentiometric Surface Elevation (feet NAVD88)[3]
MW-31	02/05/18	S&W	17.47	10.29	—	0	7.18
MW-32	02/23/09	Farallon	13.62	11.44	—	0	2.18
MW-32	05/19/09	Farallon	13.62	12.45	—	0	1.17
MW-32	08/25/09	Farallon	13.62	11.96	—	0	1.66
MW-32	12/09/09	Farallon	13.62	11.08	—	0	2.54
MW-32	09/29/15	PES	—	11.44	—	—	—
MW-32	08/11/17	S&W	13.62	11.19	—	0	2.43
MW-32	02/05/18	S&W	13.62	9.48	—	0	4.14
MW-33	02/23/09	Farallon	17.23	1.53	—	—	—
MW-33	05/19/09	Farallon	17.23	—	—	—	—
MW-33	08/25/09	Farallon	17.23	—	—	—	—
MW-33	12/09/09	Farallon	17.23	—	—	—	—
MW-34	02/23/09	Farallon	17.13	12.74	11.3	1.44	—
MW-34	05/19/09	Farallon	17.13	11.41	11.29	0.12	—
MW-34	08/25/09	Farallon	17.13	11.81	—	0	5.32
MW-34	12/09/09	Farallon	17.13	10.97	—	0	6.16
MW-34	09/29/15	PES	—	11.26	Sheen	Sheen	—
MW-34	08/11/17	S&W	17.06	11.05	—	0	6.01
MW-34	02/05/18	S&W	17.06	9.4	—	0	7.66
MW-35	02/23/09	Farallon	13.96	17.49	10.79	6.7	—
MW-35	05/19/09	Farallon	13.96	17.8	10.7	7.1	—
MW-35	08/25/09	Farallon	13.96	17.85	11.44	6.41	—
MW-35	12/09/09	Farallon	13.96	17.56	10.45	7.11	—
MW-35	09/29/15	PES	—	17.75	10.79	6.96	—
MW-35	08/11/17	S&W	17.44	17.25	10.4	6.85	6.49
MW-35	02/08/18	S&W	17.44	17.49	8.89	8.6	7.86
MW-36	02/23/09	Farallon	17.41	11.67	—	0	5.74
MW-36	05/19/09	Farallon	17.41	11.6	—	0	5.81
MW-36	08/25/09	Farallon	17.41	12.19	—	0	5.22
MW-36	12/09/09	Farallon	17.41	11.33	—	0	6.08
MW-36	09/29/15	PES	—	11.67	—	—	—
MW-36	08/15/17	S&W	17.38	11.45	—	0	5.93
MW-36	02/05/18	S&W	17.38	9.84	—	0	7.54
MW-37	02/23/09	Farallon	17.55	11.81	—	0	5.74
MW-37	05/19/09	Farallon	17.55	11.76	—	0	5.79
MW-37	08/25/09	Farallon	17.55	12.36	—	0	5.19
MW-37	12/09/09	Farallon	17.55	11.49	—	0	6.06
MW-37	09/29/15	PES	—	11.81	—	—	—
MW-37	08/15/17	S&W	17.50	11.61	—	0	5.89
MW-37	02/05/18	S&W	17.50	10	—	0	7.50
MW-38	02/23/09	Farallon	17.45	11.73	—	0	5.72
MW-38	05/19/09	Farallon	17.45	11.9	—	0	5.55
MW-38	05/21/09	Farallon	17.45	12.24	—	0	5.21
MW-38	08/25/09	Farallon	17.45	12.29	—	0	5.16
MW-38	12/09/09	Farallon	17.45	11.39	—	0	6.06
MW-38	09/29/15	PES	—	12.89	—	—	—
MW-38	08/15/17	S&W	17.38	11.69	—	0	5.69
MW-38	02/05/18	S&W	17.38	10.68	—	0	6.70

Table 3 - Summary of Recent Water Level Measurements, LNAPL Thickness, and Groundwater Elevation Data

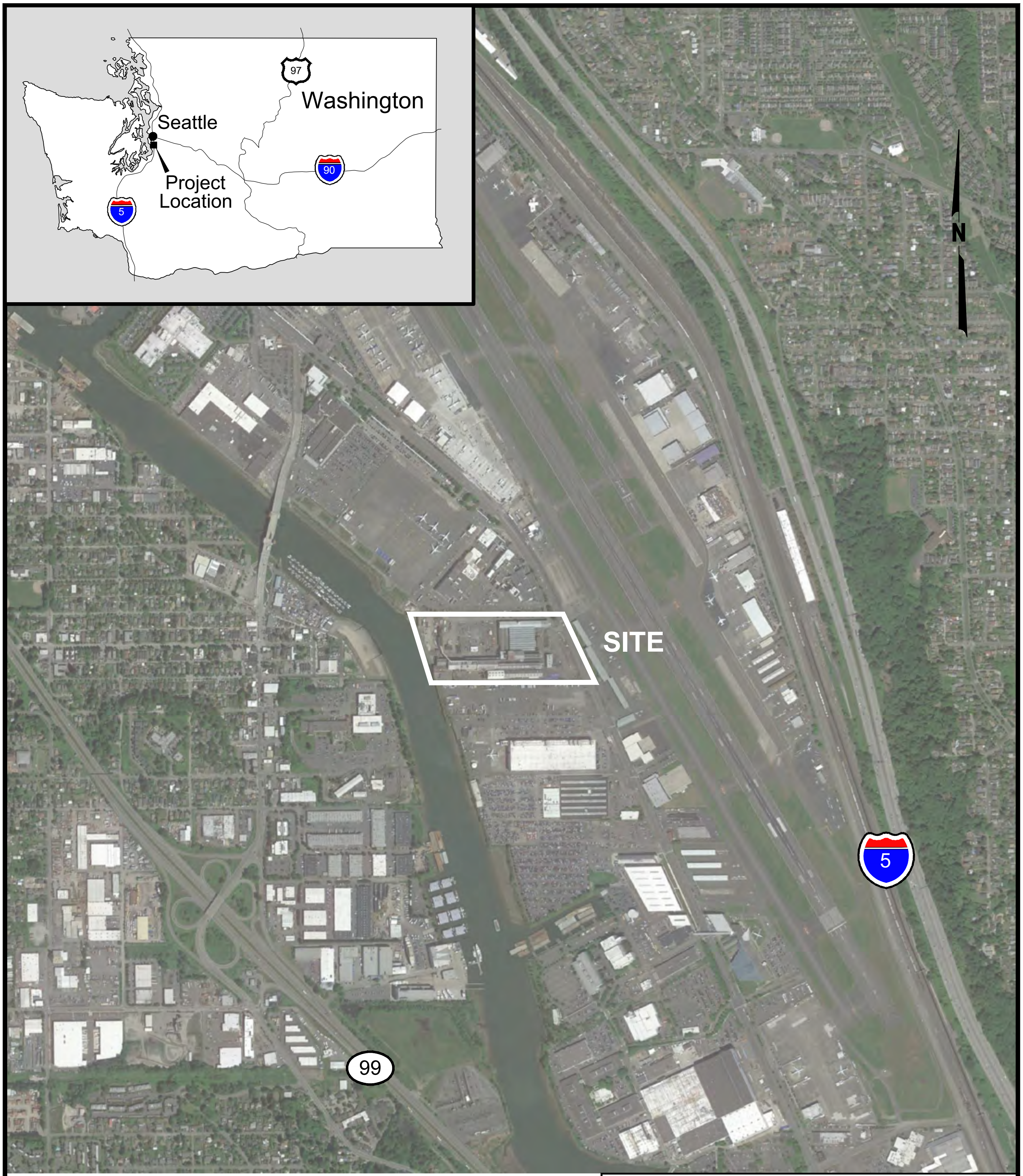
Monitoring Well ID	Date	Collected By	Top of Casing Elevation (feet NAVD88)[1]	Depth to Water (feet)[2]	Depth to LNAPL (feet)	LNAPL Thickness (feet)	Potentiometric Surface Elevation (feet NAVD88)[3]
MW-39	02/23/09	Farallon	20.83	14.47	—	0	6.36
MW-39	05/19/09	Farallon	20.83	14.74	—	0	6.09
MW-39	05/21/09	Farallon	20.83	17.69	—	0	3.14
MW-39	08/25/09	Farallon	20.83	14.96	—	0	5.87
MW-39	12/09/09	Farallon	20.83	12.42	—	0	8.41
MW-39	09/29/15	PES	—	14.91	—	—	—
MW-39	08/15/17	S&W	20.80	14.8	—	0	6.00
MW-39	02/05/18	S&W	20.80	15.04	—	0	5.76
MW-40	02/23/09	Farallon	17.19	11.38	—	0	5.81
MW-40	05/19/09	Farallon	17.19	11.59	—	0	5.60
MW-40	08/26/09	Farallon	17.19	11.9	—	0	5.29
MW-40	12/18/09	Farallon	17.19	10.98	—	0	6.21
MW-40	09/30/15	PES	—	11.42	—	—	—
MW-40	08/15/17	S&W	17.15	11.28	—	0	5.87
MW-40	02/05/18	S&W	17.15	9.79	—	0	7.36
MW-41	02/23/09	Farallon	17.37	11.56	—	0	5.81
MW-41	05/19/09	Farallon	17.37	11.6	—	0	5.77
MW-41	08/26/09	Farallon	17.37	12.1	—	0	5.27
MW-41	12/18/09	Farallon	17.37	11.19	—	0	6.18
MW-41	09/30/15	PES	—	11.62	—	—	—
MW-41	08/15/17	S&W	17.33	11.44	—	0	5.89
MW-41	02/05/18	S&W	17.33	9.95	—	0	7.38
MW-42	02/23/09	Farallon	17.54	11.46	—	0	6.08
MW-42	05/19/09	Farallon	17.54	11.95	—	0	5.59
MW-42	05/21/09	Farallon	17.54	11.98	—	0	5.56
MW-42	08/25/09	Farallon	17.54	12.23	—	0	5.31
MW-42	12/09/09	Farallon	17.54	11.49	—	0	6.05
MW-42	09/29/15	PES	—	11.39	—	—	—
MW-42	08/15/17	S&W	17.48	11.77	—	0	5.71
MW-42	02/05/18	S&W	17.48	10.45	—	0	7.03
MW-43	02/23/09	Farallon	17.49	10.27	—	0	7.22
MW-43	05/19/09	Farallon	17.49	11.98	—	0	5.51
MW-43	08/25/09	Farallon	17.49	11.33	—	0	6.16
MW-43	12/09/09	Farallon	17.49	9.6	—	0	7.89
MW-43	09/29/15	PES	—	13.3	—	—	—
MW-43	08/15/17	S&W	17.44	11.04	—	0	6.40
MW-43	02/05/18	S&W	17.44	14.71	—	0	2.73
MW-44	02/25/09	Farallon	17.14	12.73	—	0	4.41
MW-44	05/19/09	Farallon	17.14	11.8	—	0	5.34
MW-44	08/25/09	Farallon	17.14	11.24	—	0	5.90
MW-44	12/18/09	Farallon	17.14	10.1	—	0	7.04
MW-44	09/29/15	PES	—	12.31	—	—	—
MW-44	08/15/17	S&W	17.07	11.01	—	0	6.06
MW-44	02/05/18	S&W	17.07	14.1	—	0	2.97
MW-45	02/23/09	Farallon	17.16	11.31	—	0	5.85
MW-45	05/19/09	Farallon	17.16	11.35	—	0	5.81
MW-45	05/21/09	Farallon	17.16	11.45	—	0	5.71
MW-45	08/25/09	Farallon	17.16	11.9	—	0	5.26

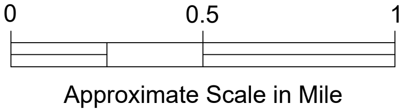
Table 3 - Summary of Recent Water Level Measurements, LNAPL Thickness, and Groundwater Elevation Data

Monitoring Well ID	Date	Collected By	Top of Casing Elevation (feet NAVD88)[1]	Depth to Water (feet)[2]	Depth to LNAPL (feet)	LNAPL Thickness (feet)	Potentiometric Surface Elevation (feet NAVD88)[3]
MW-45	12/09/09	Farallon	17.16	11.05	—	0	6.11
MW-45	09/29/15	PES	—	11.49	—	—	—
MW-45	08/15/17	S&W	17.04	11.2	—	0	5.84
MW-45	02/05/18	S&W	17.04	9.84	—	0	7.20
MW-46	02/23/09	Farallon	17.74	11.99	—	0	5.75
MW-46	05/19/09	Farallon	17.74	12.18	—	0	5.56
MW-46	05/21/09	Farallon	17.74	12.42	—	0	5.32
MW-46	08/25/09	Farallon	17.74	12.61	—	0	5.13
MW-46	12/09/09	Farallon	17.74	11.85	—	0	5.89
MW-46	09/29/15	PES	—	11.95	—	—	—
MW-46	08/15/17	S&W	17.67	12.05	—	0	5.62
MW-46	02/05/18	S&W	17.67	11.14	—	0	6.53
MW-47	02/23/09	Farallon	20.80	11.47	—	0	9.33
MW-47	05/19/09	Farallon	20.80	15.42	—	0	5.38
MW-47	05/21/09	Farallon	20.80	15.9	—	0	4.90
MW-47	08/25/09	Farallon	20.80	15.6	—	0	5.20
MW-47	12/09/09	Farallon	20.80	14.6	—	0	6.20
MW-47	09/29/15	PES	—	Dry	—	—	—
MW-47	08/15/17	S&W	20.78	15.32	—	0	5.46
MW-47	02/05/18	S&W	20.78	14.9	—	0	5.88
MW-48	02/23/09	Farallon	17.33	11.44	—	0	5.89
MW-48	05/19/09	Farallon	17.33	11.5	—	0	5.83
MW-48	05/21/09	Farallon	17.33	11.66	—	0	5.67
MW-48	08/25/09	Farallon	17.33	12.01	—	0	5.32
MW-48	12/09/09	Farallon	17.33	11.11	—	0	6.22
MW-48	09/29/15	PES	—	11.65	—	—	—
MW-48	08/15/17	S&W	17.24	11.36	—	0	5.88
MW-48	02/05/18	S&W	17.24	10.02	—	0	7.22
MW-49	02/23/09	Farallon	17.33	11.33	—	0	6.00
MW-49	05/19/09	Farallon	17.33	11.23	—	0	6.10
MW-49	08/25/09	Farallon	17.33	11.85	—	0	5.48
MW-49	12/09/09	Farallon	17.33	10.95	—	0	6.38
MW-49	09/29/15	PES	—	11.36	—	—	—
MW-49	08/15/17	S&W	17.24	11.15	—	0	6.09
MW-49	02/05/18	S&W	17.24	9.45	—	0	7.79
MW-50	02/23/09	Farallon	17.69	11.28	—	0	6.41
MW-50	05/19/09	Farallon	17.69	12.16	—	0	5.53
MW-50	05/21/09	Farallon	17.69	15.05	—	0	2.64
MW-50	08/25/09	Farallon	17.69	11.82	—	0	5.87
MW-50	12/09/09	Farallon	17.69	10.41	—	0	7.28
MW-50	09/29/15	PES	—	13.44	—	—	—
MW-50	08/15/17	S&W	17.64	11.41	—	0	6.23
MW-50	02/05/18	S&W	17.64	13.57	—	0	4.07
MW-51	02/23/09	Farallon	17.46	11.03	—	0	6.43
MW-51	05/19/09	Farallon	17.46	12.17	—	0	5.29
MW-51	05/21/09	Farallon	17.46	14.9	—	0	2.56
MW-51	08/25/09	Farallon	17.46	11.58	—	0	5.88
MW-51	12/09/09	Farallon	17.46	10.22	—	0	7.24

Table 3 - Summary of Recent Water Level Measurements, LNAPL Thickness, and Groundwater Elevation Data

Monitoring Well ID	Date	Collected By	Top of Casing Elevation (feet NAVD88)[1]	Depth to Water (feet)[2]	Depth to LNAPL (feet)	LNAPL Thickness (feet)	Potentiometric Surface Elevation (feet NAVD88)[3]
MW-51	09/30/15	PES	—	10.95	—	—	—
MW-51	08/15/17	S&W	17.40	11.18	—	0	6.22
MW-51	02/05/18	S&W	17.40	13.40	—	0	4.00
MW-52	02/23/09	Farallon	17.67	10.92	—	0	6.75
MW-52	05/19/09	Farallon	17.67	12.15	—	0	5.52
MW-52	05/21/09	Farallon	17.67	16.45	—	0	1.22
MW-52	08/25/09	Farallon	17.67	11.37	—	0	6.30
MW-52	12/09/09	Farallon	17.67	9.74	—	0	7.93
MW-52	09/29/15	PES	—	14.28	—	—	—
MW-52	08/15/17	S&W	17.59	11.15	—	0	6.44
MW-52	02/05/18	S&W	17.59	14.85	—	0	2.74





Jorgensen Forge Facility
8531 East Marginal Way S
Tukwila, Washington

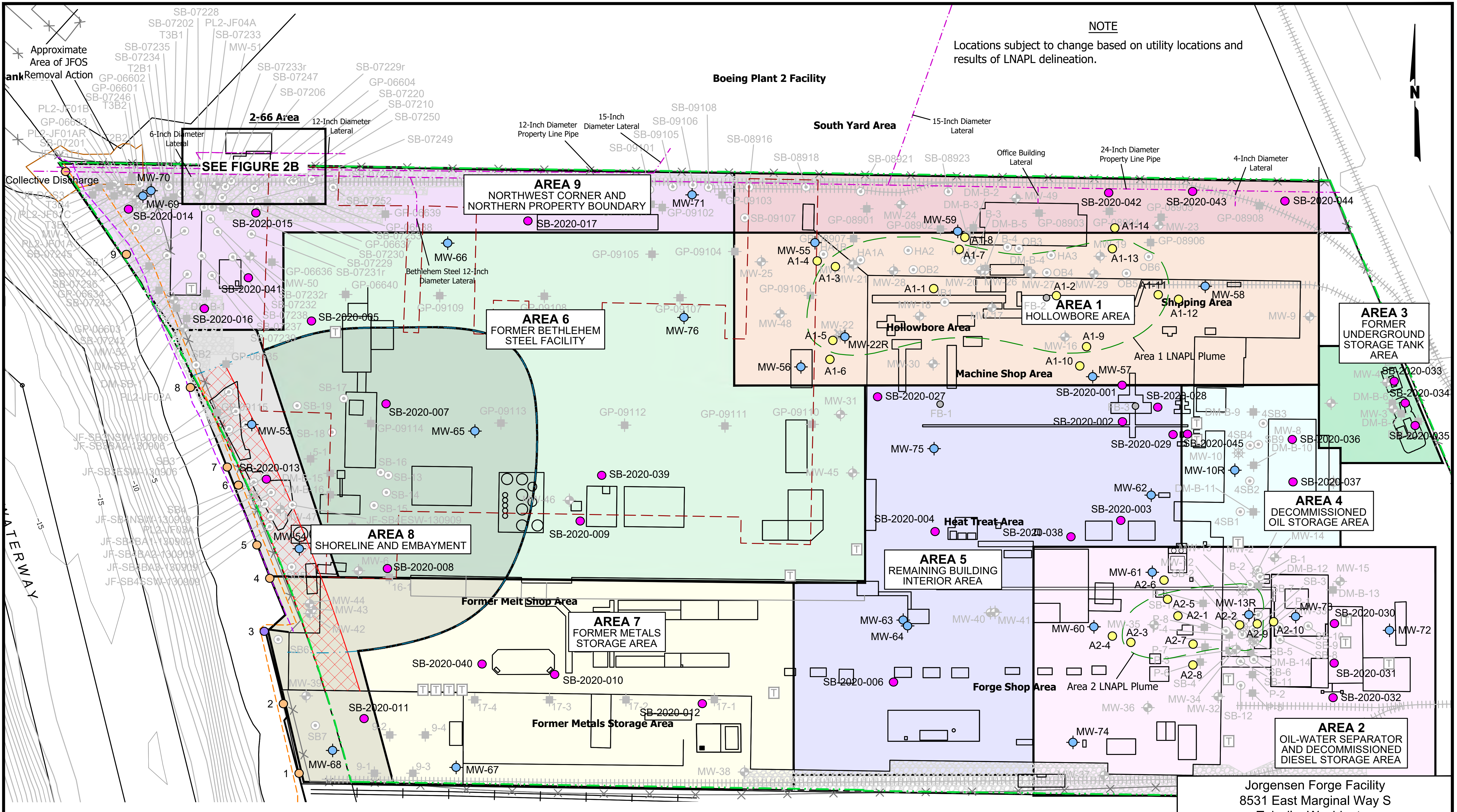
SITE LOCATION MAP

April 2020 21-1-12596-013

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive\211\12596\013\21-1-12596-013 Site Location.dwg Date: 04-14-2020 Login: JRS



Explanation	
🟩	Approximate Property Boundary
▨	Top of Shoreline Bank (2012)
▨	Top of Shoreline Bank (2014)
🟥	Former Bethlehem Steel Facility
▨	Former Embayment
▨	Estimated Extent of LNAPL on Groundwater (Farallon, August 2009)
▨	Steam Tunnel
▨	Railroad
▨	Bulkhead Area
3 ●	Outfall (Active)
9 ●	Outfall (Inactive)
SB-19 ●	Soil Boring Location (Various)
MW-23 ●	Monitoring Well Location (Various)
P-7 ●	Probe Boring (Various)
MW-2 ●	Decommissioned
MW-22 ●	Location Unknown
☐	Transformer
MW-22 ●	Location Unknown
FB-1 ●	FB Location (Various)
SB-2020-001 ●	Proposed Soil Boring
MW-69 ●	Proposed Monitoring Well
A2-1 ●	Proposed LNAPL Delineation Probe Boring

0 100 200

Scale in Feet

Jorgensen Forge Facility
8531 East Marginal Way S
Tukwila, Washington

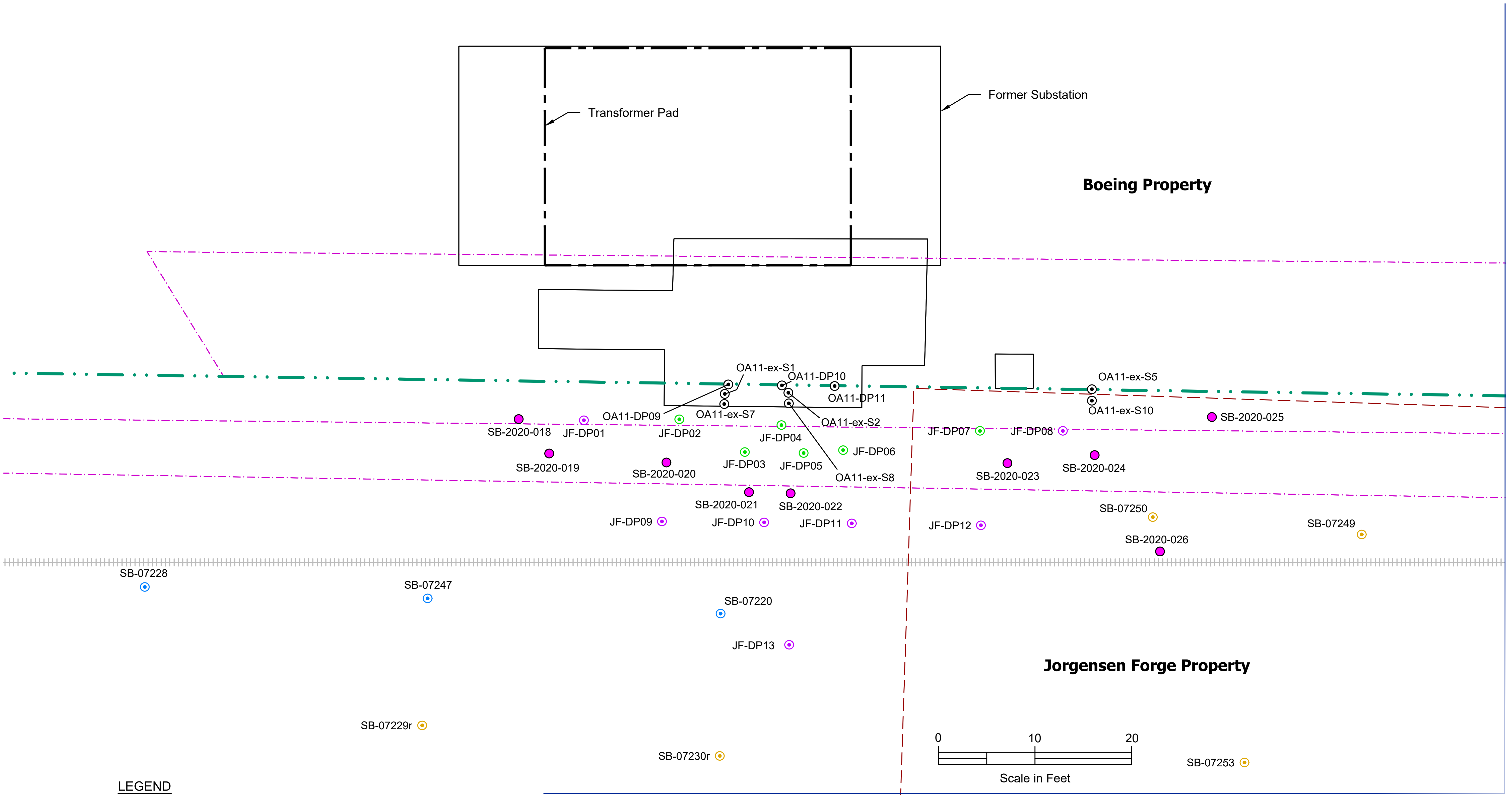
PROPOSED INVESTIGATION LOCATIONS

April 2020
21-1-12596-013

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2A

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive\211\12596\013\21-1-12596-013 Investigation Points.dwg Layout: Figure 2A Date: 04-09-2020 Login: JRS



LEGEND

▬ · ▬ Approximate Property Boundary
— · — Outfall Pipelines
– – – Former Bethlehem Steel Facility
┼┼┼┼ Railroad
JF-DP02 ⊙ Soil Boring Location (FS Tier 1, 2017)
JF-DP01 ⊙ Soil Boring Location (FS Tier 2, 2017)
SB-07227 ⊙ Soil Boring Location (Phase I Investigation, 2003)
SB-07562 ⊙ Soil Boring Location (Phase II Investigation, 2005)
OA11-DP10 ⊙ Soil Boring Location (Previous Sampling)
SB-2020-018 ● Proposed Soil Boring

NOTES

1. Figure adapted from client file, *141500101002_1-8.dwg*, prepared by PES Environmental, Inc.dated April 2015, and client figures *Total PCB and Total TPH Analytical Results for Soil*, Figure 3.1, dated February 24, 2004, *Exploration Locations and Storm Pipes Surveyed*, Figure 2.1, dated July 29, 2005, and *Tier 1 and Tier 2 Soil Boring Locations on Jorgensen Forge*, Figure 2, dated July 28, 2017.

N

8531 East Marginal Way
Tukwila, Washington

PROPOSED INVESTIGATION LOCATIONS SOUTH OF OA-11

April 2020 21-1-12596-013

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2B

Filename: C:\Users\jrs\CAD Group Dropbox\JDrive\211\12596\013\21-1-12596-013 TP Investigation Points.dwg Layout: Figure 20B Date: 04-14-2020 Login: JRS

ATTACHMENT 1: INADVERTENT DISCOVERY PLAN

Attachment 1

Inadvertent Discovery Plan

CULTURAL RESOURCES REPORT COVER SHEET

Author: Sarah M.H. Steinkraus
Title of Report: 8531 East Marginal Way South Remedial Investigation Project Cultural Resources Monitoring and Inadvertent Discovery Plan

Date of Report: March 20, 2020

County(ies): King Section: 33 Township: 4 Range: 4E
Quad: Seattle North Acres: 20.7

PDF of report submitted (REQUIRED) ☒ Yes

Historic Property Inventory Forms to be Approved Online? ☐ Yes ☒ No

Archaeological Site(s)/Isolate(s) Found or Amended? ☐ Yes ☒ No

TCP(s) found? ☐ Yes ☒ No

Replace a draft? ☐ Yes ☒ No

Satisfy a DAHP Archaeological Excavation Permit requirement? ☐ Yes # ☒ No

Were Human Remains Found? ☐ Yes DAHP Case # ☒ No

Archaeological Site #:
HPI 720360
HPI 720357
HPI 720359
______
______
______
______
______
______

8531 East Marginal Way South Remedial Investigation Project Cultural Resources Monitoring and Inadvertent Discovery Plan

King County, Washington

March 20, 2020

Prepared for:

Shannon & Wilson, Inc.
400 N 34th Street, Suite 100
Seattle, WA 98103

Prepared by:

Stell
6100 219th St. SW, Suite 480
Mountlake Terrace, WA 98043

By Sarah M.H. Steinkraus, MS, RPA

TABLE OF CONTENTS

FIGURES

1 INTRODUCTION

1.1 PROJECT INFORMATION

Stell was contracted by Shannon & Wilson, Inc. to create a cultural resources monitoring and inadvertent discovery plan for the 8531 East Marginal Way South Remedial Investigation Project, King County, Washington project (Project) (Figure 1) (see Appendix A for Inadvertent Discovery Plan). This project is being conducted on behalf of Earle M. Jorgensen who owned the the property from 1965 to 1992. The remedial investigation is being completed under an Agreed Order ith the Washington State Department of Ecology (AO DE 14143).

The current project will include:

- Laser-induced fluorescence (LIF) investigation – This will use direct-push probe drilling but will NOT remove soil from the subsurface (a windowed probe with fiber optics is used).
- Direct-push soil sampling (2 inch)
- Hollow-stem auger (HSA) soil sampling (2 inch)
- Installation of wells in above-mentioned HSA boreholes
- Groundwater sampling from existing and new wells

The Project area is within an area designated as very highly likely to yield cultural materials by the Department of Archaeology and Historic Places (DAHP) predictive model. A total of 19 Cultural Resources surveys have been conducted within 0.5 miles of the Project area and a total of 9 archaeology sites (including precontact, historic-era, and multicomponent sites) have been documented within 1 mile of the Project area.

1.2 PROJECT AREA

The Project area is located on the right (eastern) bank of the Lower Duwamish Waterway (LDW), approximately four miles upstream from the mouth of the Duwamish River, in Section 33 of Township 24 North, Range 4 East, Willamette Meridian. The Project is located in King County Parcel No. 000160-0023, in King County, Washington (see Figure 1).

Figure 1. Project area location map projected on the USGS (2019) topographic quadrangle (from Earley and Heideman 2019).

1.3 PROJECT BACKGROUND

A cultural resources review within the Project area (which did not include any fieldwork) was conducted in October of 2019 by Perteet (Earley and Heideman 2019). This was for a separate project within the current Project area. In the report, one of the recommendations made was that archaeological monitoring should be conducted within this parcel due to the likelihood of locating previously undocumented cultural materials. Please see Earley and Heideman (2019) for more background information of the Project area.

1.4 REGULATORY ENVIRONMENT

This Project is being conducted on behalf of Earle M. Jorgensen who owned the property from 1965 to 1992. The remedial investigation is being completed under an Agreed Order with the Washington State Department of Ecology (AO DE 14143).

2 ARCHAEOLOGICAL MONITORING PLAN

To satisfy the requirements of Washington State DAHP, Stell will provide on-site monitoring, daily logs during monitoring activities, and a technical report at the close of monitoring for the 8531 East Marginal Way South Project. Sarah M.H. Steinkraus, MS, RPA will be the lead archaeologist on this Project. Ms. Steinkraus meets the Secretary of the Interior's, and thus Washington State's, criteria for a Professional Archaeologist. Ms. Steinkraus has extensive experience in conducting archaeological surveys, assessments, and monitoring in the Puget Sound region.

2.1 ON-SITE MONITORING

The archaeological monitor will watch any ground disturbing activities within the Project area. LIF surveys will not be monitored as there is no way to monitor any potential impacts of this procedure. The monitor will closely look for any organic or shell midden deposits, signs of soil oxidation, lithic or bone artifacts, or animal or human bones. Nine historic buildings are located within the Project area. Two were recommended as potentially eligible for the National Register of Historic Places (Earley and Heideman 2019). A total of three Historic Property Inventories (HPIs) that are potentially eligible for the National Register of Historic Places are located within the Project area (see Appendix B). Aside from these buildings no previously recorded cultural resources are located within the Project area. If artifacts or other potential archaeological deposits are observed, the archaeological monitor will direct the contractor to temporarily cease work in the immediate vicinity while the monitor conducts a close inspection.

The archaeological monitor may from time to time request a temporary halt to work activities in order to document archaeological materials or for a closer inspection an area or spoils. Such documentation usually takes a few minutes (entailing photographs and written descriptions) but may take longer. The archaeologist will give an estimate of the amount of time needed to document materials to the equipment operator and/or foreman and will update them of any changes to the estimate.

If potentially significant archaeological deposits are discovered during the investigation while the archaeological monitor is on site, the monitor will direct the contractor to cordon off the area within 30 feet of the discovery and initiate the find reporting and evaluation processes described in the Inadvertent Discovery Plan (Attachment A). If evidence of cultural resources is found in exposed surfaces within the Project area, it will be further investigated to establish whether it is eligible for listing in the National Register of Historic Places (NRHP).

If human remains are encountered, the King County Sherriff and Medical Examiner will be immediately notified (Attachment A). If the remains are determined not to be associated with a criminal investigation, the DAHP will be immediately contacted, as well as any affected tribes, if applicable (Attachment A).

2.1.1 MONITORING LOG

The archaeological monitor will complete a monitoring log for each monitoring session to document time in the field, the day's progress and findings, and any difficulties encountered, and actions proposed or taken to alleviate them.

2.1.2 MONITORING REPORT

Following the conclusion of archaeological monitoring activities, Stell will prepare a report describing the conduct and findings of this work effort. The report will include a discussion of the Project, the methods used in monitoring, and observations about site geology, environmental history, and any cultural resources that were observed. Photographs, sketches, or maps may be included, as needed. The report will be submitted to Shannon & Wilson, Inc. in complete draft form prior to it being sent to the Washington State DAHP and affected tribes for review.

2.1.3 HEALTH AND SAFETY

Stell will create a Health and Safety Plan for use by their staff for this Project. Staff will be briefed on that plan and will at all times comply with it. Field staff will have all necessary training and certification prior to commencing monitoring activities including Hazardous Waste Operations and Emergency Response (HAZWOPER) training.

3 REFERENCES

Earley, Amber, and Eileen Heideman

2019 *Cultural Resources Assessment of the Star Forge Development Project, King County, Washington*. Prepared for Star Forge LLC. Prepared by Perteet, Seattle, Washington.

APPENDIX A:
INADVERTENT DISCOVERY PLAN

Inadvertent Discovery Plan for the 8531 East Marginal Way South Remedial Investigation Project
King County, Washington

1 INTRODUCTION

Shannon & Wilson, Inc. plans to complete remedial investigation activities within the project area in King County, Washington. This will include laser-induced fluorescence investigation (using direct-push probe drilling but will NOT remove soil from the subsurface. A windowed probe with fiber optics is used); direct-push soil sampling (2 inch); hollow-stem auger (HSA) soil sampling (2 inch); installation of wells in above-mentioned HSA boreholes; and groundwater sampling from existing and new wells. The following Inadvertent Discovery Plan (IDP) outlines procedures to follow, in accordance with federal laws, if archaeological materials or human remains are discovered.

State laws are in place which protect archaeological resources. The Archaeological Sites and Resources law (RCW Chapter 27.53) outlines the protection of archaeological resources. Shannon & Wilson, Inc. will act in accordance with State laws in dealing with the treatment of cultural resources and the consultation of concerned parties. Potentially concerned parties include: the Duwamish Tribe, Suquamish Tribe, Snoqualmie Tribe, Tulalip Tribes, Muckleshoot Tribe, Stillaguamish Tribe, and the Department of Archaeology & Historic Preservation (DAHP), and the City of Tukwila.

The monitoring archaeologist will have the ability to halt construction if they observe or identify any cultural materials and will have adequate time to assess, record, and potentially analyze any resources that might be uncovered. DAHP will be notified of all discoveries that occur during the course of the Project. The results of this monitoring effort will be documented at the completion of the project.

This document serves as the plan for dealing with any discoveries of human skeletal remains, artifacts, sites, or any other cultural resources that are potentially eligible for listing in the National Register of Historic Places (NRHP). This plan is intended to provide guidance to Shannon & Wilson, Inc. so they can:

1. Comply with applicable local and State laws and regulations, particularly Title 27 Revised Codes of Washington Chapter 27.44 Indian Graves and Records, Chapter 27.53 Archaeological Sites and Resources, and Title 68 Chapter 60.050 Protection of historic graves,
2. Describe to regulatory and review agencies the procedures that Shannon & Wilson, Inc. will follow to prepare for and deal with inadvertent discoveries, and
3. Provide direction and guidance to project personnel on the proper procedures to be followed should an inadvertent discovery occur.

2 RECOGNIZING CULTURAL MATERIALS

A cultural resource discovery could be from the precontact or historic eras. Examples include:

- An accumulation of shell, burned rocks, or other food related materials;
- Bones or small pieces of bone;
- An area of charcoal or very dark stained soil with artifacts;
- Stone tools or waste flakes (i.e. an arrowhead, or stone chips);
- Clusters of tin cans or bottles, logging or agricultural equipment that appears to be older than 50 years;
- Buried railroad tracks, decking, or other industrial materials; and
- Historic structures, portions of historic structures, or associated utilities aged 40 years or older.

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

3 ON-SITE RESPONSIBILITIES

STEP 1: STOP WORK. If any Shannon & Wilson, Inc. employee, contractor, or subcontractor believes that they have uncovered a cultural resource at any point during the project, all work adjacent to the discovery must stop. The discovery location should be secured at all times.

STEP 2: NOTIFY MONITOR. If there is an archaeological monitor for the project, notify that person. If there is a monitoring plan in place, the monitor will follow its provisions. If there is no archaeological monitor in place the Project Manager should be notified at which time they should contact a professional archaeologist to examine the find and determine if it is a cultural resource or not and provide significance recommendations.

STEP 3: NOTIFY AND CONSULT WITH DAHP. Immediately contact DAHP to assist in the significance evaluation of all inadvertent discoveries of cultural resources. Any discovery deemed eligible for listing in the National Register of Historic Places (NRHP) will be assessed and treated per the provisions set forth in this document (Attachment A). If the state agency representatives determine that the discovery is an eligible cultural resource, they and the affected tribe(s), will consult to determine appropriate treatment to be presented and agreed upon in a Memorandum of Agreement (MOA) or other appropriate documentation.

Mitigation measures will be developed in consultation with City of Tukwila, DAHP, and the affected tribes (where appropriate), which could include avoidance through redesign, conducting data recovery and/or relocating materials or remains. Agreed upon treatment measures performed by Shannon & Wilson, Inc. may include protecting in place or data recovery such as mapping, photography, limited probing, and sample collection, or other measures. This information is covered by the Public Records Act (RCW 42.17.250) and specific components of the records are exempt from disclosure (RCW 42.17.310(1)(k)) to avoid the looting or depredation of such sites.

4 PROTOCOL FOR TREATMENT OF HUMAN REMAINS

As per RCW 68.50.645, in the event that human remains, or material evidence of burial sites are encountered within the Project Area, whether during planned maintenance and construction activities, authorized archaeological excavations, or as a result of natural processes, the following protocol will be strictly followed:

1. If human skeletal remains are located within the Project Area, then all activity that may cause further disturbance to the remains will cease within at least 30 feet.
2. The area of the find will be secured and protected from further disturbance.
3. The finding of human skeletal remains will be reported to the King County Medical Examiner and local law enforcement in the most expeditious manner possible. The remains will not be touched, moved, or further disturbed.
4. The county medical examiner will assume jurisdiction over the human skeletal remains and make a determination of whether those remains are forensic or non-forensic. If the county medical examiner determines the remains are non-forensic, then they will report that finding to the Department of Archaeology and Historic Preservation (DAHP) who will then take jurisdiction over the remains.
5. The DAHP will notify any appropriate cemeteries and all affected tribes of the find.
6. The State Physical Anthropologist will make a determination of whether the remains are Indian or Non-Indian and report that finding to any appropriate cemeteries and the affected tribes.
7. The DAHP will then handle all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains.

Failure to follow this human remains protocol is a misdemeanor in Washington State.

5 PROTOCOL FOR RESPONSE TO VANDALISM

Vandalism consists of disturbance to historic properties, including unauthorized digging into archaeological sites or collection of artifacts. The probability for vandalism within the project is low; however, if at any time, employees or contractors encounter unauthorized visitors who appear to be digging or collecting materials from the ground surface, or are in possession of excavation equipment, or if a Shannon & Wilson, Inc. representative encounters evidence of recent unauthorized excavations or abandoned digging equipment (such as screens or shovels), the following protocol will be implemented.

1. If a possible vandal or looter is present, the Shannon & Wilson, Inc. representative will note information about the person, their equipment, and their vehicle and immediately relay the information to the work supervisor, who will confirm the information and notify the King County Sheriff's Office.
2. If the Shannon & Wilson, Inc. representative notes abandoned excavations or digging equipment, they will notify within 24 hours the cultural resources coordinator, who will notify the King County Sheriff's Office and the DAHP. The cultural resources coordinator will visit the site as soon as possible to assess any damage.
3. If a Native American site has been vandalized, the cultural resources coordinator will notify representatives of the affected tribes and the DAHP about this assessment and will invite them to attend the site inspection.
4. The assessment of impact will be described in a formal letter report from Shannon & Wilson, Inc. to the City of Tukwila, affected tribes, and DAHP, if applicable.
5. In consultation with the City of Tukwila, affected tribes, and DAHP, Shannon & Wilson, Inc. will identify what actions, if any, should be taken to mitigate damage to an affected site and/or prevent further damage.
6. Any act of vandalism or looting that involves human remains will also trigger the protocol for the treatment of human remains outlined above.
7. All acts of vandalism or looting will be referred to the King County Sheriff for investigation and possible prosecution.

6 PROTOCOL FOR EMERGENCY RESPONSE

A number of events can occur within the Project that require a rapid response in order to safeguard facilities, provide for protection of wildlife habitat, protect public and private property, and prevent serious injury or loss of human life. These include, but are not limited to; wild fire, wind and electrical storms, mass wasting events (erosion), flood, earthquake, and dam or other Project facility failure. The emergency response protocol is designed to be implemented after such events have occurred.

1. The supervisor of response will notify the cultural resources coordinator of the location and nature of the emergency activities.
2. The cultural resources coordinator will check relevant databases for historic properties in the vicinity of the emergency.
3. If historic properties are in the area of the emergency or the response (for example, both the area of the wild fire and the location of the construction of a fire line), then the cultural resources coordinator will be responsible for conducting a professional review by a qualified person of the condition of those properties.
4. The cultural resources coordinator will use existing documentation as a comparison to a field visit to determine if historic properties and/or cultural resources have been destroyed, damaged, or endangered by the emergency event or the response. If any of these conditions exist, then the cultural resources coordinator will document them in the field with mapping, photographs, and, in the case of imminent loss, collection of artifacts. The cultural resources coordinator will prepare a report documenting the nature and location of the emergency event, the nature of the response, the impact on the historic properties and/or cultural resources, and any proposals to prevent further damage to the properties and to mitigate for the loss. This report will be submitted to the City of Tukwila, affected tribes, and DAHP within 4 months of the event for review and comment. After a 30-day comment period, the comments of all of the consulting parties will be incorporated into a final report and copies will be sent to all of the participating parties.
5. If no alteration to the condition of the properties has occurred, a letter to that effect noting the date(s) of the field visit(s) will be placed on file in lieu of the formal report.

7 AGENCY CONTACTS

Shannon & Wilson, Inc.
Primary Contact: Shoshana Howard
Mobile: 206-695-6811

Cultural Resources Specialist, Stell
Primary Contact: Sarah Steinkraus, Principal Investigator/ Senior Archaeologist
Mobile: 360-620-5840

Washington Dept. of Ecology
Primary Contact: Maureen Sanchez
Mobile: 425-649-7254

King County Medical Examiner
Contact Number: 206-731-3232

King County Sheriff
Contact Number: 206-296-3311 or 911

City of Tukwila Police Department
Contact Number: 206 433-1808

Department of Archaeology & Historic Preservation Office
Primary Contact: Stephanie Jolivette, Local Government Archaeologist
Office: 360-586-3088

Secondary Contact: Dr. Guy Tasa, State Physical Anthropologist
Office: 360-586-3534

Tribal Contacts:

Duwamish Tribe
Primary Contact: Cecile Hansen, Chairwoman
Office: 206-431-1582

Suquamish Tribe
Primary Contact: Dennis Lewarch, Tribal Historic Preservation Officer
Office: 360-394-8529

Snoqualmie Nation
Primary Contact: Steve Mullen-Moses, Director of Archaeology and Historic Preservation
Office: 425-495-6097

Tulalip Tribes
Primary Contact: Richard Young, Cultural Resources Director
Office: 360-716-2652

Muckleshoot Indian Tribe
Primary Contact: Laura Murphy, Archaeologist
Office: 253-876-3272

Stillaguamish Tribe
Primary Contact: Kerry Lyste, Tribal Historic Preservation Officer
Office: 360-652-7362 ext. 226

APPENDIX B- HPI FORMS

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two Property ID: 720357

Location

Address: 8531 E Marginal Way S, Seattle, WA, 98108, USA

Geographic Areas: King Certified Local Government, King County, T24R04E33, SEATTLE SOUTH Quadrangle

Information

Number of stories: N/A

Construction Dates:

Construction Type	Year	Circa
Built Date	1942	☐
Addition	1943	☐
Addition	1962	☐
Addition	1965	☐
Addition	1966	☐
Addition	1967	☐
		☑

Historic Use:

Category	Subcategory
Industry/Processing/Extraction	Industry/Processing/Extraction - Manufacturing Facility
Industry/Processing/Extraction	Industry/Processing/Extraction - Manufacturing Facility

Historic Context:

Category
Industry/Manufacturing
Military
Maritime - Protecting our Shores

Architect/Engineer:

Category	Name or Company

Thematics:

Local Registers and Districts

Name	Date Listed	Notes

Project History

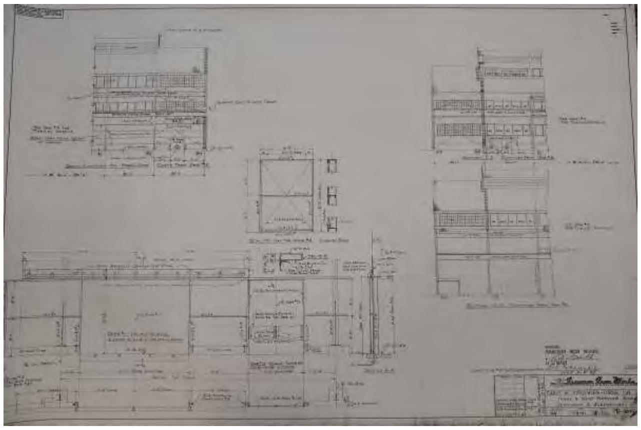
Project Number, Organization, Project Name	Resource Inventory	SHPO Determination	SHPO Determined By, Determined Date
2019-10-08126, , Star Forge	10/25/2019	Determined Eligible	Holly Borth, 11/21/2019
2019-10-08126, , Star Forge	2/6/2020	Survey/Inventory	

Historic Property Report

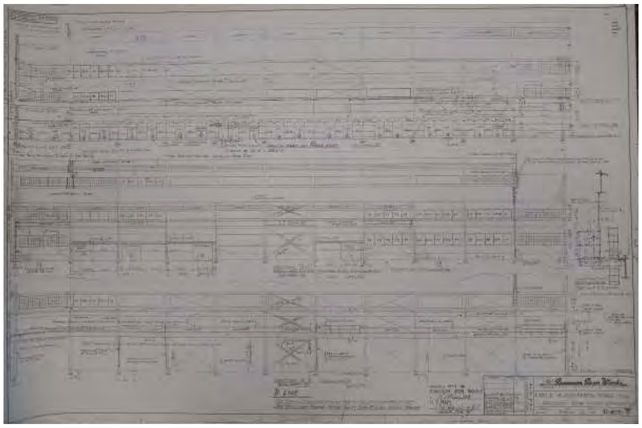
Resource Name: Isaacson Iron Works Plant Number Two Property ID: 720357

Photos

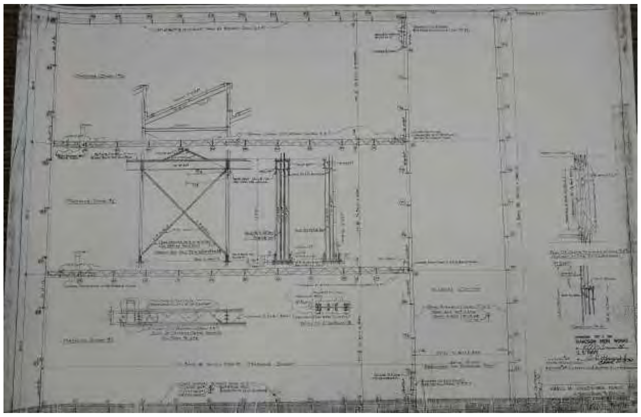
East end of Billet Yard, Forge Shop and Heat Treat (left to right), view to the northwest.



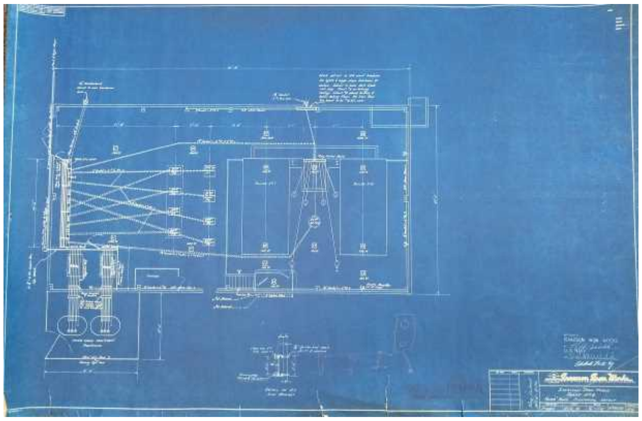
Isaacson Plant Number Two Forge & Heat Treat Sections - 1942.jpg



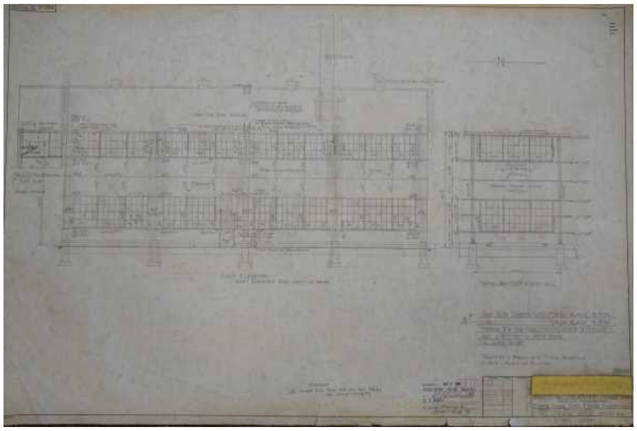
Isaacson Forge & Heat Treat Elevations - 1941.jpg



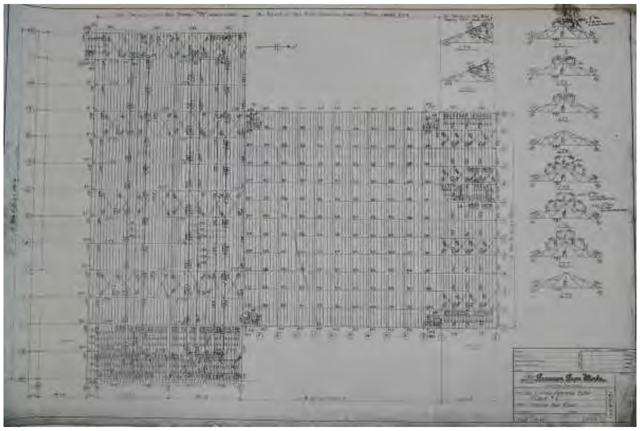
Issacson Plant Number Two Framing Plan Machine & Erection Shop - 1941.jpg



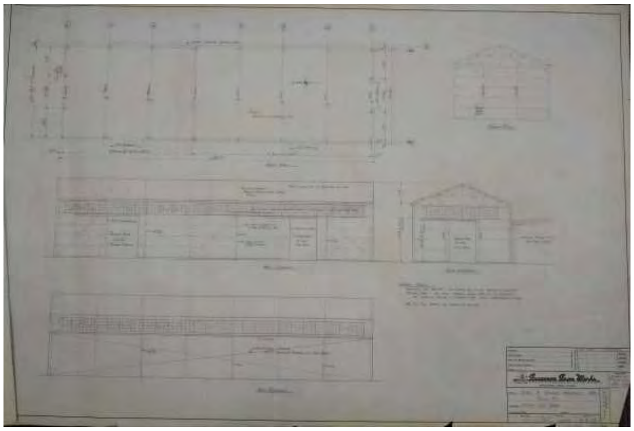
Isaacson Power House Electrical - 1941.jpg



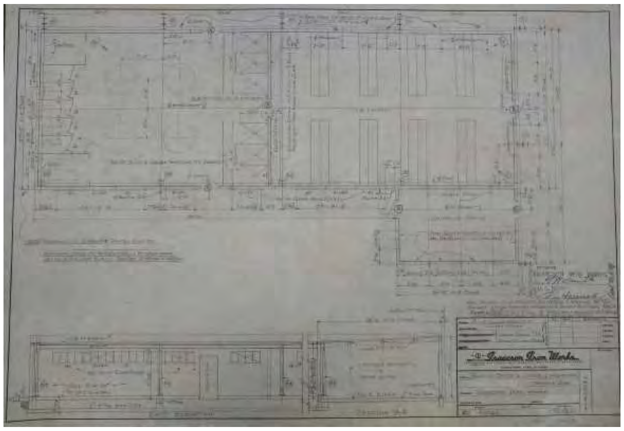
Isaacson Power House E&W Elev - 1941.jpg



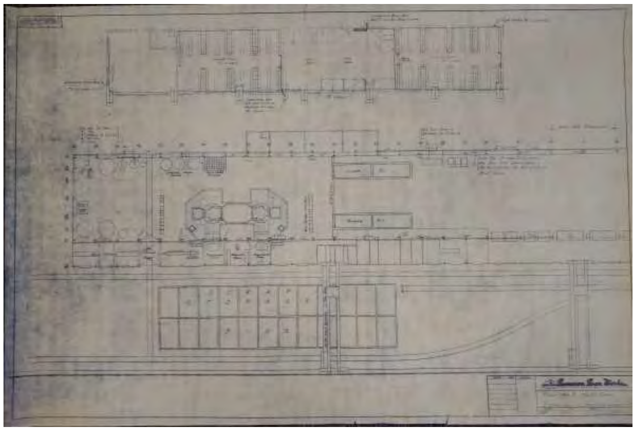
Isaacson Plant Number Two Top Chord Framing Plan - 1942.jpg



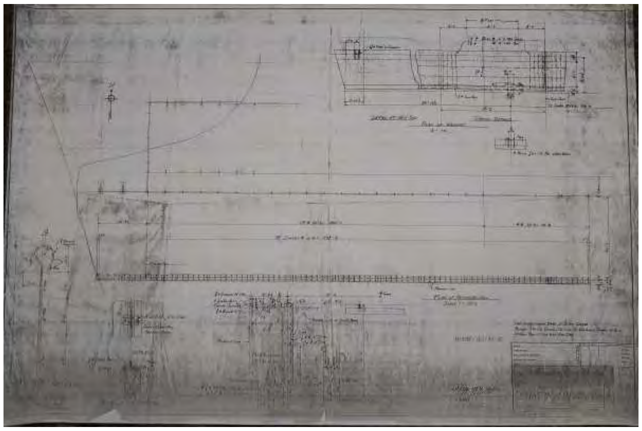
Isaacson Plant Number Two Stores & Anchor Warehouse - 1953.jpg



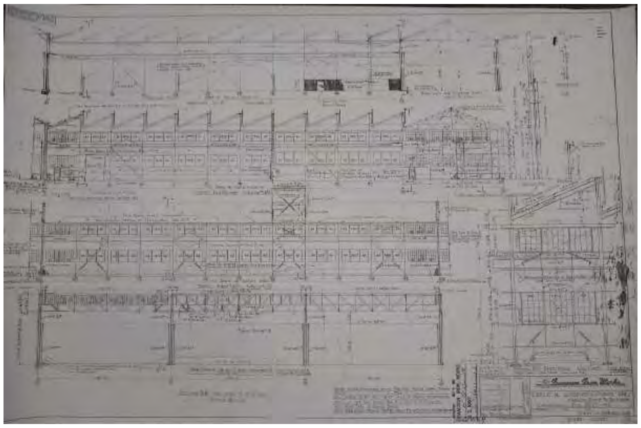
Isaacson Plant Number Two Shipping Office & Locker Rooms - 1942.jpg



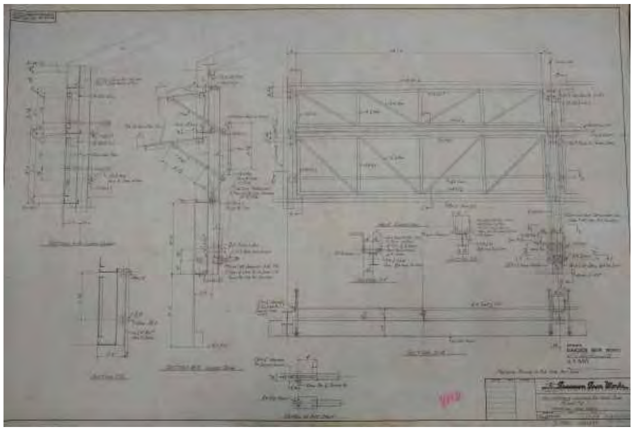
Isaacson Plant Number Two Melt Shop Steam & Oil Lines - 1943.jpg



Isaacson Plant Number Two Melt Shop Retaining Wall Details - 1942.jpg



Isaacson Plant Number Two Machine Shop & Shipping Elevations & Sections - 1941.jpg



Isaacson Plant Number Two Forge Shop Louvres - 1943.jpg

DSC_0271.JPG

DSC_0270.JPG

DSC_0269.JPG

DSC_0268.JPG

DSC_0267.JPG


DSC_0266.JPG


DSC_0265.JPG


DSC_0264.JPG


DSC_0263.JPG


DSC_0262.JPG


DSC_0261.JPG

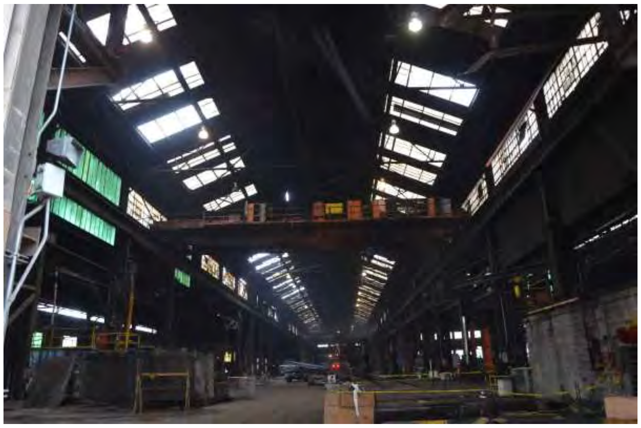

DSC_0260.JPG


DSC_0259.JPG


DSC_0258.JPG


DSC_0257.JPG


DSC_0256.JPG


DSC_0255.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two Property ID: 720357

DSC_0254.JPG

DSC_0253.JPG

DSC_0252.JPG

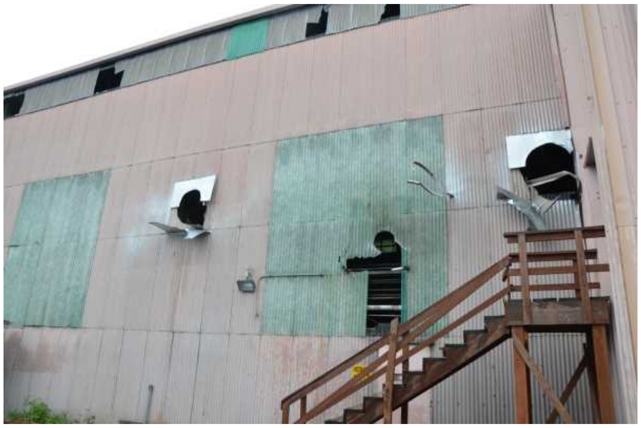
DSC_0251.JPG

DSC_0250.JPG

DSC_0249.JPG


DSC_0248.JPG


DSC_0247.JPG


DSC_0246.JPG


DSC_0245.JPG


DSC_0244.JPG


DSC_0243.JPG

DSC_0242.JPG

DSC_0241.JPG

DSC_0240.JPG

DSC_0239.JPG

DSC_0238.JPG

DSC_0237.JPG

DSC_0236.JPG

DSC_0235.JPG

DSC_0234.JPG

DSC_0281.JPG

DSC_0280.JPG

DSC_0279.JPG

DSC_0278.JPG

DSC_0277.JPG

DSC_0276.JPG

DSC_0275.JPG

DSC_0274.JPG

DSC_0273.JPG


DSC_0272.JPG


DSC_0230.JPG


DSC_0229.JPG


DSC_0228.JPG


DSC_0227.JPG


DSC_0226.JPG

DSC_0225.JPG

DSC_0224.JPG

DSC_0223.JPG

DSC_0222.JPG

DSC_0221.JPG

DSC_0220.JPG

DSC_0219.JPG

DSC_0218.JPG

DSC_0217.JPG

DSC_0216.JPG

DSC_0215.JPG

DSC_0214.JPG


DSC_0213.JPG


DSC_0212.JPG


DSC_0211.JPG


DSC_0210.JPG


DSC_0209.JPG


DSC_0208.JPG

DSC_0207.JPG

DSC_0206.JPG

DSC_0205.JPG

DSC_0204.JPG

DSC_0203.JPG

DSC_0202.JPG


DSC_0201.JPG


DSC_0200.JPG


DSC_0199.JPG


DSC_0198.JPG


DSC_0197.JPG


DSC_0196.JPG


DSC_0195.JPG


DSC_0194.JPG


DSC_0193.JPG


DSC_0192.JPG


DSC_0191.JPG


DSC_0190.JPG

DSC_0189.JPG

DSC_0188.JPG

DSC_0187.JPG

DSC_0186.JPG

DSC_0233.JPG

DSC_0232.JPG

DSC_0231.JPG

DSC_0145.JPG

DSC_0144.JPG

DSC_0143.JPG

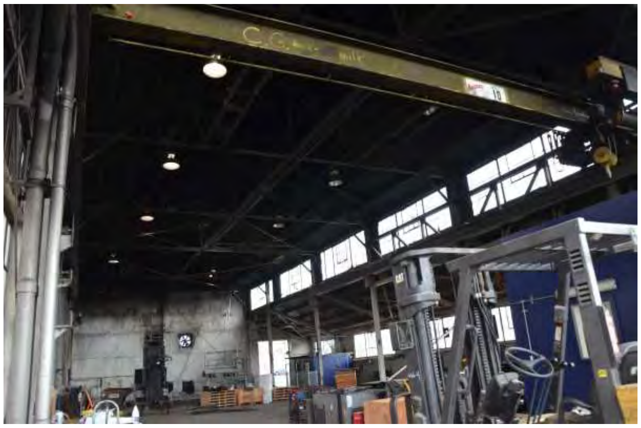
DSC_0127.JPG

DSC_0126.JPG

DSC_0125.JPG

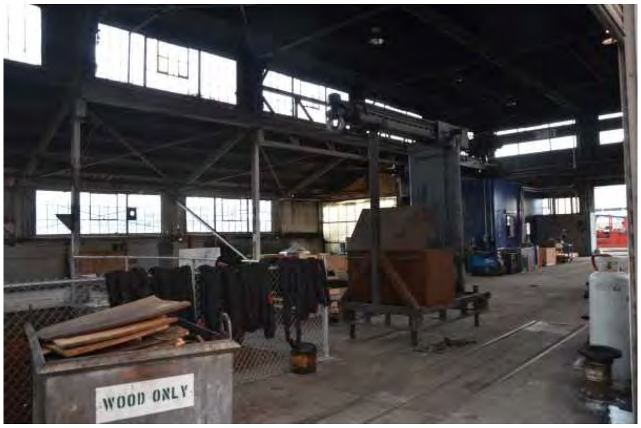
DSC_0124.JPG

DSC_0123.JPG



DSC_0152.JPG

DSC_0151.JPG



DSC_0150.JPG

DSC_0149.JPG

DSC_0148.JPG

DSC_0147.JPG

DSC_0146.JPG

South side of Plant Two following construction of Melt Shop in 1943 (scrap metal storage in foreground) (Isaacson Iron Works 1943)

East side of the Machine Shop (Isaacson Iron Works 1943)

East end of the shipping area with southern portion of plant in background, view to the southwest.

northwest corner of Melt Shop Warehouse, with Melt Shop in background, view to the southeast.

North end of Plant Number Two: (left to right) Erection Shop (Hollowbore), Machine Shop, Heat Treat, Melt Shop. View to the southeast.

West half of Plant Number Two: Melt Shop and Melt Shop Warehouse (far right).

West end of Erection Shop (Hollowbore)

PDF0917-01 - Isaacson Plant Number Two Machine Shop & Shipping - 1941.pdf

PDF0916-01 - Isaacson Plant Number Two Melt Shop West Floor Plan - 1943.pdf

PDF0914-01 - EMJ Plant Number Two Melt Shop Floor Plan - 1966.pdf

PDF0913-01 - Isaacson Plant Number Two E&W Elevations - 1942.pdf

PDF0912-01 - Isaacson Plant Number Two Machine Shop Addn - 1942.pdf

PDF0911-01 - Isaacson Plant Number Two EMJ Div Machine Shop - 1941.pdf

PDF0910-01 - Isaacson Womens Service Bldg - 1942.pdf

PDF0908-01 - Isaacson Plot Plan Oxygen Lines - 1956.pdf

PDF0907-01 - Isaacson Power House Floor - 1941.pdf

PDF0904-01 - Isaacson Power House Foundation - 1941.pdf

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two Property ID: 720357

Inventory Details - 10/25/2019

Common name: Jorgensen Forge Corporation

Date recorded: 10/25/2019

Field Recorder: Eileen Heideman

Field Site number: IIW-19-01

SHPO Determination

Detail Information

Characteristics:

Category	Item
Foundation	Concrete - Poured
Form Type	Utilitarian
Roof Type	Varied Roof Lines
Roof Material	Metal - Corrugated
Cladding	Metal - Corrugated
Structural System	Metal - Steel
Plan	Irregular

Surveyor Opinion

Property appears to meet criteria for the National Register of Historic Places: Yes

Property is located in a potential historic district (National and/or local): Yes

Property potentially contributes to a historic district (National and/or local): Yes

Significance narrative: The bulk of the building was constructed in 1942, with the addition of the Melt Shop in 1943, and the later additions of the Melt Shop Warehouse (1962), Shipping (ca.1965),the Billet Yard (1967), and the Ladle and Furnace Roof Shop (1966) (King County Department of Assessments 1941-1974; Wayne Turk, personal communication, September23, 2019). The core of the building, dating to the original construction period of 1942-1943, is easily recognizable among the later additions, and the interior spaces largely retained their original use throughout the active use of the plant. Removal of equipment from the plant occurred in 2019 (personal communication, Wayne Turk, September23, 2019).

This building is associated closely with the massive buildup of industry associated with the Second World War, with Isaacson Iron Works employees forging much of the material used to build and operate the Liberty ships that provided material to the Allied Army throughout the war as well as the bulldozers used by the Seabees in construction of Pacific theater runways and bases. Although the construction of the Billet Yard, Melt Shop Warehouse and Shipping areas in the 1960s resulted in some loss of integrity of design, the core of the building is largely unaltered and is easily recognizable from the exterior as the World War Two-era building. This building is significant under Criterion A for its association with the wartime industry and is recommended eligible for the National Register of Historic Places.

Physical description:

As the primary building and center of industry on the property, Plant Number Two was largely identified by areas of use. These areas include the Melt Shop and Melt Shop Warehouse, Forge Shop, Heat Treating Shop (Heat Treat), Machine Shop, Erection Shop (now called Hollowbore), Shipping, Automotive Shop, Billet Yard, and maintenance, lunch and locker rooms. These areas are to a certain degree defined on the exterior of the building by different rooflines (i.e., the Machine Shop has a sawtooth roof to allow for increased natural light for machine tooling of products, while the Melt Shop, Heat Treat and the Forge Shop have high rooflines to accommodate the larger equipment and higher temperatures required in these areas. The interior of the building is connected and designed for a flow of raw materials to finished product.

The building has an irregular footprint that forms a rough L shape. A variety of materials were used in construction, but the majority of the building is constructed with steel, resting on a poured concrete foundation, with the exterior and most of the roof clad in corrugated metal. Some windows are steel multi-light fixed and awning windows, although some windows consist of fiberglass panels, particularly on the south and west sides of the building. A scale and scale house stand on the south side of the building.

Bibliography:

Earley, Amber and Eileen Heideman
2019 Cultural Resources Assessment of the Star Forge Development Project, King County, Washington. Report prepared for Star Forge, LLC. Perteet, Seattle, Washington and Cascade Heritage Consultants, Seattle, Washington.
King County Department of Assessments
1941-1974 Property cards, Parcel Number 000160-0023. On file at Puget Sound Regional Branch, Washington State Archives, Bellevue, Washington.
2019 Parcel Number 000160-0023
https://blue.kingcounty.com/Assessor/eRealProperty/Dashboard.aspx?
ParcelNbr=0001600023, accessed October 2019.
Sanborn Map Company
1957 Sanborn Fire Insurance Maps of Seattle, Volume 8, 1929 Updated to 1960, Sheet 1384. Sanborn Map Company, New York.
Forging Ahead (FA). Volumes 1-7. Isaacson Iron Works, Seattle, Washington.
1943c "The Victory Fleet is on the Way." Volume 3, Number 1, October 1943: 3-5.
1944a "The American Merchant Marine and its Part in the War Effort." Special Issue, May 22 :10-11.
1944c "Buldozer's[sic] Prominent in the War News." Volume 4, Number 2, June: 14-15.

Inventory Details - 2/6/2020

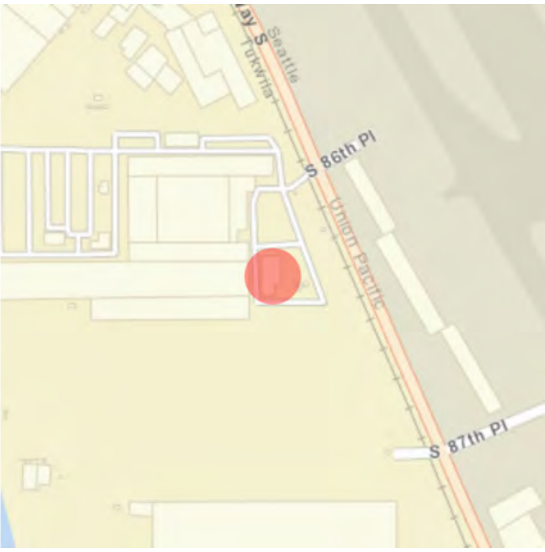
Common name:	
Date recorded:	2/6/2020
Field Recorder:	Mindy Graddon
Field Site number:	
SHPO Determination	

Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359

Location



Address: 8531 E Marginal Way S, Seattle, WA, 98108, USA

Geographic Areas: King Certified Local Government, King County, T24R04E33, SEATTLE SOUTH Quadrangle

Information

Number of stories: N/A

Construction Dates:

Construction Type	Year	Circa
Built Date	1943	☐

Historic Use:

Category	Subcategory
Industry/Processing/Extraction	Industry/Processing/Extraction - Energy Facility
Industry/Processing/Extraction	Industry/Processing/Extraction - Energy Facility

Historic Context:

Category
Industry/Manufacturing

Architect/Engineer:

Category	Name or Company

Thematics:

Local Registers and Districts

Name	Date Listed	Notes

Project History

Project Number, Organization, Project Name	Resource Inventory	SHPO Determination	SHPO Determined By, Determined Date
2019-10-08126, , Star Forge	10/25/2019	Determined Eligible	Holly Borth, 11/21/2019
2019-10-08126, , Star Forge	2/6/2020	Survey/Inventory	

Photos

South end of building (Plant Number Two to left), view to the north.

DSC_0142.JPG

DSC_0141.JPG

DSC_0140.JPG

DSC_0139.JPG

DSC_0138.JPG

DSC_0137.JPG

DSC_0136.JPG

DSC_0135.JPG

DSC_0134.JPG

DSC_0133.JPG

DSC_0132.JPG

DSC_0131.JPG

DSC_0130.JPG

DSC_0129.JPG

DSC_0128.JPG

Power House in 1961, prior to conversion to Aluminum Heat Treat, view to the southwest (King County Department of Assessments 1941-1974).

Northwest corner of building, view to the southeast.

Northeast corner of building, view to the southwest.

Power House with power lines and electrical equipment to right and Plant Number Two to left, view to the northwest.

Historic Property Report

Inventory Details - 10/25/2019

Common name:	Jorgensen Forge Corporation Aluminum Heat Treat Building
Date recorded:	10/25/2019
Field Recorder:	Eileen Heideman
Field Site number:	IIW-1903
SHPO Determination	

Detail Information

Characteristics:

Category	Item
Foundation	Concrete - Poured
Form Type	Utilitarian
Roof Type	Gable
Roof Material	Metal - Corrugated
Cladding	Metal - Corrugated
Structural System	Metal - Steel
Plan	L-Shape

Surveyor Opinion

Property appears to meet criteria for the National Register of Historic Places: Yes

Property is located in a potential historic district (National and/or local): Yes

Property potentially contributes to a historic district (National and/or local): Yes

Significance narrative: This building was constructed in 1942 or 1943 and served as the Power House for Plant Number Two, which required a large amount of electricity to keep the plant in operation around the clock during its wartime production period. The building was later converted by the Jorgensen Forge Corporation into an Aluminum Heat Treat Building, but with the exception of the replacement of the garage doors and removal of some electrical equipment, the exterior of the building is largely unaltered. These changes resulted in some loss of integrity of association and design, but the exterior is still easily recognizable as the power plant. This building is closely associated with World War Two-era production at Isaacson Iron Works Plant Two, and, together with the main plant building, is recommended eligible for the National Register of Historic Places under Criterion A.

Physical description:

This building is a tall (two-story), gable-roofed building with a north/south-oriented ridge and a shorter, single-story shed ell on the northern two-thirds of the building’s east side. The building is clad with corrugated steel siding, and the roof is also covered with corrugated metal. The building is lit with steel multi-light fixed, awning and pivot windows. Some of these windows have been painted over or otherwise covered, but are largely intact. Large industrial ventilators line the ridge. The building is accessed by large garage openings on the north end of the building’s west side, and at the south end of the building. Power line poles and electrical equipment stand near the southeast corner of the building.

Bibliography:

Earley, Amber and Eileen Heideman
2019 Cultural Resources Assessment of the Star Forge Development Project, King County, Washington. Report prepared for Star Forge, LLC. Perteet, Seattle, Washington and Cascade Heritage Consultants, Seattle, Washington.
King County Department of Assessments
1941-1974 Property cards, Parcel Number 000160-0023. On file at Puget Sound Regional Branch, Washington State Archives, Bellevue, Washington.
2019 Parcel Number 000160-0023
https://blue.kingcounty.com/Assessor/eRealProperty/Dashboard.aspx?ParcelNbr=0001600023, accessed October 2019.
Sanborn Map Company
1957 Sanborn Fire Insurance Maps of Seattle, Volume 8, 1929 Updated to 1960, Sheet 1384. Sanborn Map Company, New York.

Inventory Details - 2/6/2020

Common name:	
Date recorded:	2/6/2020
Field Recorder:	Mindy Graddon
Field Site number:	
SHPO Determination	

Historic Property Report

Resource Name: Isaacson Iron Works Office Headquarters

Property ID: 720360

Location

Address: 8531 E Marginal Way S, Seattle, WA, 98108, USA

Geographic Areas: King Certified Local Government, King County, T24R04E33, SEATTLE SOUTH Quadrangle

Information

Number of stories: N/A

Construction Dates:

Construction Type	**Year**	**Circa**
Built Date	1950	☐
Remodel	1970	☑

Historic Use:

Category	**Subcategory**
Industry/Processing/Extraction	
Industry/Processing/Extraction	

Historic Context:

Category
Industry/Manufacturing

Architect/Engineer:

Category	**Name or Company**

Thematics:

Local Registers and Districts

Name	Date Listed	Notes

Project History

Project Number, Organization, Project Name	Resource Inventory	SHPO Determination	SHPO Determined By, Determined Date
2019-10-08126, , Star Forge	10/25/2019	Determined Eligible	Holly Borth, 11/21/2019
2019-10-08126, , Star Forge	2/6/2020	Survey/Inventory	

Historic Property Report

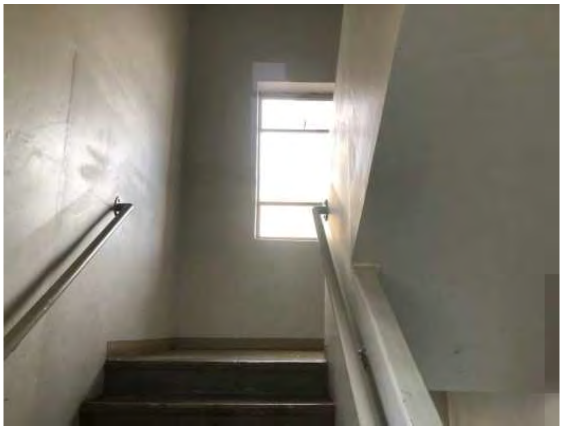
Resource Name: Isaacson Iron Works Office Headquarters

Property ID: 720360

Photos

Office headquarters, view to the northwest.

AdminBuildingInterior 09.jpg



AdminBuildingInterior 08.jpg

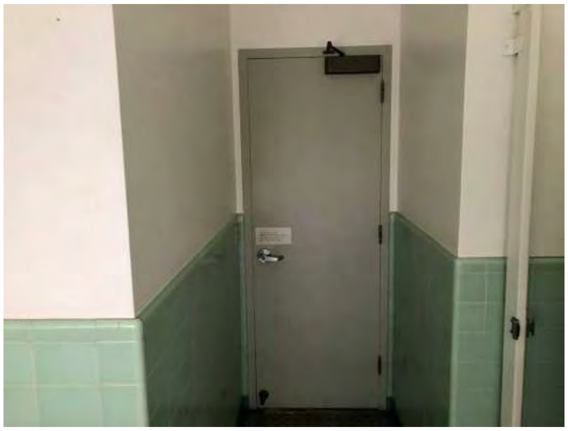
AdminBuildingInterior 07.jpg

AdminBuildingInterior 06.jpg

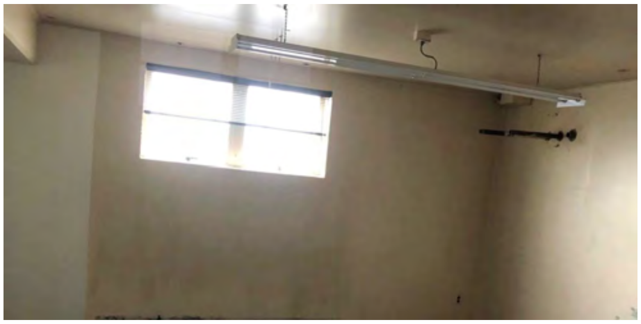
AdminBuildingInterior 05.jpg

AdminBuildingInterior 04.jpg

AdminBuildingInterior 03.jpg



AdminBuildingInterior 02.jpg



AdminBuildingInterior 01.jpg

AdminBuildingExterior 09.jpg

AdminBuildingExterior 08.jpg

AdminBuildingExterior 07.jpg

AdminBuildingExterior 06.jpg

AdminBuildingExterior 05.jpg

AdminBuildingExterior 04.jpg

AdminBuildingExterior 03.jpg

AdminBuildingExterior 02.jpg

AdminBuildingExterior 01.jpg

Office in 1951 shortly after construction, view to the west (King County Department of Assessment 1941-1974)

Window opening on south side of building, showing extent of infill, view to the north.

West end of building, view to the southeast.

Southwest corner of building, view to the northeast.

Northeast corner of building, view to the southwest.

Historic Property Report

Resource Name: Isaacson Iron Works Office Headquarters

Property ID: 720360

Inventory Details - 10/25/2019

Common name: Jorgensen Forge Corporation Office Headquarters

Date recorded: 10/25/2019

Field Recorder: Eileen Heideman

Field Site number: IIW-19-04

SHPO Determination

Detail Information

Characteristics:

Category	**Item**
Foundation	Concrete - Poured
Form Type	Utilitarian
Roof Type	Flat with Eaves
Roof Material	Metal - Standing Seam
Cladding	Brick
Structural System	Masonry - Poured Concrete
Plan	Rectangle

Styles:

Period	**Style Details**
Modern Movement	Modern

Surveyor Opinion

Property appears to meet criteria for the National Register of Historic Places: No

Property is located in a potential historic district (National and/or local): No

Property potentially contributes to a historic district (National and/or local): No

Significance narrative: The office headquarters building was built in 1950 for the Isaacson Iron Works and was later altered by the Jorgensen Forge Corporation (King County Department of Assessments 1941-1974). Alterations include replacement and alteration of the roof form, removal and partial replacement of the windows, and redesign of the main entrance. These changes have caused loss of integrity of design, materials, and workmanship. This building was constructed after the main period of significance for Plant Number Two and lacks association with this period of the property history. This building is therefore recommended not eligible for the National Register of Historic Places.

Physical description: This brick-veneered building stands on the north end of the property, adjacent to the Hollowbore section of Plant Two. The building has a flat roof with overhanging, boxed-in eaves (a later alteration). The building is lit with metal-frame awning windows, a replacement of the original multi-light steel-frame windows, which were also partially filled in. The single-story main entrance is located on the east end of the building and is covered by a flat roof with boxed-in eaves. A rear entrance on the south side of the building is sheltered by a small porch with a south wall and a flat roof. The building has undergone extensive alterations since its construction and bears little resemblance to its original appearance.

Bibliography:

Earley, Amber and Eileen Heideman
2019 Cultural Resources Assessment of the Star Forge Development Project, King County, Washington. Report prepared for Star Forge, LLC. Perteet, Seattle, Washington and Cascade Heritage Consultants, Seattle, Washington.
King County Department of Assessments
1941-1974 Property cards, Parcel Number 000160-0023. On file at Puget Sound Regional Branch, Washington State Archives, Bellevue, Washington.
2019 Parcel Number 000160-0023
https://blue.kingcounty.com/Assessor/eRealProperty/Dashboard.aspx?ParcelNbr=0001600023, accessed October 2019.
Sanborn Map Company
1957 Sanborn Fire Insurance Maps of Seattle, Volume 8, 1929 Updated to 1960, Sheet 1384. Sanborn Map Company, New York.

Inventory Details - 2/6/2020

Common name:	
Date recorded:	2/6/2020
Field Recorder:	Mindy Graddon
Field Site number:	
SHPO Determination	

ATTACHMENT 2: FIELD FORMS

Attachment 2

Field Forms

CONTENTS

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIELD LOG OF BORING

DRILL COMPANY/DRILLER: ____________________
DRILL RIG EQUIPMENT: ____________________
DRILLING METHOD: ____________________
HAMMER TYPE: __________ ROD TYPE/DIA.: __________
HAMMER WEIGHT: __________ HAMMER DROP: __________
CASING SIZE/TYPE: __________ HOLE SIZE: __________

JOB NO: __________ BORING NO: __________
JOB NAME: ____________________
LOGGED BY: ____________________
LOCATION: __________ ELEV.: __________
START DATE: __________ END DATE: __________
WEATHER DURING DRILLING: ____________________

SAMPLE DATA

TIME DATE	SAMP. NO. TYPE	DEPTH FROM TO	DRIVING RESISTANCE BLOWS / 6 INCH	L. REC. # JARS	DRILL ACTION	CONTACTS / GROUNDWATER	PID	ENV. SAMPLE	CONST. %		FIELD IDENTIFICATION [Density/consistency, color, *Group Name* (*USCS*); moisture; constituent properties (particle size, plasticity, etc.); organics; structure; other; unit name]
									G		
									S		
									F		
									G		
									S		
									F		
									G		
									S		
									F		
									G		
									S		
									F		
									G		
									S		
									F		
									G		
									S		
									F		
									G		
									S		
									F		

SUMMARY FIELD LOG OF BORING

DEPTH		USCS CLASSIF.	GENERALIZED SOIL DESCRIPTION FOR DRAFTED GINT LOG
FROM	TO		

COMMENTS (i.e. materials used, visitors, problems, etc.):

GROUNDWATER DATA

WATER DEPTH	TIME	DATE

SUMMARY OF TIME AND FOOTAGE

FOOTAGE DRILLED: __________
SAMPLES: __________ Attempted
__________ Recovered
DRILL/SAMPLE ______ hrs. STANDBY: ______ hrs.
SETUP/CLEANUP: ______ hrs. WELL INSTALL: ______ hrs.
OTHER: ____________________

BORING: __________ SHEET ______ OF ______

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIELD LOG OF GEOPROBE

PROBING COMPANY/DRILLER:
PROBE RIG EQUIPMENT:
PROBING METHOD:
PROBE DIAM.: TYP. RUN LENGTH:
WEATHER DURING DRILLING:

JOB NO: PROBE NO:
JOB NAME:
LOGGED BY:
LOCATION: ELEV.:
START DATE: END DATE:

PROBE RUN AND SAMPLE DATA

TIME DATE	RUN NO.	RUN FROM TO	LENGTH RECOVERED	FIELD CLASSIFICATION [Density/consistency, color, slightly, minor, MAJOR, then trace constituents; moisture; structure; other; (Geology) USCS classification.]	PID READING	SAMPLE NO.	SAMPLE DEPTH FROM TO	SAMPLE PURPOSE OR COMMENT

SUMMARY FIELD LOG OF GEOPROBE

DEPTH		USCS CLASSIF.	GENERALIZED SOIL DESCRIPTION FOR DRAFTED GINT LOG
FROM	TO		

COMMENTS (i.e. materials used, visitors, problems, etc.):

GROUNDWATER DATA

WATER DEPTH	TIME	DATE

SUMMARY OF TIME AND FOOTAGE

PROBE/SAMPLE hrs. STANDBY: hrs.
SETUP/CLEANUP: hrs. DECON: hrs.
OTHER:

BORING: SHEET OF

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

WELL / VWP CONSTRUCTION LOG

JOB NO. ________________

BORING NO: ____________________ APPROX. GROUND ELEV: ____________________ ft.

INSPECTOR: ____________________ LOCATION: ______________________________

INSTALL DATE: ______________________________ (indicate if several installation dates)

ECOL. TAG NO: ______________________________

TOTAL DRILLED DEPTH: ______________________ ft.

TOTAL SAMPL. DEPTH: ______________________ ft.

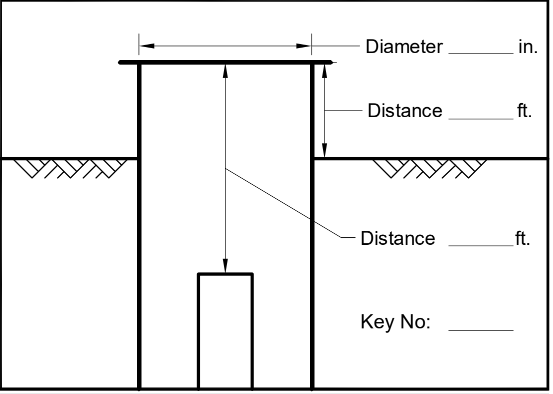
DRILLING METHOD: ______________________ (HSA, Mud Rotary, ect.)

DRILLING FLUID USED: ______________________ (Bentonite, Polymer, ect.)

BOREHOLE DIAMETER: ______________________ in.

DRILL MUD REMOVAL RMKS: ____

SURFACE MONUMENT DETAILS



Diameter ______ in.

Distance ______ ft.

Distance ______ ft.

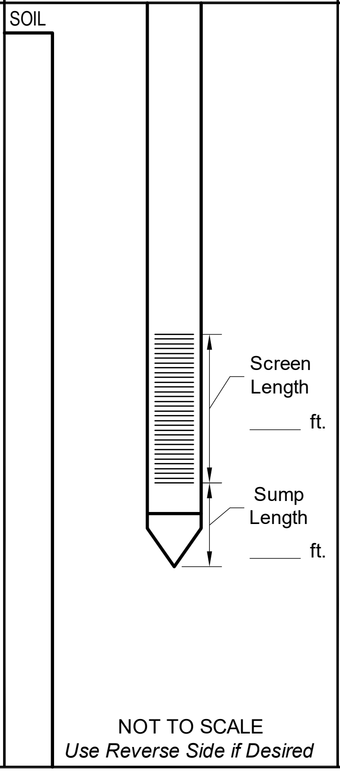
Key No: ______

PIPE / INSTRUMENT DETAILS

DEPTH		WELL / VWP NO.	SOLID	SLOTTED	DESCRIPTION (include OD/ID, slot width, pipe material, schedule, etc.)	VWP
FROM	TO					

SKETCH

▒ SAND	▩ BENT. CHIPS
▨ BENT. GROUT	▧ BENT. CEMENT



Screen Length ______ ft.

Sump Length ______ ft.

NOT TO SCALE
Use Reverse Side if Desired

HOLE BACKFILL DETAILS

DEPTH		FILTER	SEAL	DESCRIPTION (include seal or filter type, size, gINT code, etc.)	POUR	TREMIE
FROM	TO					

ADDITIONAL WELL DETAILS

CENTRALIZERS: ☐ Yes ☐ No → Type: ____________________ Depths: ____________________

CASING JOINTS: ☐ Threaded ☐ Glued End Cap Type: ______________ How Secured: ______________

DEPTH TO WATER AFTER INSTALLATION: __________ ft.

INSTALLATION MATERIALS USED

SAND: ________ bags

CEMENT: ________ bags

BENTONITE POWDER: ________ bags

BENT. CHIPS/PELLETS: ________ bags

SLOTTED PVC: ________ ft.

BLANK PVC: ________ ft.

____

VWP INITIALIZATION DETAILS

TRANSDUCER DEPTH: VWP #1 ____________________ ft.

VWP #2 ____________________ ft.

SER.# / PRESSURE RATING: VWP #1 ______________ / ______________ psi

VWP #2 ______________ / ______________ psi

VWP # and Reading Type	Zero Reading	Zero Temp	Date and Time of Reading	Readout Box S/N
#1 Unsaturated				
#1 Saturated				
#2 Unsaturated				
#2 Saturated				

ADDITIONAL COMMENTS: ____

____

____

Filename: J:\Support\library\FIELD AND LAB FORMS\AutoCAD_Well_VWP Construction Log.dwg Date: 02-10-2011 Login: sac

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

WELL DEVELOPMENT LOG

JOB NO. ____________________
PAGE _______ OF _______

OWNER / LOCATION: ____ DATE: ______________________

WELL NO: ________________ WEATHER: ______________________________ PERSONNEL: ________________

ECOLOGY TAG NO: ______________________ MEASURING POINT (MP): ______________________

LOCK NO. OR COMBINATION: __________ CASING DIA: ______ in. CASING: _______ gal / ft. TIME / PID HEADSPACE: _____________ ppm

CASING STICKDOWN < OPEN MON. RIM: _______________ ft. MON. HEIGHT: ______ ft. MONUMENT TYPE & DIA: ______________ in.

SURGE BLOCK TYPE: _______________ PRODUCT THICKNESS: ___________ ft. PRODUCT MEASUREMENT METHOD: ________________

TIME / STATIC WL < MP: ___________ ft. DEVELOPMENT METHOD: (Bailer-SS, Teflon, HDPE) (Hand Waterra) (Powered Waterra) (Other__________________)

TIME / VWP READING: _______________ (Digits, Temp.) VWP READOUT BOX ID: _______________ DECON. METHOD: ________________

WELL DEPTH < MP: __________ ft. (Hard or Soft?) WATER COLUMN HEIGHT: __________ ft. VOLUME IN WELL: _____________ gal.

WATER VOLUME ADDED? ____________ (Tap or Distilled?) VOLUME PURGED: __________ gal. REPAIRS NEEDED? ________________

MEANS OF SEDIMENT MEASUREMENT IN PURGE WATER: ________________________________ SCREEN LENGTH: _______________ ft.

FIELD PARAMETERS

START TIME/ WATER VOLUME ADDED, if any (gal)	END TIME	INTERVAL SURGED/ PURGED (ft > TD*)	TOTAL VOLUME PURGED (gal)	SEDIMENT THICKNESS (in or ml)	COLOR/ ODOR/ SHEEN?	FIELD PARAMETERS, if any (including units)		

*TD = Total Depth of Well

PURGE WATER DISPOSITION: ___________________________ DRUM NUMBERS / LOCATION: ______________________________

RELATIVE RECOVERY RATE: ___________ (Rapid - Moderate - Slow) FINAL WELL DEPTH < MP: ___________ ft. SHEEN / ODOR? ___________

COMMENTS: ____

CASING CAP LEFT LOOSE OR TIGHT ? __________________ WAS ALL SEDIMENT REMOVED? ___________

PAGE _____ OF _____ WELL NO: ___________

Filename: J:\Support\library\FIELD AND LAB FORMS\AutoCAD_Well Development Log.dwg Date: 02-10-2011 Login: sac

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

JOB NO.:

Project:

Conducted by:

Weather:

WATER LEVEL MEASUREMENTS

Location ID	Date	Time	PID Reading (ppm)		Measuring Point (MP)	Depth to Water from MP (feet)	Depth to LNAPL from MP (feet)	Comments (i.e. pressure change when opened, inaccesibility, etc.)
			Monument	Casing				

Comments:

Checked By:

Date:

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

WATER SAMPLING LOG

JOB NO. ____________________
PAGE ______ OF ______

OWNER / LOCATION: ____________________ DATE: ____________________

WELL NO: ______________ SAMPLE NO: ______________ ECOLOGY TAG NO: ______________ DUPLICATE NO: ______________

WEATHER: ____________________ MS / MSD? Yes ☐ No ☐

WELL SITE CONDITIONS / MP DEFINITION: ____________________
(MP is typically the north PVC rim)

SAMPLING DATA

TIME STARTED: ____________________

PID HEAD SPACE: ____________________ ppm

MP DISTANCE ABOVE / BELOW GROUND SURFACE: __________ ft.

TOTAL DEPTH OF WELL BELOW MP: ____________________ ft.

DTW BELOW MP: ____________________ ft.

WATER COLUMN IN WELL: ____________________ ft.

CASING DIAMETER: ____________________ in.

GALLONS PER FOOT: ____________________

GALLONS IN WELL: ____________________

TIME PURGING STARTED: ____________________

LNAPL THICKNESS: ______________ ft. Sample ☐

DNAPL THICKNESS: ______________ ft. Sample ☐

SAMPLE CONTAINERS

Number	Size	Type	Pres.

FIELD PARAMETERS

GALLONS REMOVED	TEMP. (C°)	D.O. (mg / L)	SP.COND. (ms / cm^3)	TDS (g / L)	SALINITY (ppt)	pH	ORP	TURBIDITY (NTU)	COLOR	TIME	DTW (ft)
Initial											
After Sampling											

EVACUATION METHOD: ____________________

PUMP INTAKE DEPTH (if applicable): ____________________

PURGE WATER DISPOSITION (e.g., drum #): ____________________

WATER QUALITY (e.g., sheen, odor): ____________________

WATER QUALITY METER(S) USED; CALIBRATION DATE / TIME: ____________________

SAMPLING METHOD: ____________________ SAMPLE TIME: ______________

SAMPLING PERSONNEL: ____________________ DUPLICATE "TIME": ______________

REMARKS (e.g., recovery rate): ____________________

TIME COMPLETED: ______________

WELL CASING VOLUMES

Gal / ft 1-1/4" = 0.077 2" = 0.16 3" = 0.37 4" = 0.65
1-1/2" = 0.10 2-1/2" = 0.24 3-1/2" = 0.50 6" = 1.46

Filename: J:\Support\library\FIELD AND LAB FORMS\AutoCAD_Water Sampling Log.dwg Date: 02-10-2011 Login: sac

ATTACHMENT 3: AVAILABLE BORING LOGS

Attachment 3

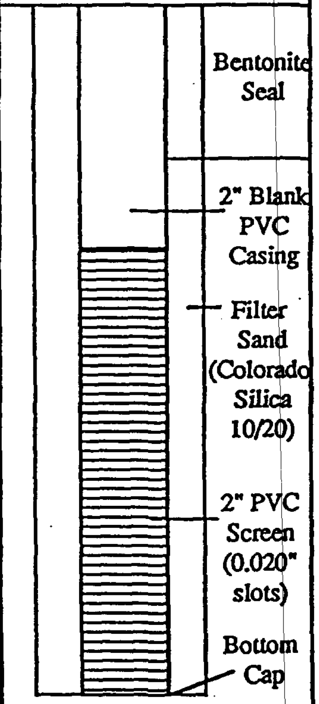
Available Boring Logs

SEACOR

BORING LOG

BORING: MW-1
PAGE 1 of 1

PROJECT Jorgenson Steel
LOCATION 8531 East Marginal Way South, Seattle, WA
SURFACE ELEVATION --------
CASING TOP ELEVATION --------
START 0815 2-7-91
FINISH 1015 2-7-91
SAMPLER J GIEBER
MONITORING DEVICE ---------
SUBCONTRTACTOR AND EQUIPMENT Environmental Drilling, Mobile B-61; 8" HSA
COMMENTS Grab samples collected for logging purposes

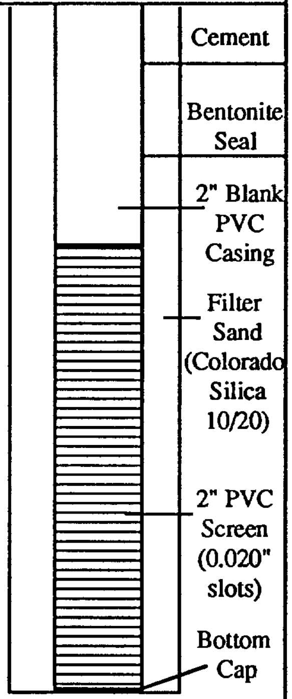
Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Temporary Well Construction Details
			0	Asphaltic Concrete		
				Dark Brown Sand moist, medium sand	SP	
			5	dark gray, wet, oily odor		
			10	saturated		
			15	Boring terminated at 15 feet. Groundwater encountered at approximately 11 feet during drilling. Boring converted to a temporary ground water monitoring well on 2-7-91. Well abondoned by removing top (i.e. blank) casing joint, filling with bentonite slurry and capping with asphaltic cold patch at the surface on 3-6-91.		
			20			
			25			

SEACOR

BORING LOG

BORING: MW-2
PAGE 1 of 1

PROJECT Jorgenson Steel
LOCATION 8531 East Marginal Way South, Seattle, WA
SURFACE ELEVATION ------------
CASING TOP ELEVATION ------------
START 10:30 2-7-91
FINISH 12:00 2-7-91
SAMPLER J GIEBER
MONITORING DEVICE ------------
SUBCONTRTACTOR AND EQUIPMENT Environmental Drilling, Mobile B-61; 8" HSA
COMMENTS Grab samples collected for logging purposes

Penetration Results Blows 6"-6"-6"	Sample Depth Interval,feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Well Construction Details
			0	Asphaltic Concrete		
				Brown Silty Sand moist	SM	
			5	Dark Brown Sand moist,oily odor	SP	
			10	dark gray, saturated		
			15	Boring terminated at 15 feet. Groundwater encountered at approximately 11 feet during drilling. Boring converted to a ground water monitoring well on 2-7-91.		
			20			
			25			

SEACOR

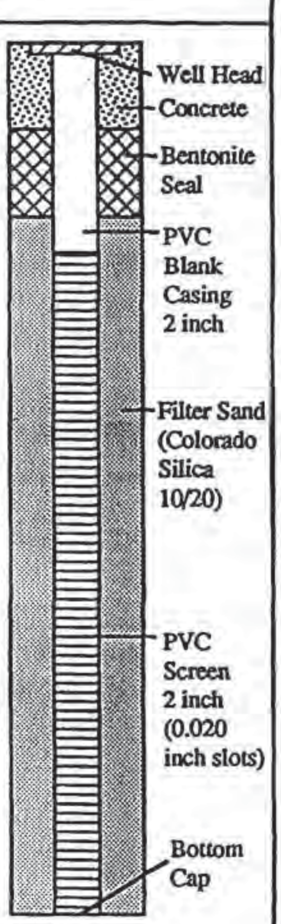
BORING LOG

BORING: MW-3
PAGE 1 of 1

PROJECT EARLE M. JORGENSON; 00075-005-01 LOCATION SEATTLE, WA
SURFACE ELEVATION ——— CASING TOP ELEVATION 14.05*
START 5/21/91 0855 FINISH 5/21/91 0930
SAMPLER C. VAN DIJK MONITORING DEVICE PHOTOIONIZATION DETECTOR
SUBCONTRTACTOR AND EQUIPMENT ENVIRONMENTAL DRILLING, MOBILE B-61, 8" HSA
COMMENTS SOIL SAMPLES COLLECTED USING A 2 INCH O.D. SPLIT SPOON SAMPLER

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	Asphaltic Concrete	
			2'	Dark Brown Gravelly SAND moist, loose, medium to very coarse grained, (fill)	
			5		SP
			10		
1-1-5	▨	15		Dark Grey SAND saturated, loose, fine- grained, with silt	SP
				Dark Grey SAND saturated, medium dense, fine- to medium-grained	
			15		
3-5-8	▨	80			
					SP
			20	medium- to coarse-grained	
1-4-7	▨	30			
			25	Boring terminated at 21.5 feet. Groundwater encountered at approximately 10 feet during drilling. Boring converted to a groundwater monitoring well on 5/21/91.	

Boring Abandonment/ Well Construction Details



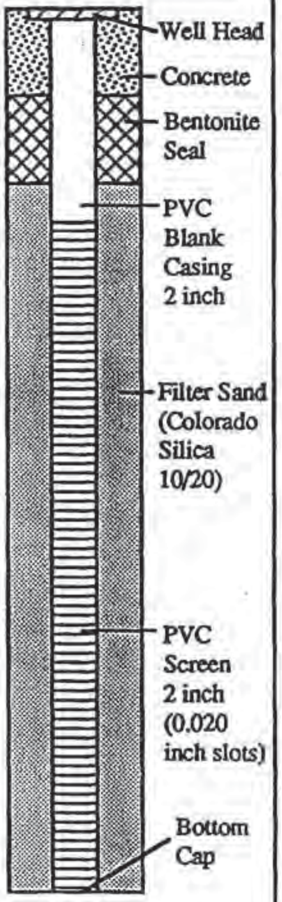
*NOTE:
Casing Top Elevation relative to SEACOR TBM with an assumed elevation of 15.00 feet above Mean Sea Level.

SEACOR

BORING LOG

BORING: MW-4
PAGE 1 of 1

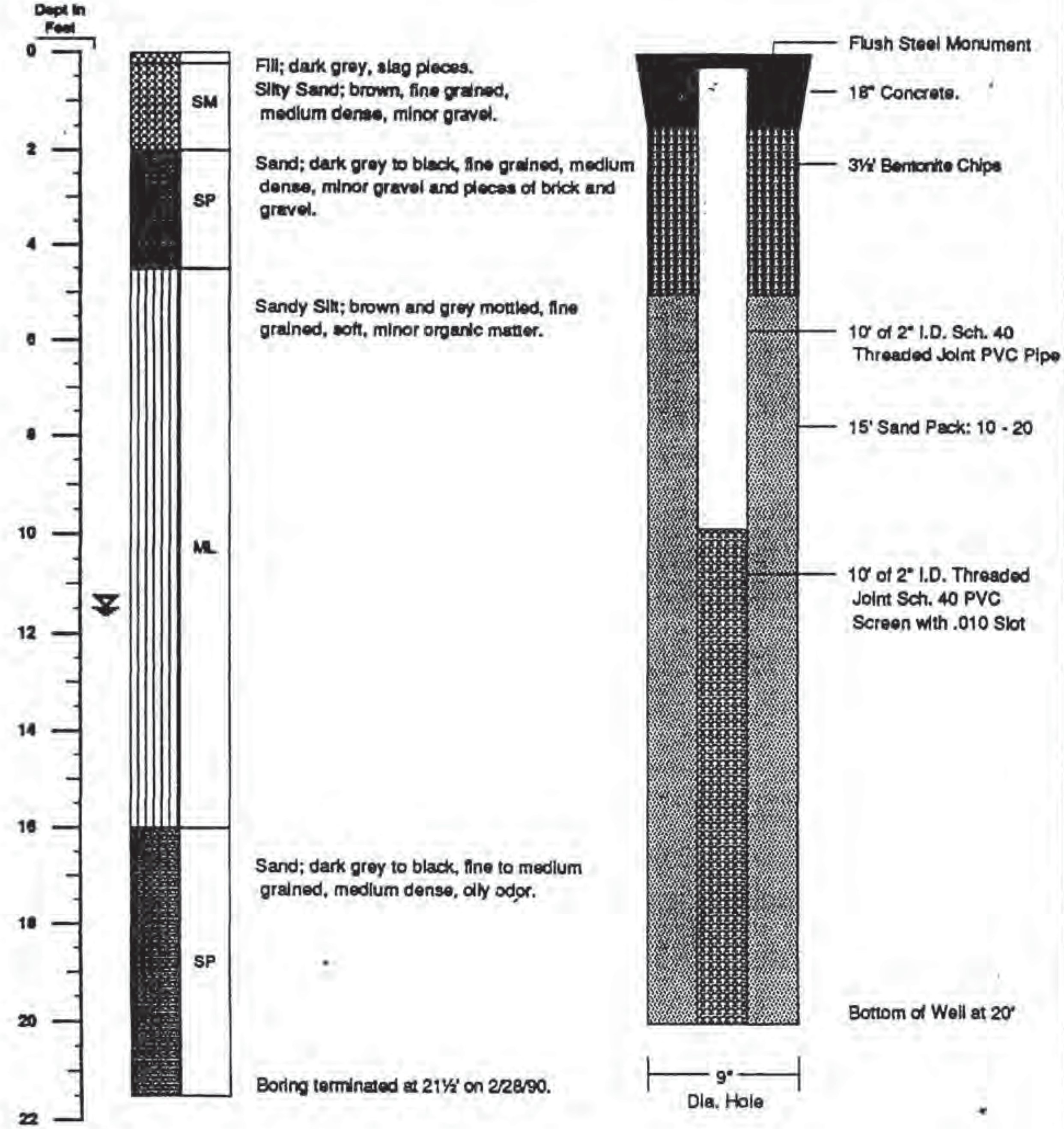
PROJECT EARLE M. JORGENSON; 00075-005-01 LOCATION SEATTLE, WA
SURFACE ELEVATION ——— CASING TOP ELEVATION 14.05*
START 5/21/91 1240 FINISH 5/21/91 1315
SAMPLER C. VAN DIJK MONITORING DEVICE PHOTOIONIZATION DETECTOR
SUBCONTRTACTOR AND EQUIPMENT ENVIRONMENTAL DRILLING, MOBILE B-61, 8" HSA
COMMENTS SOIL SAMPLES COLLECTED USING A 2 INCH O.D. SPLIT SPOON SAMPLER

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	Asphaltic Concrete		
			2'	Dark Brown Gravelly SAND moist, loose, medium to very coarse grained, (fill)		
			5		SP	
1-2-2	▨	50	10	Dark Grey Silty SAND saturated, loose, fine- grained	SM	
				Dark Grey SAND saturated, loose, fine- to medium-grained		
2-3-4	▨	200	15		SP	
2-9-10	▨	200	20	medium- to coarse-grained		
			25	Boring terminated at 21.5 feet. Groundwater encountered at approximately 10 feet during drilling. Boring converted to a groundwater monitoring well on 5/21/91.		*NOTE: Casing Top Elevation relative to SEACOR TBM with an assumed elevation of 15.00 feet above Mean Sea Level.

Current Well MW-5

Geologic Boring & Well Construction Log

MW - 1



Fill; dark grey, slag pieces.
Silty Sand; brown, fine grained, medium dense, minor gravel.

Sand; dark grey to black, fine grained, medium dense, minor gravel and pieces of brick and gravel.

Sandy Silt; brown and grey mottled, fine grained, soft, minor organic matter.

Sand; dark grey to black, fine to medium grained, medium dense, oily odor.

Boring terminated at 21½' on 2/28/90.

Flush Steel Monument
18" Concrete.
3½' Bentonite Chips
10' of 2" I.D. Sch. 40 Threaded Joint PVC Pipe
15' Sand Pack: 10 - 20
10' of 2" I.D. Threaded Joint Sch. 40 PVC Screen with .010 Slot
Bottom of Well at 20'

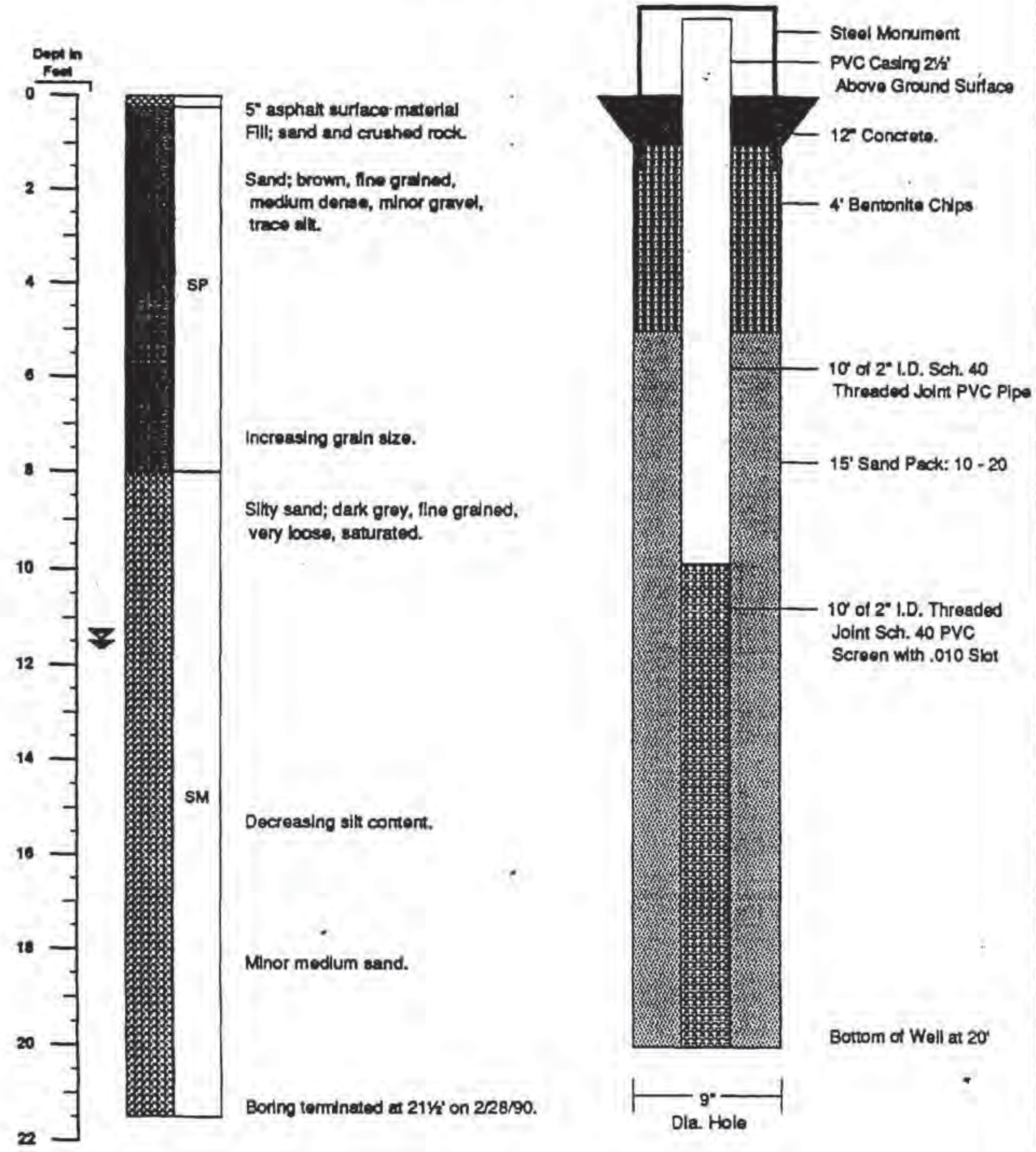
NOTES: Groundwater was observed at 11½' during drilling.
Monitoring Well Installed by GeoBoring, Inc on 2/28/90.
D&M Supervision by R. Clark.

Job No. 20136-002-005 — **Dames & Moore**

Current Well MW-6

Geologic Boring & Well Construction Log

MW - 2



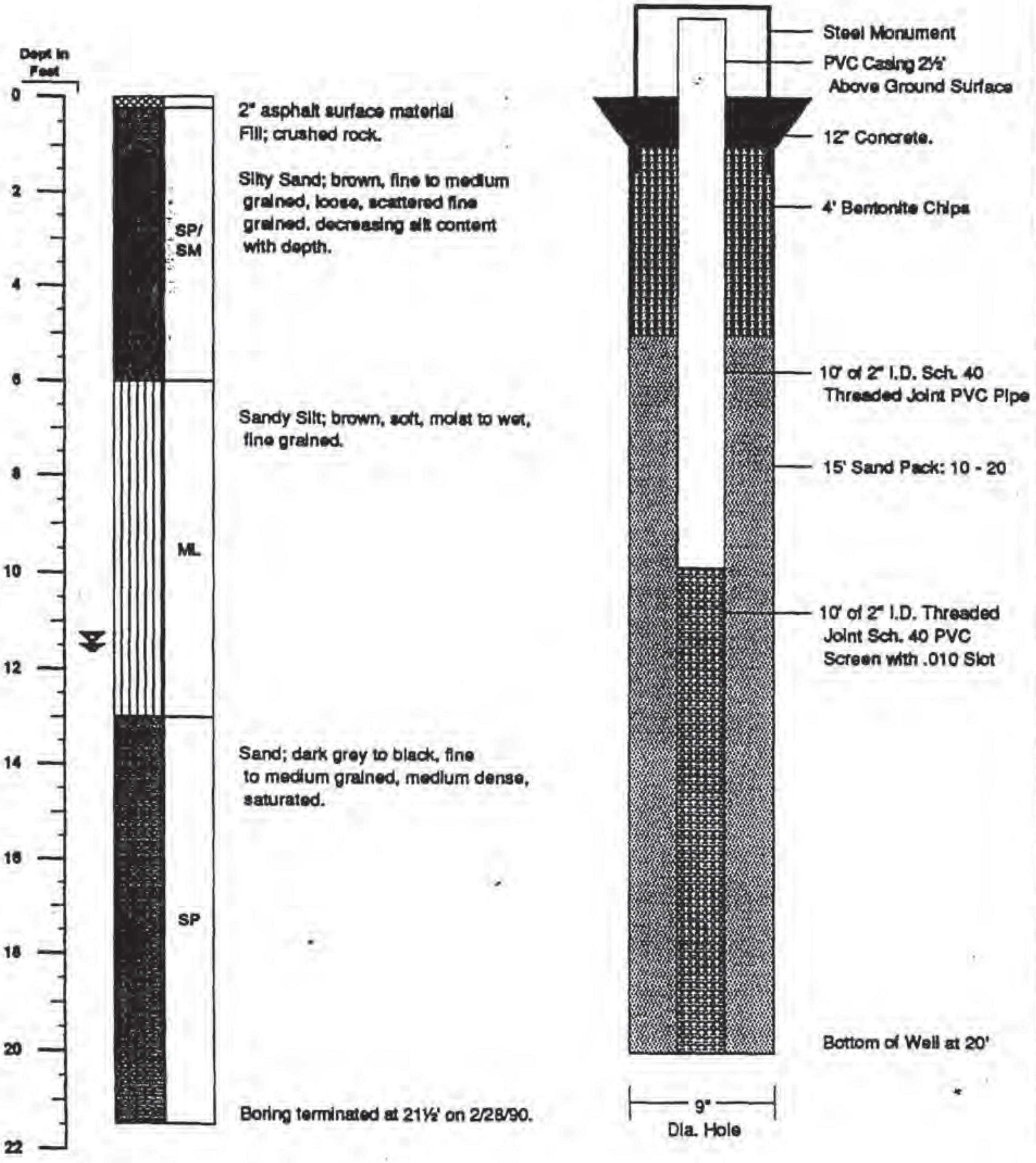
NOTES: Groundwater was observed at 11½' during drilling.
Monitoring Well Installed by GeoBoring, Inc on 2/28/90.
D&M Supervision by R. Clark.

Job No. 20136-002-005 **Dames & Moore**

Current Well MW-7

Geologic Boring & Well Construction Log

MW - 3



2" asphalt surface material
Fill; crushed rock.

Silty Sand; brown, fine to medium grained, loose, scattered fine grained. decreasing silt content with depth.

Sandy Silt; brown, soft, moist to wet, fine grained.

Sand; dark grey to black, fine to medium grained, medium dense, saturated.

Boring terminated at 21½' on 2/28/90.

Steel Monument

PVC Casing 2½' Above Ground Surface

12" Concrete.

4' Bentonite Chips

10' of 2" I.D. Sch. 40 Threaded Joint PVC Pipe

15' Sand Pack: 10 - 20

10' of 2" I.D. Threaded Joint Sch. 40 PVC Screen with .010 Slot

Bottom of Well at 20'

NOTES: Groundwater was observed at 11½' during drilling.
Monitoring Well Installed by GeoBoring, Inc on 2/28/90.
D&M Supervision by R. Clark.

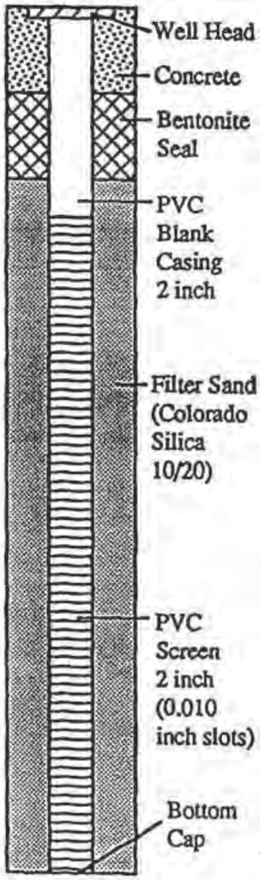
Job No. 20136-002-005 **Dames & Moore**

SEACOR

BORING LOG

BORING: MW-8
PAGE 1 of 1

PROJECT EARLE M. JORGENSEN
LOCATION 40 FEET WEST OF GUARD SHACK
SURFACE ELEVATION ———
CASING TOP ELEVATION
START 10/10/91; 1000
FINISH 10/10/91; 1230
SAMPLER P. SCHMIDT
MONITORING DEVICE NA
SUBCONTRACTOR AND EQUIPMENT McGARRETT DRILLING, GP 1000R
COMMENTS ASPHALT PARKING / DRIVEWAY

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	Asphaltic Concrete / Gravel		
		2		Dark Brown and Black SAND damp, slag material, oil staining	SP	
				Dark Gray Clayey SILT moist, soft, organic rich	ML	
1-1-2 4-4-6 3-1-1	▨ ▨ ▨		5	Dark Brown SAND moist, fine- to medium-grained, slight organics, no petroleum odors 8.0 - 8.5 saturated	SP	
1-1-1 2-2-5 3-4-5	▨ ▨ ▨		10	Dark Gray Sandy CLAY moist, organic rich, soft, charcoal, rotting odor grades slightly sandy (very fine-grained)	CL	
5-7-8 6-7-8	▨ ▨		15	Dark Gray to Black SAND saturated, clean, medium-grained, slight petroleum-like odor odor more organic-like remains uniform to 20.0'	SP	
			20 25	Bottom hole at 20 feet. Boring terminated at 20 feet. Groundwater encountered at approximately 12 feet during drilling. Boring converted to a groundwater monitoring well on 10/10/91.		Hand auger to 5.0'. Hollow stem auger to 20.0'. SPT sampler (cuttings in drum).

SEACOR

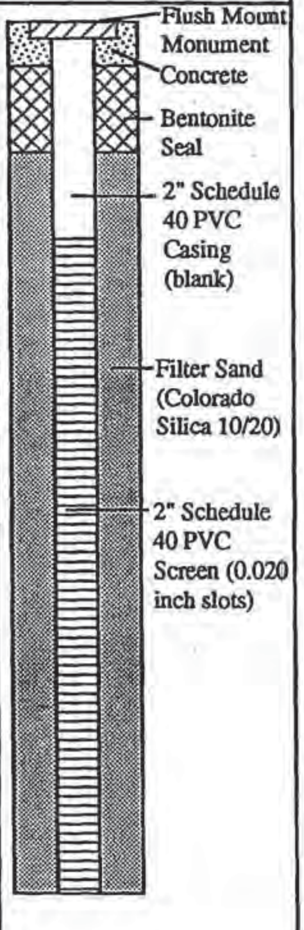
BORING LOG MW-9

BORING: MW-9
PAGE 1 of 1

PROJECT JORGENSEN
LOCATION MW-9
SURFACE ELEVATION
CASING TOP ELEVATION
START 0830 3-19-92
FINISH 1030 3-19-92
SAMPLER G. EHLERS
MONITORING DEVICE PHOTOIONIZATION DETECTOR
SUBCONTRACTOR AND EQUIPMENT LAYNE ENVIRONMENTAL SERVICES; CME-75
COMMENTS 8" HSA, SOIL SAMPLES COLLECTED USING A 3.0 INCH O.D. , 2 FOOT LONG SPLIT SPOON SAMPLER, 140 LB. HAMMER

Penetration Results Blows 6"-6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
	▨	0	0 1'	0-2" ASPHALTIC CONCRETE 2"-6" Gray crushed GRAVEL (base coarse)	SP
	▨	0		Brown SAND loose to medium dense, damp, fine-grained	ML
3-6-4-4	▨	0	5	Gray SILT soft, wet, some wood fragments, organic odor	SP
1-2-2-1	▨	0		Red Brown SAND loose, damp, some interlayered silt lenses 1" thick becomes medium-grained at 5.0 feet. no odor gray, saturated, fine-grained, two 1" layers of coarse sand. no odor at 7 feet	
1/12,1/12	▨	0	10		ML
2-4-6-9	▨	0		Gray SILT very soft, saturated, some wood fragments and layers of very fine sand grades to very fine sandy silt at 10.0'	
1-1-1-1	▨	0	15		
				Dark Gray SAND loose, saturated, medium-grained red specks 4' of heave @17.0', no sample collected water added during drilling	SP
			20	Boring terminated at approx. 20.0 feet. Groundwater encountered at approx. 8.5 feet during drilling. Boring converted to a groundwater monitoring well on 3-19-92. Approx. 60 gallons of water added during drilling.	
			25		

Boring Abandonment/ Well Construction Details

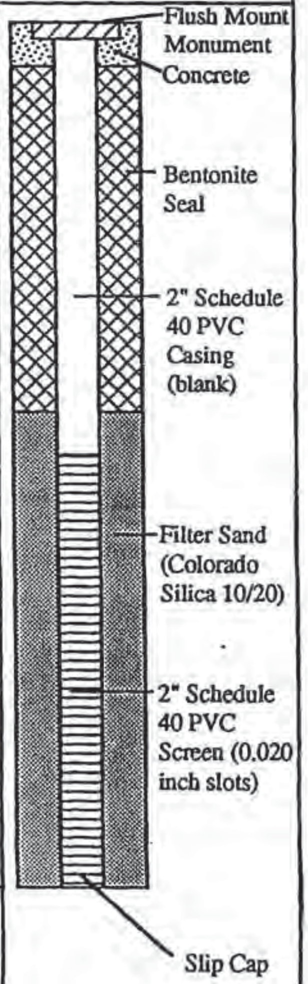


SEACOR

BORING LOG MW-10

BORING: MW-10
PAGE 1 of 1

PROJECT JORGENSEN
LOCATION MW-10
SURFACE ELEVATION
CASING TOP ELEVATION
START 1130 3-19-92
FINISH 1250 3-19-92
SAMPLER G. EHLERS
MONITORING DEVICE PHOTOIONIZATION DETECTOR
SUBCONTRACTOR AND EQUIPMENT LAYNE ENVIRONMENTAL SERVICES; CME-75
COMMENTS 8" HSA, SOIL SAMPLES COLLECTED USING A 3.0 INCH O.D., 2 FOOT LONG SPLIT SPOON SAMPLER, 140 LB. HAMMER

Penetration Results Blows 6"-6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	0-2" ASPHALTIC CONCRETE 2"-6" Gray Crushed GRAVEL (base coarse)	SP	
				Red-Brown SAND loose, damp (fill), some brick and wood fragments		
4-4-2-2	▨	0	5	Brown SAND loose, damp, medium-grained dark gray, wet to saturated, 2" layer of coarse sand, 1" piece of wood at 7 feet	SP	
1-2-2-2	▨	0	▽			
1/12-2-3	▨	0	10	Gray SILT soft, wet to saturated, some wood fragments	ML	
1-1-1/12	▨	0		Gray SAND loose, saturated, very fine-grained		
1-1-2-3	▨	0	15	becomes fine-grained at 14.5 feet, two 1" layers of very fine sand	SP	
3-4-4-3	▨	0		water added during drilling		
			20	Boring terminated at 20 feet. Groundwater encountered at approximately 8.0 feet during drilling. Boring converted to a groundwater monitoring well on 3-19-92. Approximately 20 gallons of water added during drilling.		
			25			

SEACOR

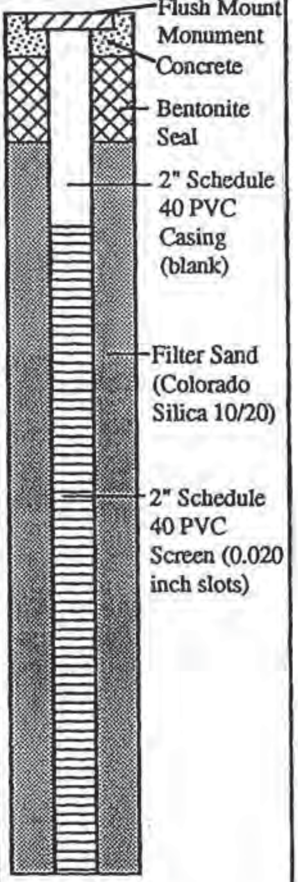
BORING LOG MW-11

BORING: MW-11
PAGE 1 of 1

PROJECT JORGENSEN LOCATION MW-11
SURFACE ELEVATION CASING TOP ELEVATION
START 1415 3-19-92 FINISH 1515 3-19-92
SAMPLER G. EHLERS MONITORING DEVICE PHOTOIONIZATION DETECTOR
SUBCONTRACTOR AND EQUIPMENT LAYNE ENVIRONMENTAL SERVICES; CME-75
COMMENTS 8" HSA, SOIL SAMPLES COLLECTED USING A 3.0 INCH O.D., 2 FOOT LONG SPLIT SPOON SAMPLER, 140 LB. HAMMER

Penetration Results Blows 6"-6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	0-3" ASPHALTIC CONCRETE 3"-6" Gray Crushed GRAVEL (base coarse)	SP
				Brown SAND loose, damp	ML
				Gray Brown SILT soft, damp	SP
3-4-5-7	▨	0	5	Brown SAND loose, damp, medium-grained golden brown, with 2" layer of silty fine sand at 5 feet	
1-2-1-2	▨		▽	dark gray, wet to saturated at 7 feet	
1-2-3-3	▨		10	Dark Gray SILT soft, saturated, some wood fragments and some fine sand	ML
				Dark Gray Silty SAND loose, saturated, fine-grained	SM
2-5-4-6	▨			Dark Gray SAND loose, soft, saturated, medium-grained, red specks	
1-2-4-7	▨		15	becomes medium- to coarse-grained at 14.5 feet no sample collected	SP
			20	Boring terminated at 20.0 feet. Groundwater encountered at approximately 8.5 feet during drilling. Boring converted to a groundwater monitoring well on 3-19-92. Approximately 20 gallons of water added during drilling.	
			25		

Boring Abandonment/ Well Construction Details



SEACOR

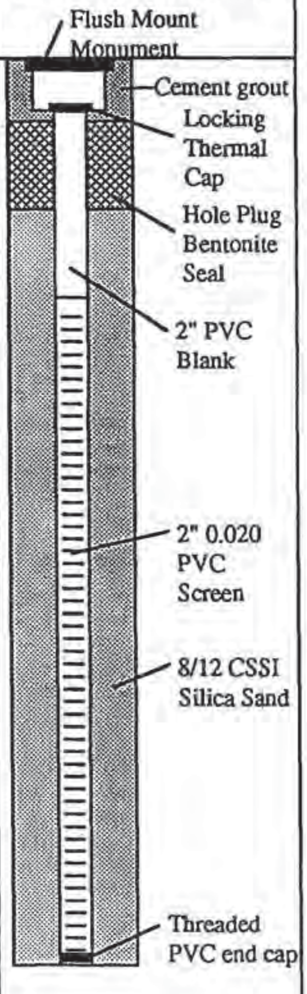
BORING LOG

BORING: MW-12
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 2
LOCATION 8531 E. MARGINAL WAY S. SEATTLE WA.
SURFACE ELEVATION
CASING TOP ELEVATION 13.71
START 8/27/92
FINISH 8/27/92
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE HNU
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING, INC. 8" O.D. HSA
COMMENTS SOIL SAMPLES COLLECTED CONTINOUSLY USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
Hand Auger to 5'				Gray arkosic SAND no fines, few pebbles, very fine to coarse-grained, very well graded, loose, dry	SW
14/15/16		0.4	5		
8/9/11		0.4			
5/6/7		1.0		Clayey Silty SAND with organic material, fine to coarse-grained, loose, slightly plastic moist	SM
9/8/9		1.4	10		
17/18/21		1.6		Gray arkosic SAND no fines/gravel, very fine to coarse-grained, very well graded, loose, wet	SW
11/12/14		1.8			
10/13/15		0.2	15		
8/9/12		2.8			
8/9/11		1.2			
8/12/14		0.4			
			20	Boring terminated at 20 feet Groundwater encountered at approximately 11 feet	
			25		

Boring Abandonment/ Well Construction Details



SEACOR

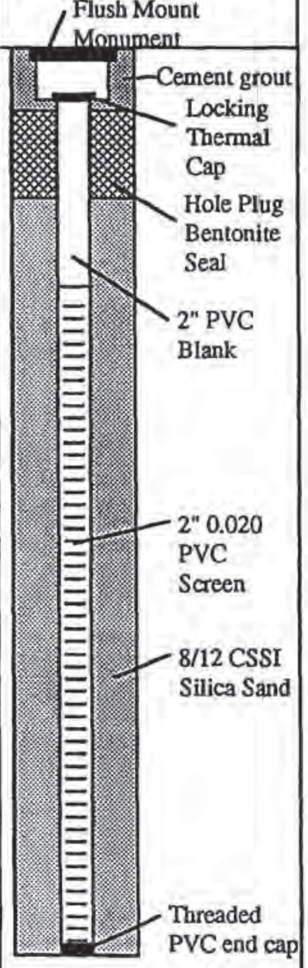
BORING LOG

BORING: MW-13
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 2
LOCATION 8531 E. MARGINAL WAY S. SEATTLE WA.
SURFACE ELEVATION
CASING TOP ELEVATION 13.99
START 8/27/92
FINISH 8/27/92
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE HNU
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING, INC. 8" O.D. HSA
COMMENTS SOIL SAMPLES COLLECTED CONTINOUSLY USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
Hand Auger to 5'				Gray arkosic SAND no fines, very fine to coarse-grained, very well graded, loose, dry	SW
10/11/12		4.8	5	3" Clay lens	
9/11/12		1.6		moist	
3/5/6		1.2		Clayey Silty SAND with organic material, fine to coarse-grained, loose, slightly plastic moist	SM
9/11/12		0.8	10	Dark green Clayey SILT	ML
10/12/14		0.2		Gray arkosic SAND no fines, very fine to coarse-grained, very well graded, loose, wet	SW
16/17/18		0.3			
8/12/14		0.5	15		
8/9/13		0.6			
11/12/14		0.4			
8/11/13		1.8			
			20	Boring terminated at 20 feet Groundwater encountered at approximately 10.5 feet	
			25		

Boring Abandonment/ Well Construction Details



SEACOR

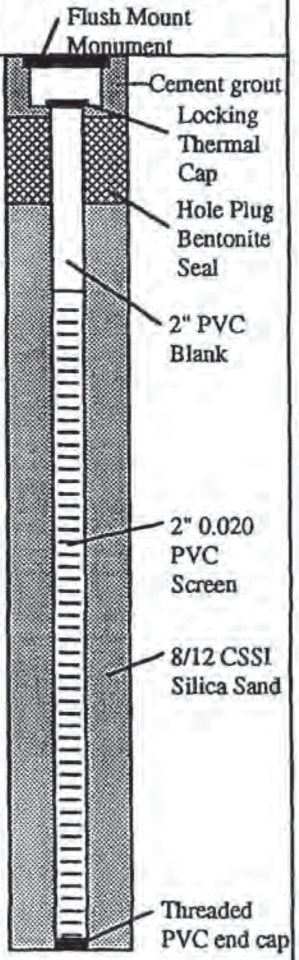
BORING LOG

BORING: MW-14
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 2
LOCATION 8531 E. MARGINAL WAY S. SEATTLE WA.
SURFACE ELEVATION
CASING TOP ELEVATION 14.13
START 8/27/92
FINISH 8/27/92
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE HNU
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING, INC. 8" O.D. HSA
COMMENTS SOIL SAMPLES COLLECTED CONTINOUSLY USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
Hand Auger to 5'				Gray arkosic SAND no fines or gravel, very fine to coarse-grained, very well graded, dry	SW
7/7/8		3.0	5		
4/4/5		1.0		moist	
3/3/4		2.2			
8/10/11		0.6	10	Dark Gray Clayey SILT, slightly plastic, damp	ML
10/11/12		0.8			
12/18/17		0.8		wet	
				Gray arkosic SAND no fines or gravel, very fine to coarse-grained, very well graded, wet	SW
7/9/12		2.0	15		
9/12/13		0.6		brown	
8/9/16		0.6		dark gray	
8/11/13		1.8			
			20	Boring terminated at 20 feet Groundwater encountered at approximately 10.5 feet	
			25		

Boring Abandonment/ Well Construction Details



SEACOR

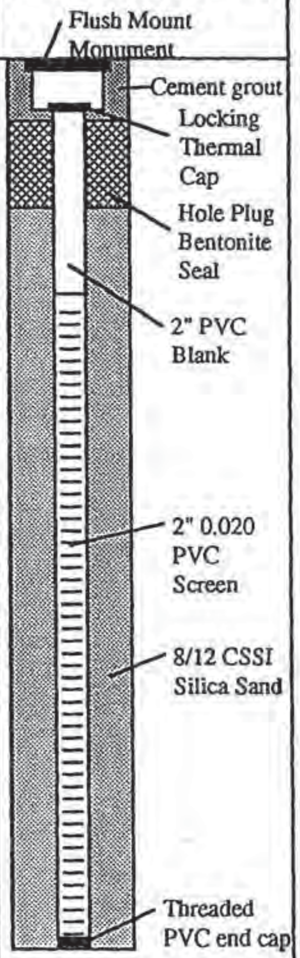
BORING LOG

BORING: MW-15
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 2
LOCATION 8531 E. MARGINAL WAY S. SEATTLE WA.
SURFACE ELEVATION
CASING TOP ELEVATION 14.15
START 8/27/92
FINISH 8/27/92
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE HNU
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING, INC. 8" O.D. HSA
COMMENTS SOIL SAMPLES COLLECTED CONTINOUSLY USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
Hand Auger to 5'				Brown arkosic SAND, no fines or gravel subrounded, very fine to coarse-grained, very well graded, dry	SW
			5		
9/12/13		0			
13/15/15		---			
3/3/4		0.2			
3/6/7		6.2	10	Dark Gray Clayey SILT, slightly plastic moist	ML
4/4/4		0		Clayey Sandy SILT, moist to wet	ML
5/10/12		0		Dark gray Silty SAND, very fine graded, poorly graded, wet	SM
8/10/11		0	15	Gray arkosic SAND no fines of gravel, very fine to coarse-grained, very well graded, wet	SW
7/9/12		0			
7/13/15		0			
9/12/15		0			
			20	Boring terminated at 20 feet Groundwater encountered at approximately 11 feet	
			25		

Boring Abandonment/ Well Construction Details



SEACOR

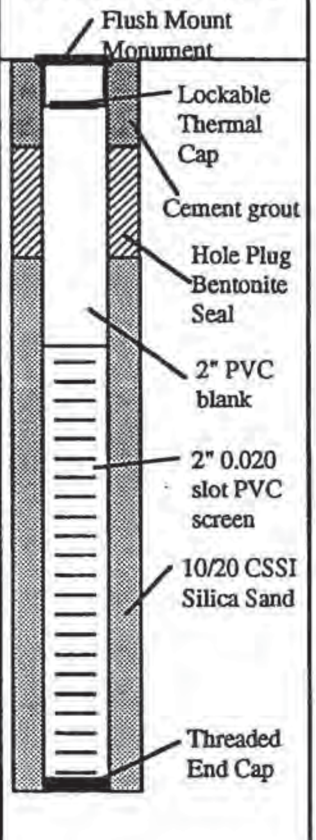
BORING LOG

BORING: MW-16
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION 48.96'
START 8-29-92 0900
FINISH 8-29-92 1015
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT GEOBORING & DEVELOPMENT, INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
Hand Auger to 5 feet			0	CONCRETE	
		15.0 15.2 14.1 14.0 23.0 13.5 0.5 5.8		Brown arkosic SAND,no fines/gravels, subrounded, very fine to coarse-grained, very well graded, very loose to loose,dry	SW
			5		
6/6/9		0			
4/6/8		0			
6/7/4		38.4		gray some fine gravel, moist to wet	
2/2/1		33.4	10	Gray SAND, very fine-grained, poorly graded, some silt toward the bottom, wet, petroleum-like odor	SP
2/2/4		0		Dark gray Clayey SILT with organics, slightly plastic, stiff, moist to wet	ML
1/3/4		12.8 0		Gray SAND, very fine-grained, poorly graded, loose, wet	SP
3/4/5		0	15		
				Boring terminated at 16 feet Groundwater encountered at approximately 11.5 feet	
			20		
			25		

Boring Abandonment/ Well Construction Details



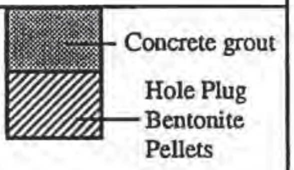
00075-018-01

SEACOR

BORING LOG

BORING: MW-17
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION
START 8-29-92 1100
FINISH 8-29-92 1120
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT N/A
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A HAND AUGER

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	CONCRETE		
	▨	14.2 17.1 13.1		Gray arkosic SAND, no fines/gravel, subrounded, very fine to coarse-grained, very well graded, medium dense to loose, dry	SW	
				Boring terminated at 2.5 feet due to refusal		
			5	Groundwater not encountered		
			10			
			15			
			20			
			25			

SEACOR

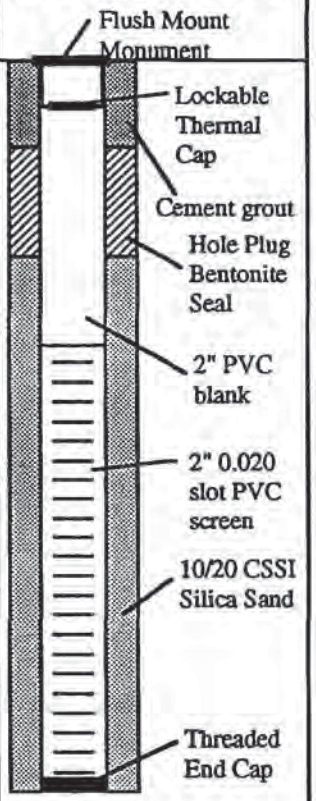
BORING LOG

BORING: MW-18
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION 48.77'
START 8-29-92 1220
FINISH 8-29-92 1400
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT GEOBORING & DEVELOPMENT, INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
Hand Auger to 5'			0	CONCRETE	
		0 0 0		Brown arkosic SAND, no fines/gravels, sub-rounded, very fine to coarse-grained, very well graded, medium dense, dry	SW
		0		Gray Silty SAND, very fine-grained, dense, dry	SP
		0 0 0 0	5	Brown arkosic SAND, no fines/gravels, sub-rounded, very fine to coarse-grained, very well graded, medium dense, dry	SW
4/7/8		0			
9/7/7		0		gray	
				Gray SAND, very fine-grained, dry	SP
6/4/3		0		Gray SAND, very fine-grained, as above, dry	SW
1/3/2		0	10	Dark gray Clayey SILT with organics, very stiff, slightly plastic, loose, moist	ML
3/5/6		0		Dark gray SAND, no gravels, few fines, very fine-grained, poorly graded, medium dense, wet	SP
4/4/3		0			
4/5/5		0	15	Boring terminated at 16 feet Groundwater encountered at approximately 11.5 feet	
			20		
			25		

Boring Abandonment/ Well Construction Details



SEACOR

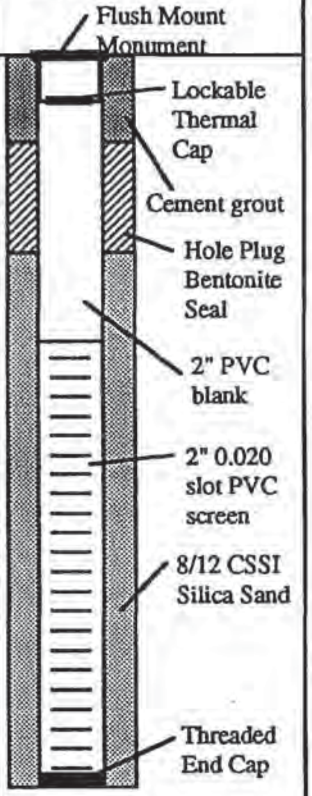
BORING LOG

BORING: MW-19
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION 48.62'
START
FINISH 8-28-92 1026
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 8" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
2/3/4		2.3		Brown arkosic SAND, no fines/gravel, very fine to coarse-grained, very well sorted loose, dry	SW
				Dark gray SILT	ML
3/6/7 6/6/7			5	Brown arkosic SAND, no fines/gravel, very fine to coarse-grained, very well sorted loose, dry	SW
3/3/3		6.0		with organics, hydrocarbon-like odor	
				Dark gray Clayey SILT with organics, moist	ML
3/4/5		0	10	Gray arkosic SAND, no fines/gravel, very fine to coarse-grained, very well sorted, loose, saturated	SW
4/5/6		0			
3/5/8				Dark gray SAND, very fine-grained, poorly sorted, wet, hydrocarbon-like odor	SP
10/12/16					
			15	presence of oil	
				Boring terminated at 16 feet	
				Groundwater encountered at approximately 11.5 feet	
			20		
			25		

Boring Abandonment/ Well Construction Details



SEACOR

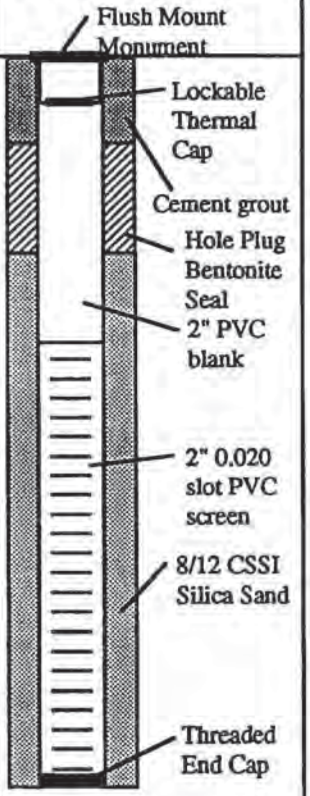
BORING LOG

BORING: MW-20
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION 49.44'
START 8/28/92
FINISH 8/28/92 1030
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING, INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
18/18/18		0		Brown arkosic SAND, no fines/gravel, very fine to coarse-grained, very well graded, dry	SW
12/13/15		0	5	gray, medium dense	
11/13/13		0		presence of oil	
4/4/7		0		Gray SAND, no fines/gravels, very fine-grained, poorly graded, medium dense, moist, petroleum-like odor	SP
6/6/6		3.2	10	wet	
8/10/11		0			
6/12/14		0.8			
6/11/14		1.7 1.5 0.6	15	dense, presence of oil	
				Boring terminated at 16 feet Groundwater encountered at approximately 11.5 feet	
			20		
			25		

Boring Abandonment/ Well Construction Details



00075-018-01

SEACOR

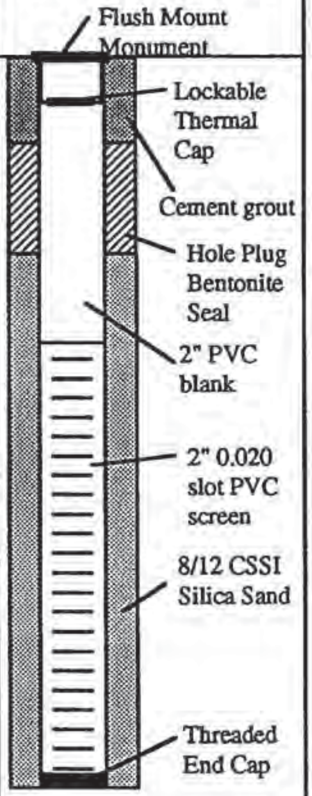
BORING LOG

BORING: MW-21
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION 48.61'
START 8/28/92 1215
FINISH 8/28/92 1330
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING, INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
				Brown arkosic SAND, no fines/gravel, subrounded, very fine to coarse-grained, very well sorted, very dense, dry	SW
1/7/27		0.2			
21/23/27		0.4		dense	
18/23/24		0	5	moist	
11/16/19		0		with organics	
6/10/15		0.3		Gray SAND, very fine-grained,poorly sorted, wet	SP
10/12/15		0.8	10	Dark gray Clayey SILT with sand, wood fragments, very stiff	ML
3/4/5		0.2		Dark gray SAND, very fine- grained, poorly sorted, medium dense, wet	SP
5/5/5		0.1			
5/6/7		0	15	Boring terminated at 16 feet Groundwater encountered a approximately 11.5 feet	
			20		
			25		

Boring Abandonment/ Well Construction Details



SEACOR

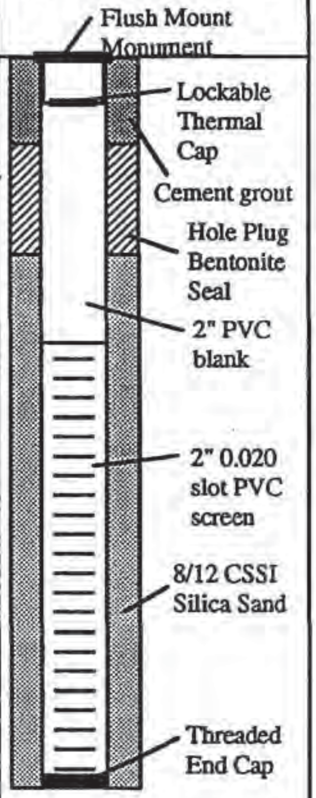
BORING LOG

BORING: MW-22
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION 48.26'
START 8/28/92 1340
FINISH 8/28/92 1514
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING, INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5"X 6" BRASS SLEEVES.

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
25/18		0		Brown, arkosic SAND, no fines/gravel, subrounded, very fine to coarse-grained, very well graded, dense, dry	SW
8/10/12		0		Dark gray SILT, medium dense, dry	ML
18/25/28		0		SAND, as above, very dense	SW
5/7/8		0	5	Dark gray SILT, medium dense, dry	ML
				SAND with wood fragments, very fine-grained, medium dense, moist	SP
6/7/8		0		SAND, as above, medium dense, moist	SW
6/7/8		0		SAND with organics, very fine-grained, medium dense, moist	SP
5/8/9		0			
5/6/6		0	10	Dark gray Clayey SILT, very stiff, low plasticity, medium dense, moist to wet	ML
7/8/9		0		Dark gray SAND, very fine-grained, poorly sorted, medium dense, wet,	SP
6/8/10		0	15	Gray arkosic SAND, no fines/gravels, subrounded, very fine to coarse-grained, medium dense, wet	SW
				Boring terminated at 16 feet	
				Groundwater encountered at approximately 11.5 feet	
			20		
			25		

Boring Abandonment/ Well Construction Details



SEACOR

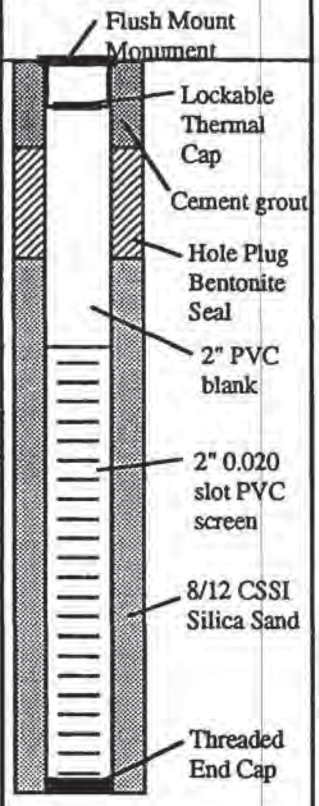
BORING LOG

BORING: MW-23
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION 49.06'
START 8/31/92 1055
FINISH 8/31/92 1250
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING, INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
20/24/25		0		Brown, arkosic SAND, very fine to coarse-grained, subrounded, very well graded, very dense, dry	SW
12/12/14		0			
				moist	
21/25/27		0	5	Dark gray SAND, very fine-grained, poorly graded, medium dense, moist	SP
5/6/7		0		Brown arkosic SAND, subrounded very fine to coarse-grained, very well graded, medium dense, moist	SW
4/6/7		0		Dark gray Clayey SILT, slightly plastic, stiff to very stiff, moist	ML
14/15/19		0		Gray SAND, subrounded, very fine to coarse-grained, very well graded, medium dense, moist to wet at 11 feet.	SW
7/8/9		0	10		
			15	Boring terminated at 16 feet. Groundwater encountered at approximately 11.5 feet	
			20	MW-23 originally abandoned as soil boring(to 11.5') and backfilled with bentonite. After 5 minutes redrilled to 16' with wood plug in end of auger, and completed as a monitoring well.	
			25		

Boring Abandonment/ Well Construction Details



SEACOR

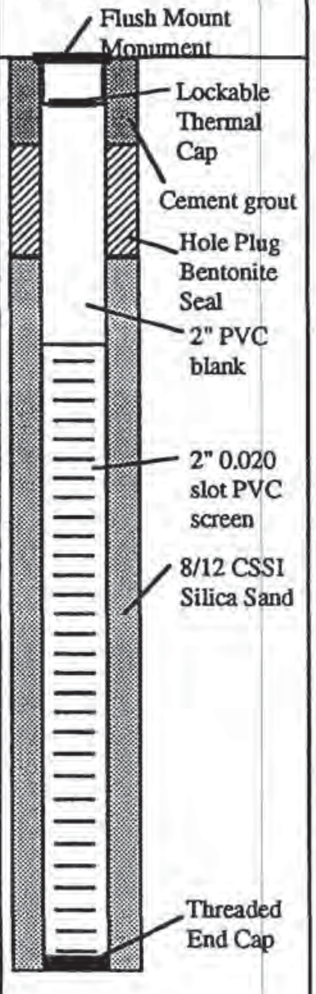
BORING LOG

BORING: MW-24
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION ———
CASING TOP ELEVATION 49.09'
START 9/14/92 0945
FINISH 9/14/92
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5 " X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
				Brown, arkosic SAND, subrounded, very fine to coarse-grained, dense, dry	SW
17/18/18		>2500			
12/7/8		1067 1700	5	Gray SAND, very fine-grained, poorly sorted, medium dense, dry,	SP
				Brown to Gray, arkosic SAND, very fine to coarse-grained, very well graded, medium dense, dry	SW
3/6/6		800 >2500		Gray Clayey SILT with organics, slightly plastic, moist	ML
			10	Gray SAND, as above, wet	SW
4/5/6		1200 160		Gray Clayey SILT, as above, wet	ML
3/4/5		1253 204		Gray, arkosic SAND, very fine to fine-grained, poorly sorted, loose, wet	SP
7/10/17		1400 >2500	15		
15/28/32		400 900		very dense	
			20	Boring Terminated at 20 feet. Groundwater encountered at approximately 11.5 feet.	
			25		

Boring Abandonment/ Well Construction Details



SEACOR

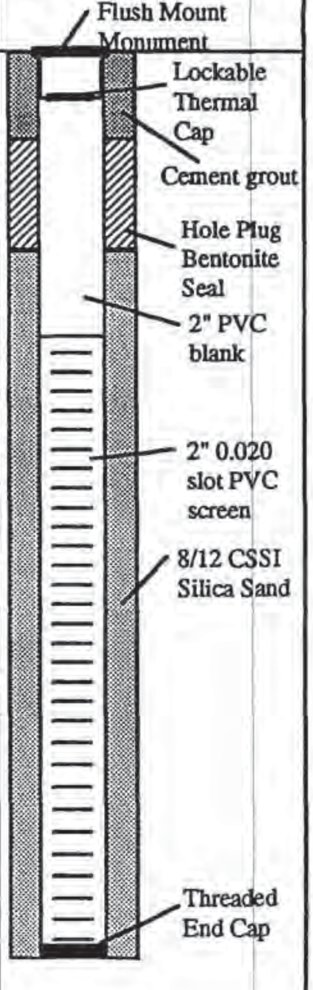
BORING LOG

BORING: MW-25
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION ——
CASING TOP ELEVATION 48.90'
START 9/14/92 1100
FINISH 9/14/92 1215
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC. ; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	CONCRETE with rebar	
				Brown, arkosic, SAND, subrounded, very fine to coarse-grained, very well graded, dense, dry	SW
15/20/21		>2500			
18/16/10		428	5		
9/18/13		1000 850		Gray SAND, very fine to fine-grained, poorly graded, dense, moist to wet	SP
4/5/7		0	10	Gray Clayey SILT with organics slightly plastic, moist	ML
3/5/9		0		Gray SAND, very fine to fine-grained, poorly graded, medium dense, wet	SP
11/13/14		0	15	Gray SAND, subrounded, very fine to coarse-grained, very well graded, medium dense, wet	SW
9/14/16		257 43		with wood fragments	
9/15/17		0	20	no wood fragments	
				Boring terminated at 21.5 feet. Groundwater encountered at approximately 11.5 feet.	
			25		

Boring Abandonment/ Well Construction Details



FARALLON *consulting*

975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-37

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

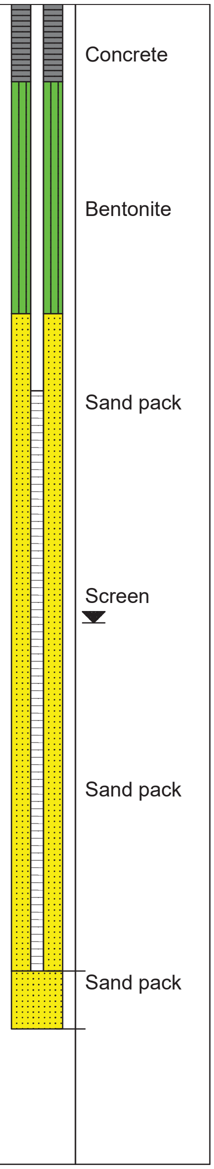
Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started:	02/09/09 1143	**Sampler Type:**	18" Split spoon
Date/Time Completed:	02/09/09 1205	**Drive Hammer (lbs.):**	300
Equipment:	CME 75	**Depth of Water ATD (ft bgs):**	16
Drilling Company:	Cascade Drilling	**Total Boring Depth (ft bgs):**	26.5
Drilling Foreman:	David Gose	**Total Well Depth (ft bgs):**	25
Drilling Method:	Hollow stem auger		

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (ppm*)	Sample ID	Sample Analyzed
0		0-5 feet Vac trucked out							
5	☒	Well-graded SAND with gravel (85% sand, 15% gravel), fine to coarse sand, fine gravel, brown, very loose, moist, no odor.	SW	▨	66	2/2/3	1.6	MWS-37-020909-1 FD-020909	
10	☒	Well-graded SAND with gravel (85% sand, 15% gravel), fine to coarse sand, fine gravel, brown, loose, moist, no odor.	SW	▨	66	1/3/5	2.5	MWS-37-020909-2	
15	☒	Well-graded SAND with gravel (85% sand, 15% gravel), fine to coarse sand, fine gravel, brown, loose, moist, no odor.	SW	▨	100	2/3/4	1.7	MWS-37-020909-3	
		SILT (100% silt), brown, medium stiff, wet at 16 feet, musty organic odor.	ML	▨					
		Poorly-graded SAND (100% sand), fine to medium, grey, loose, wet, musty organic odor.	SP	▨					
20	☒	Poorly-graded SAND (100% sand), fine to medium, black, loose, wet, no odor.	SP	▨	100	3/3/5	1.1	MWS-37-020909-4	
25	☒	Poorly-graded SAND (100% sand), fine to medium, black, loose, wet, no odor.	SP	▨	100	6/7/8	0.5	MWS-37-020909-5	
30									

Boring/Well Construction Details



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 10-25

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-38

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

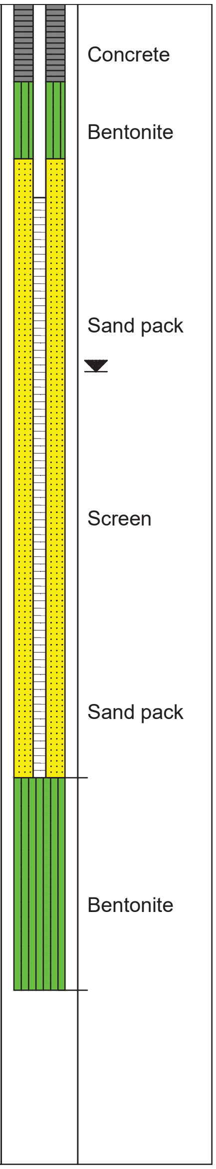
Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/09/09 0943
Date/Time Completed: 02/09/09 1005
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: 18" Split spoon
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): 9.5
Total Boring Depth (ft bgs): 25.5
Total Well Depth (ft bgs): 20

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		0-4 feet Vac trucked out								
5		Poorly-graded SAND (100% sand), fine to medium sand, brown, very loose, moist, no odor.	SP		100	2/2/3	1.0	MWS-38-020909-1		
		SILT (100% silt), brown, soft, moist, no odor.	ML							
10		Poorly-graded SAND (100% sand), fine to medium sand, brown, very loose, moist, no odor.	SP		100	1/2/3	2.2	MWS-38-020909-2		
		Sandy SILT (60% silt, 40% sand), fine sand, brown, soft, wet, no odor.	ML							
15		Poorly-graded SAND (100% sand), fine to medium sand, brown, loose, wet, no odor, aluminum-like metal shards.	SP		100	2/3/4	2.6	MWS-38-020909-3		
20		Well-graded SAND (100% sand), fine to coarse sand, black, medium dense, wet, no odor, aluminum-like metal shards.	SW		100	7/8/10	3.1	MWS-38-020909-4		
25		Well-graded SAND (100% sand), fine to coarse sand, black, loose, wet, no odor, aluminum-like metal shards.	SW		100	5/5/8	3.6	MWS-38-020909-5		
30										



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 5-20

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON
consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-39

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

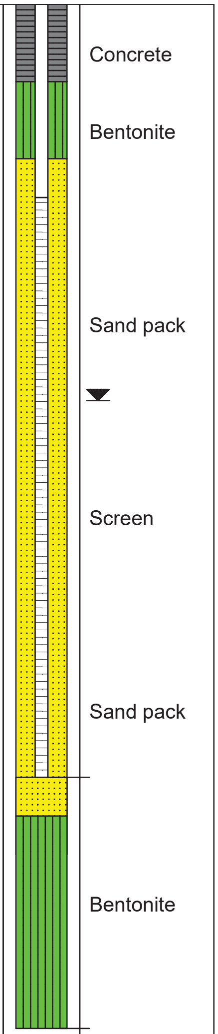
Logged By: D. Clement

Date/Time Started: 02/11/09 0815
Date/Time Completed: 02/11/09 1020
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: 18" Split spoon
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): 10
Total Boring Depth (ft bgs): 26.5
Total Well Depth (ft bgs): 20

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (ppm*)	Sample ID	Sample Analyzed
0		0-5 feet Vac trucked out							
5	☒	Poorly-graded SAND (60% sand, 35% gravel, 5% silt), fine to coarse sand, fine to coarse gravel, brown, dense, moist, no odor.	SP		80	12/22/33	1.3	MWS-39-021109-1	
10	☒	Silty GRAVEL with sand (55% gravel, 30% sand, 15% silt), fine to coarse sand, fine to coarse gravel, brown, dense, wet below approximately 10.25 feet, musty odor.	GM		100	17/22/32	2.2	MWS-39-021109-2	
15	☒	No recovery, metal or rocks in boring.							
20	☒	No recovery, metal or rocks in boring. Metal fragments observed in auger soil coming out of boring.							
25	☒	No recovery, metal or rocks in boring.							
30									

Boring/Well Construction Details



Well Construction Information

Monument Type: Stickup
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 5-20

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

Ground Surface Elevation (ft): NA
Top of Casing Elevation (ft): NA
Boring Abandonment: Sand, bentonite
Surveyed Location: **X:** NA **Y:** NA

FARALLON
consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-40

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, Washington

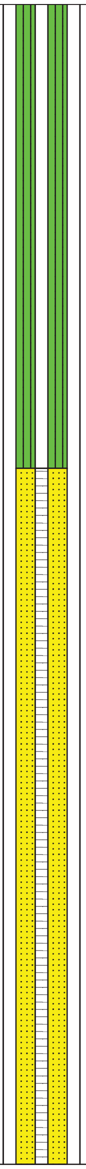
Farallon PN: 394-002

Logged By: Jeff Keller

Date/Time Started: 7/19/08 1200
Date/Time Completed: 7/19/08 1400
Equipment: LA HSA
Drilling Company: Cascade Drilling, Inc.
Drilling Foreman: Curtis A.
Drilling Method: Hollow Stem Auger

Sampler Type: NA
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): 15.5
Total Boring Depth (ft bgs): 25
Total Well Depth (ft bgs): 25

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		Boring not logged or sampled. See boring log for MW-41 for lithology.								
5										Casing Bentonite
10										
15										Sand Pack
20										Screen
25										



Well Construction Information

Monument Type: Flush Mount HD
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 10-25

Filter Pack: Sand
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON
consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-41

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, Washington

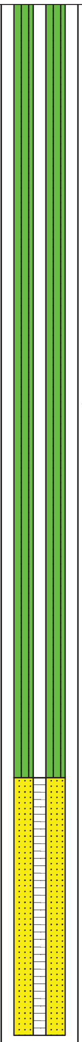
Farallon PN: 394-002

Logged By: Jeff Keller

Date/Time Started: 7/19/08 0930
Date/Time Completed: 7/19/08 1200
Equipment: LA HSA
Drilling Company: Cascade Drilling, Inc.
Drilling Foreman: Curtis A.
Drilling Method: Hollow Stem Auger

Sampler Type: D&M SS 16
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): 15.5
Total Boring Depth (ft bgs): 41.5
Total Well Depth (ft bgs): 40

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		Air knife								
5	☒	Poorly-graded SAND, medium to coarse, brown, medium dense, moist, no odor	SP	▨	100	5/11/15	0.0	MWS 41-071908-01		
10	☒	Poorly-graded SAND, medium to coarse, brown, very loose, moist, no odor	SP	▨	30	6/4/2	0.1	MWS 41-071908-02		Casing
15	☒	Poorly-graded SAND, fine to coarse, black, medium dense, wet, no odor	SP	▨	100	11/14/25	2.2	MWS 41-071908-03		▽
20	☒	Poorly-graded SAND, fine to coarse, black, very dense, wet, no odor	SP	▨	50	25/50	0.4	MWS 41-071908-04		Bentonite
25	☒	Poorly-graded SAND, fine to coarse, black, very dense, wet, no odor	SP	▨	10	24/28/40	0.1	MWS 41-071908-05		
30	☒	Poorly-graded SAND, fine to coarse, black, very dense, wet, no odor	SP	▨	10	50	0.9	MWS 41-071908-06		Screen
35		No recovery								Sand Pack
40		Heaving sands - no recovery.								
45										



Well Construction Information

Monument Type: Flush mount HD
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 30-40

Filter Pack: Sand
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON
consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

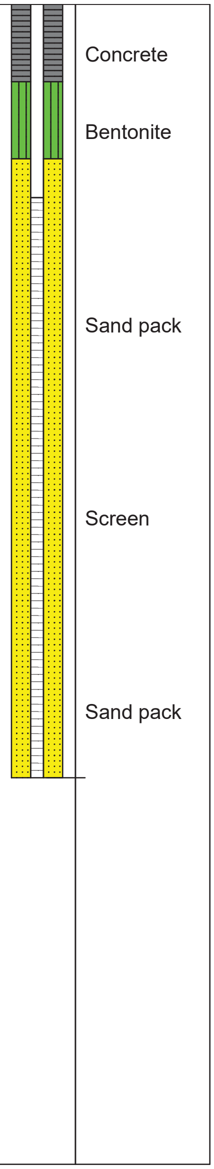
Log of Boring: MW-42

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA
Farallon PN: 394-002
Logged By: D. Clement

Date/Time Started: 02/10/09 1300
Date/Time Completed: 02/10/09 1515
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: NS
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): NS
Total Boring Depth (ft bgs): 20
Total Well Depth (ft bgs): 20

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 25 30		Boring not logged or sampled. See boring log for MW-44 for lithology.								

Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 5-20

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-43

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

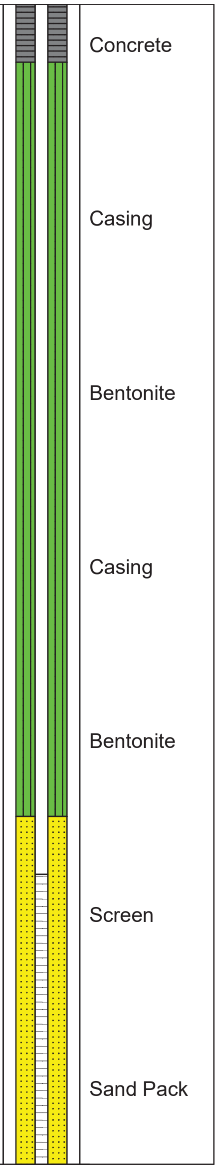
Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/10/09 1045
Date/Time Completed: 02/10/09 1300
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow Stem Auger

Sampler Type: NA
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): NS
Total Boring Depth (ft bgs): 40
Total Well Depth (ft bgs): 40

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		Boring not logged or sampled. See boring log for MW-44 for lithology.								
5										
10										
15										
20										
25										
30										
35										
40										



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2"
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 30-40

Filter Pack: 2/12 Sand
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-44

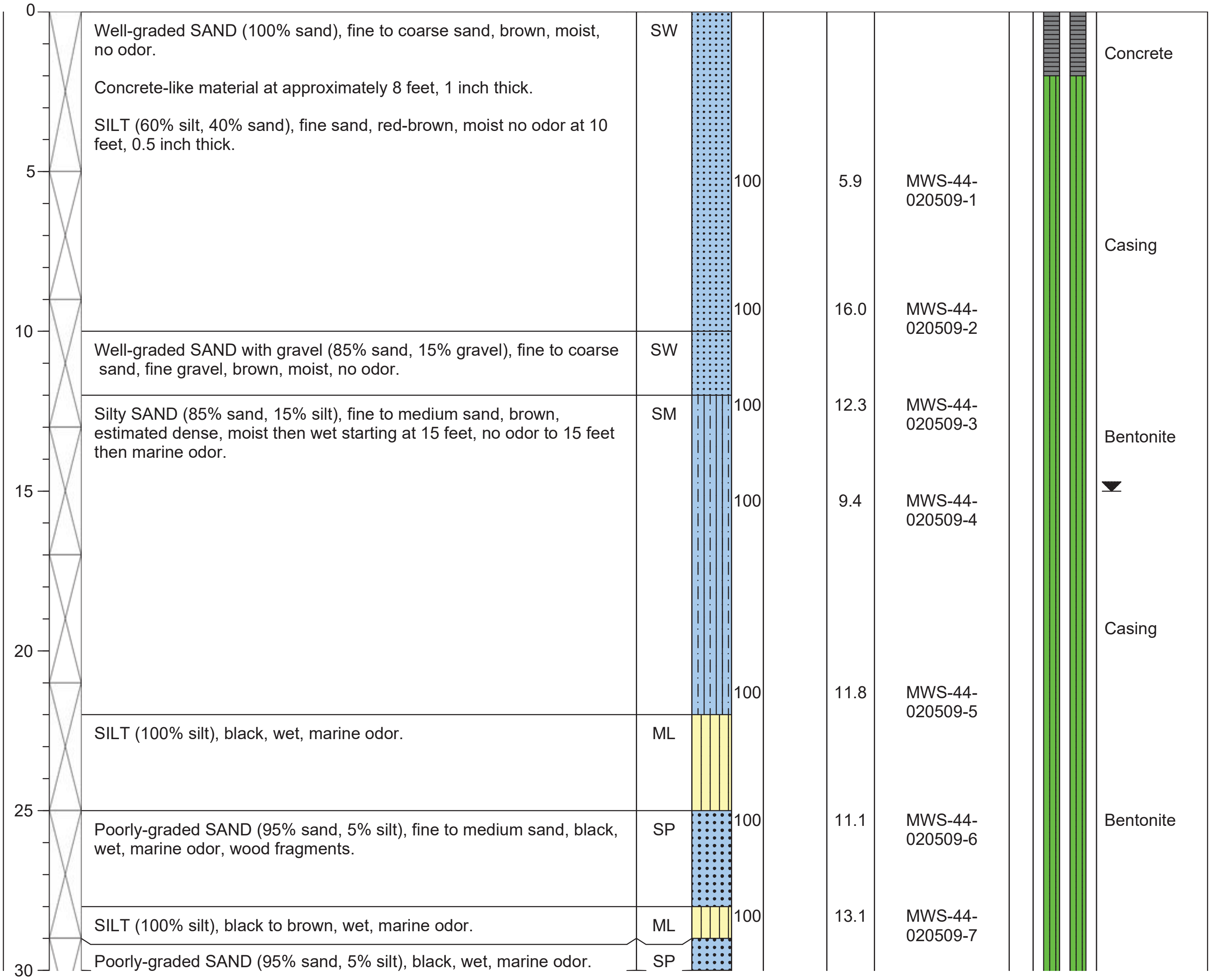
Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/05/09 0840
Date/Time Completed: 02/05/09 1115
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Direct Push sampling / Hollow Stem Auger install

Sampler Type: 4' Macrocore
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): 15
Total Boring Depth (ft bgs): 60
Total Well Depth (ft bgs): 60



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		Well-graded SAND (100% sand), fine to coarse sand, brown, moist, no odor. Concrete-like material at approximately 8 feet, 1 inch thick. SILT (60% silt, 40% sand), fine sand, red-brown, moist no odor at 10 feet, 0.5 inch thick.	SW							Concrete
5					100		5.9	MWS-44-020509-1		Casing
					100		16.0	MWS-44-020509-2		
10		Well-graded SAND with gravel (85% sand, 15% gravel), fine to coarse sand, fine gravel, brown, moist, no odor.	SW							
		Silty SAND (85% sand, 15% silt), fine to medium sand, brown, estimated dense, moist then wet starting at 15 feet, no odor to 15 feet then marine odor.	SM		100		12.3	MWS-44-020509-3		Bentonite
15					100		9.4	MWS-44-020509-4		▼
20										Casing
					100		11.8	MWS-44-020509-5		
		SILT (100% silt), black, wet, marine odor.	ML							
25		Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, black, wet, marine odor, wood fragments.	SP		100		11.1	MWS-44-020509-6		Bentonite
		SILT (100% silt), black to brown, wet, marine odor.	ML		100		13.1	MWS-44-020509-7		
30		Poorly-graded SAND (95% sand, 5% silt), black, wet, marine odor.	SP							

Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2"
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 50-60

Filter Pack: 2/12 Sand
Surface Seal: Concrete
Annular Seal: Bentonite

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

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8	PID (ppm)	Sample ID	Sample Analyzed	Well Construction Details
		SILT (100% silt), black to brown, wet, marine odor, wood fragments.	ML							Casing
		Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, brown, wet, marine odor.	SP		100		18.9	MWS-44-020509-8		
35		SILT (100% silt), black, wet, marine odor at 35 feet, 2 inches thick.								
		Poorly-graded SAND (100% sand), fine to medium sand, brown, wet, marine odor.	SP		100		20.9	MWS-44-020509-9		Bentonite
40										
		Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, black, wet, marine odor.	SP		100		20.3	MWS-44-020509-10		
										Casing
45					100		24.5	MWS-44-020509-11		
					100		38.7	MWS-44-020509-12		Sand pack
50										
					100		35.2	MWS-44-020509-13		
55										Screen
					100		39.7	MWS-44-020509-14		
60					100		6.0	MWS-44-020509-15		

Well Construction Information

Monument Type:	Heavy-duty flush mount	**Filter Pack:**	2/12 Sand	**Ground Surface Elevation (ft):**	NA
Casing Diameter (inches):	2"	**Surface Seal:**	Concrete	**Top of Casing Elevation (ft):**	NA
Screen Slot Size (inches):	0.010	**Annular Seal:**	Bentonite	**Boring Abandonment:**	NA
Screened Interval (ft bgs):	50-60			**Surveyed Location:** **X:** NA	**Y:** NA

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-45

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/05/09 1130
Date/Time Completed: 02/05/09 1220
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Direct Push sampling / Hollow Stem Auger install

Sampler Type: 4' Macrocore
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): 9
Total Boring Depth (ft bgs): 40
Total Well Depth (ft bgs): 40

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		Vac trucked out								Concrete
5		Poorly-graded SAND with gravel (60% sand, 40% gravel), fine to coarse sand, fine gravel, brown, moist, no odor.	SP							
		Poorly-graded SAND (100% sand), fine to medium sand, brown, moist to 9 feet then wet, no odor.	SP							Casing
										▼
					100		0.1	MWS-45-020509-1		
10										
		SILT (100% silt), black, wet, organic odor.	ML		100		0.1	MWS-45-020509-2 FD-020509		
		Poorly-graded SAND (100% sand), brown-black, wet, no odor.	SP							Bentonite
15										
					100		0.0	MWS-45-020509-3		
										Casing
20										
					100		0.2	MWS-45-020509-4		
25										

Well Construction Information

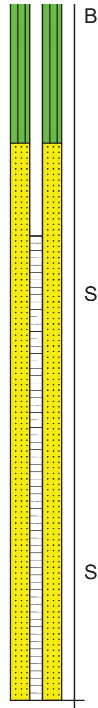
Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2"
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 30-40

Filter Pack: 2/12 Sand
Surface Seal: Concrete
Annular Seal: Bentonite

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

Log of Boring:MW-45

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (ppm)	Sample ID	Sample Analyzed	Well Construction Details
					100		0.0	MWS-45- 020509-5		Bentonite
30		Poorly-graded SAND (100% sand), brown-black, wet, musty odor. Approximately 60% of the sample is woody debris mixed in with the soil.	SP		100		0.0	MWS-45- 020509-6		Screen
35					100		0.1	MWS-45- 020509-7		
		Poorly-graded SAND (100% sand), black, wet, no odor.	SP		100		0.1	MWS-45- 020509-8		Sand Pack
40					100		0.0	MWS-45- 020509-9		
45										



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2"
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 30-40

Filter Pack: 2/12 Sand
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-46

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

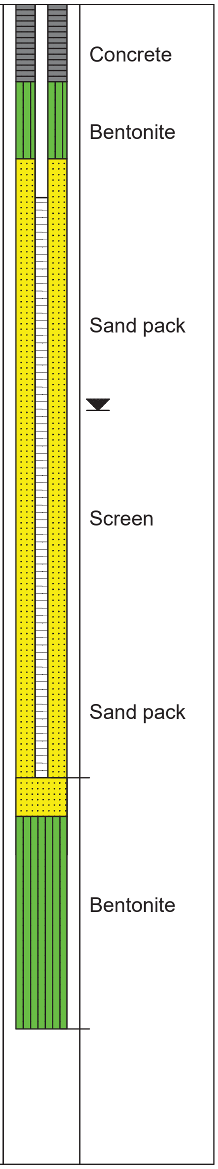
Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/11/09 1245
Date/Time Completed: 02/11/09 1315
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: 18" Split spoon
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): 10.5
Total Boring Depth (ft bgs): 26.5
Total Well Depth (ft bgs): 20

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		0-5 feet Vac trucked out								
5	☒	Well-graded SAND (100% sand), fine to coarse sand, brown, loose, moist, no odor.	SW		100	3/5/6	0.5	MWS-46-021109-1		
10	☒	Well-graded SAND (100% sand), fine to coarse sand, brown, loose, moist, no odor. SILT (100% silt), grey with red mottling, medium stiff, wet, solvent-like odor from 10.5 to 11 feet.	SW ML		100	1/3/5	0.6	MWS-46-021109-2		
15	☒	Poorly-graded SAND (100% sand), fine to medium sand, black, loose, wet, no odor.	SP		100	5/3/9	0.7	MWS-46-021109-3		
20	☒	Poorly-graded SAND (100% sand), fine to medium sand, black, medium dense, wet, no odor.	SP		100	8/12/13	0.5	MWS-46-021109-4		
25	☒	Poorly-graded SAND (100% sand), fine to medium sand, black, medium dense, wet, musty organic odor.	SP		100	13/18/15	0.8	MWS-46-021109-5 FD-021109		
30										



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 5-20

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

Ground Surface Elevation (ft): NA
Top of Casing Elevation (ft): NA
Boring Abandonment: Sand, bentonite
Surveyed Location: **X:** NA **Y:** NA

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-47

Page 1 of 1

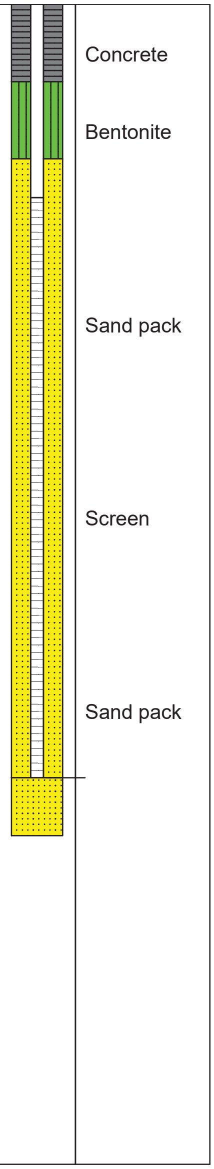
Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/11/09 1400
Date/Time Completed: 02/11/09 1530
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: NS
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): NS
Total Boring Depth (ft bgs): 20
Total Well Depth (ft bgs): 20

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		Boring not logged or sampled.								
5										
10										
15										
20										
25										
30										

Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 5-20

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-48

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

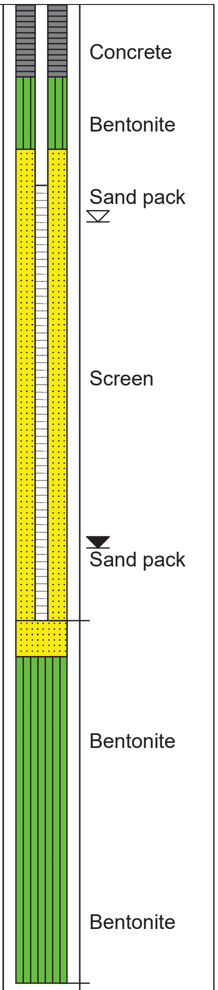
Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/12/09 1255
Date/Time Completed: 02/12/09 1320
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: 18" Split spoon
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): 6, 15
Total Boring Depth (ft bgs): 27
Total Well Depth (ft bgs): 17

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		Vac trucked out								
5		Poorly-graded SAND (100% sand), fine to medium sand, brown, loose, moist, no odor.	SP		100	2/3/5	0.6	MWS-48-021209-1		
		Well-graded SAND (100% sand), fine to coarse sand, black, loose, wet, no odor.	SW							
10		Well-graded SAND (100% sand), fine to coarse sand, black, loose, wet, no odor.	SW		100	2/3/5	0.4	MWS-48-021209-2		
		SILT (100% silt), black, medium stiff, wet, organic odor.	ML							
15		SILT (100% silt), black, medium stiff, saturated at 15, no odor.	ML		100	2/5/6	0.6	MWS-48-021209-3		
		Well-graded SAND (100% sand), fine to coarse sand, black, loose, wet, no odor.	SW							
20		Well-graded SAND (100% sand), fine to coarse sand, black, medium dense, wet, no odor.	SW		100	7/8/8	0.4	MWS-48-021209-4		
25		Well-graded SAND (100% sand), fine to coarse sand, black, loose, wet, organic odor, wood fragments.	SW		100	6/7/8	0.4	MWS-48-021209-5 GR-MW48-021209 @23-27 feet bgs FD-021209		
30										



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 5-17

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-49

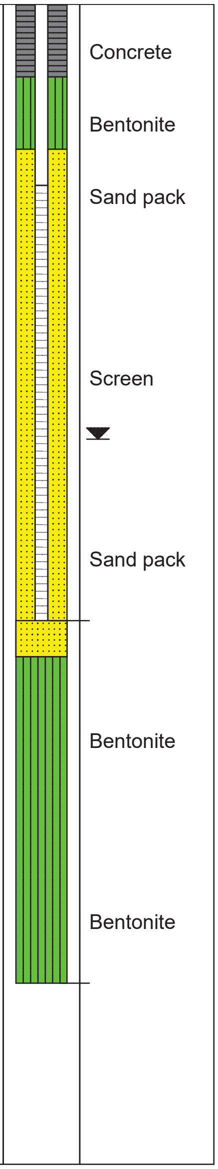
Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA
Farallon PN: 394-002
Logged By: D. Clement

Date/Time Started: 02/13/09 0818
Date/Time Completed: 02/13/09 0850
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: 18" Split spoon
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): 12
Total Boring Depth (ft bgs): 27
Total Well Depth (ft bgs): 17

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		Vac trucked out								Concrete Bentonite
5	☒	Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, brown, dense, moist, no odor.	SP	▨	100	8/15/16	1.4	MWS-49-021309-1		Sand pack
10	☒	Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, brown, medium dense, moist, no odor.	SP	▨	33	9/20/22	2.4	MWS-49-021309-2		Screen
15	☒	Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, brown, dense, moist to 12 feet then wet, no odor.	SP	▨	100	12/18/22	1.2	MWS-49-021309-3		Sand pack
20	☒	Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, brown, medium dense, wet, no odor.	SP	▨	100	10/12/18	1.1	MWS-49-021309-4		Bentonite
25	☒	Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, brown, medium dense, wet, no odor.	SP	▨	100	8/10/10	1.2	MWS-49-021309-5 GR-MW49-021309 @23-27 feet bgs RB-021309		Bentonite
30										



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 5-17

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-50

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

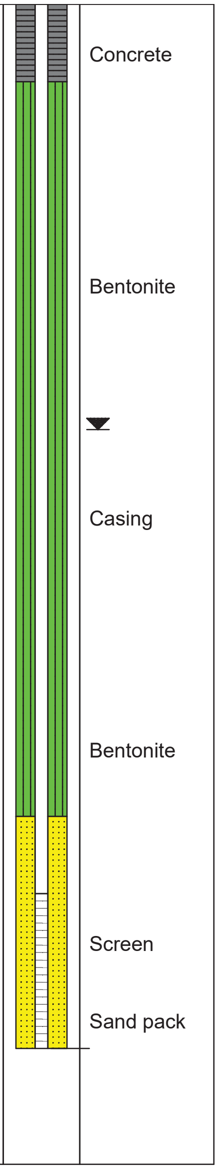
Logged By: D. Clement

Date/Time Started: 02/12/09 0935
Date/Time Completed: 02/12/09 1000
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: 18" Split spoon
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): 11
Total Boring Depth (ft bgs): 27
Total Well Depth (ft bgs): 27

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (ppm*)	Sample ID	Sample Analyzed
0		Vac trucked out							
5	☒	Well-graded SAND (95% sand, 5% gravel), fine to coarse sand, fine gravel, brown, loose, moist, no odor.	SW		100	5/6/8	0.1	MWS-50-021209-1	
10	☒	Well-graded SAND (95% sand, 5% gravel), fine to coarse sand, fine gravel, brown, very loose, moist, no odor.	SW		100	2/2/2	0.7	MWS-50-021209-2	
		Sandy SILT (60% silt, 40% sand), brown, soft, wet, musty organic odor.	ML						
15	☒	Poorly-graded SAND (95% sand, 5% silt), black, loose, wet, no odor.	SP		100	2/4/6	0.3	MWS-50-021209-3	
20	☒	Poorly-graded SAND (95% sand, 5% silt), brown, loose, wet, no odor.	SP		100	3/6/9	0.2	MWS-50-021209-4	
25	☒	Poorly-graded SAND (95% sand, 5% silt), brown, loose, wet, no odor.	SP		100	3/3/4	0.2	MWS-50-021209-5	
30									

Boring/Well Construction Details



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 23-27

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-51

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

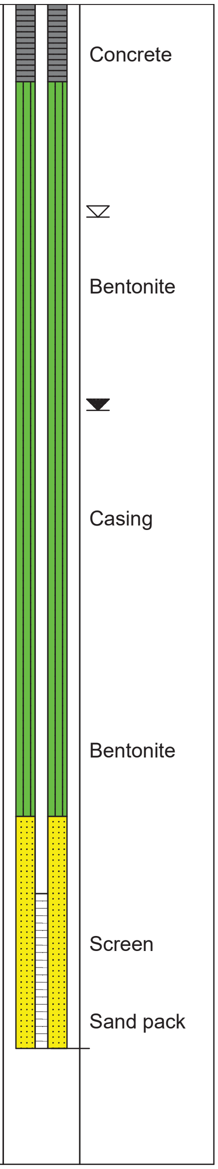
Logged By: D. Clement

Date/Time Started: 02/12/09 1118
Date/Time Completed: 02/12/09 1140
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: 18" Split spoon
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): 5.5, 10.5
Total Boring Depth (ft bgs): 27
Total Well Depth (ft bgs): 27

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (ppm*)	Sample ID	Sample Analyzed
0		Vac trucked out							
5	☒	Well-graded SAND (100% sand), fine to coarse sand, brown, loose, moist then wet at 5.5, no odor.	SW		100	3/3/7	1.2	MWS-51-021209-1	
10	☒	Well-graded SAND (100% sand), fine to coarse sand, black, very loose, moist then wet at 5.5, no odor. SILT (100% silt), black, soft, saturated at 10.5, musty organic odor.	SW ML		100	1/1/2	1.1	MWS-51-021209-2	
15	☒	Poorly-graded SAND (100% sand), fine to medium sand, black, very loose, wet, musty organic odor.	SP		100	1/2/3	0.9	MWS-51-021209-3	
20	☒	Poorly-graded SAND (100% sand), fine to medium sand, black, loose, wet, no odor.	SP		100	2/5/6	0.2	MWS-51-021209-4	
25	☒	Poorly-graded SAND (100% sand), fine to medium sand, black, loose, wet, no odor.	SP		100	3/3/4	0.5	MWS-51-021209-5	
30									

Boring/Well Construction Details



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 23-27

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

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

975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: MW-52

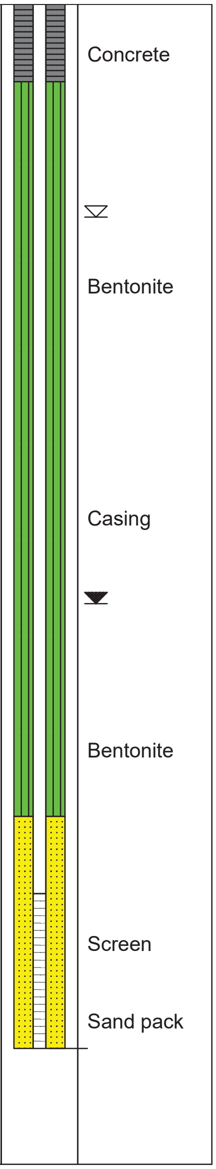
Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA
Farallon PN: 394-002
Logged By: D. Clement

Date/Time Started: 02/12/09 0750
Date/Time Completed: 02/12/09 0825
Equipment: CME 75
Drilling Company: Cascade Drilling
Drilling Foreman: David Gose
Drilling Method: Hollow stem auger

Sampler Type: 18" Split spoon
Drive Hammer (lbs.): 300
Depth of Water ATD (ft bgs): 5.5,15.5
Total Boring Depth (ft bgs): 27
Total Well Depth (ft bgs): 27

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		Vac trucked out								Concrete
5	☒	Well-graded SAND with gravel (60% sand, 40% gravel), fine to coarse sand, fine to coarse gravel, brown, medium dense, moist then wet at 5.5, no odor.	SW	▨	66	6/10/18	1.1	MWS-52-021209-1		Bentonite
10	☒	Well-graded SAND (100% sand), fine to medium, brown, very loose, wet, no odor.	SW	▨	100	1/2/3	1.0	MWS-52-021209-2		Casing
15	☒	Well-graded SAND (100% sand), fine to medium, brown, very loose, wet, no odor. Sandy SILT (60% silt, 40% sand), fine sand, brown, soft, saturated at 15.5, no odor.	SW ML	▨	100	2/2/2	1.4	MWS-52-021209-3		Bentonite
20	☒	Well-graded SAND (100% sand), fine to coarse sand, brown, very loose, wet, no odor. Poorly-graded SAND (100% sand), fine to medium sand, black, very loose, wet, no odor.	SW SP	▨	100	2/2/2	1.5	MWS-52-021209-4		Screen
25	☒	Poorly-graded SAND (100% sand), fine to medium sand, black, loose, wet, no odor.	SP	▨	100	2/3/4	2.1	MWS-52-021209-5		Sand pack
30										



Well Construction Information

Monument Type: Heavy-duty flush mount
Casing Diameter (inches): 2
Screen Slot Size (inches): 0.010
Screened Interval (ft bgs): 23-27

Filter Pack: 2/12 Sand pack
Surface Seal: Concrete
Annular Seal: Bentonite

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

SEACOR

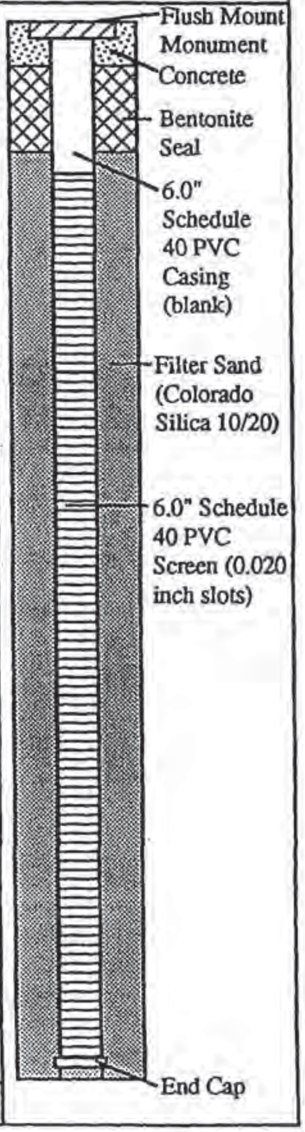
BORING LOG EX-1

BORING: EX-1
PAGE 1 of 1

PROJECT JORGENSEN
LOCATION EX-1
SURFACE ELEVATION
CASING TOP ELEVATION
START 0920 3-20-92
FINISH 1100 3-20-92
SAMPLER G. EHLERS
MONITORING DEVICE PHOTOIONIZATION DETECTOR
SUBCONTRACTOR AND EQUIPMENT LAYNE ENVIRONMENTAL SERVICES; CME-75
COMMENTS 12" HSA, SOIL SAMPLES COLLECTED USING A 3.0 INCH O.D., 2 FOOT LONG SPLIT SPOON SAMPLER, 140 LB. HAMMER

Penetration Results Blows 6"-6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	0-2" ASPHALTIC CONCRETE	
		1'		2"-6.0' Gray GRAVEL (crushed) medium dense, damp (backfill from UST excavation)	
2-4-4-3	▨		5		
3-3-2-2	▨	1700	▽	Brown SAND loose, damp, fine-grained, some fine organics	SP
2-2-1-1	▨	1750	10	Gray Sandy SILT soft, wet to saturated, very fine-grained, some wood fragments, strong petroleum-like odor (PLO)	ML
2-3-3-9	▨	1700		Dark Gray SAND very loose, saturated, very fine-grained, strong (PLO) becomes fine-grained at 13.5'	SP
4-9-13-15	▨	310	15	medium dense, 2" interbedded silt layers 1/2" thick, faint PLO at 15', 1' heave, water added during drilling	
1-4-9-17	▨	1300		becomes medium-grained @ 17.0' moderate PLO	
4-16-25-19	▨	380	20	2' heave, no recovery at 22.0'	
1-4-7-9	▤			Boring terminated at 24.5 feet. Groundwater encountered at approximately 8.5 feet during drilling. Boring converted to a groundwater monitoring well on 3-20-92. 80 gallons of water added during drilling.	
			25		

Boring Abandonment/ Well Construction Details



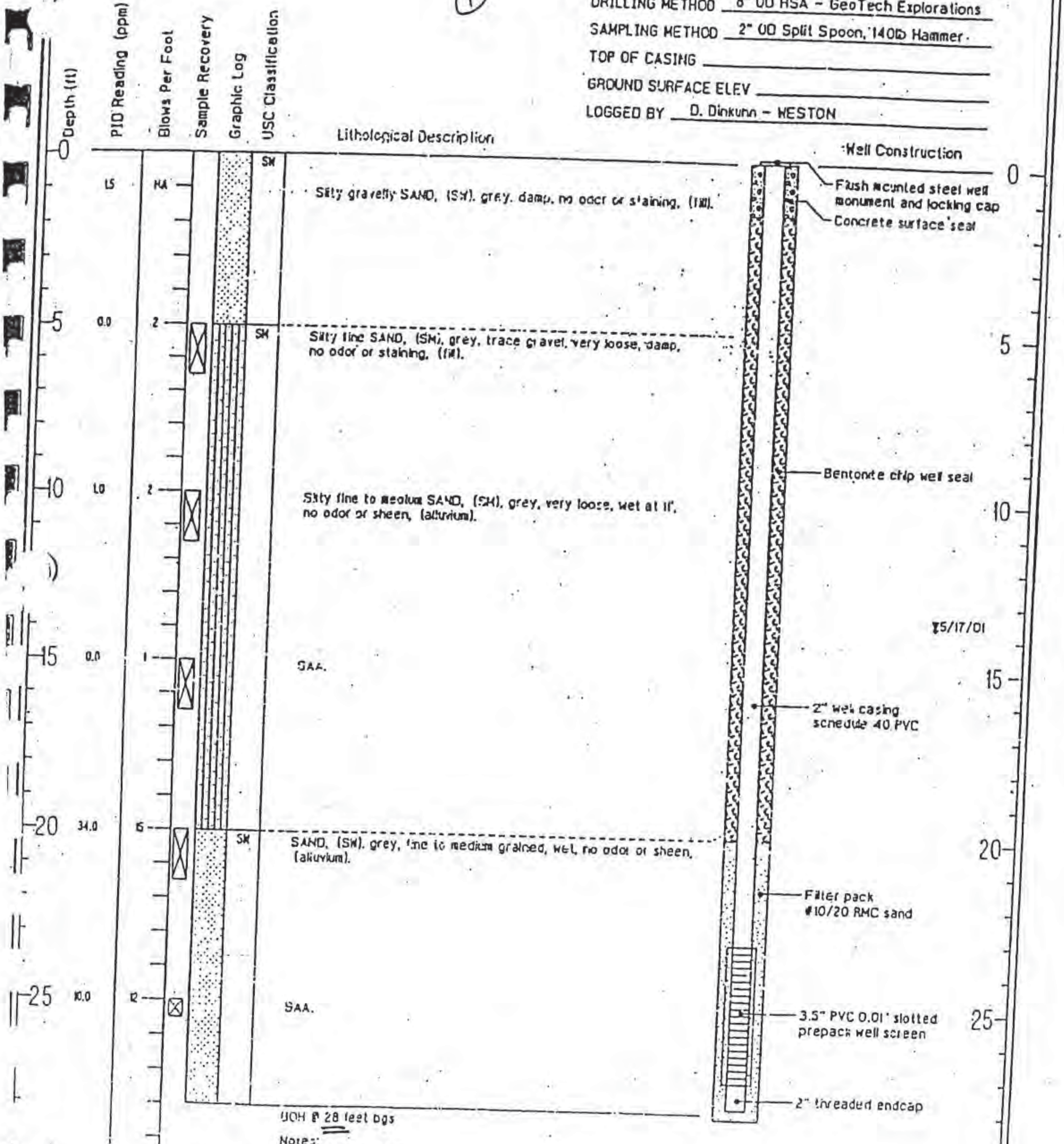
2

MONITORING WELL PL2-JF01AR

WESTON

①

PROJECT Boeing - Plant 2
DATE COMPLETED 09 May 2001
DRILLING METHOD 8" OD HSA - GeoTech Explorations
SAMPLING METHOD 2" OD Split Spoon, 140lb Hammer.
TOP OF CASING
GROUND SURFACE ELEV
LOGGED BY D. Dinkuhn - WESTON



Depth (ft)	PID Reading (ppm)	Blows Per Foot	Sample Recovery	USC Classification	Lithological Description
0	1.5	HA		SM	Silty gravelly SAND, (SM). grey. damp, no odor or staining, (fill).
5	0.0	2	☒	SM	Silty fine SAND, (SM), grey, trace gravel, very loose, damp, no odor or staining, (fill).
10	1.0	2	☒		Silty fine to medium SAND, (SM). grey, very loose, wet at 11', no odor or sheen, (alluvium).
15	0.0	1	☒		SAA.
20	34.0	6	☒	SW	SAND, (SW). grey, fine to medium grained, wet, no odor or sheen, (alluvium).
25	10.0	12	☒		SAA.

BOH @ 28 feet bgs

Notes:
BOH = Bottom of hole
SAA = Same as above.
HA = Hand grab sample
No soil samples were collected for laboratory analysis

PLATE
A-17

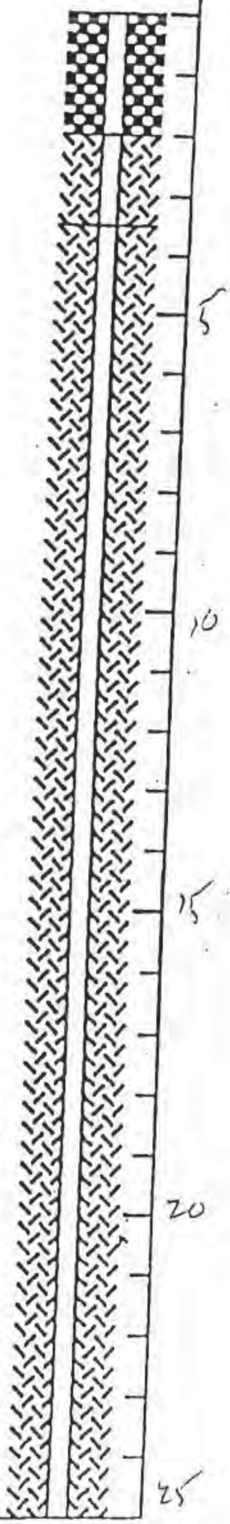
Sheet 1 of 3

Boring PL2-JF01B

Project	Boeing RFI	Start Date	03/10/95
Location	Plant 2 Seattle, WA	Finish Date	03/21/95
Project No.	03709-034-300	Driller	
Contractor	Weston	Drilling Co.	PTL
Logged by	Stoopes	Drilling Method	HSA
		Sampling Method	2 in. Split Spoon
		Top of Casing (ft)	13.51
		Boring Diam. (in)	10
		Ground Surf. Elev. (ft)	13.85
		Total Depth (ft)	51.50

②

Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
							GP	Gravel with sand (GP), brown (10YR5/3), 60% angular gravel/slag to 3 in., 40% medium sand, dense, moist.
							SP	Sand (SP), grayish brown (10YR5/2), 100% fine to medium sand, trace pebbles, loose, moist; Silt interbeds with iron oxide staining @ 16 ft.
5				☒	10			
10				☒	4			
15				☒	10			
20				☒	35			Becomes dense

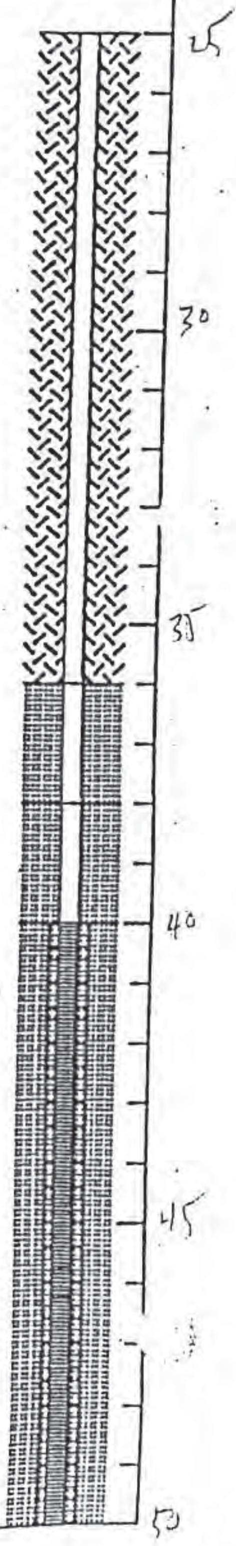


Sheet 2 of 3

Boring PL2-JF01B

Project Boeing RFI
Location Plant 2 Seattle, WA
Project No. 03709-034-300
Contractor Weston
Logged by Stoopes

Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
				☒	21			Med. dense
30					24			
35				☒	32			Dense
40					46			
45					39			

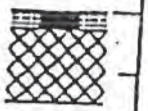


Boring PL2-JF01B

Project Boeing RFI
Location Plant 2 Seattle, WA
Project No. 03709-034-300
Contractor Weston
Logged by Stoopes

50

Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
				☒	32			
					32		ML	Silt with sand (ML), brown (10YR5/3), 80% silt, 20% fine sand, soft, wet.
55								
60								
65								
70								



MONITORING WELL PL2-JF01C

WESTON
MANAGERS DESIGNERS/CONSULTANTS

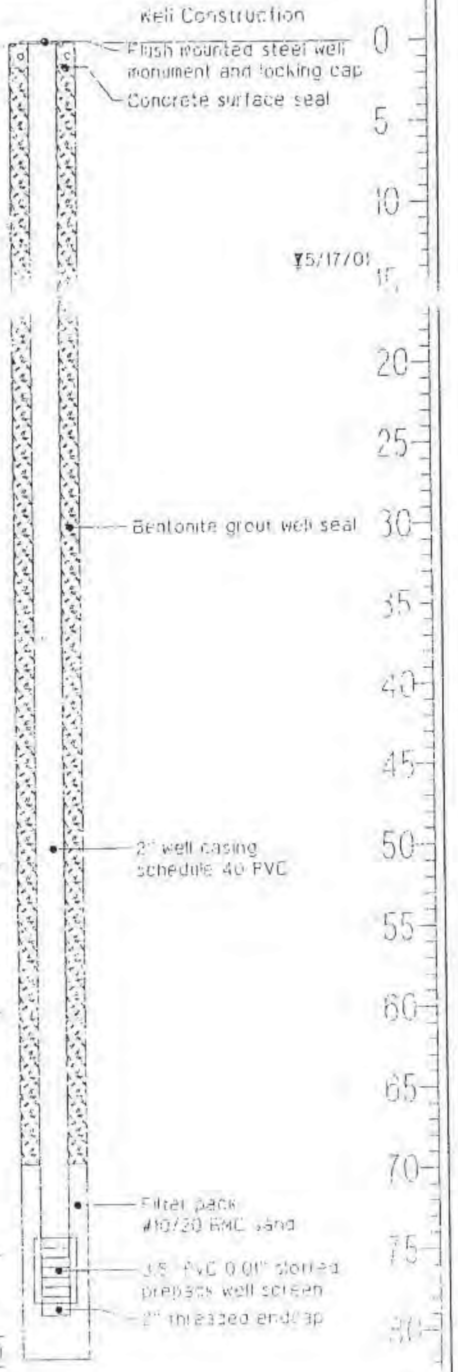
PROJECT Boeing - Plant 2
DATE COMPLETED 9 May 2001
DRILLING METHOD 8" OD HSA - GeoTech Explorations
SAMPLING METHOD 2" OD Split Spoon, 140lb Hammer
TOP OF CASING
GROUND SURFACE ELEV
LOGGED BY D. Dinkuhn - WESTON

Depth (ft)	PID Reading (ppm)	Blows Per Foot	Sample Recovery	Graphic Log	USC Classification	Lithological Description
0					GW	Sandy GRAVEL, (GW), brown, moist, (fill)
					SP	SAND, (SP), greyish brown, fine to medium grained, trace pebbles, loose to medium dense, damp to wet, silt interbeds, (alluvium)
					ML	Sandy SILT, (ML), brown, 80% silt, 20% fine sand, wet, (alluvium)
60	0.0	72	☒		SW	SAND, (SW), grey, fine to medium grained, wet, no odor or sheen, (alluvium)
65	0.0	64	☒			SAA
70	0.0	51	☒			SAA
75	0.0	33	☒		SM	Silty SAND, (SM), grey, fine sand, wet, no odor or sheen, (alluvium)
80	0.0	11	☒		ML	Sandy SILT, (ML), grey, fine sand, wet, no odor or sheen, (alluvium)

BOH @ 81.5 feet bgs

Notes:
BOH = Bottom of hole
SAA = same as above
No soil samples were collected for laboratory analysis.
Lithology for 0 to 60 feet taken from PL2-JF01B log.

Well Construction



PLATE

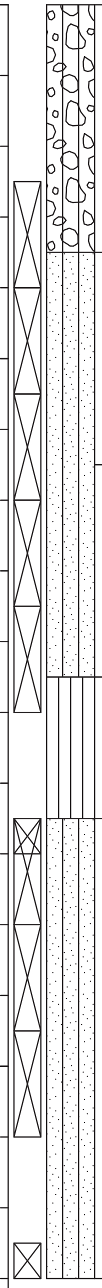
WESTON SOLUTIONS

Monitoring Well PL2-JF04A

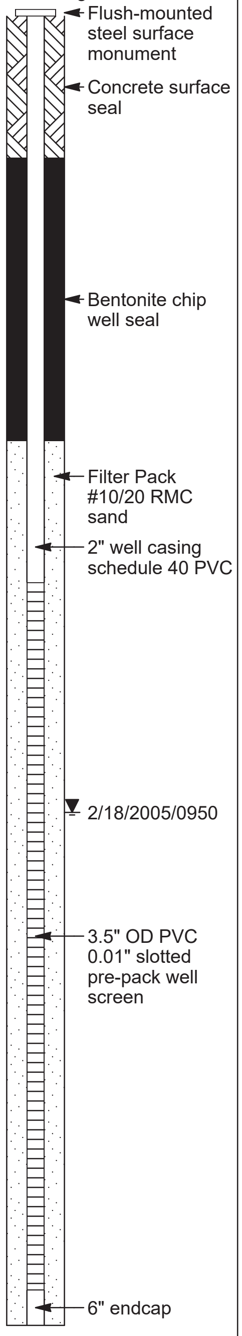
PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 16, 2005
DRILLING METHOD Hollow Stem Auger
TOP OF CASING ELEV (ft) 14.48 feet NGVD29
GROUND SURFACE ELEV (ft) -
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0				GM	Silty GRAVEL (GM), Brown, dry, (fill).
				SM	Silty SAND (SM), Dark brown, 60% sand, 40% fines, dry, (fill).
	0		84		
5					
			28		
				SM	Silty SAND (SM), Black, 85% sand, 15% fines, damp, (alluvium).
	0		30		
		P2ST-SB-MWJF04A-0080 PCBs	19		
				ML	Sandy SILT (ML), Black, damp, (alluvium).
10		P2ST-SB-MWJF04A-0100 PCBs	11		
			8		
				SM	Silty SAND (SM), Black, wet, (alluvium).
		P2ST-SB-MWJF04A-0120 PCBs			
			14		
		P2ST-SB-MWJF04A-0140 PCBs	13		
15					
		P2ST-SB-MWJF04A-0160 PCBs	20		
			86		
		P2ST-SB-MWJF04A-0180 PCBs			Bottom of hole @ 18 feet

Sample Recovery / Graphic Log



Well Diagram

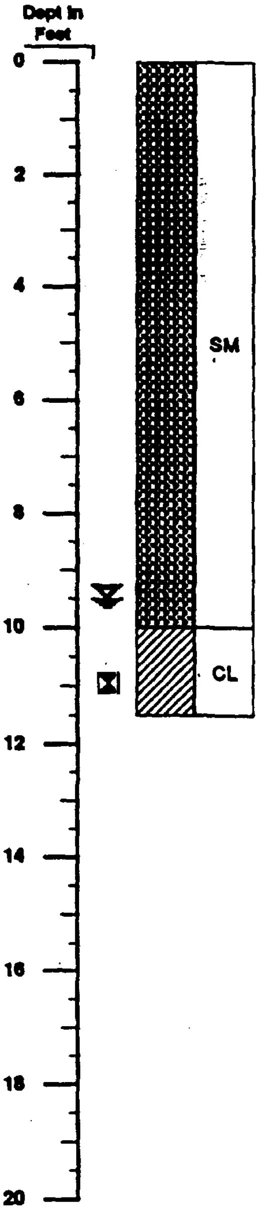


BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-3

Geologic Boring Log

B - 1



10" surface material of crushed rock fill.

Silty Sand; grey, moist, dense, medium to coarse.

Clay; grey, Medium stiff, moderate to low plasticity. Minor iron staining and organic material.

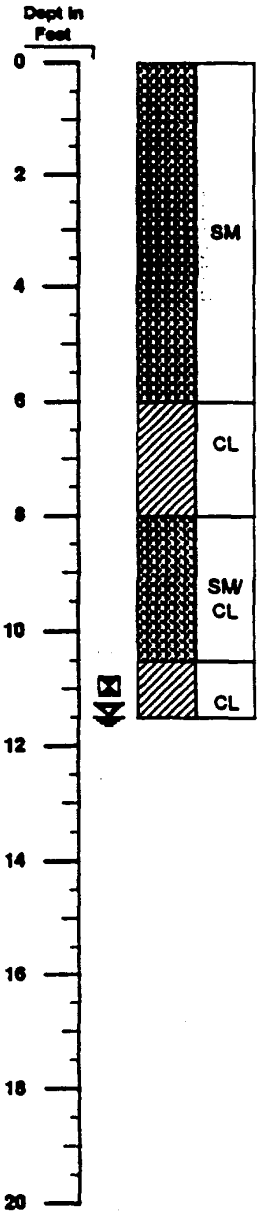
Boring terminated at 11½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.*
Groundwater was observed at 9½' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by D. Watterson
☒ - Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 2



1 - 2" surface material of asphalt.

Silty Sand; olive, moist, loose. Sand is predominately fine to medium grained and subangular. Scattered clay nodules.

Silty Sand; tan and grey,layered sequence, saturated, loose, predominately fine grained.

Silty Clay; grey, saturated, firm, low to medium plasticity.

Silty Sand; grey, saturated, medium density, predominately fine grained.

Silty Clay; grey, saturated, firm, low plasticity.

Clay; grey, saturated, medium stiff, moderate to low plasticity. Minor organic material.

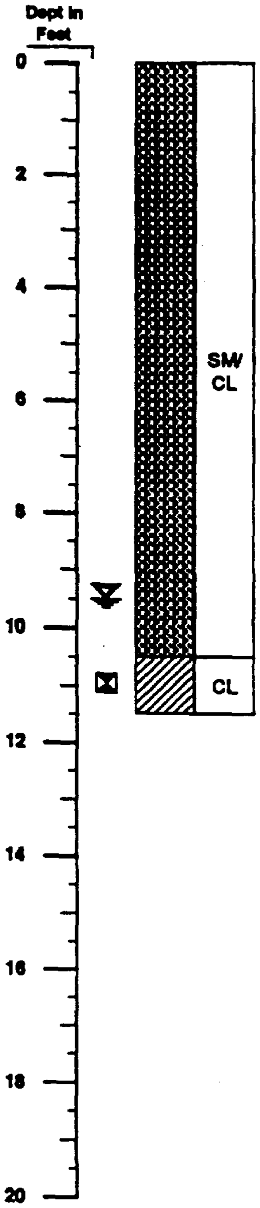
Boring terminated at 11½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 11½' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by D. Watterson
☒-Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 3



2" surface material of asphalt.

Silty Sand; olive with scattered iron staining, very fine to medium, moist, firm to dense, no odor, minor organic matter.

Silty Clay; grey, low plasticity, minor organic matter. Scattered silt lenses.

Increasing water saturation with depth.

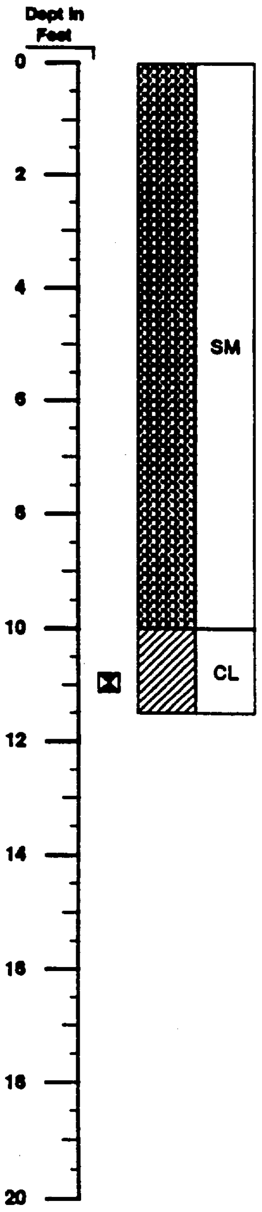
Clayey Sand; grey, loose, friable, fine grained, saturated.
grades to-
Clay; grey, dense, low plasticity, saturated, minor silt, no odor.
Boring terminated at 11½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 9½' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by D. Watterson
☒-Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 4



4" surface material of asphalt.

Silty Sand; olive to olive grey, very fine to fine grained, moist, no odor.

Silty Clay; grey, stiff, low plasticity, saturated, minor organic matter, slight hydrogen sulfide odor, decreasing silt with depth. Cuttings coated with strong oil, strong oil odor.

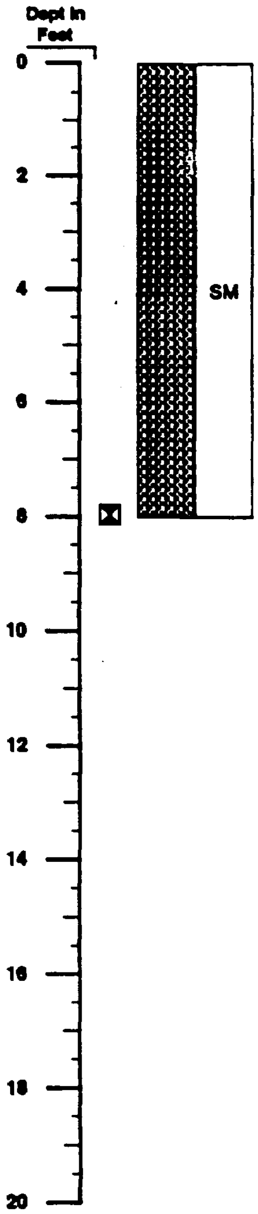
Boring terminated at 11½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
NO groundwater was observed during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by D. Watterson
☒ - Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 5



4" surface material of asphalt.

Silty Sand; dark olive grey, fine grained, well-sorted, dense to loose, moist, scattered cobbles to 1.5".

Soil saturated with product at 6½', strong oil odor.

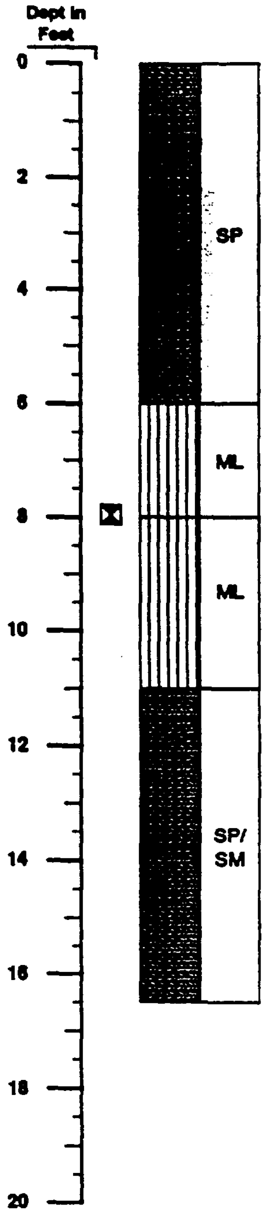
Boring terminated at 8' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
No groundwater was observed during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by D. Watterson and K. Lockard.
☒ - Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 6



3" surface material of asphalt pavement, crushed rock and fill.

sand; brown, fine grained, medium dense.

Silt; dark grey, stiff; scattered organic matter, possible groundwater at 7½', samples are saturated with fuel.

Silt; dark grey, soft; with lenses of sand, dark grey, fine to medium grained, strong odor of fuel, cuttings are saturated.

Silty Sand; dark grey, fine grained, loose, lenses of sand, dark grey, fine to medium grained, loose, decreasing silt content with depth. Strong odor of fuel, cuttings are saturated with fuel.

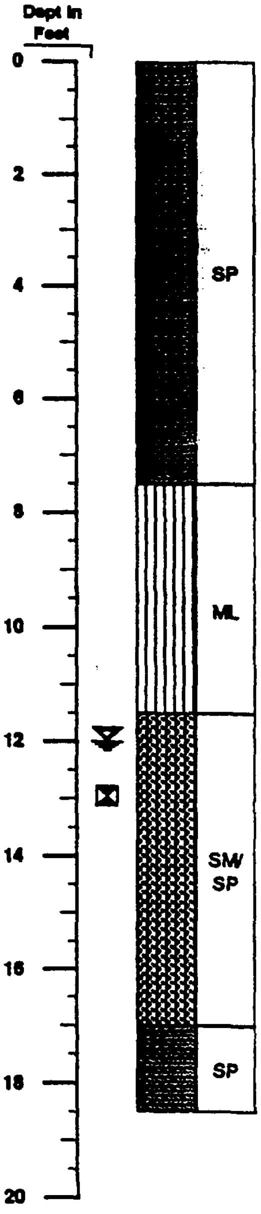
Boring terminated at 16½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater depth uncertain.
Drilled by GeoBoring, Inc.
D&M Supervision by D. Watterson and K. Lockard.
☒ -Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 7



3" surface materail of asphalt.
1¼" crushed rock, fill.

Sand; brown, fine to medium grained, medium dense.

Silt; dark grey, stiff; with minor organic matter. Strong odor of fuel.

Silty sand & Sand; dark grey, fine to medium grained, loose. Strong odor of fuel; sample possibly saturated with fuel.

Sand; dark grey, fine to medium grained, medium dense. Strong odor of fuel.

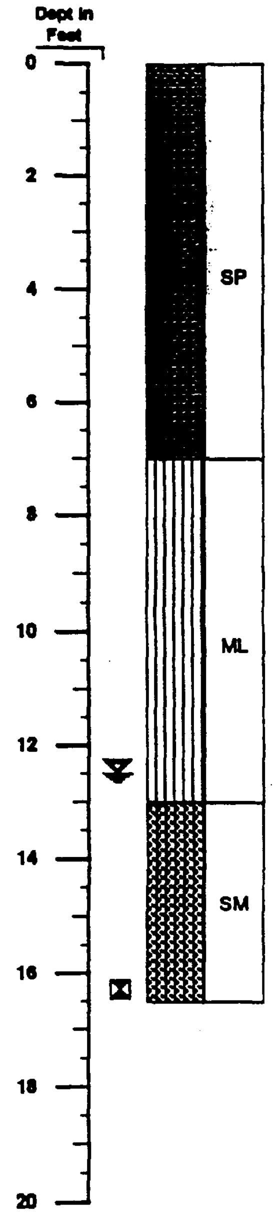
Boring terminated at 16½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 12' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by R. Clark.
☒ - Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 8



3" surface material asphalt and crushed asphalt.

Silty Sand & Sand; brown, fine to medium grained, medium dense to loose.

Silt; dark grey, soft to medium stiff; with minor organic matter.

Silty Sand; dark grey, loose, high silt content.

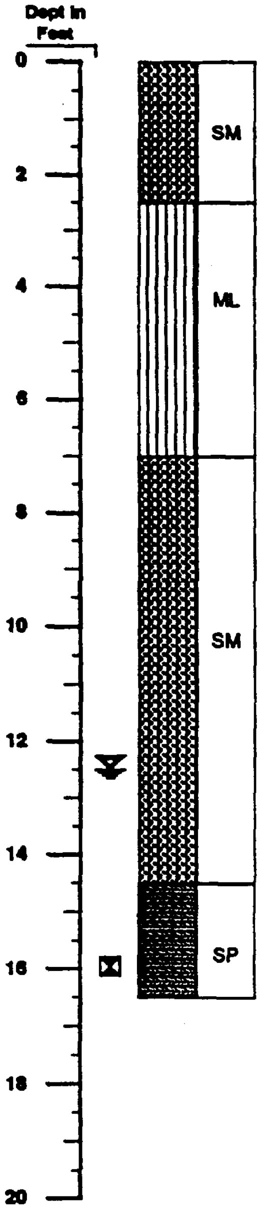
Boring terminated at 16½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 12½' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by R. Clark.
☒-Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 9



6" asphalt surface material
crushed rock, fill
Silty Sand; brown and grey mottled, fine grained, scattered gravel.

Silt; dark grey to black, medium stiff, minor organic matter.

Silty sand; dark grey, fine grained, loose, slight amount of silt.

Sand; dark grey, fine grained, loose.

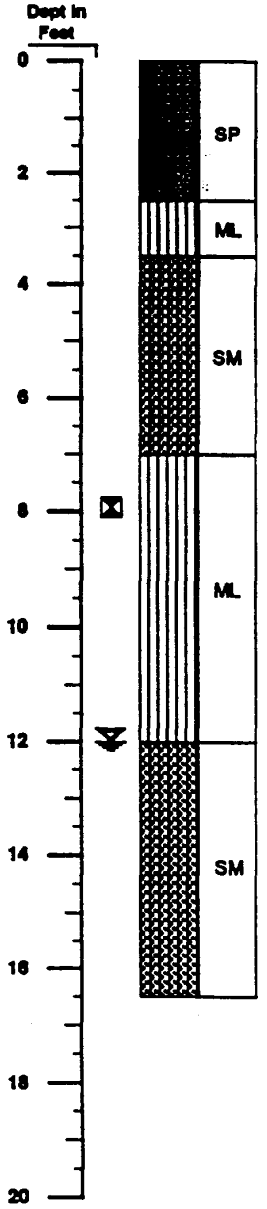
Boring terminated at 16½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 12½' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by R. Clark.
☒ -Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 10



6" asphalt surface material
crushed rock, fill.
Sand; brown, fine grained, medium dense.

Silt; dark grey, stiff, minor sand, fine grained.

Silty Sand; brown.

Silt; dark grey, soft, minor organic matter.

grades to-
Silty sand; dark grey, fine to medium grained, loose, saturated,
slight fuel odor.

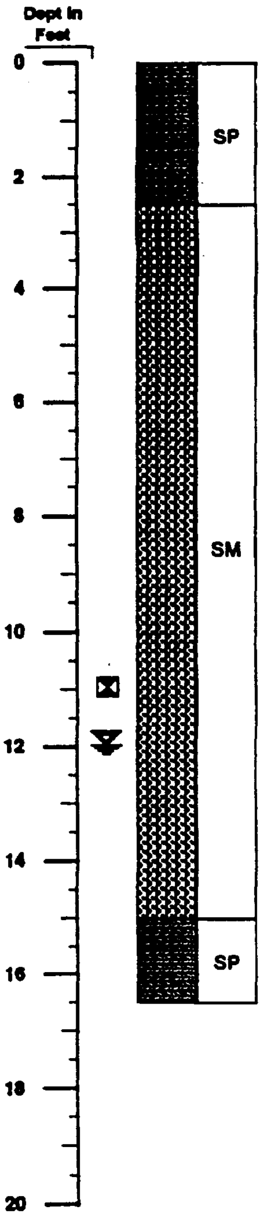
Boring terminated at 16½' on 3/1/90,

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 12' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by R. Clark.
☒ - Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 11



3" asphalt surface material
crushed rock, fill.

Sand; brown, fine to medium grained, medium dense.

Silty Sand; brown, fine grained, loose, silt content varies with depth.

Scattered layers of grey silt with minor organic matter, stiff, saturated, cuttings have fuel odor.

Increasing moisture content with depth.

Sand; dark grey to black, fine to medium grained, loose, saturated, slight fuel odor in sand.

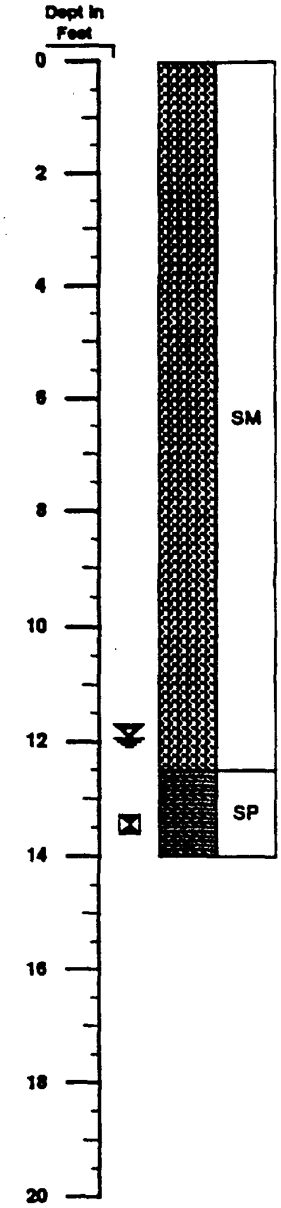
Boring terminated at 16½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 12' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by R. Clark.
☒ - Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 12



3" asphalt surface material
crushed rock, fill.

Silty Sand; brown, fine to medium grained, dense.

Silty Sand; brown fine grained, loose, saturated, scattered lenses of grey silt, loose, slight odor from soil.

Sand; dark grey to black, fine to medium, scattered lenses of grey silt, loose, saturated cuttings are very oily.

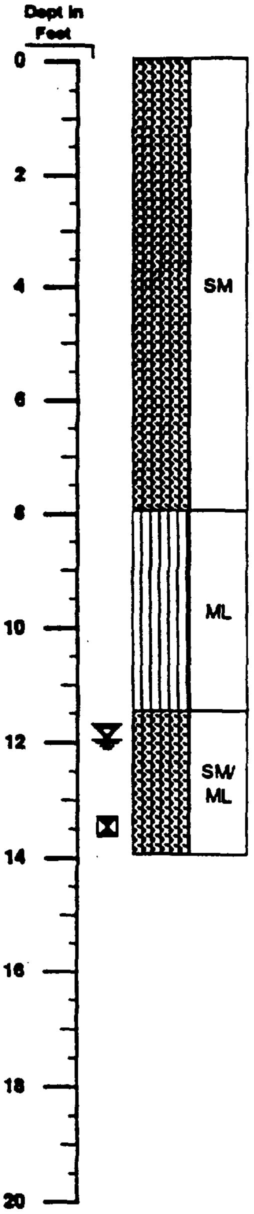
Boring Terminated at 14' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 12' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by R. Clark.
☒ - Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 13



2" asphalt surface material
crushed rick, fill.

Silty Sand; brown, loose, fine grained.

Scattered lenses of sand; grey, fine to very fine, loose.

Silt; grey, soft, minor organic matter.

Layered Silty Sand & Silt; as above, with slight oily odor.

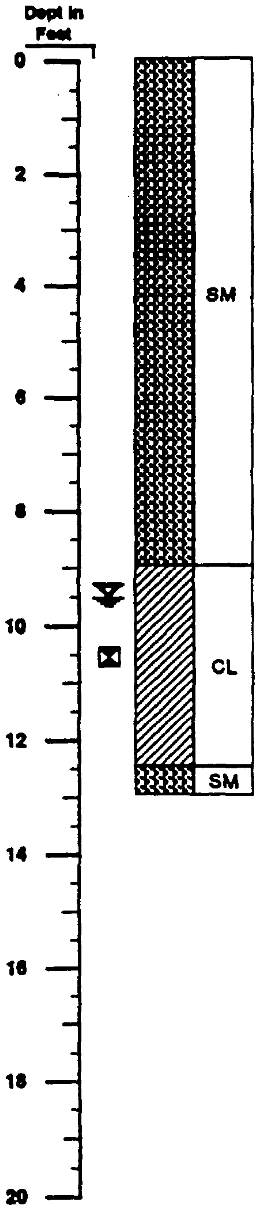
Boring Terminated at 14' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 12' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by R. Clark.
☒-Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 14



5" asphalt surface material.

Silty Sand; olive, fine to medium, moist to saturated, scattered iron staining, no odor, minor clay nodules to ½".

Decreasing grain size.

Clay Lenses; olive, 3" thick at 5', low to moderate plasticity, firm, scattered iron nodules, minor organic matter.

Clay; grey, saturated, low plasticity, minor organic matter, soft, scattered iron stains, increasing with depth.

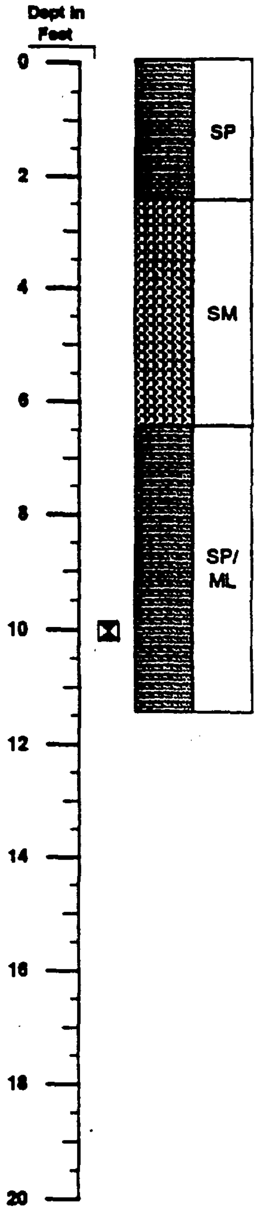
Silty Sand; grey, saturated, well sorted, moderately firm.
Boring terminated at 13' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
Groundwater was observed at 9.5' during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by K. Lockard, and D. Watterson
☒ -Sample Collected for laboratory analysis.

Job No. 20136-002-005 — **Dames & Moore**

Geologic Boring Log

B - 15



4" asphalt surface material.
crushed rock, fill.

Sand; brown, fine grained, very slight amount of silt, medium dense.

Silty Sand; brown, fine grained, medium dense, fill.

Sand; brown, grading to dark grey to black with depth, fine grained, loose, moist to saturated, minor lenses of dark grey silt.

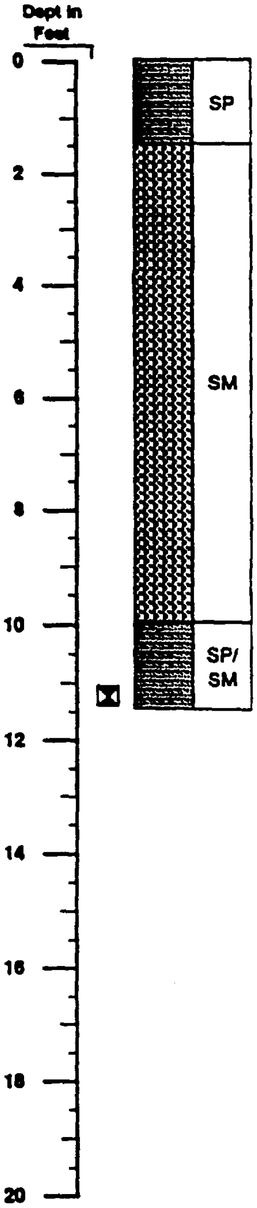
Boring terminated at 11½' on 2/28/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
No groundwater was observed during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by R. Clark.
☒-Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

B - 16



4" asphalt surface material.
crushed rock, fill.
Sand; brown, fine to medium grained, medium dense.

Silty Sand; brown, fine grained, loose.

Sand; dark grey to black, fine to medium grained with scattered lenses of dark grey silt, loose, saturated.

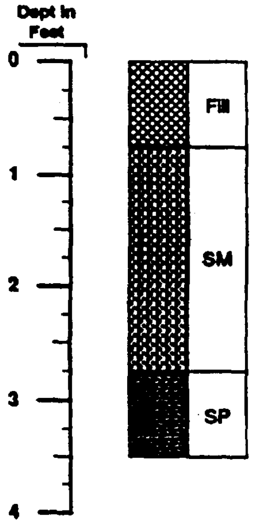
Boring terminated at 11½' on 2/28/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
No groundwater was observed during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by R. Clark.
☒-Sample Collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

SB - 1



Fill; 10" crushed rock, slag, gravel, assorted debris.

Silty, Clayey Sand; dark grey, well sorted, fine to medium grained, firm, slightly moist, minor iron staining.

Sand; grey, medium to coarse grained, well sorted, subangular, moist, minor gravel.

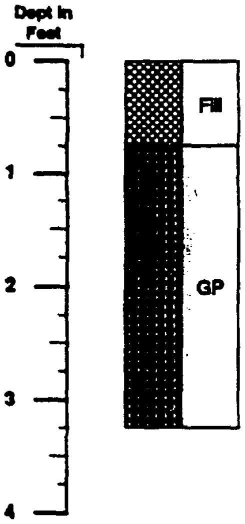
Boring terminated at 3½' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
No groundwater was observed during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by D. Watterson
A disturbed composite sample was collected for laboratory analysis.

Job No. 20136-002-005 **Dames & Moore**

Geologic Boring Log

SB - 2



Fill; 10" crushed rock, slag, assorted debris.

Fill; grey brown, white, black, orange, chrushed rocks, slag, asphalt?, scattered white coating on particles - possibly ash or acid residue, dry, very dense, minor coarse sand and gravel, no odor.

Boring terminated at 3¼' on 3/1/90.

NOTES: Borehole was backfilled with bentonite chips to one foot below grade then capped with concrete.
No groundwater was observed during drilling.
Drilled by GeoBoring, Inc.
D&M Supervision by D. Watterson
A disturbed composite sample was collected for laboratory analysis.

Job No. 20136-002-005 — **Dames & Moore**

SEACOR

BORING LOG

BORING: B-1
PAGE 1 of 1

PROJECT Jorgensen Steel
LOCATION 5' N of N corner of oil water separator
SURFACE ELEVATION
CASING TOP ELEVATION
START 12:50 12/12/90
FINISH 2:30 12/12/90
SAMPLER T. Slotta
MONITORING DEVICE HNU Photoionization Detector
SUBCONTRTACTOR AND EQUIPMENT Environmental West - Mobile B-61
COMMENTS

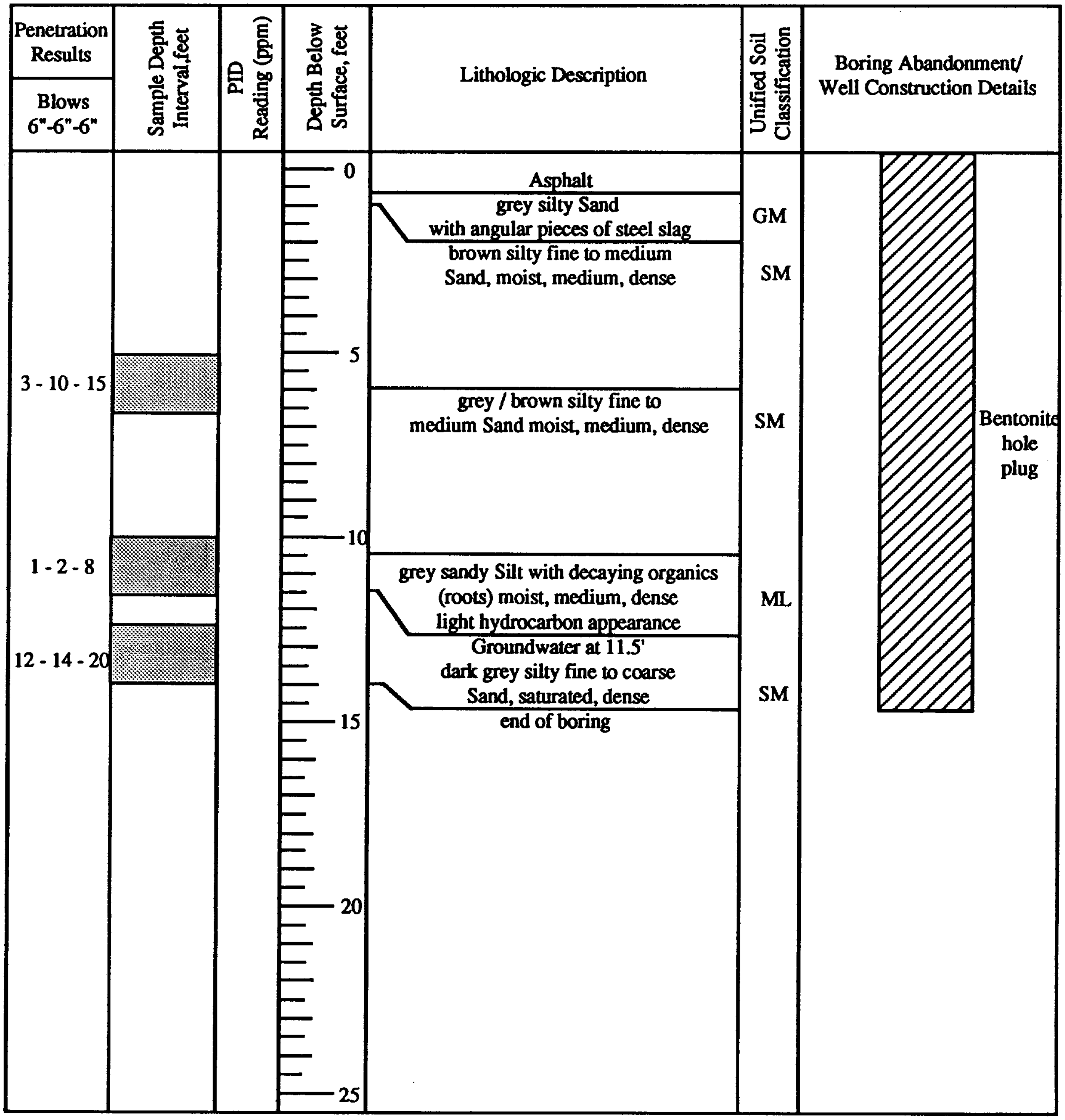
Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	Asphalt		Bentonite hole plug
				grey silty sand with chunks of steel slag road base - very dense	GM	
8 - 22 - 42	▨			grey brown silty fine to medium Sand moist, medium, dense/ dense interbedded with a 6" grey sandy silt layer at 3' becomes medium dense@ 5'	SM/ ML	
			5			
6 - 6 - 14	▨					
2 - 3 - 1	▨					
3 - 1 - 4	▨		10	black silty fine to medium, Sand with decaying organic material (wood) hydrocarbon odor & sheen moist, medium dense becomes a sandy silt with same Groundwater @ 11.5'	SM/ ML	
3 - 10 - 11	▨			dark grey silty fine to coarse Sand saturated, medium dense	SM	
				end of boring		
			15			
			20			
			25			

SEACOR

BORING LOG

BORING: B-2
PAGE 1 of 1

PROJECT Jorgensen Steel
LOCATION 12ft. west of oil/H20 separator
SURFACE ELEVATION
CASING TOP ELEVATION
START 2:30 12/12/90
FINISH 3:45 12/12/90
SAMPLER T. Slotta
MONITORING DEVICE HNU Photoionization Detector
SUBCONTRTACTOR AND EQUIPMENT Environmental West - Mobile B-61
COMMENTS



Penetration Results Blows 6"-6"-6"	Sample Depth Interval,feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	Asphalt		Bentonite hole plug
				grey silty Sand with angular pieces of steel slag	GM	
				brown silty fine to medium Sand, moist, medium, dense	SM	
3 - 10 - 15	▨		5	grey / brown silty fine to medium Sand moist, medium, dense	SM	
1 - 2 - 8	▨		10	grey sandy Silt with decaying organics (roots) moist, medium, dense light hydrocarbon appearance	ML	
12 - 14 - 20	▨			Groundwater at 11.5' dark grey silty fine to coarse Sand, saturated, dense	SM	
			15	end of boring		

SEACOR

BORING LOG

BORING: B-3
PAGE 1 of 1

PROJECT Jorgensen Steel
LOCATION 10ft. west of cutting oil holding tank
SURFACE ELEVATION
CASING TOP ELEVATION
START 4:00 12/1290
FINISH
SAMPLER T. Slotta
MONITORING DEVICE HNU Photoionization Detector
SUBCONTRTACTOR AND EQUIPMENT Environmental West - Mobile B-61
COMMENTS

Penetration Results Blows 6"-6"-6"	Sample Depth Interval,feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	Asphalt		▨
				brown silty Sand with angular (1-2") Gravel moist,dense	GM	▨
				brown silty fine to medium Sand. moist, medium, dense with an interbed of sandy Silt at 4'	SM/ ML	▨
			5			▨
6 - 14 - 13	▒					▨
3 - 6 - 9	▒			grey silty fine to medium Sand moist, medium, dense	SM	▨ Bentonite hole plug
				grey sandy Silt moist, medium, dense, with decaying organics wood, organic odor (sweet) Groundwater @ 10.5'	ML	▨
2 - 4 - 6	▒		10			▨
				grey silty fine to medium Sand moist, medium, dense, organic odor (sweet)	SM	▨
				end of boring		▨
			15			▨
			20			▨
			25			

SEACOR

BORING LOG

BORING: B-4
PAGE 1 of 1

PROJECT Jorgensen Steel
LOCATION 5' N. of cutting oil holding tank
SURFACE ELEVATION
CASING TOP ELEVATION
START 9:30
FINISH
SAMPLER T.Slotta
MONITORING DEVICE HNU Photoionization Detector
SUBCONTRTACTOR AND EQUIPMENT Environmental West - Moble B- 61
COMMENTS

Penetration Results Blows 6"-6"-6"	Sample Depth Interval,feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	Asphalt		Bentonite hole plug
				grey brown silty fine to medium Sand, with angular (1-2") Gravel road base, moist, dense	GM	
			5	grey brown silty fine to medium Sand, moist medium dense	SM	
6-16-17	▨			brown sandy Silt lense at 5.5' moist, medium dense	ML	
4-6-4	▨			grey brown silty fine to medium Sand, moist, medium dense	SM	
2-2-4	▨		10	grey sandy clayey Silt, very plastic, moist, medium dense	ML	
				grey silty fine to coarse Sand at 11 feet saturated, medium dense Groundwater at 11 feet	SM	
			15	end of boring		
			20			
			25			

SEACOR

BORING LOG

BORING: B-5
PAGE 1 of 1

PROJECT Jorgensen Steel
LOCATION 7" E of cutting oil holding tank
SURFACE ELEVATION
CASING TOP ELEVATION
START 10:30
FINISH ?
SAMPLER T.Slotta
MONITORING DEVICE HNU Photoionization Detector
SUBCONTRTACTOR AND EQUIPMENT Environmental West - Moble 61
COMMENTS moved 2 feet North and 2 feet east - same, moved 2 feet further North - same

Penetration Results Blows 6"-6"-6"	Sample Depth Interval,feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	Asphalt		▨ Bentonite hole plug
				grey brown silty fine to medium Sand with angular Gravel moist dense	GM	
13-12-5	▨		5	brown silty fine to medium Sand, moist, medium dense bu ried concrete @ 5' (see comments)	SM	
				(End of Boring)		
			10			
			15			
			20			
			25			

HAND AUGER BORING LOGS

Boring HA-1A 1/24/91

Sample I.D.	Depth (Feet)	USCS Symbol	Description
	0-0.5	--	Asphalt and gravel.
	0.5-4.9	SP	Dark brown SAND, medium grained, loose, moist.
	4.9-7.0	ML	Grey clayey SILT, medium stiff, moist, petroleum odor.
	7.0-8.5	SP	Grey SAND, medium grained, loose, wet, petroleum sheen on water surface. GROUNDWATER at 8.0 feet.

Boring HA-1-B 1/24/91

Sample I.D.	Depth (Feet)	USCS Symbol	Description
	0-0.5	--	Asphalt and gravel.
	0.5-6.0	SP	Dark brown SAND, medium grained, stiff, loose, moist.
	6.0-6.5	ML	Grey clayey SILT, medium stiff, moist.
HA-1-B @ 7.2'	6.5-8.0	SP	Grey SAND, medium grained, loose, moist to wet GROUNDWATER at 8.0 feet.

USCS = Unified Soil Classification System

Boring HA-2 1/24/91

Sample I.D.	Depth (Feet)	USCS Symbol	Description
	0-1.2	--	Asphalt and gravel
	1.2-3.6	SM	Grey brown silty SAND, fine to medium grained, loose, moist, oxide staining.
	3.6-5.6	SP	Dark brown SAND, medium grained, loose, moist.
	5.6-6.7	ML	Grey clayey SILT, medium stiff, moist, organic odor.
HA-2 @ 9.5'	6.7-10	SM	Grey silty SAND, fine to medium grained, loose, moist, petroleum odor and sheen on water surface. GROUNDWATER at 9.5 feet.

Boring HA-3 1/24/91

Sample I.D.	Depth (Feet)	USCS Symbol	Description
	0-0.5		Asphalt and gravel.
	0.5-4.6	SP	Brown SAND, medium grained, loose, moist.
	4.6-5.8	ML	Grey clayey SILT, medium stiff, moist.
HA-3 @ 10.3'	5.8-10.5	SP	Brown SAND, medium grained, loose, moist, petroleum sheen on water surface. GROUNDWATER at 10.3 feet.

USCS = Unified Soil Classification System

Boring HA-4 1/24/91

Sample I.D.	Depth (Feet)	USCS Symbol	Description
	0-0.5		Asphalt and gravel.
	0.5-8.6	SP	Grey brown SAND, medium grained, loose moist, petroleum odor.
HA-4 @ 9.2'	8.6-9.5	ML	Grey clayey SILT, medium stiff, moist. GROUNDWATER at 9.2 feet.

Boring HA-5 2/13/91

Sample I.D.	Depth (Feet)	USCS Symbol	Description
	0-0.5		Gravel
	0.5-5	SP	Brown SAND, medium grained loose, moist.
	5-6	ML	Grey clayey SILT, medium stiff, moist.
HA-1 @ 9.5'	6-10	SP	Brown SAND, medium grained, loose, moist GROUNDWATER at 9.5 feet.

Boring HA-6 2/13/91

Sample I.D.	Depth (Feet)	USCS Symbol	Description
	0-0.5		GRAVEL
	0.5-5	SP	Dark brown SAND, medium grained, loose, moist.
	5-6	ML	Grey clayey SILT, medium stiff, loose, moist
HA-2 @ 8'	6-8.5	SP	Brown SAND, medium grained, loose, moist to wet. GROUNDWATER at 8 feet.

USCS = Unified Soil Classification System

SEACOR

BORING LOG

BORING: SB-9
PAGE 1 of 1

PROJECT EARLE M. JORGENSEN
LOCATION WEST OF ABOVE GROUND TANK FARM
SURFACE ELEVATION ———
CASING TOP ELEVATION NA
START 10/10/91; 1305
FINISH 10/10/91; 1500
SAMPLER P. SCHMIDT
MONITORING DEVICE NA
SUBCONTRACTOR AND EQUIPMENT McGARRETT DRILLING, GP-1000R, 8" HSA
COMMENTS AC DRIVEWAY

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	Asphaltic Concrete / Gravel		
				Dark Brown to Slight Golden Silty SAND damp, lacks organics, loose, no distinctive odor graded blackish brown	SM	Advanced hole to 5 feet with hand auger.
				Gray CLAY	CL	
1 - 18" No Recovery	▨		5	damp to moist, organic rich, petroleum-like odor		
3-2-4	▨			Dark Brown to Black SAND moist, clean, medium-grained, heavy sheen, strong petroleum-like odor, heavy black staining (oil-like)	SP	
2-1-1	▨					Boring backfilled with bentonite to 1 feet and capped with concrete to grade.
1-1-1	▨		10	Dark Gray Silty CLAY	CL	
				moist, slight organics, soft, no petroleum odor wet sandy clay at 10.9 - 11.0 feet		
				Drilling terminated at 9.5 feet. Bottom hole at 11 feet.		
			15			
			20			
			25			

00075-009-01

SEACOR

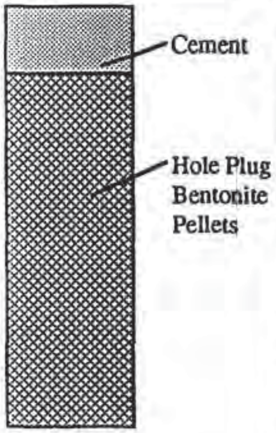
BORING LOG

BORING: 4-SB-1
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 4
LOCATION 8531 E. Marginal Way S. Seattle, Washington
SURFACE ELEVATION ———
CASING TOP ELEVATION ———
START 8/27/92 1445
FINISH 8/27/92 1510
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC. ; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5"X6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
	Hand Auger Post-hole to 5 feet		0	Asphaltic Concrete	
				SAND with brick fragments(fill)	
				Brown Arkosic SAND, very fine to coarse grained, no silt/gravel, very well graded, dry	SW
			5		
11-14-15	▩	0			
11-16-19	▩	0		dark gray with organics	
4-5-6	▩	0			
			10	Dark Gray Clayey SILT, slightly plastic, damp	ML
				Boring terminated at 9.5 feet. Groundwater not encountered	
			15		
			20		
				* Field methods did not indicate the presence of volatile organic compounds in collected soil samples. No soil samples were submitted for laboratory analysis.	
			25		

Boring Abandonment/ Well Construction Details



SEACOR

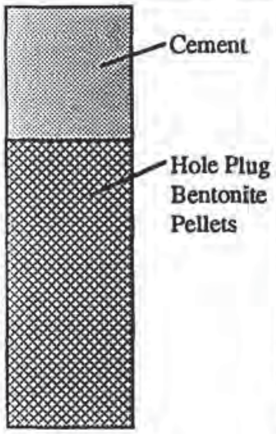
BORING LOG

BORING: 4-SB-2
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 4
LOCATION 8531 E. Marginal Way S. Seattle, Washington
SURFACE ELEVATION ——
CASING TOP ELEVATION ——
START 8/27/92 1525
FINISH 8/27/92 1545
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5"X6" BRASS SLEEVES.

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	Asphaltic Concrete	
	Hand Auger Post-hole to 5 feet			SAND	SW
				Dark Gray SILT	ML
				Brown Arkosic SAND, very fine to coarse grained, no silt/gravel, very well graded, dry	SW
			5		
11-8-8		0			
9-11-13		0		dark gray, moist	
9-11-12		0.4			
			10	Dark Gray Clayey SILT, slightly plastic, damp	ML
				Boring terminated at 9.5 feet. Groundwater not encountered	
			15		
			20		
			25		

Boring Abandonment/ Well Construction Details



SEACOR

BORING LOG

BORING: 4-SB-3
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 4
LOCATION 8531 East Marginal Way S. Seattle, Washington
SURFACE ELEVATION ———
CASING TOP ELEVATION ———
START 8/27/92 1550
FINISH 8/27/92 1620
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5"X6" BRASS SLEEVES.

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	Asphaltic Concrete	
	Hand Auger Post-hole to 5 feet			FILL	
				Dark Gray SILT	ML
				Brown Arkosic SAND, very fien to coarse grained, no silt/gravel, very well graded, dry	SW
			5		
9-11-12		0			
9-10-11		0		gray, moist	
9-11-13		0		moist to wet	
			10		
7-9-11		0.2		Dark Gray Clayey SILT, slightly plastic, damp to wet	ML
				Backfill hole @ 1040	
			15	Boring terminated at 11 feet. Groundwater not encountered	
			20		
			25		

Boring Abandonment/ Well Construction Details

SEACOR

BORING LOG

BORING: 4-SB-4
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 4
LOCATION 8531 Marginal Way E. Seattle, Washington
SURFACE ELEVATION ———
CASING TOP ELEVATION ———
START 1000 8/31/92
FINISH 1050 8/31/92
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5"X6" BRASS SLEEVES.

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	Asphaltic Concrete		
	Hand Auger Post-hole to 5 feet			Dark Gray SAND, very fine grained, poorly graded	SP	
				Dark Gray SILT, some clay	ML	
	▨		5	Brown Arkosic SAND, Very fine to coarse grained, no silt/gravel, very well graded, dry	SW	
7-8-9	▨	11.7				
7-7-8	▨	5.3		gray		
12-12-8	▨	3.9		with organics, wet		
6-6-8	▨	3.5	10	Dark Gray Clayey SILT, slightly plastic, wet	ML	
			15	Boring terminated at 11 feet. Groundwater not encountered		
			20			
			25			

MAJOR DIVISIONS				TYPICAL NAMES
COARSE-GRAINED SOILS MORE THAN HALF IS LARGER THAN No. 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN No. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN No. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE-GRAINED SOILS MORE THAN HALF IS SMALLER THAN No. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLACTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLACTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGINIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

KEY TO BORING LOG

▨ = Undisturbed soil sample submited for laboratory analysis

░ = Classification sample

▤ = No sample recovery

BLOWS = Blows required to drive sampler 18 inches in 6 inch intervals with a 140 pound hammer falling 30 inches.

PID = Photoionization detector reading (10.2 electron-volt lamp. Calibrated using a 102ppm isobutylene standard gas).

SEACOR	DWN RB APPR DATE 10/23/92 JOB# 00075-018-01	SOIL CLASSIFICATION CHART AND KEY TO SEACOR BORING LOGS

DISK:0032 DWG:GEOLOGY2

SEACOR

BORING LOG

BORING: IB-1
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION
START 8-29-92 1500
FINISH 8-29-92 1600
SAMPLER SIVILLE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT N/A
COMMENTS SOIL SAMPLES CONTINOUSLY COLLECTED USING A HAND AUGER

Penetration Results	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
Blows 6"-6"-6"						
			0	CONCRETE		▒ Cement grout
	▨	4.2 11.9 14.9		Light Gray arkosic SAND,no fines or gravel subrounded, very fine to coarse-grained, well graded, medium dense to loose, dry, odor at 1 foot	SW	▩ Hole Plug Bentonite Pellets
			5	Boring terminated at 2.5 feet due to refusal Groundwater not encountered		
			10			
			15			
			20			
			25			

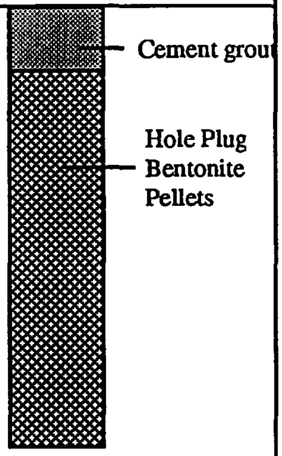
SEACOR

BORING LOG

BORING: IB-2
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION
START 8-29-92 1604
FINISH 8-29-92 1727
SAMPLER SIVILLE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT N/A
COMMENTS SOIL SAMPLES CONTINOUSLY COLLECTED USING A HAND AUGER

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	CONCRETE		Cement grout
		0 15.9 11.4 0 0 0 6.5 4.6 3.6 5.1 0.4 0 0 2.1 0 2.8 9.4		Light Gray arkosic SAND, no fines/gravel, subrounded, very fine to coarse-grained, very well graded, medium dense to loose, dry	SW	Hole Plug Bentonite Pellets
			5	Dark Gray SAND, some silt, no gravel, very fine-grained, poorly graded, medium dense to dense, moist	SP	
				Light Gray arkosic SAND, no fines/gravel, subrounded, very well graded, very fine to coarse-grained, medium dense to loose, dry with small gravel with organics	SW	
			10	Boring Terminated at 9.5 feet Groundwater not encountered		
			15			
			20			
			25			



SEACOR

BORING LOG

BORING: IB-3
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION
START 8-29-92 1750
FINISH 8-29-92 1910
SAMPLER SIVILLE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT N/A
COMMENTS SOIL SAMPLES CONTINOUSLY COLLECTED USING A HAND AUGER

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	CONCRETE		Cement grout
	░ ▨ ░ ░ ░ ░	313 225 60.3 38.4 24.6 8.8		Light Gray arkosic SAND, no fines/gravel subrounded, very fine to coarse-grained, very well graded, loose, dry, odor	SW	Hole Plug Bentonite Pellets
	░ ░	27.1 33.0	5	Dark Gray SAND, some silt, no gravel, very fine-grained, poorly sorted, medium dense to dense, moist	SP	
	░ ▨ ░ ░ ░ ░ ░ ░ ▨	26.3 29.6 39.9 19.1 6.7 7.4 6.3 5.9 1.6		Light Gray arkosic SAND, no fines/gravel subrounded, very fine to coarse-grained, very well graded, loose, moist with gravel	SW	
			10	with organics Boring Terminated at 9.5 feet Groundwater not encountered		
			15			
			20			
			25			

SEACOR

BORING LOG

BORING: OB-2
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION
START 8-28-92 1530
FINISH 8-28-92 1602
SAMPLER SIVILLE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINOUSLY COLLECTED USING A 3"O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

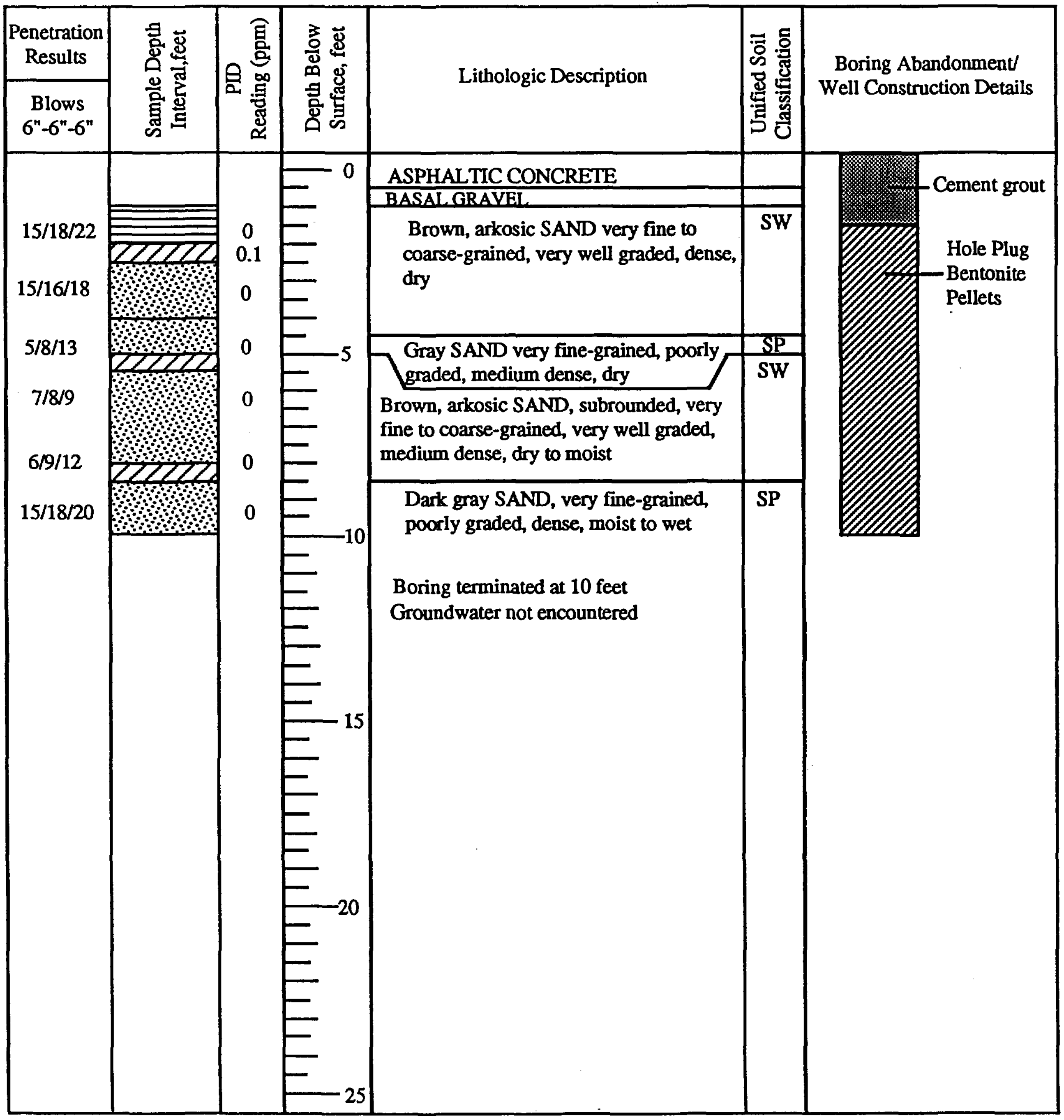
Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	ASPHALTIC CONCRETE		Cement grout
				BASAL GRAVEL		
12/13/15		0.6		Brown arkosic SAND, no fines/gravel, subrounded, very fine to coarse-grained very well graded, medium dense, dry	SW	Hole Plug Bentonite Pellets
7/10/11		0				
15/15/12		0.2	5	Gray with petroleum-like odor, moist		
9/12/15		11		Dark Gray SAND, very fine-grained, poorly graded, medium dense, moist, presence of oil	SP	
9/10/12		1.2				
5/8/8				oil coating on brass sleeves with wood particles		
			10	Boring terminated at 10 feet Groundwater not encountered		
			15			
			20			
			25			

SEACOR

BORING LOG

BORING: OB-3
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION
START 8-31-92 1515
FINISH 8-31-92 1550
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLE CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES



Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	ASPHALTIC CONCRETE		Cement grout
				BASAL GRAVEL		
15/18/22		0 0.1		Brown, arkosic SAND very fine to coarse-grained, very well graded, dense, dry	SW	Hole Plug Bentonite Pellets
15/16/18		0				
5/8/13		0	5	Gray SAND very fine-grained, poorly graded, medium dense, dry	SP	
7/8/9		0		Brown, arkosic SAND, subrounded, very fine to coarse-grained, very well graded, medium dense, dry to moist	SW	
6/9/12		0				
15/18/20		0		Dark gray SAND, very fine-grained, poorly graded, dense, moist to wet	SP	
			10	Boring terminated at 10 feet Groundwater not encountered		
			15			
			20			
			25			

00075-018-01

SEACOR

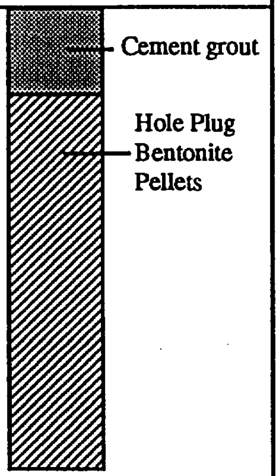
BORING LOG

BORING: OB-4
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION
START 8-31-92 1415
FINISH 8-31-92 1445
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification
			0	ASPHALTIC CONCRETE	
				BASAL GRAVEL	
6/7/8		0		Brown, arkosic SAND, subrounded, very fine to coarse-grained, very well graded, medium dense, dry	SW
6/7/8		0			
7/9/14		1.3 5.0	5	gray, moist	
15/16/18		4.1 2.6		Dark gray SAND with organics, very fine-grained, poorly graded, moist, hydrocarbon-like odor	SP
12/13/15		2.5 1.0		Gray, arkosic SAND, subrounded, very fine to coarse-grained, very well graded medium dense to dense, hydrocarbon-like odor	SW
9/12/13		5.8 2.9	10	Dark gray SILT, medium dense, wet, presence of oil	ML
				Boring terminated at 10 feet	
				Groundwater not encountered	
			15		
			20		
			25		

Boring Abandonment/ Well Construction Details

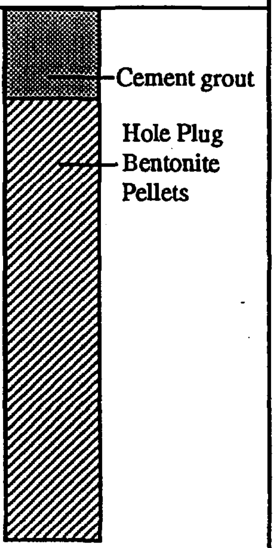


SEACOR

BORING LOG

BORING: OB-5
PAGE 1 of 1

PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHIGNTON
SURFACE ELEVATION
CASING TOP ELEVATION
START 8-31-92 1332
FINISH 8-31-92 1415
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINOUSLY COLLECTED USING A 8" O.D. SPLIT SPOOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

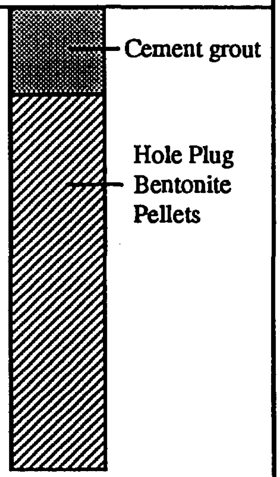
Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	ASPALHTIC CONCRETE		 Cement grout Hole Plug Bentonite Pellets
				BASAL GRAVEL		
2/2/1		0		Brown arkosic SAND, subrounded, very fine to coarse-grained, very well graded, very loose to medium dense, dry	SW	
4/6/12		0				
12/13/16		1.3 5.0	5	Dark gray sandy SILT with organics, medium dense, dry	ML	
22/26/28		4.1 2.6		Gray arkosic SAND, subrounded, very fine to coarse-grained, very well graded, medium dense, moist	SW	
17/23/27		2.5 1.0		with small gravel		
15/27/23		5.8 2.9	10	presence of oil		
		0.7				
				Dark gray SAND, very fine-grained, poorly graded,wet, presence of oil	SP	
				Boring terminated at 11.5 feet		
			15	Groundwater encountered at approximately 11.5 feet		
			20			
			25			

SEACOR

BORING LOG

BORING: OB-6
PAGE 1 of 1

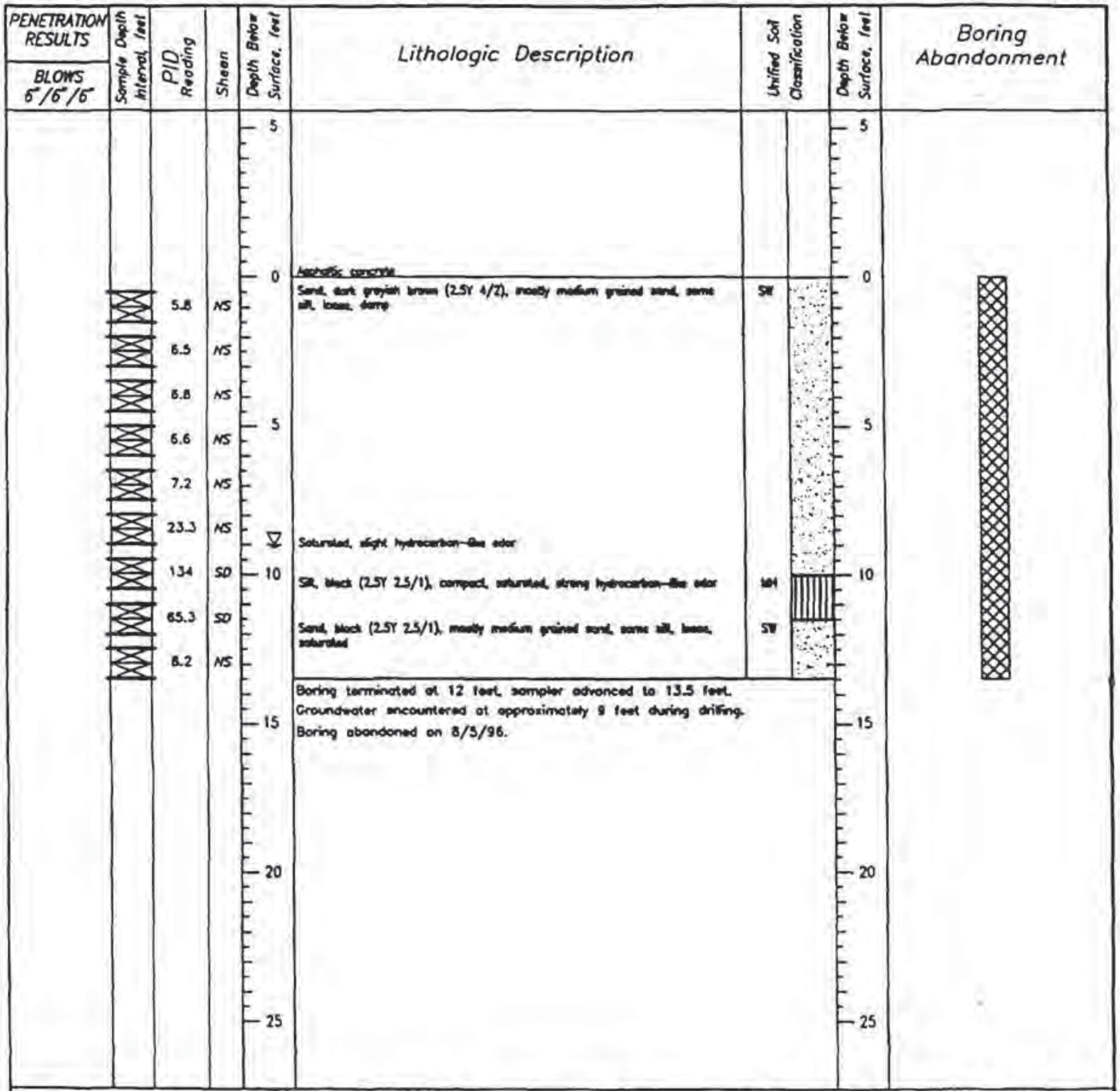
PROJECT FORGE FACILITY AREA 1
LOCATION 8531 E. MARGINAL WAY S. SEATTLE, WASHINGTON
SURFACE ELEVATION
CASING TOP ELEVATION
START 8-31-92 1252
FINISH 8-31-92 1332
SAMPLER SIVILLE/POSTLETHWAITE
MONITORING DEVICE MICROTIP PID
SUBCONTRACTOR AND EQUIPMENT CASCADE DRILLING INC.; 8" O.D. HSA
COMMENTS SOIL SAMPLES CONTINUOUSLY COLLECTED USING A 3" O.D. SPLIT SPOON SAMPLER LINED WITH 2.5" X 6" BRASS SLEEVES

Penetration Results Blows 6"-6"-6"	Sample Depth Interval, feet	PID Reading (ppm)	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Boring Abandonment/ Well Construction Details
			0	ASPHALTIC CONCRETE		
38/47/43		0		Brown arkosic SAND, subrounded, very fine to coarse-grained, very well graded, very dense to dense, dry	SW	
18/20/23		0				
21/28/32		0	5	Gray SAND, some silt, very fine-grained poorly sorted, very dense, dry	SP	
22/39/25		0		Brown arkosic SAND, subrounded, very fine to coarse-grained, very well graded, very dense, moist	SW	
8/10/11		0		with small gravel		
8/11/13		0		wet		
			10	Dark gray SAND, very fine-grained, poorly graded, wet Boring terminated at 10 feet Groundwater not encountered	SP	
			15			
			20			
			25			

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY JORGENSEN FORGE FACILITY - AREA 2 JOB # 00075-025-01 BORING/WELL SB-1
LOCATION 8531 E. MARGINAL WAY, TUKWILA, WA. SURFACE ELEVATION
START 8/5/96 0800 FINISH 8/5/96 0900 CASING TOP ELEVATION
LOGGED BY H. RUIZ MONITORING DEVICE MICROTIP MP-1000 PID
SUBCONTRACTOR AND EQUIPMENT HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG
COMMENTS SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER



PENETRATION RESULTS BLOWS 6"/6"/6"	Sample Depth Interval, feet	PID Reading	Sheen	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Depth Below Surface, feet	Boring Abandonment
				5			5	
				0	Asphaltic concrete		0	
	⊠	5.8	NS		Sand, dark greyish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SW		▩
	⊠	6.5	NS					▩
	⊠	6.8	NS					▩
				5			5	▩
	⊠	6.6	NS					▩
	⊠	7.2	NS					▩
	⊠	23.3	NS	∇	Saturated, slight hydrocarbon-like odor			▩
	⊠	134	SD	10	Silt, black (2.5Y 2.5/1), compact, saturated, strong hydrocarbon-like odor	ML	10	▩
	⊠	65.3	SD		Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, loose, saturated	SW		▩
	⊠	8.2	NS					▩
					Boring terminated at 12 feet, sampler advanced to 13.5 feet. Groundwater encountered at approximately 9 feet during drilling. Boring abandoned on 8/5/96.			
				15			15	
				20			20	
				25			25	

▨ Field Screen/Lithologic Description Sample
⊠ Preserved Sample
☐ No Recovery
• Sample Submitted for Laboratory Analysis

∇ Groundwater Level at Time of Drilling
▼ Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts

- - - Gradational Contact
/ Contact Located Approximately
— Contact

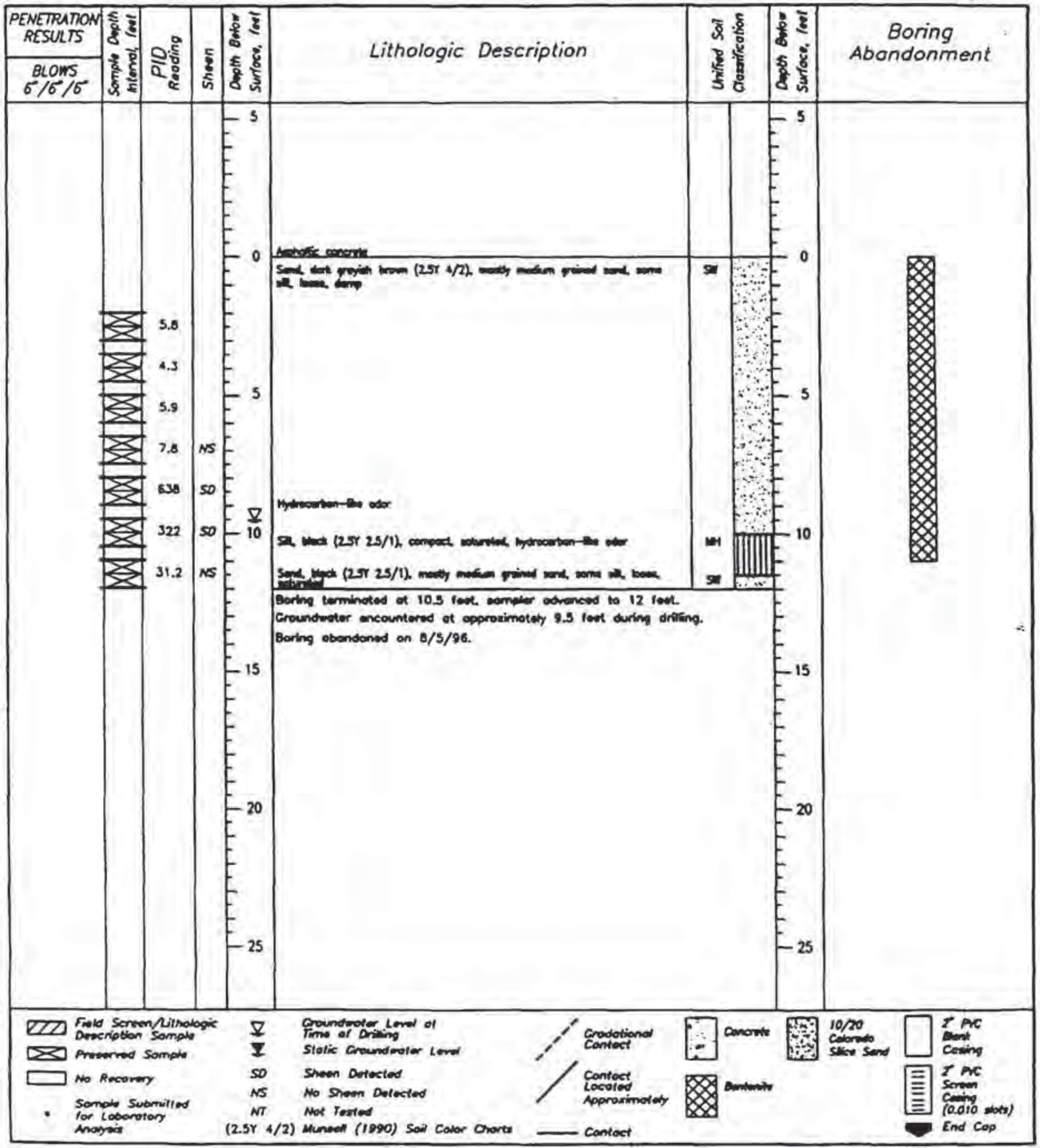
Concrete
▩ Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

DWG: JOR2501L

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY JORGENSEN FORGE FACILITY - AREA 2 JOB # 00075-025-01 BORING/WELL SB-2
LOCATION 8531 E. MARGINAL WAY, TUKWILA, WA. SURFACE ELEVATION
START 8/5/96 0923 FINISH 8/5/96 1030 CASING TOP ELEVATION
LOGGED BY H. RUIZ MONITORING DEVICE MICROTIP MP-1000 PID
SUBCONTRACTOR AND EQUIPMENT HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG
COMMENTS SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER



PID Reading	Sheen
5.8	
4.3	
5.9	
7.8	NS
638	SD
322	SD
31.2	NS

Asphaltic concrete

Sand, dark greyish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp — SW

Hydrocarbon-like odor

Silt, black (2.5Y 2.5/1), compact, saturated, hydrocarbon-like odor — MH

Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, loose, saturated — SW

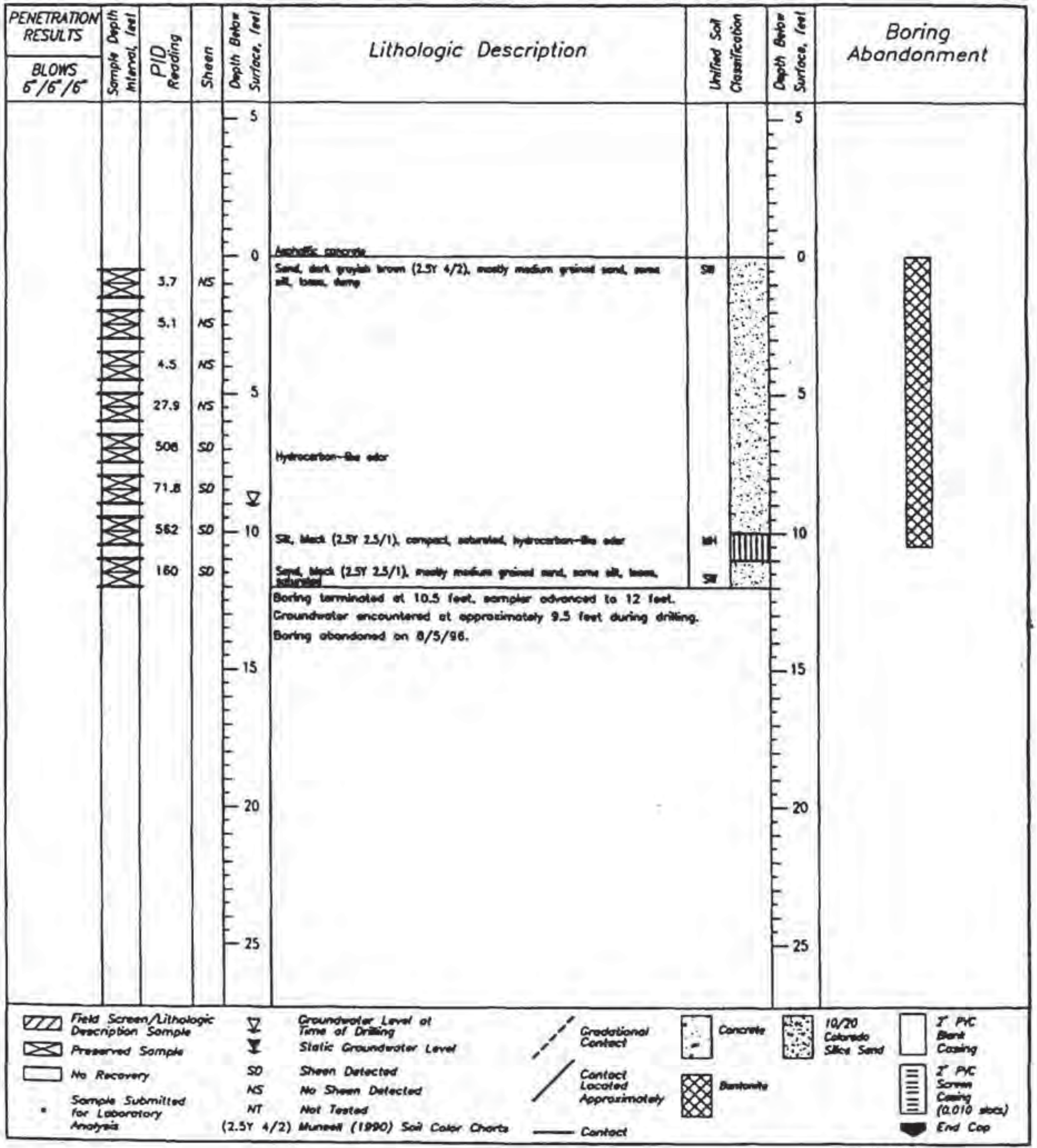
Boring terminated at 10.5 feet, sampler advanced to 12 feet.
Groundwater encountered at approximately 9.5 feet during drilling.
Boring abandoned on 8/5/96.

SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY **JORGENSEN FORGE FACILITY - AREA 2** JOB # **00075-025-01** BORING/WELL **SB-3**
LOCATION **8531 E. MARGINAL WAY, TUKWILA, WA.** SURFACE ELEVATION
START **8/5/96 1039** FINISH **8/5/96 1120** CASING TOP ELEVATION
LOGGED BY **H. RUIZ** MONITORING DEVICE **MICROTIP MP-1000 PID**
SUBCONTRACTOR AND EQUIPMENT **HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG**
COMMENTS **SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER**



PENETRATION RESULTS BLOWS 6"/6"/6"	Sample Depth Interval, feet	PID Reading	Sheen	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Depth Below Surface, feet	Boring Abandonment
				0	Asphaltic concrete		0	
	⊠	3.7	NS		Sand, dark grayish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SW		
	⊠	5.1	NS					
	⊠	4.5	NS					
	⊠	27.9	NS	5			5	
	⊠	506	SD		Hydrocarbon-like odor			
	⊠	71.8	SD	∇				
	⊠	562	SD	10	Silt, black (2.5Y 2.5/1), compact, saturated, hydrocarbon-like odor	MH	10	
	⊠	160	SD		Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, loose, saturated	SW		

Boring terminated at 10.5 feet, sampler advanced to 12 feet.
Groundwater encountered at approximately 9.5 feet during drilling.
Boring abandoned on 8/5/96.

DWG: JOR2503L

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY JORGENSEN FORGE FACILITY - AREA 2 JOB # 00075-025-01 BORING/WELL SB-4
LOCATION 8531 E. MARGINAL WAY, TUKWILA, WA. SURFACE ELEVATION
START 8/5/96 1124 FINISH 8/5/96 1246 CASING TOP ELEVATION
LOGGED BY H. RUIZ MONITORING DEVICE MICROTIP MP-1000 PID
SUBCONTRACTOR AND EQUIPMENT HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG
COMMENTS SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER

PENETRATION RESULTS BLOWS 6"/6"/6"	Sample Depth Interval, feet	PID Reading	Sheen	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Depth Below Surface, feet	Boring Abandonment
				5			5	
				0	Asphaltic concrete		0	
					Sand, dark grayish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SW		▩
	⊠	8.1	NS					▩
	⊠	4.2	NS					▩
	⊠	40.8	NS	5			5	▩
	⊠	6.7	NS					▩
	⊠	64.3	SD		Hydrocarbon-like odor			▩
				∇				▩
	⊠	657	SD	10			10	▩
					Silt, black (2.5Y 2.5/1), compact, saturated, hydrocarbon-like odor	MH		▩
	⊠	0	NS					▩
	⊠	2.8	SD		Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, saturated, patchy sheen	SW		▩
	⊠	0	NS		Boring terminated at 13 feet, sampler advanced to 14.5 feet. Groundwater encountered at approximately 9 feet during drilling. Boring abandoned on 8/5/96.			
				15			15	
				20			20	
				25			25	

▨ Field Screen/Lithologic Description Sample
⊠ Preserved Sample
▭ No Recovery
• Sample Submitted for Laboratory Analysis

∇ Groundwater Level at Time of Drilling
▼ Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts

╱ Gradational Contact
╱ Contact Located Approximately
— Contact

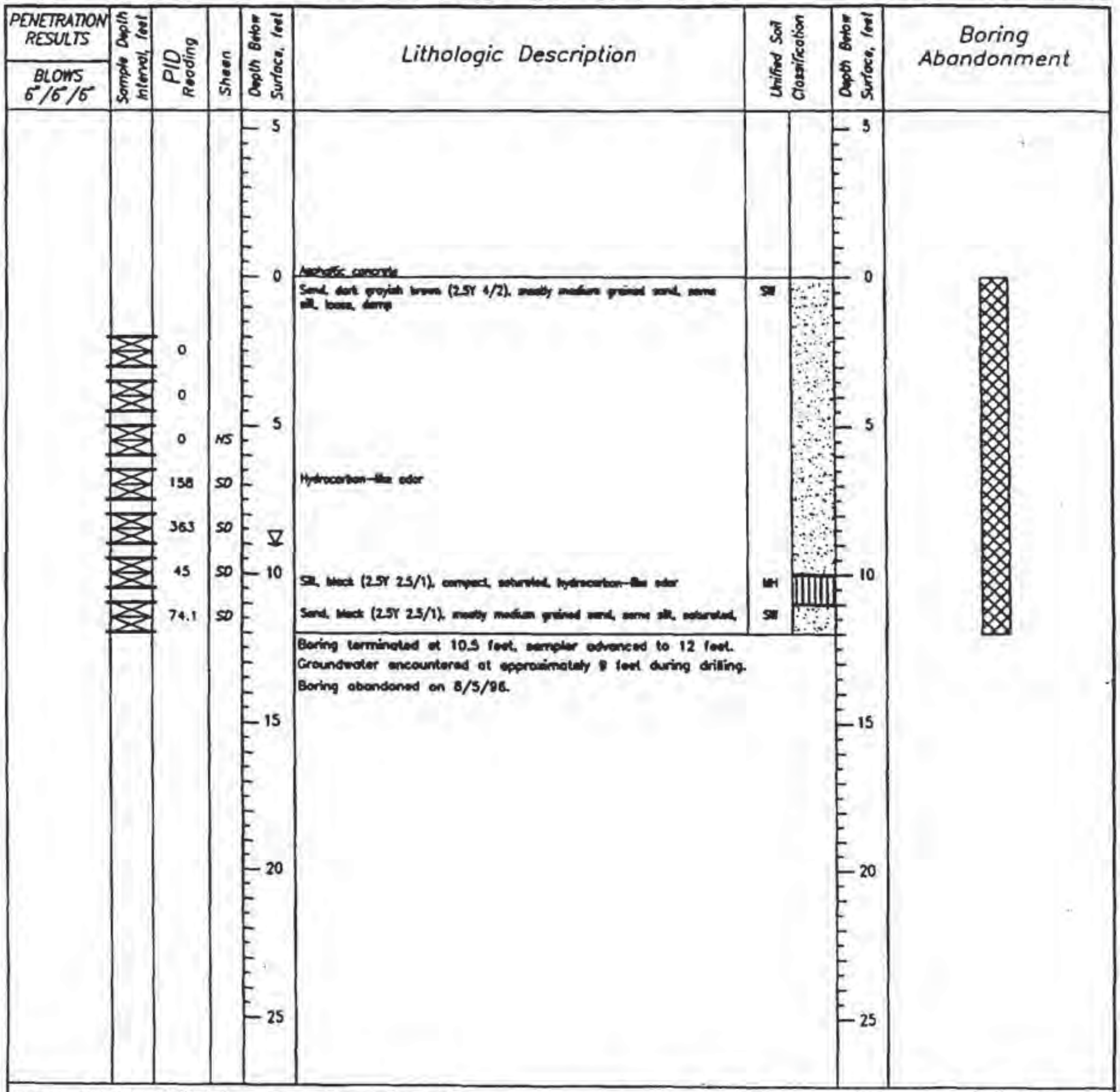
░ Concrete
▩ Bentonite
░ 10/20 Colorado Silica Sand
▯ 2" PVC Blank Casing
☰ 2" PVC Screen Casing (0.010 slots)
▼ End Cap

DWG: JOR2504L

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY **JORGENSEN FORGE FACILITY - AREA 2** JOB # **00075-025-01** BORING/WELL **SB-5**
LOCATION **8531 E. MARGINAL WAY, TUKWILA, WA.** SURFACE ELEVATION
START **8/5/96 1255** FINISH **8/5/96 1355** CASING TOP ELEVATION
LOGGED BY **H. RUIZ** MONITORING DEVICE **MICROTIP MP-1000 PID**
SUBCONTRACTOR AND EQUIPMENT **HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG**
COMMENTS **SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER**



PENETRATION RESULTS BLOWS 6"/6"/6"	Sample Depth Interval, feet	PID Reading	Sheen	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Depth Below Surface, feet	Boring Abandonment
				5			5	
				0	Asphaltic concrete		0	
					Sand, dark grayish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SW		
	⊠	0						
	⊠	0		5			5	
	⊠	0	NS					
	⊠	158	SD		Hydrocarbon-like odor			
	⊠	363	SD	▽				
	⊠	45	SD	10	Silt, black (2.5Y 2.5/1), compact, saturated, hydrocarbon-like odor	MH	10	
	⊠	74.1	SD		Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, saturated,	SW		
					Boring terminated at 10.5 feet, sampler advanced to 12 feet. Groundwater encountered at approximately 9 feet during drilling. Boring abandoned on 8/5/96.			
				15			15	
				20			20	
				25			25	

▨ Field Screen/Lithologic Description Sample
⊠ Preserved Sample
☐ No Recovery
• Sample Submitted for Laboratory Analysis

▽ Groundwater Level at Time of Drilling
▼ Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts

Gradational Contact
Contact Located Approximately
Contact

Concrete
Bentonite
10/20 Colorado Silica Sand

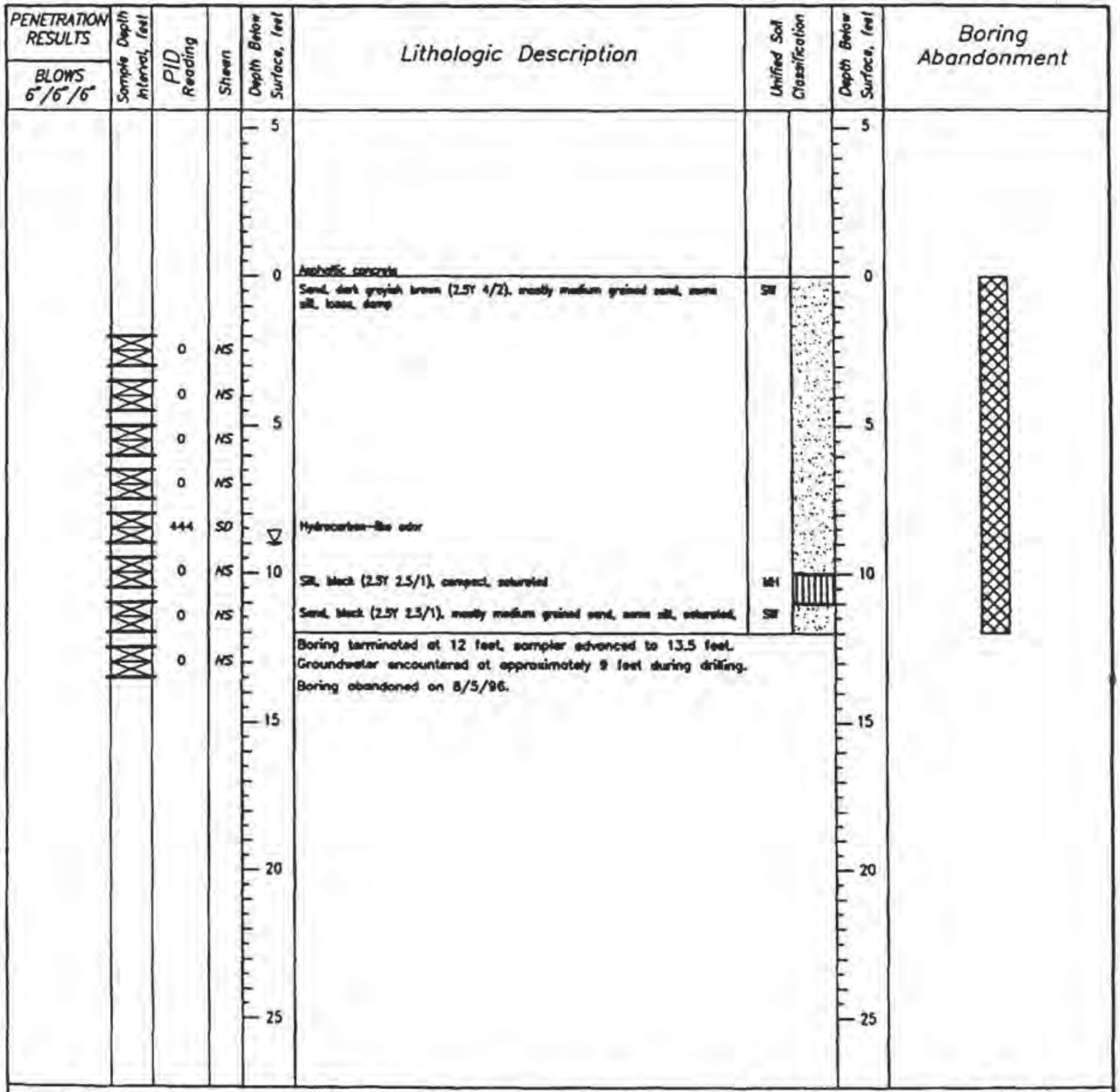
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

DWG: JOR2505L

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY JORGENSEN FORGE FACILITY - AREA 2 JOB # 00075-025-01 BORING/WELL SB-6
LOCATION 8531 E. MARGINAL WAY, TUKWILA, WA. SURFACE ELEVATION
START 8/5/96 1400 FINISH 8/5/96 1440 CASING TOP ELEVATION
LOGGED BY H. RUIZ MONITORING DEVICE MICROTIP MP-1000 PID
SUBCONTRACTOR AND EQUIPMENT HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG
COMMENTS SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER



PENETRATION RESULTS BLOWS 6"/6"/6"	Sample Depth Interval, feet	PID Reading	Sheen	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Depth Below Surface, feet	Boring Abandonment
				5			5	
				0	Asphaltic concrete		0	
					Sand, dark grayish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SW		
	☒	0	NS					
	☒	0	NS					
				5			5	
	☒	0	NS					
	☒	0	NS					
	☒	444	SD	∇	Hydrocarbon-like odor			
	☒	0	NS	10			10	
					Silt, black (2.5Y 2.5/1), compact, saturated	MH		
	☒	0	NS		Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, saturated,	SW		
	☒	0	NS		Boring terminated at 12 feet, sampler advanced to 13.5 feet. Groundwater encountered at approximately 9 feet during drilling. Boring abandoned on 8/5/96.			
				15			15	
				20			20	
				25			25	

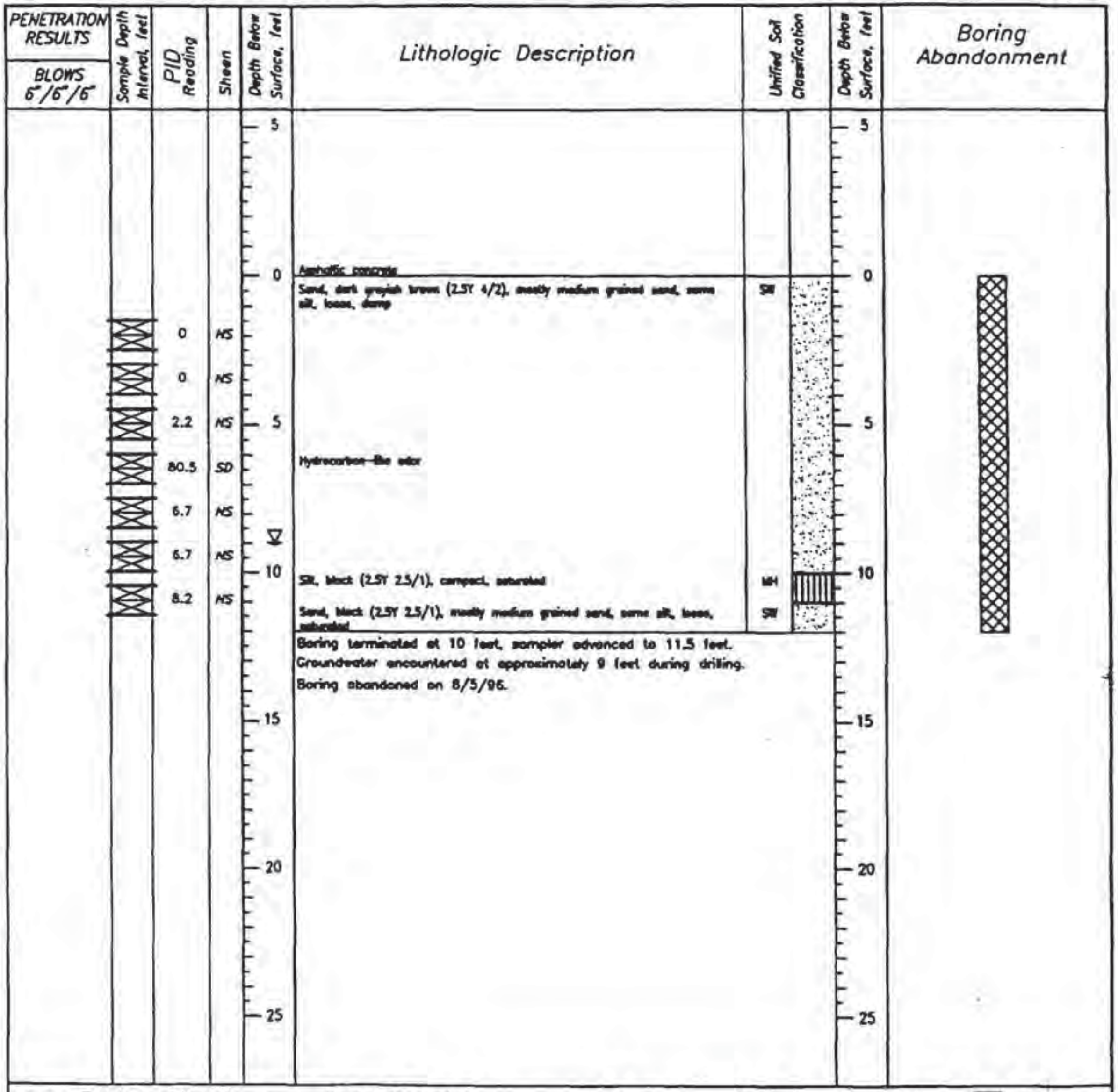
▨ Field Screen/Lithologic Description Sample	∇ Groundwater Level at Time of Drilling	Gradational Contact	Concrete	10/20 Colorado Silica Sand	2" PVC Blank Casing
☒ Preserved Sample	▼ Static Groundwater Level	Contact Located Approximately	▩ Bentonite		2" PVC Screen Casing (0.010 slots)
☐ No Recovery	SD Sheen Detected	Contact			End Cap
• Sample Submitted for Laboratory Analysis	NS No Sheen Detected				
	NT Not Tested				
	(2.5Y 4/2) Munsell (1990) Soil Color Charts				

DWG: JOR2506L

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY **JORGENSEN FORGE FACILITY - AREA 2** JOB # **00075-025-01** BORING/WELL **SB-7**
LOCATION **8531 E. MARGINAL WAY, TUKWILA, WA.** SURFACE ELEVATION
START **8/5/96 1520** FINISH **8/5/96 1555** CASING TOP ELEVATION
LOGGED BY **H. RUIZ** MONITORING DEVICE **MICROTIP MP-1000 PID**
SUBCONTRACTOR AND EQUIPMENT **HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG**
COMMENTS **SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER**



PID Reading	Sheen
0	NS
0	NS
2.2	NS
80.5	SD
6.7	NS
6.7	NS
8.2	NS

Lithologic Description	Unified Soil Classification
Asphaltic concrete	
Sand, dark grayish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SW
Hydrocarbon-like odor	
Silt, black (2.5Y 2.5/1), compact, saturated	MH
Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, loose, saturated	SW

Boring terminated at 10 feet, sampler advanced to 11.5 feet.
Groundwater encountered at approximately 9 feet during drilling.
Boring abandoned on 8/5/96.

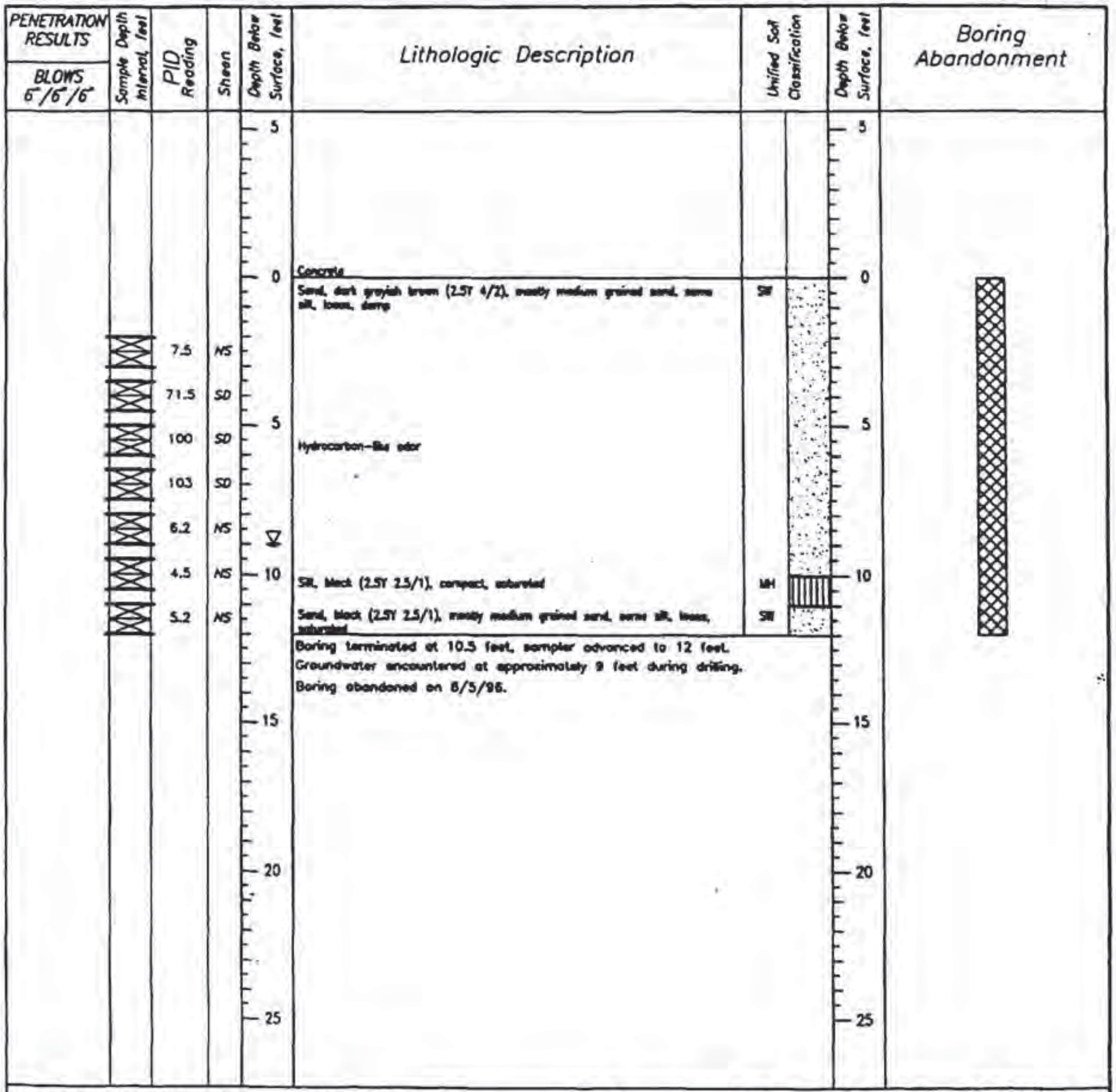
▨	Field Screen/Lithologic Description Sample
☒	Preserved Sample
☐	No Recovery
•	Sample Submitted for Laboratory Analysis
∇	Groundwater Level at Time of Drilling
▼	Static Groundwater Level
SD	Sheen Detected
NS	No Sheen Detected
NT	Not Tested
(2.5Y 4/2)	Munsell (1990) Soil Color Charts
- - -	Gradational Contact
/	Contact Located Approximately
—	Contact
⁘	Concrete
▩	Bentonite
⁙	10/20 Colorado Silica Sand
☐	2" PVC Blank Casing
☰	2" PVC Screen Casing (0.010 slots)
▼	End Cap

DWG: JOR2507L

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY **JORGENSEN FORGE FACILITY - AREA 2** JOB # **00075-025-01** BORING/WELL **SB-8**
LOCATION **8531 E. MARGINAL WAY, TUKWILA, WA.** SURFACE ELEVATION
START **8/5/96 1615** FINISH **8/5/96 1710** CASING TOP ELEVATION
LOGGED BY **H. RUIZ** MONITORING DEVICE **MICROTIP MP-1000 PID**
SUBCONTRACTOR AND EQUIPMENT **HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG**
COMMENTS **SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER**



PID Reading	Sheen
7.5	NS
71.5	SD
100	SD
103	SD
6.2	NS
4.5	NS
5.2	NS

Lithologic Description	Unified Soil Classification
Concrete	
Sand, dark grayish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SW
Hydrocarbon-like odor	
Silt, black (2.5Y 2.5/1), compact, saturated	MH
Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, loose, saturated	SW

Boring terminated at 10.5 feet, sampler advanced to 12 feet.
Groundwater encountered at approximately 9 feet during drilling.
Boring abandoned on 8/5/96.

▨ Field Screen/Lithologic Description Sample
☒ Preserved Sample
☐ No Recovery
• Sample Submitted for Laboratory Analysis

▽ Groundwater Level at Time of Drilling
▼ Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts

Gradational Contact
Contact Located Approximately
Contact

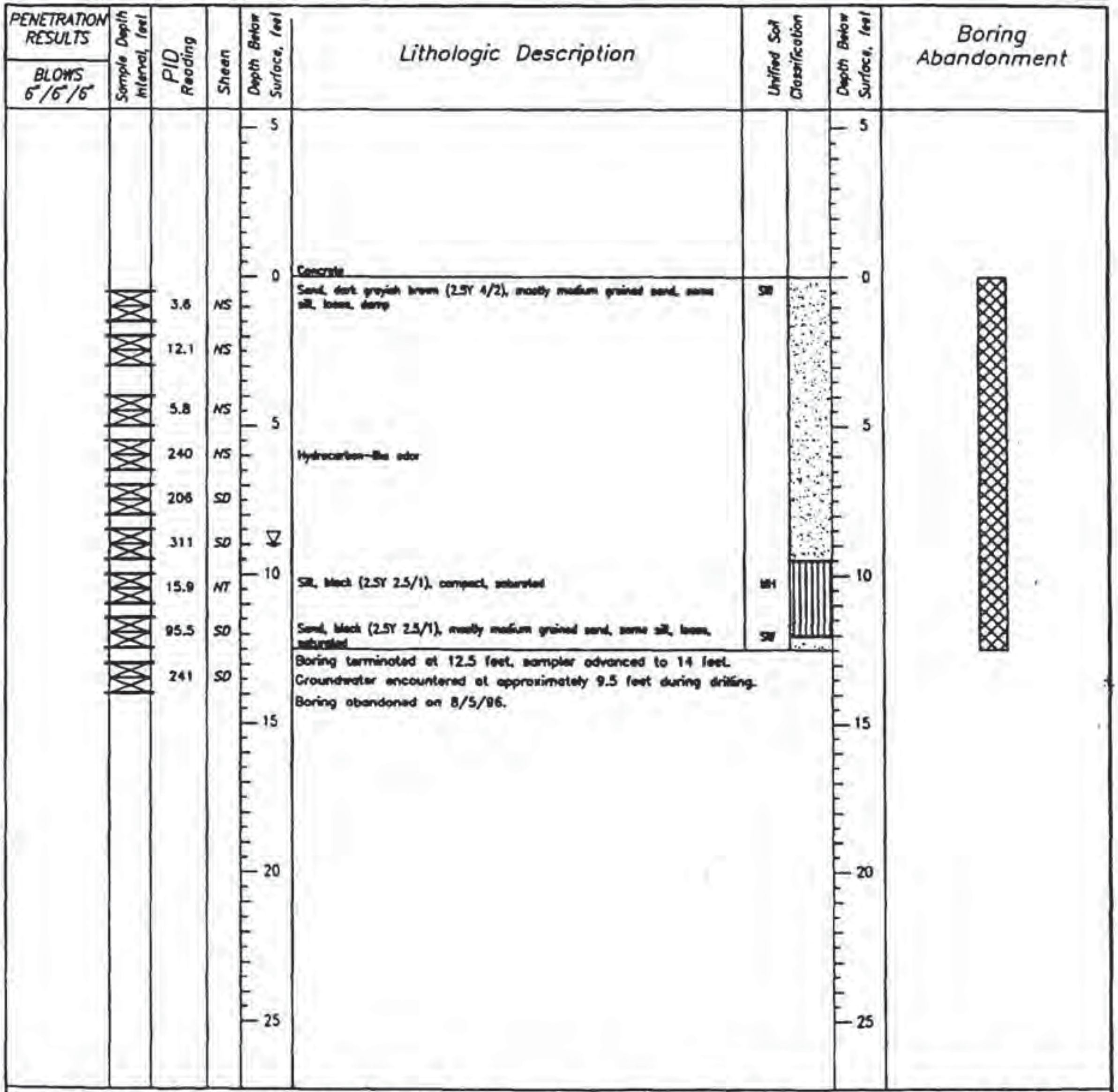
Concrete
Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

DWG: JOR2508L

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY JORGENSEN FORGE FACILITY - AREA 2 JOB # 00075-025-01 BORING/WELL SB-9
LOCATION 8531 E. MARGINAL WAY, TUKWILA, WA. SURFACE ELEVATION
START 8/6/96 0845 FINISH 8/6/96 0930 CASING TOP ELEVATION
LOGGED BY H. RUIZ MONITORING DEVICE MICROTIP MP-1000 PID
SUBCONTRACTOR AND EQUIPMENT HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG
COMMENTS SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER



PID Reading	Sheen
3.6	NS
12.1	NS
5.8	NS
240	NS
206	SD
311	SD
15.9	NT
95.5	SD
241	SD

Lithologic Description

Concrete

Sand, dark greyish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp

Hydrocarbon-like odor

Silt, black (2.5Y 2.5/1), compact, saturated

Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, loose, saturated

Boring terminated at 12.5 feet, sampler advanced to 14 feet.
Groundwater encountered at approximately 9.5 feet during drilling.
Boring abandoned on 8/5/96.

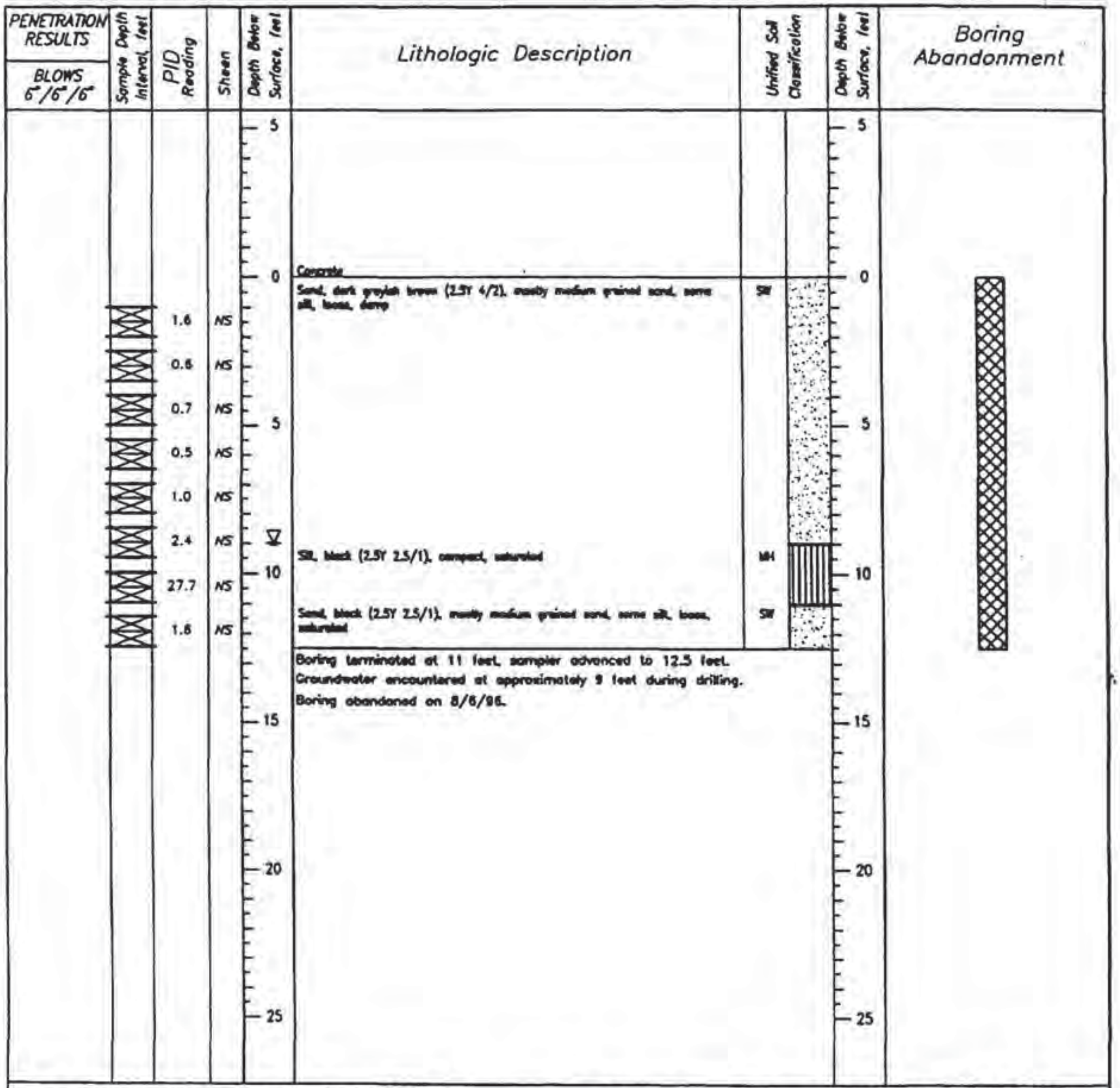
▨ Field Screen/Lithologic Description Sample	▽ Groundwater Level at Time of Drilling	Gradational Contact	Concrete
☒ Preserved Sample	▼ Static Groundwater Level	Contact Located Approximately	Bentonite
☐ No Recovery	SD Sheen Detected	—— Contact	10/20 Colorado Silica Sand
• Sample Submitted for Laboratory Analysis	NS No Sheen Detected		2" PVC Blank Casing
	NT Not Tested		2" PVC Screen Casing (0.010 slots)
	(2.5Y 4/2) Munsell (1990) Soil Color Charts		End Cap

DWG: JOR2509L

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY **JORGENSEN FORGE FACILITY - AREA 2** JOB # **00075-026-01** BORING/WELL **SB-10**
LOCATION **8531 E. MARGINAL WAY, TUKWILA, WA.** SURFACE ELEVATION
START **8/6/96 1030** FINISH **8/6/96 1100** CASING TOP ELEVATION
LOGGED BY **H. RUIZ** MONITORING DEVICE **MICROTIP MP-1000 PID**
SUBCONTRACTOR AND EQUIPMENT **HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG**
COMMENTS **SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER**



PID Reading	Sheen
1.6	NS
0.6	NS
0.7	NS
0.5	NS
1.0	NS
2.4	NS
27.7	NS
1.6	NS

Lithologic Description	Unified Soil Classification
Concrete	
Sand, dark grayish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SW
Silt, black (2.5Y 2.5/1), compact, saturated	MH
Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, loose, saturated	SW

Boring terminated at 11 feet, sampler advanced to 12.5 feet.
Groundwater encountered at approximately 9 feet during drilling.
Boring abandoned on 8/6/96.

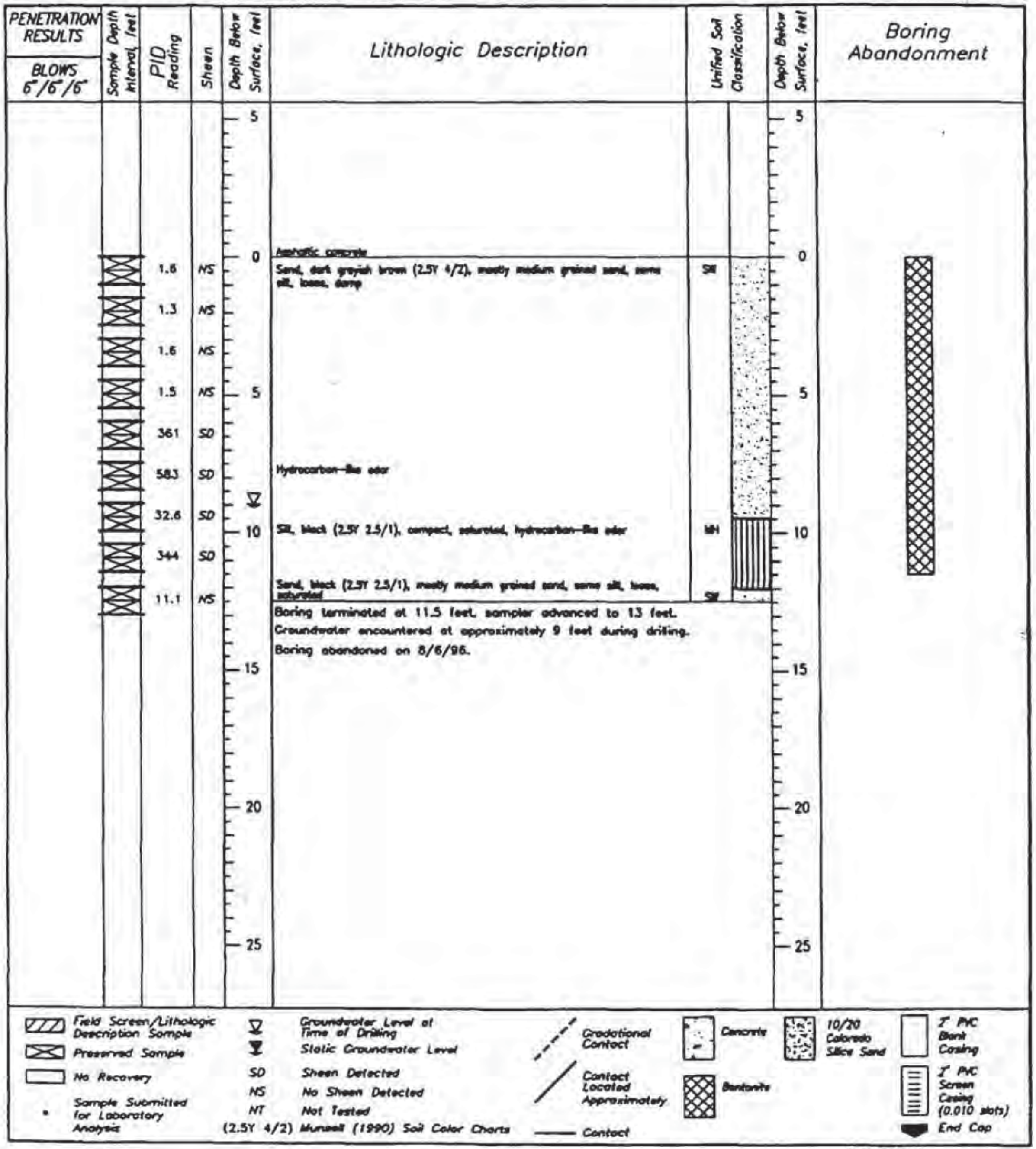
▨ Field Screen/Lithologic Description Sample
☒ Preserved Sample
☐ No Recovery
■ Sample Submitted for Laboratory Analysis
∇ Groundwater Level at Time of Drilling
▼ Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts
Gradational Contact
Contact Located Approximately
Contact
Concrete
Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

DWG: JOR2510L

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY JORGENSEN FORGE FACILITY - AREA 2 JOB # 00075-025-01 BORING/WELL SB-11
LOCATION 8531 E. MARGINAL WAY, TUKWILA, WA. SURFACE ELEVATION
START 8/6/96 1120 FINISH 8/6/96 1220 CASING TOP ELEVATION
LOGGED BY H. RUIZ MONITORING DEVICE MICROTIP MP-1000 PID
SUBCONTRACTOR AND EQUIPMENT HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG
COMMENTS SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER



PENETRATION RESULTS BLOWS 6"/6"/6"	Sample Depth Interval, feet	PID Reading	Sheen	Depth Below Surface, feet	Lithologic Description	Unified Soil Classification	Depth Below Surface, feet	Boring Abandonment
				0	Asphaltic concrete		0	
	☒	1.6	NS		Sand, dark greyish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SM		
	☒	1.3	NS					
	☒	1.6	NS					
	☒	1.5	NS	5			5	
	☒	361	SD					
	☒	583	SD		Hydrocarbon-like odor			
	☒	32.6	SD	∇				
				10	Silt, black (2.5Y 2.5/1), compact, saturated, hydrocarbon-like odor	MH	10	
	☒	344	SD					
	☒	11.1	NS		Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, loose, saturated	SM		

Boring terminated at 11.5 feet, sampler advanced to 13 feet.
Groundwater encountered at approximately 9 feet during drilling.
Boring abandoned on 8/6/96.

▨ Field Screen/Lithologic Description Sample
☒ Preserved Sample
☐ No Recovery
• Sample Submitted for Laboratory Analysis
∇ Groundwater Level at Time of Drilling
▼ Static Groundwater Level
SD Sheen Detected
NS No Sheen Detected
NT Not Tested
(2.5Y 4/2) Munsell (1990) Soil Color Charts
Gradational Contact
Contact Located Approximately
Contact
Concrete
Bentonite
10/20 Colorado Silica Sand
2" PVC Blank Casing
2" PVC Screen Casing (0.010 slots)
End Cap

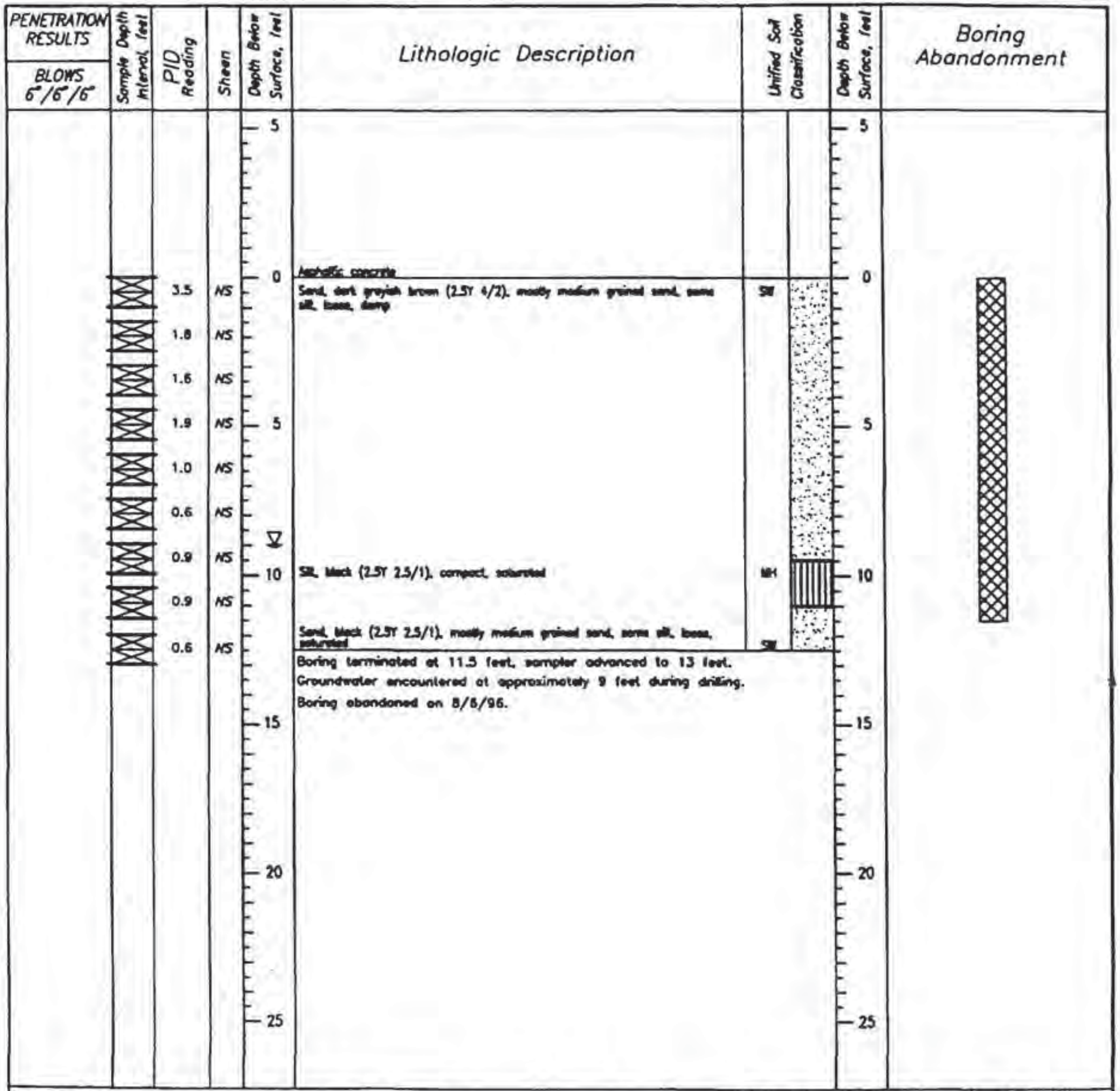
DWG: JOR2511L

J 10

SECOR
International Incorporated

PAGE 1 OF 1

FACILITY **JORGENSEN FORGE FACILITY - AREA 2** JOB # **00075-025-01** BORING/WELL **SB-12**
LOCATION **8531 E. MARGINAL WAY, TUKWILA, WA.** SURFACE ELEVATION
START **8/6/96 1220** FINISH **8/6/96 1253** CASING TOP ELEVATION
LOGGED BY **H. RUIZ** MONITORING DEVICE **MICROTIP MP-1000 PID**
SUBCONTRACTOR AND EQUIPMENT **HOLT DRILLING, INC.; LIMITED ACCESS GEOPROBE RIG**
COMMENTS **SAMPLED EVERY 1.5 FEET USING A 2" O.D. X 1.5' LONG SPLIT SPOON SAMPLER**



PID Reading	Sheen
3.5	NS
1.8	NS
1.6	NS
1.9	NS
1.0	NS
0.6	NS
0.9	NS
0.9	NS
0.6	NS

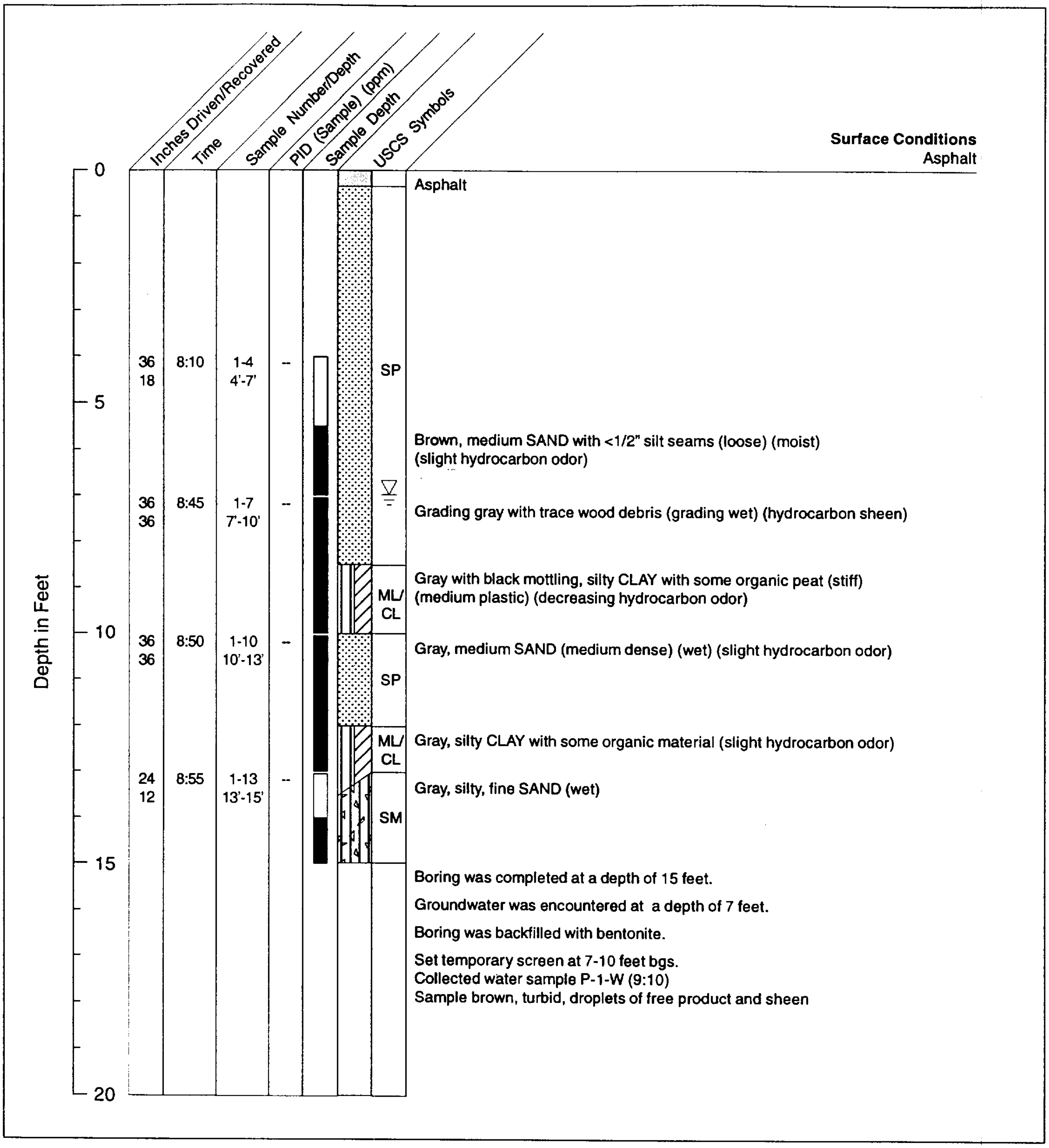
Lithologic Description	Unified Soil Classification
Asphaltic concrete	
Sand, dark grayish brown (2.5Y 4/2), mostly medium grained sand, some silt, loose, damp	SW
Silt, black (2.5Y 2.5/1), compact, saturated	MH
Sand, black (2.5Y 2.5/1), mostly medium grained sand, some silt, loose, saturated	SW

Boring terminated at 11.5 feet, sampler advanced to 13 feet. Groundwater encountered at approximately 9 feet during drilling. Boring abandoned on 8/6/96.

▨	Field Screen/Lithologic Description Sample	▽	Groundwater Level at Time of Drilling	- - -	Gradational Contact		Concrete	10/20 Colorado Silica Sand	2" PVC Blank Casing
☒	Preserved Sample	▼	Static Groundwater Level	/	Contact Located Approximately	▩	Bentonite		2" PVC Screen Casing (0.010 slots)
☐	No Recovery	SD	Sheen Detected	—	Contact				End Cap
•	Sample Submitted for Laboratory Analysis	NS	No Sheen Detected						
		NT	Not Tested						
		(2.5Y 4/2)	Munsell (1990) Soil Color Charts						

DWG: JOR2512L

31613B01.CDR



Inches Driven/Recovered	Time	Sample Number/Depth	PID (Sample) (ppm)
36 18	8:10	1-4 4'-7'	–
36 36	8:45	1-7 7'-10'	–
36 36	8:50	1-10 10'-13'	–
24 12	8:55	1-13 13'-15'	–

Surface Conditions
Asphalt

Asphalt

Brown, medium SAND with <1/2" silt seams (loose) (moist) (slight hydrocarbon odor)

Grading gray with trace wood debris (grading wet) (hydrocarbon sheen)

Gray with black mottling, silty CLAY with some organic peat (stiff) (medium plastic) (decreasing hydrocarbon odor)

Gray, medium SAND (medium dense) (wet) (slight hydrocarbon odor)

Gray, silty CLAY with some organic material (slight hydrocarbon odor)

Gray, silty, fine SAND (wet)

Boring was completed at a depth of 15 feet.

Groundwater was encountered at a depth of 7 feet.

Boring was backfilled with bentonite.

Set temporary screen at 7-10 feet bgs.
Collected water sample P-1-W (9:10)
Sample brown, turbid, droplets of free product and sheen

Geologist: VDA
Drilling method: StrataProbe
Sampling method: SS-Split Spoon, Geoprobe Water Sampler

Drill contractor: TEG Northwest
Drill date: 12/23/98

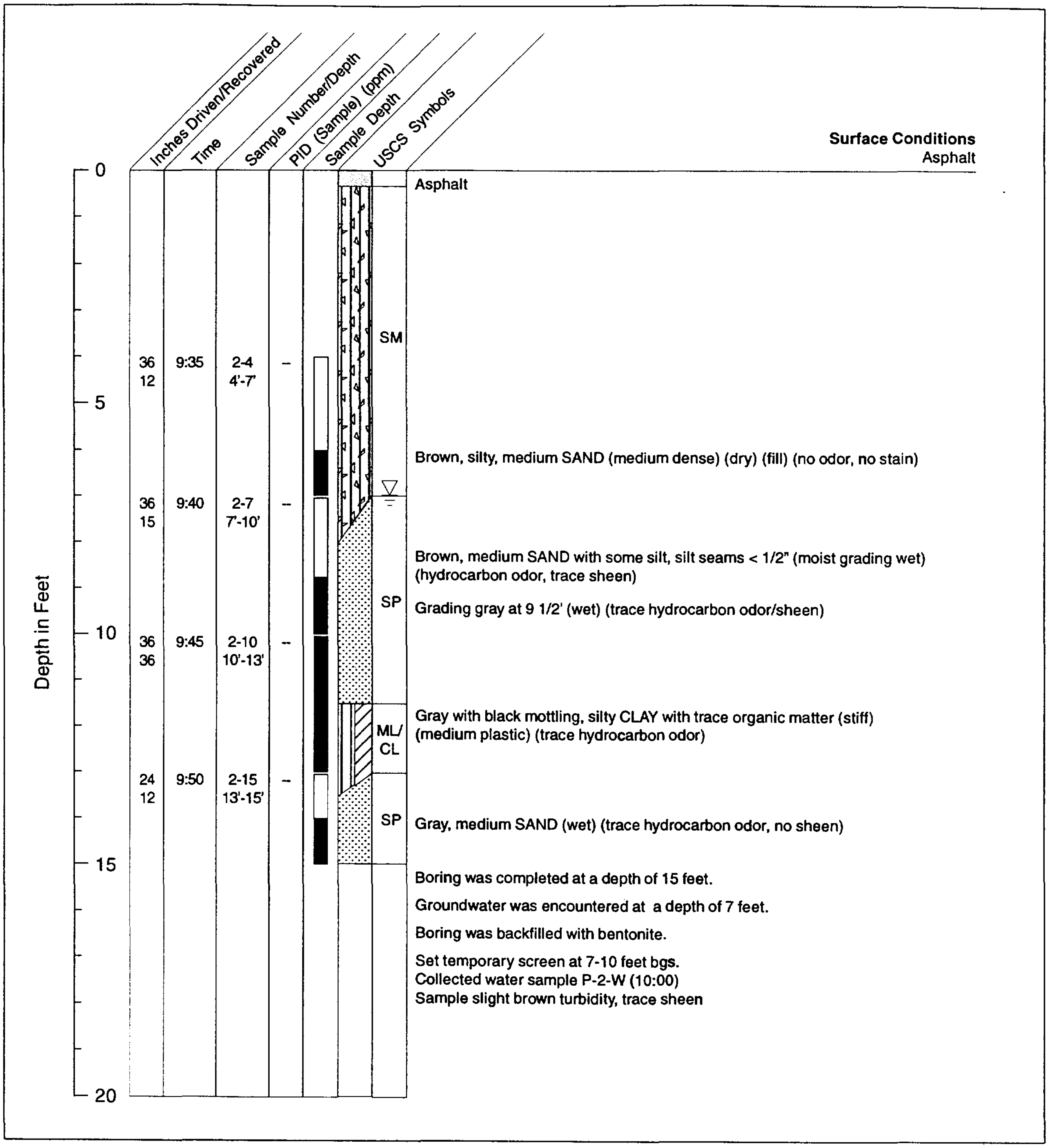
DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Job No. 31613-011-005

P-1
GEOLOGIC BORING LOG

Jorgensen Forge Facility
Seattle, Washington

31613B02.CDR



Surface Conditions
Asphalt

Inches Driven/Recovered	Time	Sample Number/Depth	PID (Sample) (ppm)
36 12	9:35	2-4 4'-7'	-
36 15	9:40	2-7 7'-10'	-
36 36	9:45	2-10 10'-13'	-
24 12	9:50	2-15 13'-15'	-

Asphalt

SM Brown, silty, medium SAND (medium dense) (dry) (fill) (no odor, no stain)

SP Brown, medium SAND with some silt, silt seams < 1/2" (moist grading wet) (hydrocarbon odor, trace sheen)

Grading gray at 9 1/2' (wet) (trace hydrocarbon odor/sheen)

ML/CL Gray with black mottling, silty CLAY with trace organic matter (stiff) (medium plastic) (trace hydrocarbon odor)

SP Gray, medium SAND (wet) (trace hydrocarbon odor, no sheen)

Boring was completed at a depth of 15 feet.

Groundwater was encountered at a depth of 7 feet.

Boring was backfilled with bentonite.

Set temporary screen at 7-10 feet bgs.
Collected water sample P-2-W (10:00)
Sample slight brown turbidity, trace sheen

Geologist: VDA
Drilling method: StrataProbe
Sampling method: SS-Split Spoon, Geoprobe Water Sampler

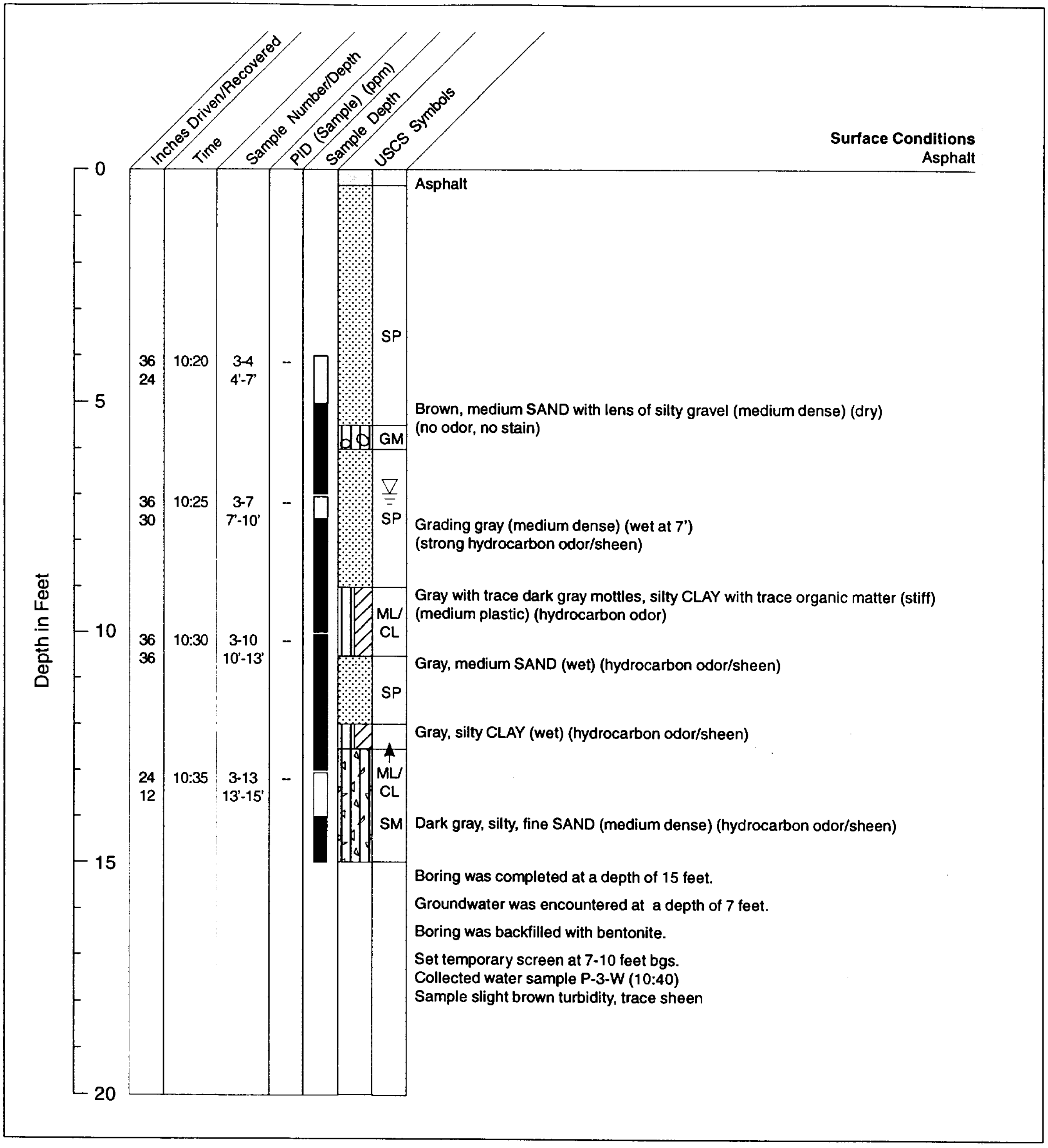
Drill contractor: TEG Northwest
Drill date: 12/23/98

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

P-2
GEOLOGIC BORING LOG

Jorgensen Forge Facility
Seattle, Washington

31613B03.CDR



Surface Conditions
Asphalt

Asphalt

Brown, medium SAND with lens of silty gravel (medium dense) (dry)
(no odor, no stain)

Grading gray (medium dense) (wet at 7')
(strong hydrocarbon odor/sheen)

Gray with trace dark gray mottles, silty CLAY with trace organic matter (stiff)
(medium plastic) (hydrocarbon odor)

Gray, medium SAND (wet) (hydrocarbon odor/sheen)

Gray, silty CLAY (wet) (hydrocarbon odor/sheen)

Dark gray, silty, fine SAND (medium dense) (hydrocarbon odor/sheen)

Boring was completed at a depth of 15 feet.

Groundwater was encountered at a depth of 7 feet.

Boring was backfilled with bentonite.

Set temporary screen at 7-10 feet bgs.
Collected water sample P-3-W (10:40)
Sample slight brown turbidity, trace sheen

Geologist: VDA
Drilling method: StrataProbe
Sampling method: SS-Split Spoon, Geoprobe Water Sampler

Drill contractor: TEG Northwest
Drill date: 12/23/98

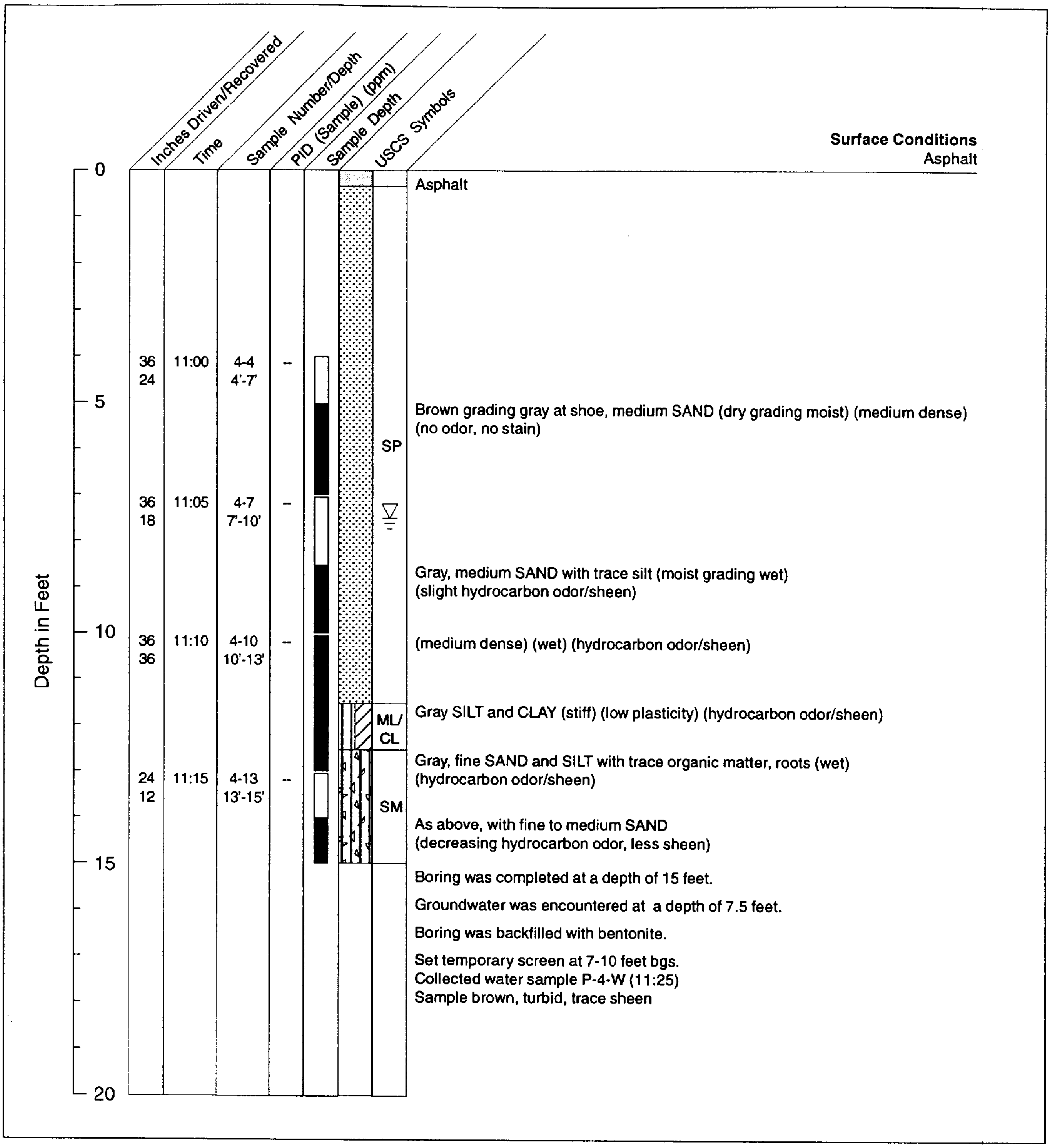
DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

P-3
GEOLOGIC BORING LOG

Jorgensen Forge Facility
Seattle, Washington

Job No. 31613-011-005

3161 3B04.CDR



Surface Conditions
Asphalt

Inches Driven/Recovered	Time	Sample Number/Depth	PID (Sample) (ppm)
36 24	11:00	4-4 4'-7'	–
36 18	11:05	4-7 7'-10'	–
36 36	11:10	4-10 10'-13'	–
24 12	11:15	4-13 13'-15'	–

Asphalt

Brown grading gray at shoe, medium SAND (dry grading moist) (medium dense) (no odor, no stain)

Gray, medium SAND with trace silt (moist grading wet) (slight hydrocarbon odor/sheen)

(medium dense) (wet) (hydrocarbon odor/sheen)

Gray SILT and CLAY (stiff) (low plasticity) (hydrocarbon odor/sheen)

Gray, fine SAND and SILT with trace organic matter, roots (wet) (hydrocarbon odor/sheen)

As above, with fine to medium SAND (decreasing hydrocarbon odor, less sheen)

Boring was completed at a depth of 15 feet.

Groundwater was encountered at a depth of 7.5 feet.

Boring was backfilled with bentonite.

Set temporary screen at 7-10 feet bgs.
Collected water sample P-4-W (11:25)
Sample brown, turbid, trace sheen

Geologist: VDA
Drilling method: StrataProbe
Sampling method: SS-Split Spoon, Geoprobe Water Sampler

Drill contractor: TEG Northwest
Drill date: 12/23/98

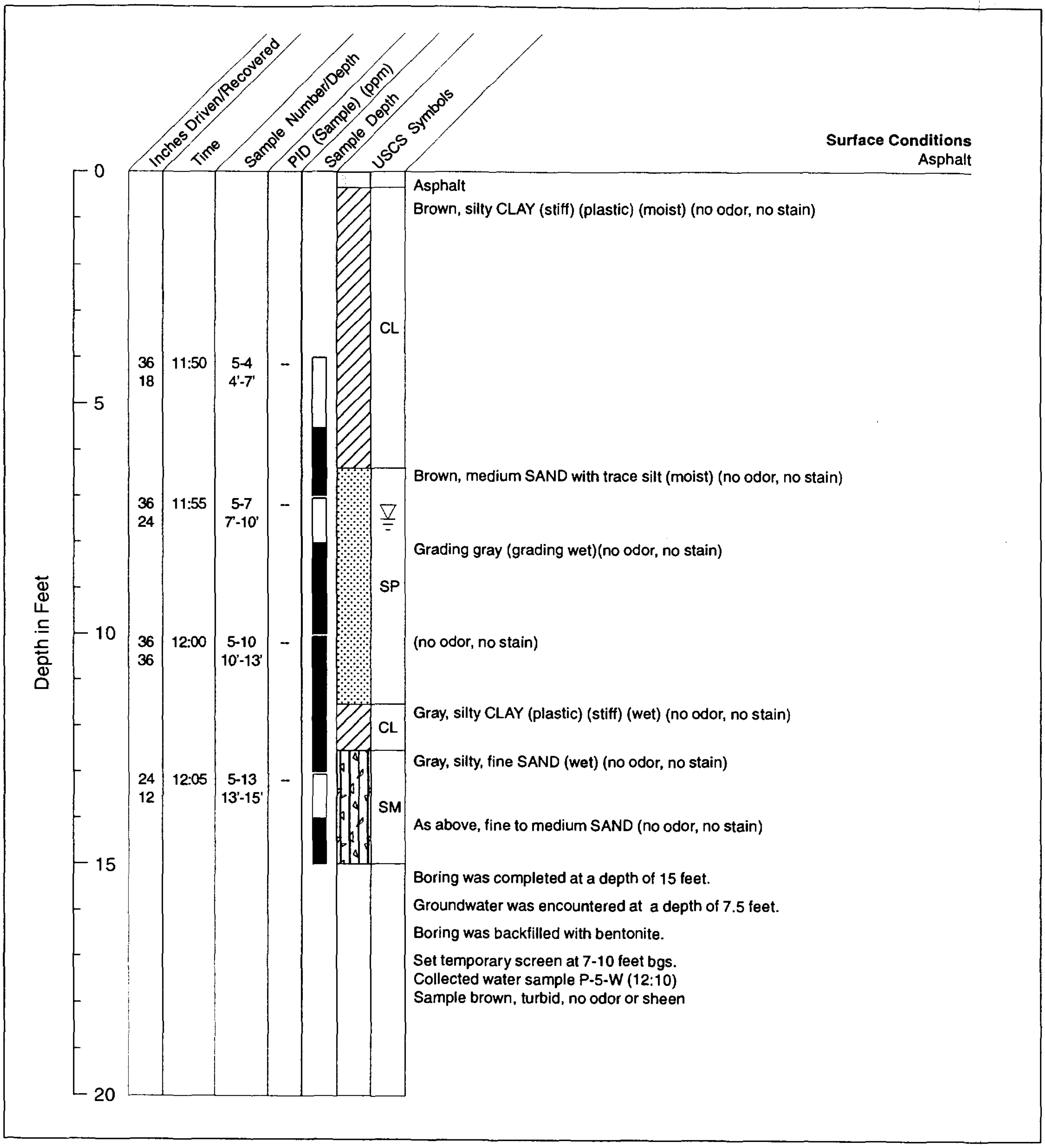
DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

P-4
GEOLOGIC BORING LOG

Jorgensen Forge Facility
Seattle, Washington

Job No. 31613-011-005

3161 3B05.CDR



Depth in Feet	Inches Driven/Recovered	Time	Sample Number/Depth	PID (Sample) (ppm)
	36 18	11:50	5-4 4'-7'	-
	36 24	11:55	5-7 7'-10'	-
	36 36	12:00	5-10 10'-13'	-
	24 12	12:05	5-13 13'-15'	-

Surface Conditions
Asphalt

Asphalt

Brown, silty CLAY (stiff) (plastic) (moist) (no odor, no stain)

Brown, medium SAND with trace silt (moist) (no odor, no stain)

Grading gray (grading wet)(no odor, no stain)

(no odor, no stain)

Gray, silty CLAY (plastic) (stiff) (wet) (no odor, no stain)

Gray, silty, fine SAND (wet) (no odor, no stain)

As above, fine to medium SAND (no odor, no stain)

Boring was completed at a depth of 15 feet.

Groundwater was encountered at a depth of 7.5 feet.

Boring was backfilled with bentonite.

Set temporary screen at 7-10 feet bgs.
Collected water sample P-5-W (12:10)
Sample brown, turbid, no odor or sheen

Geologist: VDA
Drilling method: StrataProbe
Sampling method: SS-Split Spoon, Geoprobe Water Sampler

Drill contractor: TEG Northwest
Drill date: 12/23/98

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

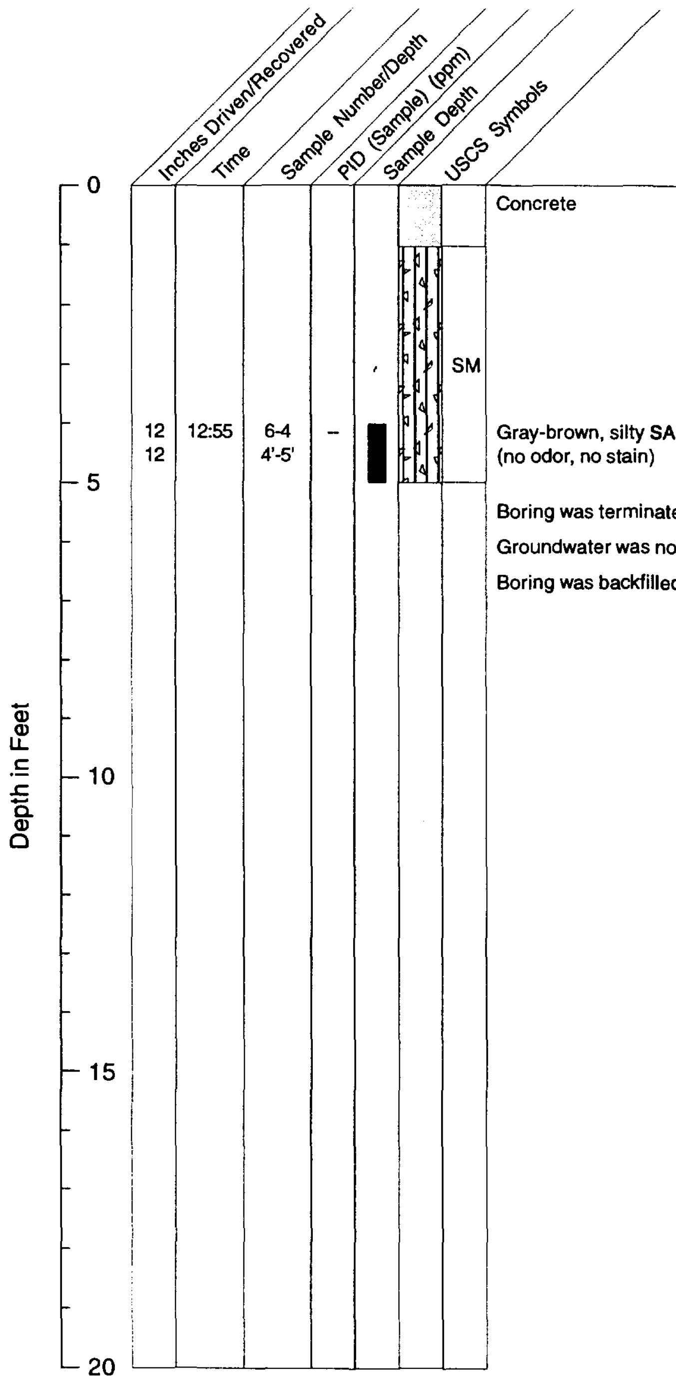
Job No. 31613-011-005

P-5
GEOLOGIC BORING LOG

Jorgensen Forge Facility
Seattle, Washington

3613B06.CDR

Surface Conditions
Concrete



Concrete

Gray-brown, silty SAND with trace gravel (medium dense) (moist) (fill)
(no odor, no stain)

Boring was terminated at a depth of 5 feet due to refusal.

Groundwater was not encountered.

Boring was backfilled with bentonite.

Geologist: VDA
Drilling method: StrataProbe
Sampling method: SS-Split Spoon, Geoprobe Water Sampler

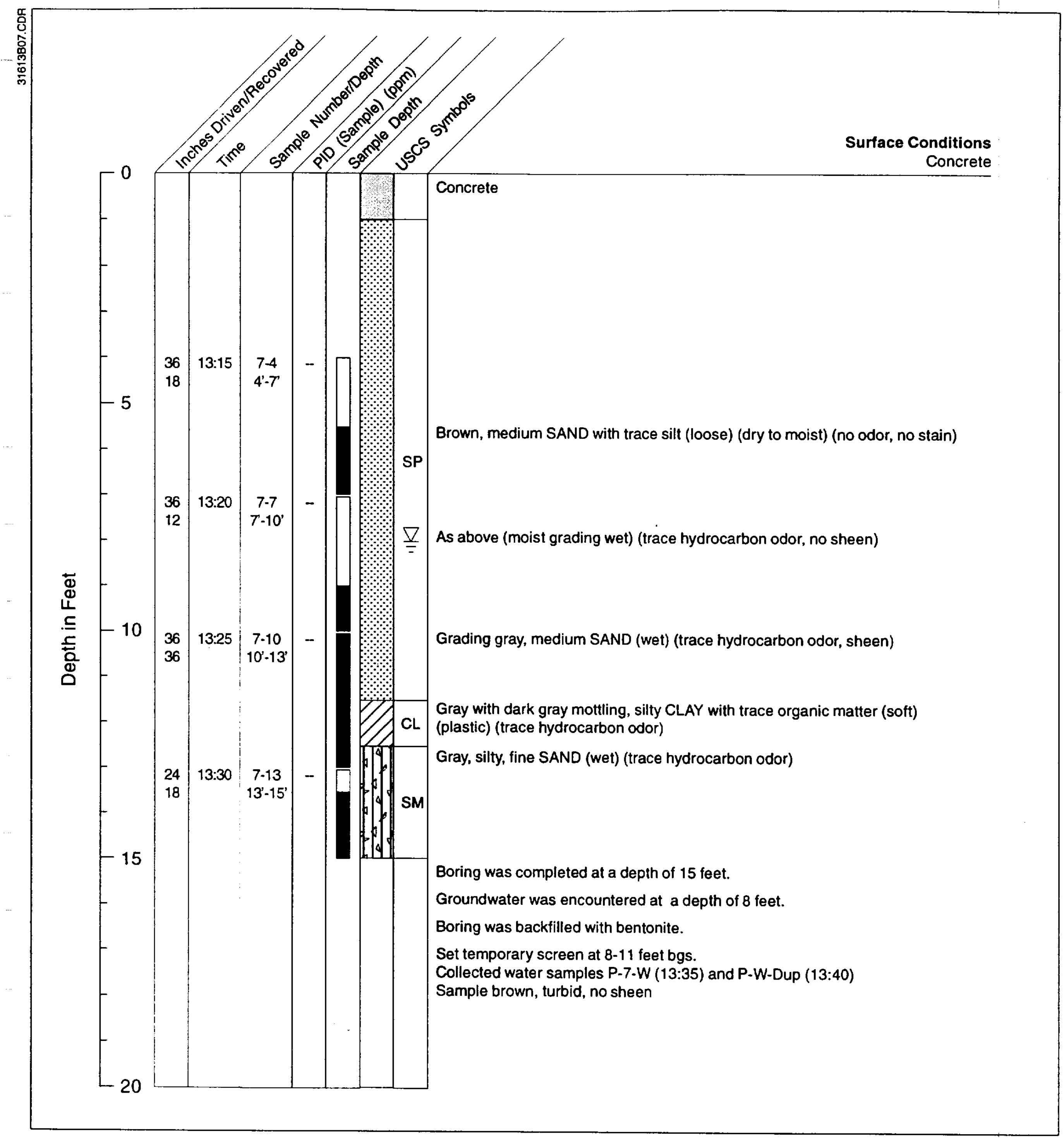
Drill contractor: TEG Northwest
Drill date: 12/23/98

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

P-6
GEOLOGIC BORING LOG

Jorgensen Forge Facility
Seattle, Washington

Job No. 31613-011-005



Inches Driven/Recovered	Time	Sample Number/Depth	PID (Sample) (ppm)
36 18	13:15	7-4 4'-7'	–
36 12	13:20	7-7 7'-10'	–
36 36	13:25	7-10 10'-13'	–
24 18	13:30	7-13 13'-15'	–

Surface Conditions
Concrete

Concrete

Brown, medium SAND with trace silt (loose) (dry to moist) (no odor, no stain)

As above (moist grading wet) (trace hydrocarbon odor, no sheen)

Grading gray, medium SAND (wet) (trace hydrocarbon odor, sheen)

Gray with dark gray mottling, silty CLAY with trace organic matter (soft) (plastic) (trace hydrocarbon odor)

Gray, silty, fine SAND (wet) (trace hydrocarbon odor)

Boring was completed at a depth of 15 feet.

Groundwater was encountered at a depth of 8 feet.

Boring was backfilled with bentonite.

Set temporary screen at 8-11 feet bgs.
Collected water samples P-7-W (13:35) and P-W-Dup (13:40)
Sample brown, turbid, no sheen

Geologist: VDA
Drilling method: StrataProbe
Sampling method: SS-Split Spoon, Geoprobe Water Sampler

Drill contractor: TEG Northwest
Drill date: 12/23/98

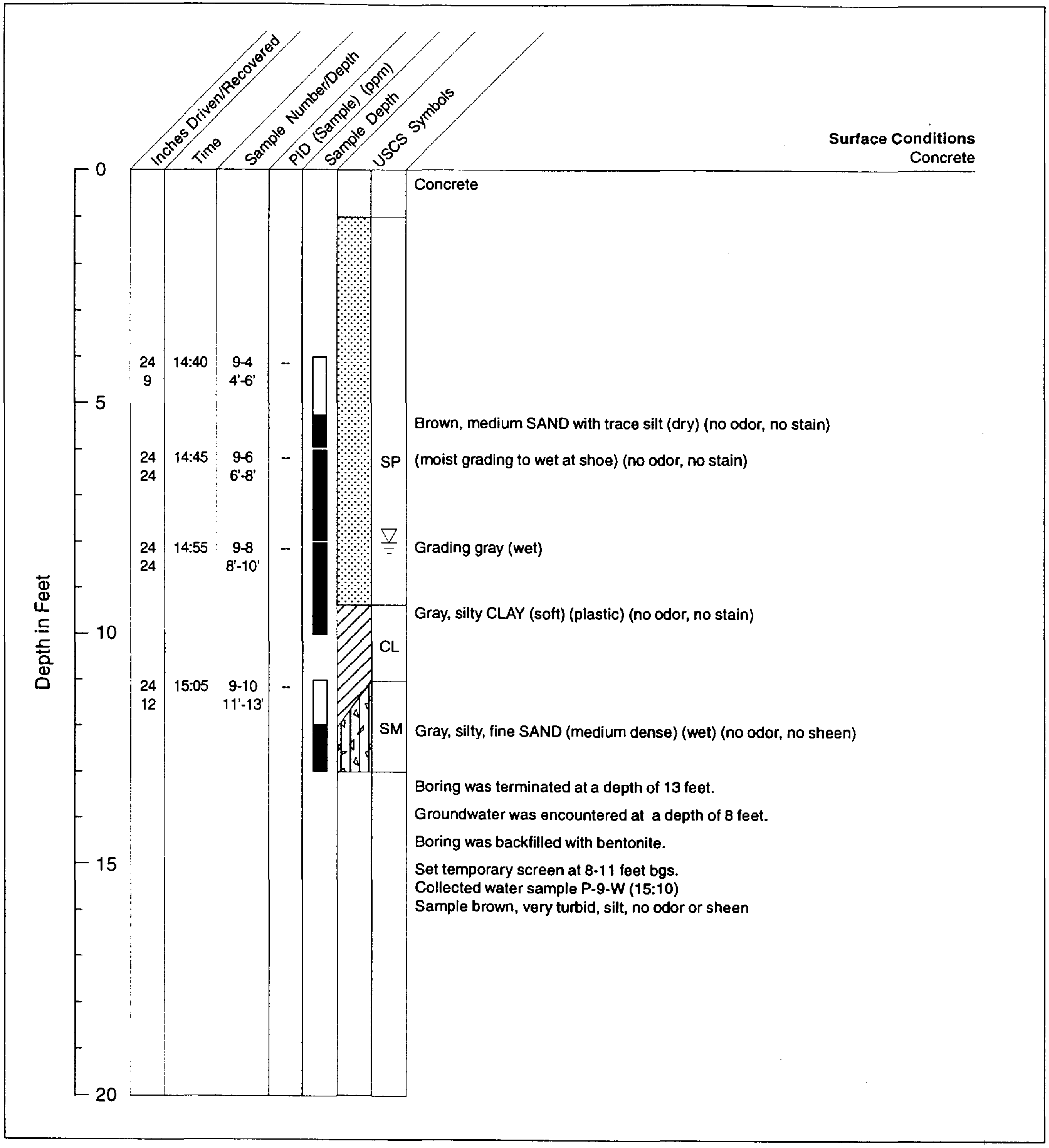
DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Job No. 31613-011-005

P-7
GEOLOGIC BORING LOG

Jorgensen Forge Facility
Seattle, Washington

31613B08.CDR



Surface Conditions
Concrete

Inches Driven/Recovered	Time	Sample Number/Depth	PID (Sample) (ppm)
24 9	14:40	9-4 4'-6'	–
24 24	14:45	9-6 6'-8'	–
24 24	14:55	9-8 8'-10'	–
24 12	15:05	9-10 11'-13'	–

Concrete

Brown, medium SAND with trace silt (dry) (no odor, no stain)

(moist grading to wet at shoe) (no odor, no stain)

Grading gray (wet)

Gray, silty CLAY (soft) (plastic) (no odor, no stain)

Gray, silty, fine SAND (medium dense) (wet) (no odor, no sheen)

Boring was terminated at a depth of 13 feet.

Groundwater was encountered at a depth of 8 feet.

Boring was backfilled with bentonite.

Set temporary screen at 8-11 feet bgs.
Collected water sample P-9-W (15:10)
Sample brown, very turbid, silt, no odor or sheen

Geologist: VDA
Drilling method: StrataProbe
Sampling method: SS-Split Spoon, Geoprobe Water Sampler

Drill contractor: TEG Northwest
Drill date: 12/23/98

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

P-9
GEOLOGIC BORING LOG

Jorgensen Forge Facility
Seattle, Washington

Job No. 31613-011-005

FARALLON CONSULTING
320 3rd Avenue NE
Issaquah, WA 98027

Log of Boring: SB-1

Page 1 of 1

Client: EMJ/Jorgensen Forge
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 831-003

Logged By: JAK and JAS

Date/Time Started: 8/26/04 0850
Date/Time Completed: 8/26/04 0915
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goble
Drilling Method: Geoprobe

Sampler Type: 4-foot sampler
Drive Hammer (lbs.): 140
Depth of Water ATD (ft bgs): 12
Total Boring Depth (ft bgs): 12
Total Well Depth (ft bgs): NA

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (units)	Sample ID	Sample Analyzed	Well Construction Details
0		FILL--GRAVEL with silt minor sand. 65% fine-coarse gravel, 20% silt, 15% fine sand. Brown, moist, no odor.			50	NA	NA	082604-0850-01	X	
		FILL--GRAVEL minor sand trace silt. 80% fine-coarse gravel, 15% fine-coarse sand, and 5% silt. Brown, moist, no odor. White brick material at 3 feet bgs.			50	NA	NA	082604-0855-02	X	Well not installed
		FILL--Silty GRAVEL with sand. 45% fine-coarse gravel, 40% silt, and 15% fine-coarse fine-course sand. Brown, moist, no odor.			50	NA	NA	082604-0900-03	X	
5		FILL--SAND trace silt. 95% fine-coarse sand, 5% silt. Brown, moist, no odor.			50	NA	NA	082604-0902-04	X	
					50	NA	NA	082604-0910-05	X	
10		SILT. 100% silt. Grey with orange mottling, moist, no-odor. SAME wet	MH		60	NA	NA	0826-04-0915-06	X	▼
15										
20										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

Ground Surface Elevation (ft): 14-feet
Top of Casing Elevation (ft): NA
Boring Abandonment: Bentonite chips
Surveyed Location: **X:** 122.30894 **Y:** 47.52696

FARALLON CONSULTING
320 3rd Avenue NE
Issaquah, WA 98027

Log of Boring: SB-2

Page 1 of 1

Client: EMJ/Jorgensen Forge
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 831-003

Logged By: JAK and JAS

Date/Time Started: 08/26/04 0940
Date/Time Completed: 08/26/04 1020
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goble
Drilling Method: Geoprobe

Sampler Type: 4-foot sampler
Drive Hammer (lbs.): 140
Depth of Water ATD (ft bgs): 14
Total Boring Depth (ft bgs): 16
Total Well Depth (ft bgs): NA

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (units)	Sample ID	Sample Analyzed	Well Construction Details
0	☒	FILL--GRAVEL minor sand trace silt. 80% fine-coarse gravel, 15% fine-coarse sand, 5% silt. Brown. moist, no odor.			40	NA	NA	082604-0940-07	X	
	☒				40	NA	NA	082604-0943-08	X	Well not installed
5	☒	FILL--SAME with marbeling			50	NA	NA	082604-0945-09	X	
	☒	FILL-SAME with cobble and black obsidion like material			70	NA	NA	082604-0952-10	X	
	☒	FILL--Gravel with sand trace silt. 70% fine-coarse gravel, 25% fine-coarse sand, and 5% silt. Marbeled brown, moist, no odor.			50	NA	NA	082604-0956-11	X	
10	☒	FILL--White brick FILL--SAND minor gravel minor silt. 75% fine-coarse sand, 15% coarse gravel, 10% silt. Grey, moist, no odor.			50	NA	NA	082604-1000-12	X	
	☒	FILL--SAND. 100% fine-coarse sand. Grey, moist, no odor, very dense. SAME but not very dense.			50	NA	NA	082604-1012-13	X	
15	☒	FILL--SAND with gravel. 65% fine-coarse sand and 35% fine-coarse gravel. Grey, wet, no odor			60	NA	NA	082604-1020-14	X	▼
20										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

Ground Surface Elevation (ft): 14-feet
Top of Casing Elevation (ft): NA
Boring Abandonment: Bentonite chips
Surveyed Location: **X:** 122.30818 **Y:** 47.52657

FARALLON CONSULTING
320 3rd Avenue NE
Issaquah, WA 98027

Log of Boring: SB-3

Page 1 of 1

Client: EMJ/Jorgensen Forge
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 831-003

Logged By: JAK and JAS

Date/Time Started: 08/26/04 1055
Date/Time Completed: 08/26/04 1300
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goble
Drilling Method: Geoprobe

Sampler Type: 4-foot sampler
Drive Hammer (lbs.): 140
Depth of Water ATD (ft bgs): NE
Total Boring Depth (ft bgs): 10
Total Well Depth (ft bgs): NA

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (units)	Sample ID	Sample Analyzed	Well Construction Details
0		FILL--GRAVEL with sand minor silt. 65% fine-coarse gravel, 20% fine-coarse sand, 15% silt. Brown, moist, no odor.			50	NA	NA	082604-1105-15	X	Well not installed
		FILL--GRAVEL with sand trace silt. 70% fine-coarse gravel, 25% fine-coarse sand, 5% silt. Brown, moist, no odor. Black obsidion like material at 2 feet.			60	NA	NA	082604-1106-16	X	
5		FILL--GRAVEL minor sand. 90% fine-coarse gravel and 10% fine-coarse sand. Marbeled brown, moist, no odor.			50	NA	NA	082604-1109-17	X	
		FILL--GRAVEL with sand trace silt. 75% fine-coarse gravel, 20% fine-coarse sand, 5% silt. Brown/orange, moist, no odor.			65	NA	NA	082604-1118-18 082604-1240-19	X	
		REFUSAL--move one foot north/ SAME as 6'-8'			50	NA	NA	082604-1246-20	X	
10		REFUSAL move one foot north, sampler breaks inside boring.			0	NA	NA			
15										
20										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

Ground Surface Elevation (ft): 15-feet
Top of Casing Elevation (ft): NA
Boring Abandonment: Bentonite chips
Surveyed Location: **X:** 122.30866 **Y:** 47.52640

FARALLON CONSULTING
320 3rd Avenue NE
Issaquah, WA 98027

Log of Boring: SB-4

Page 1 of 1

Client: EMJ/Jorgensen Forge
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 831-003

Logged By: JAK and JAS

Date/Time Started:	08/26/04 1300	**Sampler Type:**	4-foot sampler
Date/Time Completed:	08/26/04 1345	**Drive Hammer (lbs.):**	140
Equipment:	Geoprobe	**Depth of Water ATD (ft bgs):**	12
Drilling Company:	Cascade Drilling	**Total Boring Depth (ft bgs):**	16
Drilling Foreman:	Kasey Goble	**Total Well Depth (ft bgs):**	NA
Drilling Method:	Geoprobe		

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (units)	Sample ID	Sample Analyzed	Well Construction Details
0	☒	FILL--GRAVEL with sand trace silt. 85% fine-coarse gravel, 10% fine-coarse sand, and 5% silt. Brown, moist, no odor.			50	NA	NA	082604-1305-21	X	
	☒	REFUSAL--Move one foot north and begin at two feet bgs. SAME as previous in new boring.			50	NA	NA	082604-1308-22	X	Well not installed
5	☒	SAME			40	NA	NA	082604-1312-23	X	
	☒				70	NA	NA	082604-1318-24	X	
	☒				70	NA	NA	082604-1322-25	X	
10	☒	FILL--wood debris. Strong creosote odor, shiny, black.			80	NA	NA	082604-1326-26	X	
	☒	SAME as 4-11.5' FILL--SAND minor silt. 90% fine sand, 10% silt. Brown, wet, apparent creosote odor observed.			80	NA	NA	082604-1330-27 082604-1335-28	X	▼
15	☒	FILL--SAND minor silt. 85% fine sand, 15% silt. Blue/grey, wet, strong petroleum odor, sheen observed on sand.			20	NA	NA	082604-1345-29	X	
20										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

Ground Surface Elevation (ft): 21 feet
Top of Casing Elevation (ft): NA
Boring Abandonment: Bentonite chips
Surveyed Location: X: 122.30853 **Y:** 47.52620

FARALLON CONSULTING
320 3rd Avenue NE
Issaquah, WA 98027

Log of Boring: SB-5

Page 1 of 1

Client: EMJ/Jorgensen Forge
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 831-003

Logged By: JAK and JAS

Date/Time Started: 08/26/04 1415
Date/Time Completed: 08/26/04 1510
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goble
Drilling Method: Geoprobe

Sampler Type: 4-foot sampler
Drive Hammer (lbs.): 140
Depth of Water ATD (ft bgs): 12
Total Boring Depth (ft bgs): 16
Total Well Depth (ft bgs): NA

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (units)	Sample ID	Sample Analyzed	Well Construction Details
0	☒	FILL--GRAVEL minor sand, trace silt. 80% fine-coarse gravel, 15% fine-coarse sand, 5% silt. Light brown, moist, no odor.			60	NA	NA	082604-1414-30	X	
	☒	FILL-GRAVEL with sand, trace silt. 70% fine-coarse gravel, 25% fine-coarse sand, 5% silt. Orangish brown, moist, no odor.			50	NA	NA	082604-1416-31	X	Well not installed
5	☒				40	NA	NA	082604-1421-32	X	
	☒				40	NA	NA	082604-1425-33	X	
	☒				40	NA	NA	082604-1428-34	X	
10	☒				50	NA	NA	082604-1455-35	X	
	☒	REFUSAL move one foot north and begin at 10 feet bgs. FILL--SAND minor gravel. 85% fine-coarse sand and 15% fine gravel. Brown, wet, no odor.			20	NA	NA	082604-1500-36	X	▼
15	☒				100	NA	NA	082604-1505-37	X	
20										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

Ground Surface Elevation (ft): 20-feet
Top of Casing Elevation (ft): NA
Boring Abandonment: Bentonite chips
Surveyed Location: X: 122.30836 Y: 47.52599

FARALLON CONSULTING
320 3rd Avenue NE
Issaquah, WA 98027

Log of Boring: SB-6

Page 1 of 1

Client: EMJ/Jorgensen Forge
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 831-003

Logged By: JAK and JAS

Date/Time Started: 08/27/04 0845
Date/Time Completed: 08/27/04 0948
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Jaymen Lauer
Drilling Method: Geoprobe - Limited Access

Sampler Type: 4-foot sampler
Drive Hammer (lbs.): 140
Depth of Water ATD (ft bgs): 11.5
Total Boring Depth (ft bgs): 16
Total Well Depth (ft bgs): NA

Depth (feet bgs.)	Lithologic Description	USCS	% Recovery	Blow Counts 8/8/8	PID (units)	Sample ID	Sample Analyzed	Well Construction Details
0	FILL--GRAVEL trace sand. 95% fine-coarse gravel and 5% sand. Brown, moist, no odor.		30	NA	NA	082704-0856-01	X	
			40	NA	NA	082704-0900-02	X	Well not installed
	SAME with white brick.		20	NA	NA	082704-0910-03	X	
5								
			100	NA	NA	082704-0915-04 082704-0920-05	X	
	FILL--SAND. 100% fine-coarse sand. Tan, dry, no odor, very hard.							
	FILL--GRAVEL with sand trace silt. 75% fine-coarse gravel, 20% fine-coarse sand, and 5% silt. Brown, moist, no odor.		100	NA	NA	082704-0930-06	X	
	FILL--GRAVEL trace sand. 95% fine-coarse gravel, 5% fine-coarse sand. Black with obsidion like material, moist, no odor.							
10			100	NA	NA	082704-0935-07	X	
								▼
	FILL--SAME as 7.5-8. wet, some red brick.		80	NA	NA	082704-0940-08	X	
			50	NA	NA	082704-0942-09	X	
15								
	SAND trace silt. 95% fine sand and 5% silty. Grey, wet, no odor	SW						
20								

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

Ground Surface Elevation (ft): 22
Top of Casing Elevation (ft): NA
Boring Abandonment: Bentonite chips
Surveyed Location: X: 122.30840 **Y:** 47.52576

FARALLON CONSULTING
320 3rd Avenue NE
Issaquah, WA 98027

Log of Boring: SB-7

Page 1 of 1

Client: EMJ/Jorgensen Forge
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 831-003

Logged By: JAK and JAS

Date/Time Started:	08/27/04 1030	**Sampler Type:**	4-foot sampler
Date/Time Completed:	08/27/04 1120	**Drive Hammer (lbs.):**	140
Equipment:	Geoprobe	**Depth of Water ATD (ft bgs):**	13.5
Drilling Company:	Cascade Drilling	**Total Boring Depth (ft bgs):**	16
Drilling Foreman:	Jaymen Lauer	**Total Well Depth (ft bgs):**	NA
Drilling Method:	Geoprobe		

Depth (feet bgs.)	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (units)	Sample ID	Sample Analyzed	Well Construction Details
0	☒	8-inches of concrete	CO	▤	50	NA	NA	082704-1032-10	X	
		FILL--GRAVEL with sand minor silt. 40% fine-coarse gravel, 40% coarse sand, 20% silt. Brown, moist, no odor								
	☒				40	NA	NA	082704-1034-11	X	Well not installed
	☒	SAME but 50% red brick.			20	NA	NA	082704-1038-12	X	
5										
	☒	SAME no brick			20	NA	NA	082704-1044-13	X	
	☒	FILL--GRAVEL with sand, trace silt. 75% fine-coarse gravel, 20% fine-coarse sand, and 5% silt. Brown with orangish brown, moist, no odor. Metal debris.			60	NA	NA	082704-1054-14	X	
10	☒				100	NA	NA	082704-1100-15	X	
		FILL--GRAVEL trace sand. 95% fine-coarse gravel and 5% fine-coarse sand. Brown, moist, no odor.								
	☒				100	NA	NA	082704-1110-16	X	
		SAME as 6-8' interval. Brick throughout. Wet at 13.5								▼
	☒				20	NA	NA	082704-1115-17	X	
15										
20										

Well Construction Information

Monument Type:	NA	**Filter Pack:**	NA	**Ground Surface Elevation (ft):**	25
Casing Diameter (inches):	NA	**Surface Seal:**	NA	**Top of Casing Elevation (ft):**	NA
Screen Slot Size (inches):	NA	**Annular Seal:**	NA	**Boring Abandonment:**	Bentonite chips
Screened Interval (ft bgs):	NA			**Surveyed Location:**	**X:** 122.30826 **Y:** 47.52569

FARALLON
consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

USCS Classification and Graphic Legend

Major Divisions			USCS Graphic Symbol	USCS Letter Symbol	Lithologic Description
Coarse-Grained Soil (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)	▨	GW	Well graded GRAVEL, well graded GRAVEL with sand
			▨	GP	Poorly graded GRAVEL, GRAVEL with sand
		GRAVEL WITH FINES (Appreciable amount of fines)	▨	GP-GM	Poorly graded GRAVEL - GRAVEL with sand and silt
			▨	GM	Silty GRAVEL
			▨	GC	Clayey GRAVEL
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)	▨	SW	Well graded SAND
			▨	SP	Poorly graded SAND
		SAND WITH FINES (Appreciable amount of fines)	▨	SP-SM	Poorly graded SAND - silty SAND
			▨	SM	Silty SAND
			▨	SC	Clayey SAND
			▨	SM-ML	SILT - Silty SAND
Fine-Grained Soil (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)		▨	ML	SILT
			▨	CL	CLAY
			▨	OL	Organic SILT
	SILT AND CLAY (Liquid limit greater than 50)		▨	MH	Inorganic SILT
			▨	CH	Inorganic CLAY
			▨	OH	Organic CLAY
		Highly Organic Soil	▨	PT	Peat
OTHER MATERIALS	PAVEMENT		▨	AC	Asphalt concrete
			▨	CO	Concrete
	OTHER		▨	RK	Bedrock
			▨	WD	Wood Debris
			▨	DB	Debris (Miscellaneous)
			▨	PC	Portland cement

Legend

☐	Sample Interval
G	Grab Sample Interval
▼	Water level at time of drilling
▽	Water level at time of sampling
▯	Blank Casing
▤	Screened Casing

▨	Cement Grout
▥	Bentonite
▨	Sand Pack
▩	Well Cap

————	Solid line indicates sharp contact between units well defined.
- - - - - - -	Dashed line indicates gradational contact between units.

feet bgs = feet below ground surface
NE = Not Encountered
NA = Not Applicable
PID = Photoionization Detector
PN = Project Number
*ppm = parts per million total organic vapors in isobutylene equivalents using a 10.6 electron volt lamp
USCS = Unified Soil Classification System

FARALLON
consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: SB-13

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/06/09 0743
Date/Time Completed: 02/06/09 0805
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goebel
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): 5
Total Boring Depth (ft bgs): 16
Total Well Depth (ft bgs): NA

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		Asphalt, paving debris	AC							
		Well-graded SAND (100% sand), fine to coarse sand, brown, moist to 5 feet then wet, no odor.	SW							
										Bentonite
					100		45.1	SB-13-020609-1		
5										▼
					100		48.2	SB-13-020609-2		
10										
		Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, dark brown, wet, marine odor.	SP							
					100		50.3	SB-13-020609-3		
15										
							55.9	SB-13-020609-4 GR-SB-13-020609 @12-16 feet bgs		
20										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: SB-14

Page 1 of 1

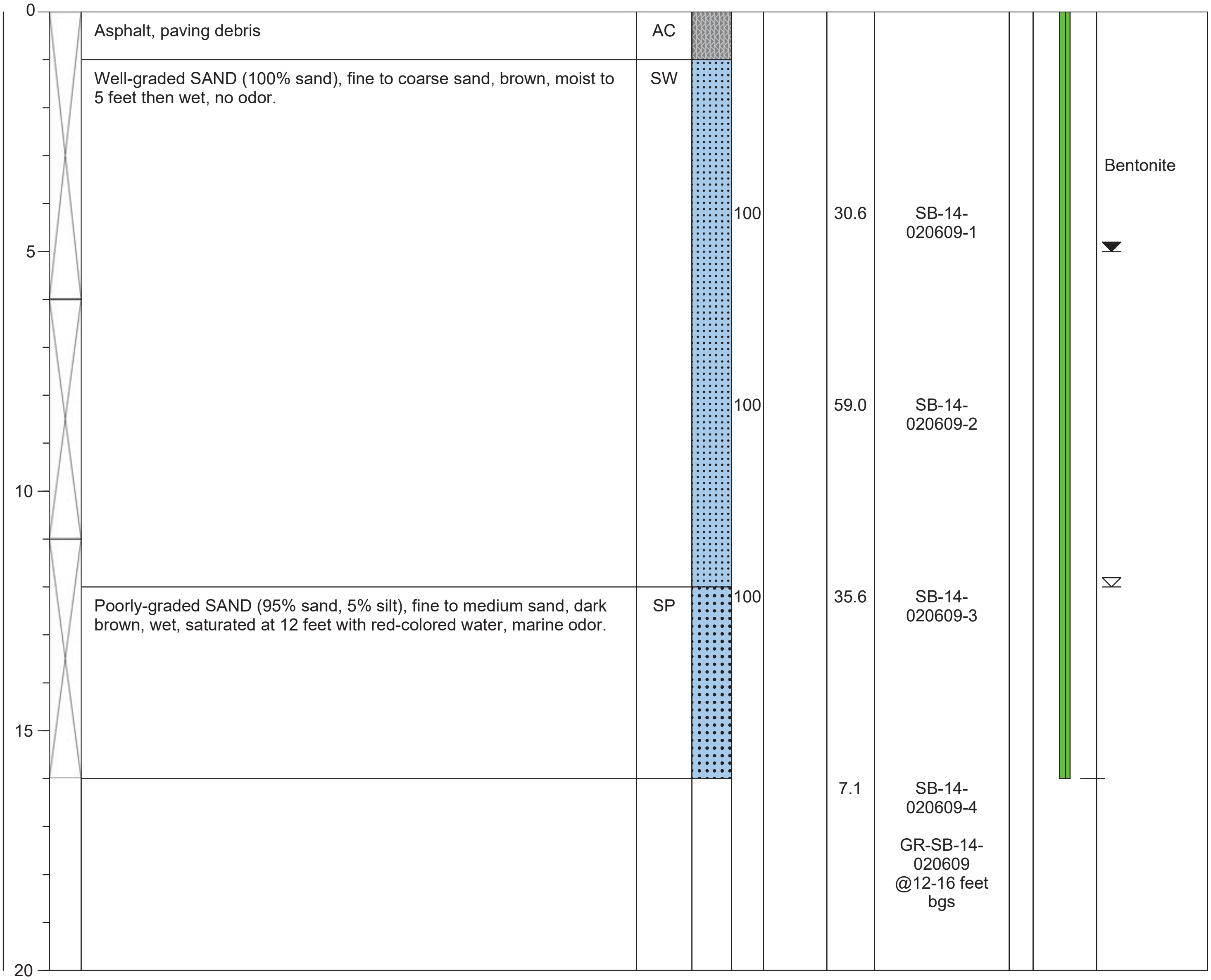
Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/06/09 0810
Date/Time Completed: 02/06/09 0830
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goebel
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): 5, 12
Total Boring Depth (ft bgs): 16
Total Well Depth (ft bgs): NA



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		Asphalt, paving debris	AC							
		Well-graded SAND (100% sand), fine to coarse sand, brown, moist to 5 feet then wet, no odor.	SW							Bentonite
					100		30.6	SB-14-020609-1		
5										
					100		59.0	SB-14-020609-2		
10										
		Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, dark brown, wet, saturated at 12 feet with red-colored water, marine odor.	SP		100		35.6	SB-14-020609-3		
15										
							7.1	SB-14-020609-4 GR-SB-14-020609 @12-16 feet bgs		
20										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: SB-15

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/06/09 0836
Date/Time Completed: 02/06/09 0900
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goebel
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): 12
Total Boring Depth (ft bgs): 16
Total Well Depth (ft bgs): NA

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		Asphalt, paving debris	AC							
		Well-graded SAND (100% sand), fine to coarse sand, brown, moist, no odor.	SW							Bentonite
					100		40.2	SB-15-020609-1		
5										
					100		60.2	SB-15-020609-2		
10										
										▼
		Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, grey, moist to 12 then wet, marine odor starting at 15.5 feet. SILT (100% silt), grey, wet, marine odor at 15.5 feet, 2 inches thick.	SP		100		16.6	SB-15-020609-3		
15										
							30.4	SB-15-020609-4 GR-SB-15-020609 @23-27 feet bgs		
20										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

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

FARALLON
consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: SB-16

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA
Farallon PN: 394-002
Logged By: D. Clement

Date/Time Started: 02/06/09 0913
Date/Time Completed: 02/06/09 0950
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goebel
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): 12
Total Boring Depth (ft bgs): 16
Total Well Depth (ft bgs): NA

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		Asphalt, paving debris	AC							
		Well-graded SAND (100% sand), fine to coarse sand, brown, moist, no odor.	SW							Bentonite
					100		16.7	SB-16-020609-1		
5										
					100		22.7	SB-16-020609-2		
10										
		Poorly-graded SAND (95% sand, 5% silt), fine to medium sand, black, moist to 12 then wet, no odor, several lenses of SILT (100% silt), black, wet, no odor.	SP		100		4.2	SB-16-020609-3		▼
15										
							11.1	SB-16-020609-4 GR-SB-16-020609 @12-16 feet bgs		
20										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: SB-17

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/05/09 1320
Date/Time Completed: 02/06/09 1020
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goebel
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): NE
Total Boring Depth (ft bgs): 6
Total Well Depth (ft bgs): NA

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		Attempted 2/5/09, no recovery. Concrete cored 2/6/09.	CO	▤						
		Well-graded SAND (100% sand), fine to coarse sand, brown, moist, no odor.	SW	🟦	100		14.2	SB-17-020609-1		
		Sandy SILT (60% silt, 40% sand), fine sand, grey, moist, no odor.	ML	🟨	100		20.7	SB-17-020609-2		Bentonite
5		Well-graded SAND (100% sand), fine to coarse sand, brown, moist, no odor, several lenses of SILT (100% silt), brown-red, moist, no odor.	SW	🟦						
					100		9.0	SB-17-020609-3		
10										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

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

FARALLON
consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: SB-18

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/05/09 1340
Date/Time Completed: 02/05/09 1400
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goebel
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): 3
Total Boring Depth (ft bgs): 6
Total Well Depth (ft bgs): NA

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		Concrete cored	CO							
		Well-graded SAND (100% sand), fine to coarse, brown, moist, no odor.	SW							
		Poorly-graded SAND (100% sand), fine to medium sand, dark brown, moist to 3 feet then wet, musty odor.	SP							
							8.6	SB-18-020509-1		
					100					Bentonite
							15.1	SB-18-020509-2		
5										
							39.1	SB-18-020509-3		
10										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

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

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: SB-19

Page 1 of 1

Client: Jorgensen Forge Corp.
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-002

Logged By: D. Clement

Date/Time Started: 02/05/09 1400
Date/Time Completed: 02/05/09 1425
Equipment: Geoprobe
Drilling Company: Cascade Drilling
Drilling Foreman: Kasey Goebel
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): NA
Depth of Water ATD (ft bgs): 4.5
Total Boring Depth (ft bgs): 6
Total Well Depth (ft bgs): NA

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		Concrete cored	CO							
		Poorly-graded SAND (95% sand, 5% gravel), fine to coarse sand, fine gravel, brown with red mottling, moist to 4.5 feet then wet, no odor.	SP							
							40.0	SB-19-020509-1		
					100					Bentonite
							62.1	SB-19-020509-2		
5		Poorly-graded SAND (100% sand), fine to medium, black, wet, strong acrid petroleum-like odor.	SP							
							86.8	SB-19-020509-3		
10										

Well Construction Information

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

Filter Pack: NA
Surface Seal: NA
Annular Seal: NA

Ground Surface Elevation (ft): NA
Top of Casing Elevation (ft): NA
Boring Abandonment: Bentonite

Surveyed Location: **X:** NA **Y:** NA

FLOYD | SNIDER
strategy ▪ science ▪ engineering

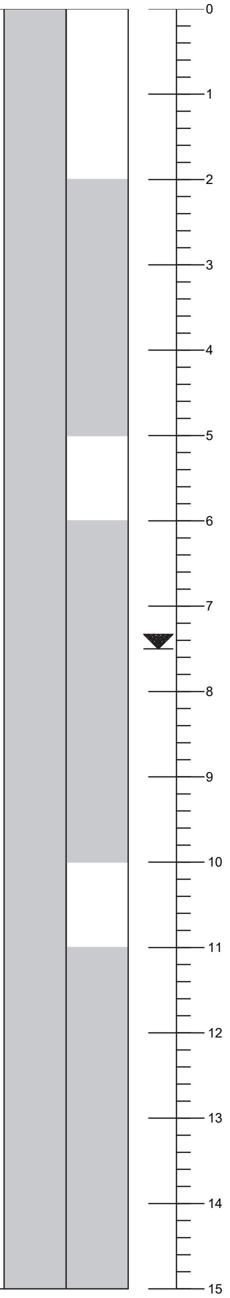
Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,796.5
Longitude/Easting: 1,275,886.8

Drill Date: January 13, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 15 ft
Groundwater ATD (ft bgs): 7.5 ft

Boring ID: T2B1

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy



SAMPLE Type/Depth	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
	0		Dark gray crushed gravel and slag (FILL)
	2	SM	Dark brown silty SAND with few small gravel, loose, dry (FILL). Gravel is mixed round and angular.
T2B1 3-5 (PID: 0.5 ppm)	3	SM	Dark gray silty SAND, dense, moist (FILL)
	5		
	6	SP	Brown-gray fine SAND, dense, wet (FILL) Saturated at 7.5 ft
T2B1 8-10 (0.6 ppm)	8	SM	Brown-gray very fine silty SAND, dense, very wet (FILL)
	10		
	11	SP	Reddish-brown fine SAND, very wet, mottled (NATIVE)
T2B1 13-15 (34 ppm)	12	SM	Dark gray fine silty SAND, very wet (NATIVE) Saturated after 13ft. Petroleum odor and sheen present at 13 .5 ft.

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
= denotes start of water saturated soil

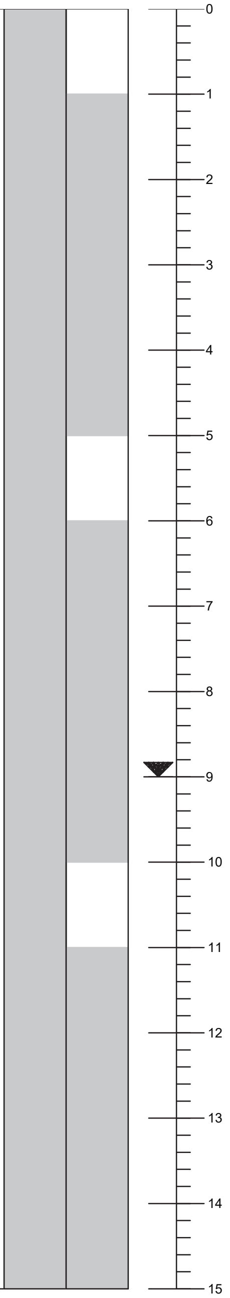
Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,797.9
Longitude/Easting: 1,275,856.3

Drill Date: January 13, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 15 ft
Groundwater ATD (ft bgs): 9 ft

Boring ID: T2B2

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy/cloudy



SAMPLE Type/Depth	DRIVEN / RECOVERED	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				Dark gray crushed gravel and slag (FILL)
			SW	Dark brown gravelly SAND, loose, dry (FILL). Some metallic slag-like material, whitish-yellow material (fire brick?) and red brick fragments.
T2B2 3-5 (PID: 1.1 ppm)			SM	Brown silty fine SAND, loose, dry (FILL). Few 0.5-1" gravels and small brick fragments.
			SP	Dark gray medium SAND, dense, moist, with pieces of glass (FILL)
T2B2 8-10 (0.6 ppm)			SP	Dark reddish-brown fine SAND, dense, wet (FILL). Red brick fragments at 7.5 ft. Lumber debri at 9.5 ft.
			SM	Brown silty SAND with few small gravel, wet (FILL)
T2B2 13-15 (0.9 ppm)			SM	Gray silty SAND,loose, saturated (NATIVE)

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
= denotes start of water saturated soil

FLOYD | SNIDER
strategy ▪ science ▪ engineering

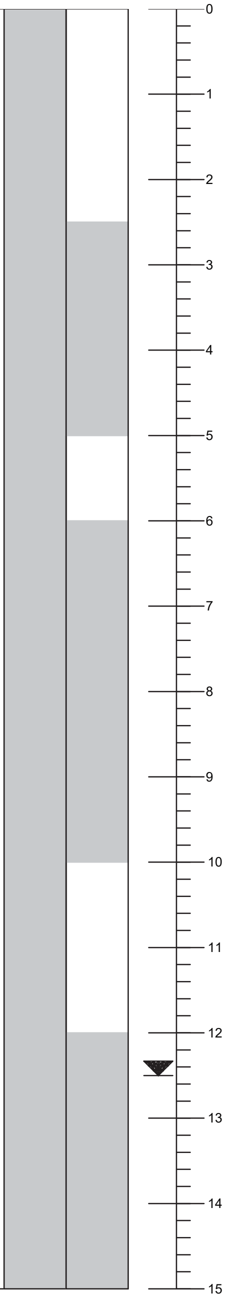
Boring ID: T2B3

Drill Date: January 13, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 15 ft
Groundwater ATD (ft bgs): 12.5 ft

Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,798.6
Longitude/Easting: 1,275,824.9

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy/cloudy



SAMPLE Type/Depth	DRIVEN / RECOVERED	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				Crushed gravel and woody plant material
T2B3 2-4 (PID: 0.8 ppm)			SM/SW	Brown silty fine SAND and gravelly fine SAND, loose, dry (FILL). Gravel is mixed round and angular.
T2B3 8-10 (0.8 ppm)			SM/SW	same as above Black tar-like material (possibly asphalt) at 8.5 ft bgs.
			SM	Reddish-brown silty SAND wth few rounded gravel, wet, some oxidation, glass and brick fragments (FILL)
T2B3 13-15 (1.4 ppm)			SP	Dark gray fine SAND, saturated, with glass shards, lumber debris, and brick fragments (FILL) Note: Unable to drill to native material due to refusal and poor recovery at 15 ft bgs.

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
= denotes start of water saturated soil

FLOYD | SNIDER
strategy ▪ science ▪ engineering

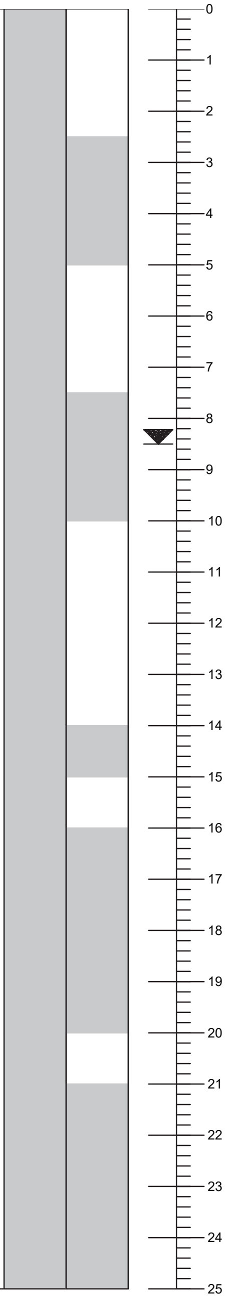
Boring ID: T2B4

Drill Date: January 13, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 25 ft
Groundwater ATD (ft bgs): 8.5 ft

Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,799.5
Longitude/Easting: 1,275,795.3

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy



SAMPLE Type/Depth	DRIVEN / RECOVERED	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				Crushed gravel and woody plant material mixed with soil
T2B4 2-4 (PID: 0.9 ppm)			SM/SW	Dark brown silty SAND with gravel, moist (FILL). No petroleum sheen or odor.
(1.3 ppm)			SW	Brown gravelly SAND, loose, wet (FILL). Gravel is small and mixed rounded and angular. Black, tar-like material at 9 ft. No petroleum sheen or oder present.
				Reddish-brown medium SAND with rounded gravel, wet (FILL)
(1.0 ppm)			SP	
T2B4 18-20 (37.4 ppm)			SP	Reddish-brown medium SAND with rounded gravel, loose, saturated (FILL). Glass shards and brick fragments. Petroleum odor and sheen observed. 2-inch layer of broken glass and crushed rock at 18 ft bgs
			SP	Reddish-brown medium SAND with rounded gravel, loose, very wet (FILL). Few glass shards.
T2B4 23-25 (31.5			SP	Gray fine SAND with few small pebbles, wet (NATIVE)

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
▼ = denotes start of water saturated soil

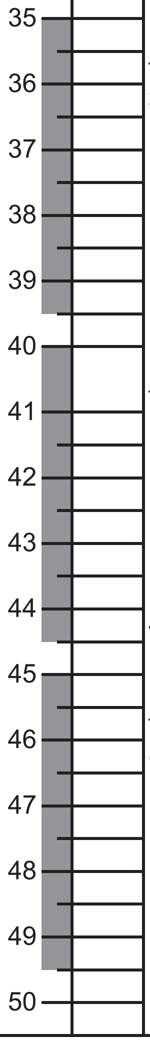
Boring Location: T2B4

Boring T2B4 Date 12/6/2012 Sheet 1 of 2
Job JFOS Job No. 010128-01.04
Logged By NS/LG Weather Rain
Drilled By Cascade
Drill Type/ Method Geoprobe
Sampling Method
Bottom of Boring 50'

PID	Sample Depth (feet)		Sample Recovery[1]		DESCRIPTION: Density, moisture, color, minor, MAJOR CONSTITUENT, non-soil substances: Odor, staining, sheen, slag, etc.
	From	To			
			15		Very limited recovery in this interval included dark brown fine silty sand and gravel with heavy sheen. Recovered volume was poured into homogenization bowl for metals TCLP analysis. (Sample ID: T2B4-15-20-121206)
			16		
			17		
			18		
			19		
			20 ▨		Medium stiff, moist, grey, fine to medium well-graded SAND with few fines, no odor, no sheen (Sample ID: T2B4-23-24.5-121206)
			21 ▨		
			22 ▨		
0.0	23	24.5	23 ▨		
			24 ▨		- 24 to 24.5 stiff, grey, clayey SILT, no odor, no sheen
0.0	25	27	25 ▨		Medium stiff, moist, grey, fine to medium well-graded SAND with few fines, no odor, no sheen (Sample IDs: T2B4-25-27-121206 and T2B4-27-28.3-121206)
			26 ▨		
0.0	27	28.3	27 ▨		
			28 ▨		
			29		
0.0	30	32	30 ▨		Medium stiff, moist, grey, fine to medium well-graded SAND with few fines, no odor, light sheen at the top of from 30 to 31 (Sample IDs: T2B4-30-32-121206 and T2B4-32-33.3-121206)
			31 ▨		
0.0	32	33.3	32 ▨		
			33 ▨		
			34		

Boring Location: T2B4

Boring T2B4 Date 12/6/2012 Sheet 2 of 2
Job JFOS Job No. 010128-01.04
Logged By NS/LG Weather Rain
Drilled By Cascade
Drill Type/ Method Geoprobe
Sampling Method
Bottom of Boring 50'

PID	Sample Depth (feet)		Sample Recovery[1]		DESCRIPTION: Density, moisture, color, minor, MAJOR CONSTITUENT, non-soil substances: Odor, staining, sheen, slag, etc.
	From	To			
0.0	35	37			Medium stiff, moist, grey, fine to coarse well-graded SAND with few fines, no odor, no sheen (Sample IDs: T2B4-35-37-121206 and T2B4-37-39-121206)
0.0	37	39			
0.0	40	42			Medium stiff, moist, grey, fine to coarse well-graded SAND with few fines, no odor, no sheen (Sample ID: T2B4-40-42-121206)
					- increasing fine sand with depth
					Medium stiff, moist, grey, fine to course well-graded SAND with few fines, no odor, no sheen. Fine sands increase with depth @45 to 45.5' decomposed wood debris layer

Notes:
1. No soil was collected from 0 to 15 feet below ground surface

FLOYD | SNIDER
strategy ▪ science ▪ engineering

Boring ID: T3B1

Drill Date: January 13, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 15 ft
Groundwater ATD (ft bgs): 9.5 ft

Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,770.3
Longitude/Easting: 1,275,888.6

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy

SAMPLE Type/Depth	DRIVEN / RECOVERED	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
		0		Crushed gravel with few slag
		1	SW	Dark brown and black gravelly SAND with and red brick fragments, dry (FILL)
T3B1 3-5 (PID: 1.1 ppm)		2	SP	Reddish-brown fine SAND, loose, dry (FILL) Turns to gray color at 4.5 ft bgs.
		5		
			SP	Gray fine SAND, dense, moist (FILL)
		7	SP	Dark gray medium sand, loose, moist (FILL). Tree branch fragment at 7.5 ft.
		8	SP	Gray coarse SAND, loose, moist (FILL)
T3B1 8-10 (3.6 ppm)		9 ▼	ML	Gray and reddish brown SILT, very soft, saturated (NATIVE)
		10	SM	Gray silty fine SAND, dense, saturated (NATIVE)
T3B1 13-15 (176 ppm)		14	ML/SP	Lense of gray fine sandy SILT 14 - 14.3 ft with gray very fine SAND below (NATIVE). Petroleum odor and sheen observed.
		15		

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
= denotes start of water saturated soil

FLOYD | SNIDER
strategy • science • engineering

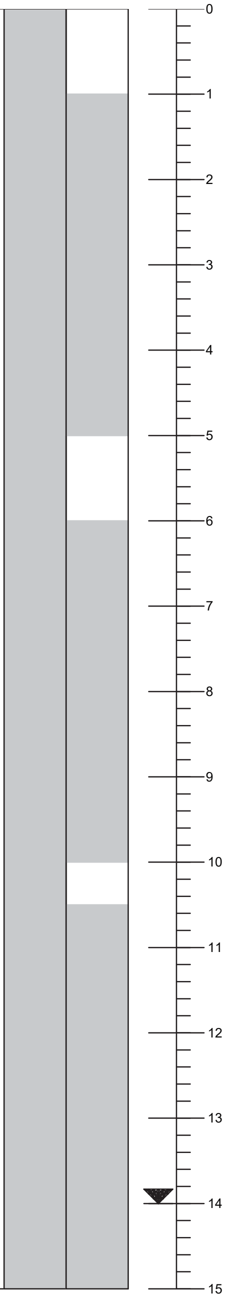
Boring ID: T3B2

Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,771.6
Longitude/Easting: 1,275,859.1

Drill Date: January 13, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 15 ft
Groundwater ATD (ft bgs): 14 ft

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy, approx 50 degrees



SAMPLE Type/Depth	DRIVEN / RECOVERED	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				Crushed gravel
			SW	Dark brown gravelly SAND, loose, dry (FILL)
T3B2 3-5 (PID: 1.6 ppm)			SP	Brown very fine SAND with trace gravel, moist (FILL). No petroleum odor or sheen, no fill debris observed.
			SP	Brown fine SAND, moist (FILL). No gravel, no petroleum odor or sheen.
			SM	Light brown, silty SAND, stiff, dry (FILL?).
			SM	Light reddish-brown, fine silty SAND, moist (NATIVE).
T3B2 8-10 (1.9 ppm)			SP	Gray and red fine SAND, dense, moist (NATIVE).
			SM	Llight brown, silty SAND mottled with light reddish-brown, moist (NATIVE).
			ML	Reddish-gray fine sandy SILT, very soft, moist (NATIVE). No gravel or debris fill noted. No petroleum sheen or odor.
T3B2 13-15 (1.9 ppm)			ML	Gray, sandy SILT, stiff, wet (NATIVE). No gravel or debris fill observed. No petroleum sheen or odor.

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
= denotes start of water saturated soil

FLOYD | SNIDER
strategy ▪ science ▪ engineering

Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,770.7
Longitude/Easting: 1,275,827.1

Drill Date: January 13, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 15 ft
Groundwater ATD (ft bgs): 13 ft

Boring ID: T3B3

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather cloudy and rainy

SAMPLE Type/Depth	DRIVEN / RECOVERED	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
	▨	0 1		Crushed gravel and woody plant material.
T3B3 3-5 (PID: 1.3 ppm)	▨ ▨	2 3 4	SP	Reddish-brown, fine SAND, moist with trace gravel and some asphalt pieces throughout, moist (FILL). No petroleum sheen or odor. No debris fill observed.
	▨	5 6 7		
T3B3 8-10 (1.8 ppm)	▨ ▨	8 9	SP	Reddish-brown fine SAND, moist (FILL). Minimal recovery Whitish-red brick fragments at 10 ft bgs.
	▨	10 11 12		
T3B3 13-15 (2.2 ppm)	▨ ▨	▼ 13 14 15	SM	Gray very fine silty SAND, wet (NATIVE).

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
= denotes start of water saturated soil

FLOYD | SNIDER
strategy ▪ science ▪ engineering

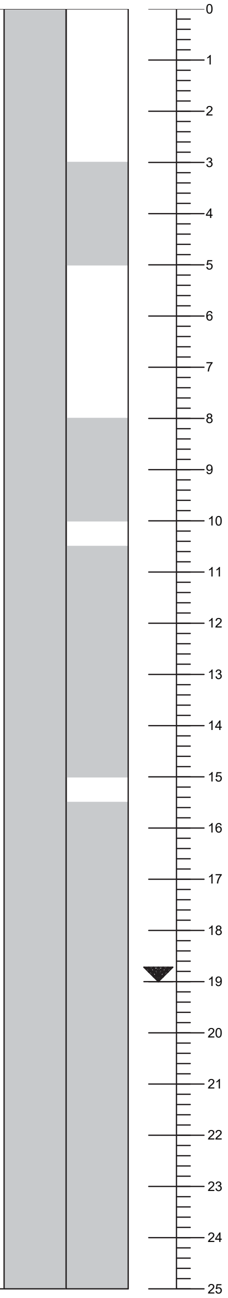
Boring ID: T3B4

Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,771.2
Longitude/Easting: 1,275,805.8

Drill Date: January 13, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 25 ft
Groundwater ATD (ft bgs): 19 ft

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy



SAMPLE Type/Depth	DRIVEN / RECOVERED	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				Woody plant debris and crushed gravel.
T3B4 3-5 (PID: 1.9 ppm)			GP	Dark brown GRAVEL mixed with whitish-red degraded brick fragments (FILL). Minimal recovery.
(1.7 ppm)			SW	Gray and brown gravelly SAND (FILL) with black tar-like material (asphalt?).
			SW	Light brown gravelly SAND (FILL).
T3B4 13-15 (0.5 ppm)			SP	Black SAND with trace small gravel, moist (FILL). Some woody plant debris and black tar-like material. Slight sheen observed.
			GP	Gray crushed GRAVEL (small and rounded) with minimal sand content, moist (FILL).
(10.2 ppm)			SP	Reddish-brown fine SAND, dense, moist (FILL). No petroleum sheen or ordor.
			SP	Black coarse SAND with black tar-like material mixed with woody (plant?) debris (FILL). Saturated at 19 ft.
			SP	Dark gray SAND, wet (FILL). Some rounded gravel, glass fragments and woody plant debris.
T3B4 23-25 (1.1			SM	Gray fine silty SAND, saturated (NATIVE). Petroleum sheen and odor at 24 ft.

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
= denotes start of water saturated soil

FLOYD | SNIDER
strategy ▪ science ▪ engineering

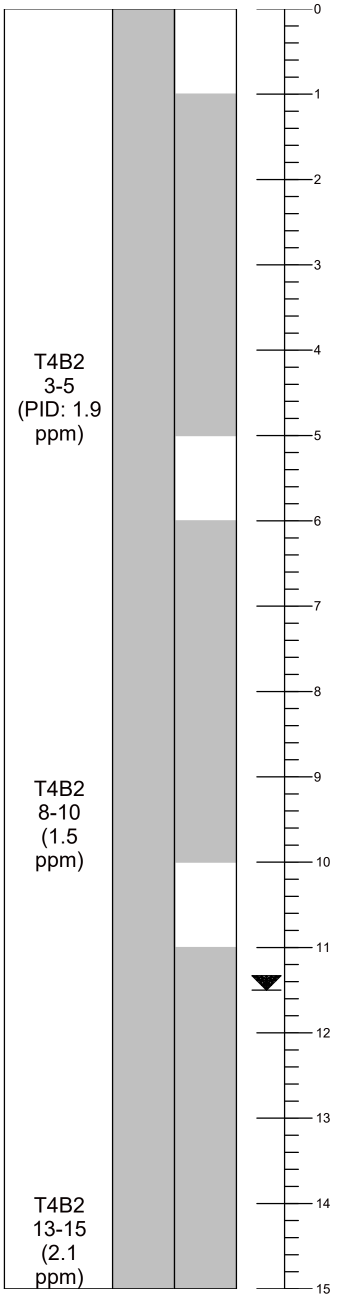
Boring ID: T4B2

Drill Date: January 14, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 15 ft
Groundwater ATD (ft bgs): 11.5 ft

Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,745.3
Longitude/Easting: 1,275,858.1

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy



SAMPLE Type/Depth	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
		Broken asphalt and crushed gravel
	SM	Dark brown silty SAND with gravel (FILL).
T4B2 3-5 (PID: 1.9 ppm)	SP	Brown fine SAND (FILL). No gravel or debris fill observed.
	SP	Light brown with orange, dense, dry SAND (FILL).
	SW	Dark brown coarse SAND (NATIVE).
	SP	Dark brown fine SAND (NATIVE).
T4B2 8-10 (1.5 ppm)	ML	Reddish-gray/brown SILT, dry (NATIVE). No gravel or debris
	SM	Reddish-brown fine silty SAND, moist (NATIVE).
T4B2 13-15 (2.1 ppm)	ML	Light gray sandy SILT, soft wet (NATIVE).

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
▼ = denotes start of water saturated soil

FLOYD | SNIDER
strategy ▪ science ▪ engineering

Boring ID: T4B3

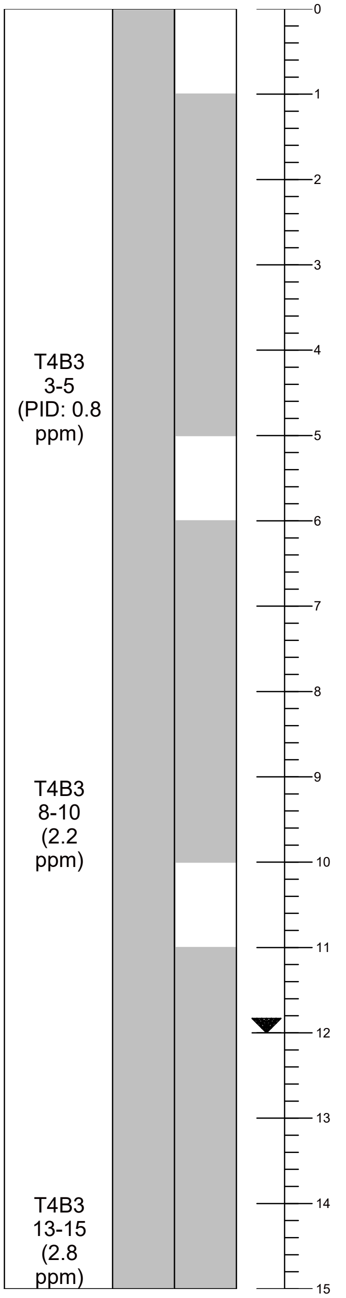
Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,755.6
Longitude/Easting: 1,275,828.2

Drill Date: January 14, 2011
Logged By: Lisa Meoli
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 15 ft
Groundwater ATD (ft bgs): 12 ft

Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy

SAMPLE Type/Depth	DRIVEN / RECOVERED	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS



USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
	Crushed gravel and vegetation
SM	Dark brown silty SAND (topsoil) with some vegetation and trace gravel.
SP	Brown fine SAND, dry (FILL).
SW	Dark brown coarse SAND, dry (FILL).
ML	Light reddish-brown SILT, very stiff with trace fine sand, dry, oxidized (FILL?)
SM	Reddish brown very fine silty SAND, saturated.
ML	Gray SILT, soft, wet (NATIVE).

Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
▼ = denotes start of water saturated soil

FLOYD | SNIDER
strategy ▪ science ▪ engineering

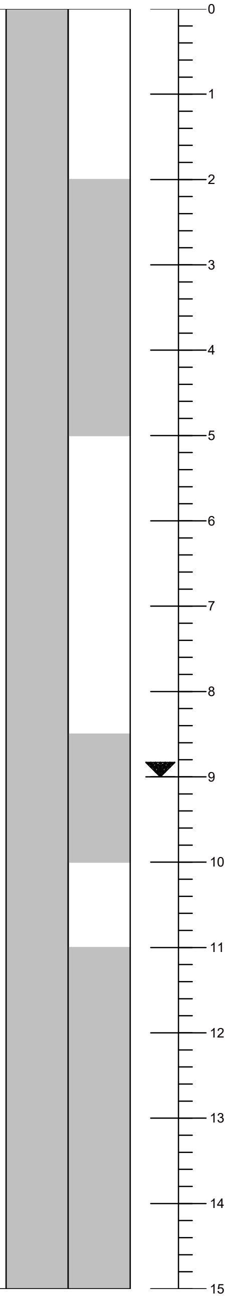
Boring ID: T5B3

Coordinate System: State Plane, NAD83
Ground Surface Elevation: NA
Latitude/Northing: 195,715.3
Longitude/Easting: 1,275,855.9

Drill Date: January 14, 2011
Logged By: Dean Brame
Drilled By: Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: direct push 2"x5' core
Boring Diameter: 2 inches
Boring Depth (ft bgs): 15 ft
Groundwater ATD (ft bgs): 9 ft

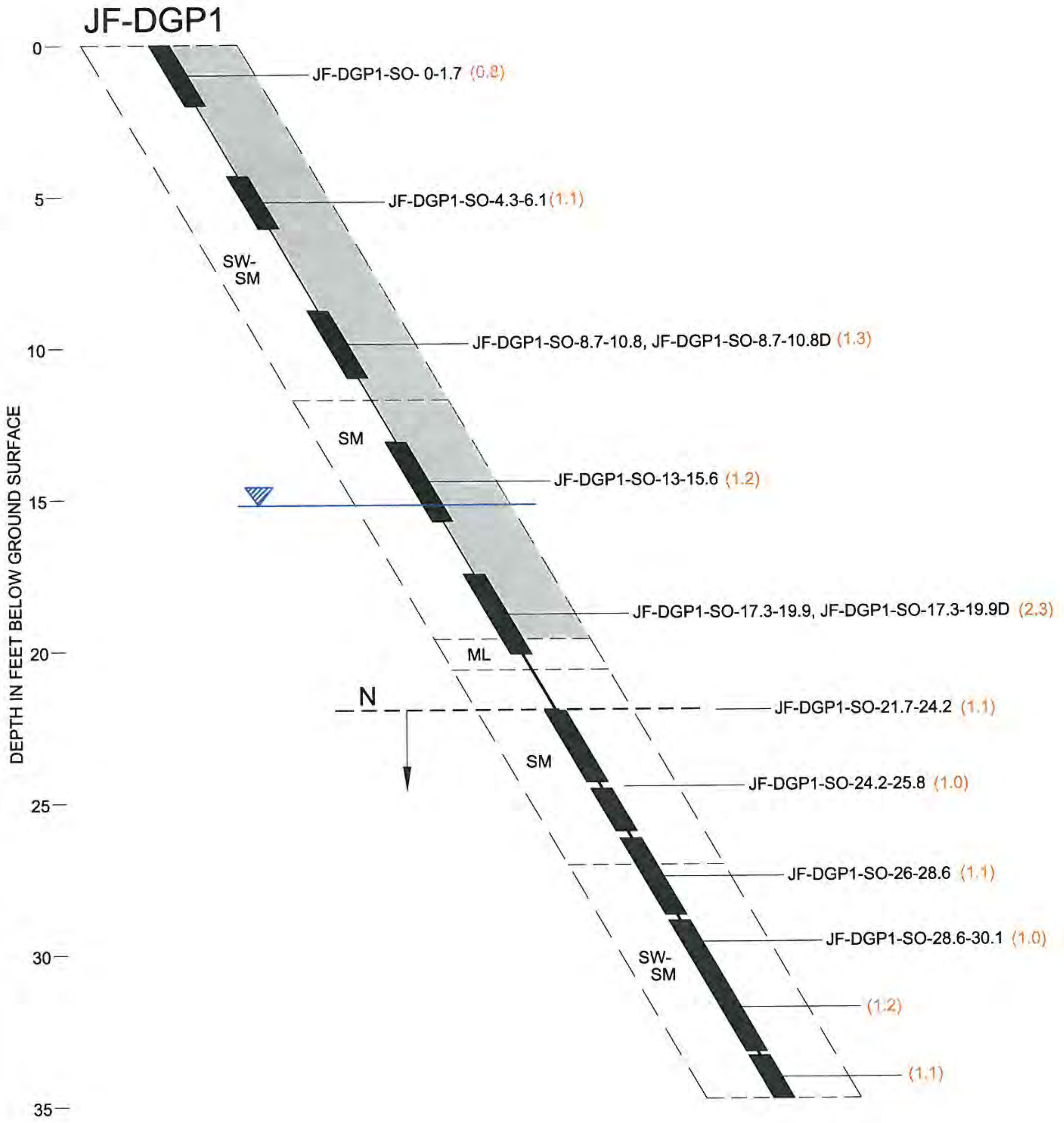
Project: Jorgensen Forge PLO
Task: BP2-JFOS
Site Location: 8351 E. Marginal Way S., Seattle, WA

Remarks: weather rainy



SAMPLE Type/Depth	DRIVEN / RECOVERED	DEPTH (FT BGS)	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				Topsoil and crushed gravel
T5B3 3-5 (PID: 2.8 ppm)			SW	Dark brown gravelly SAND, dry (FILL). Pale orange brick fragments 2.5 - 4 ft bgs. Light gray concrete at 3.5 ft bgs.
			SP	Dark brown coarse SAND, moist (FILL).
T5B3 8-10 (3.3 ppm)			SM	Brown to gray fine silty SAND, wet (FILL).
			CL	Dark gray silty CLAY, medium plasticity, wet (FILL?).
			SM	Dark grayish-brown fine sandy SILT, very wet (NATIVE).
T5B3 13-15 (2.8 ppm)			SP	Brown coarse SAND with orange mottling, wet (NATEIVE).

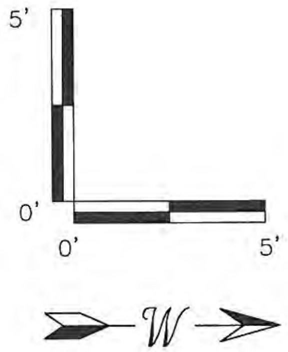
Notes:
FT BGS = Feet Below Ground Surface
USCS = Unified Soil Classification System, modified from ASTM D2488
▼ = denotes start of water saturated soil



LEGEND

BORING ADVANCED AT ANGLE 30° FROM VERTICAL
BORING TOTAL LENGTH OF 40' = VERTICAL DEPTH OF 35' BGS

▨	INDICATES ODORS, SHEEN, STAINING AND/OR FINE BLACK SUBSTANCE
▽	DEPTH TO GROUNDWATER AT TIME OF DRILLING
▰ JF-DGP1-SO-0-1.7'	SOIL SAMPLE LOCATION AND IDENTIFICATION
(1.4)	VOLATILE ORGANIC VAPOR MEASUREMENT USING PHOTOIONIZATION DETECTOR
– – – – – –	LITHOLOGIC CONTACT
N – – – – – –	INTERFACE TO NATIVE-TYPE SOIL, AS FIELD IDENTIFIED
SM	SILTY SAND AND SILTY SAND WITH GRAVEL
ML	SANDY SILT
SW/SM	WELL-GRADED SAND WITH SILT



FARALLON CONSULTING
975 5th Avenue Northwest
Issaquah, WA 98027

LOG OF BORING JF DGP1

JORGENSEN FORGE
PHASE 2 SOIL INVESTIGATION
SEATTLE, WASHINGTON

FARALLON PN: 394–001

Drawn By:DEW	Checked By:JP	Date:5/17/12	Disk Reference:394001

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Angled Boring:
JF-DGP1

Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-001

Logged By: Jon Peterson

Date/Time Started:	3/29/12 1400	**Drive Hammer (lbs.):**	Auto
Date/Time Completed:	3/29/12 1600	**Depth of Water (ft):**	12-15' bgs
Equipment:	Geoprobe	**Vertical Boring Depth (ft bgs):**	34.5
Drilling Company:	Cascade Drilling, LP	**Inclined Boring Depth (ft):**	40
Drilling Foreman:	Elijah Floyd		
Drilling Method:	Direct Push		
Sampler Type:	5' Macrocore		

Vertical Depth (feet bgs)	Inclined Depth	Sample Interval	Lithologic Description	USCS	USGS Graphic	% Recovery	Blow Counts 8/8/8	PID (ppmv)	Sample ID	Sample Analyzed	Boring/Well Construction Details
0	0		0-2' (lineal): Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown to black, moist, no odor, fine black substance*. (Silt is undifferentiated from clay).	SW-SM		40	NA	0.8	JF-DGP1-0-1.7	x	Bentonite Seal
5	5		5-7' (lineal): Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown to black, moist, no odor, fine black substance*.	SW-SM		40		1.1	JF-DGP1-SO-4.3-6.1	x	
10	10		10-12.5' (lineal): Well-graded SAND with silt and gravel, fine to coarse sand and gravel, reddish brown to black, moist, no odor, wood, fine black substance*. (Silt is undifferentiated from clay).	SW-SM		50		1.3	JF-DGP1-SO-8.7-10.8, JF-DGP1-SO-8.7-10.8D	x x	
15	15		15-18' (lineal): Silty SAND with gravel, fine to coarse sand and gravel, orange to black, wet, no odor, light sheen, fine black substance*.	SM		60		1.2	JF-DGP1-SO-13-15.6	x	▼
	20		20-22.3' (lineal): Silty SAND with gravel, fine to coarse sand and gravel, orange to black, wet, odor, sheen, wood, fine black substance*.	SM		70		2.3	JF-DGP1-SO-17.3-19.9, JF-DGP1-SO-17.3-19.9D	x x	
20			22.3-23.5' (lineal): Sandy SILT, fine sand, gray to black, wet, no odor, wood.	ML							
25	25		25-29.8' (lineal): Silty SAND, fine, gray, wet, no odor, coarsening downward. Soil below 25' (lineal) was field-identified as consistent with "Native soils" identified in the Boeing Phase 1 investigation.	SM		96		1.1 1.0	JF-DGP1-SO-21.7-24.2 JF-DGP1-SO-24.2-25.8	x x	
	30		30-31' (lineal): Silty SAND, fine to medium sand, gray, wet, no odor.	SM		96		1.1 1.0	JF-DGP1-SO-26-28.6 JF-DGP1-SO-28.6-30.1 (archived)	x	
30			31-34.8' (lineal): Well-graded SAND with silt, fine to medium, dark gray, wet, no odor, some thin silty layers.	SW-SM							
	35		35-39.8' (lineal): Well-graded SAND with silt, fine to medium, dark gray, wet, no odor.	SW-SM		96		1.2 1.1			
35	40										

*** Fine substance used to describe an observed material that was not able to be classified as to soil type or origin.**

Well Construction Information

Monument Type:	NA	**Filter Pack:**	NA	**Ground Surface Elevation (ft msl):**		NA
Casing Diameter (in):	NA	**Surface Seal:**	Concrete	**Top of Casing Elevation (ft msl):**		NA
Screen Slot Size (in):	NA	**Annular Seal:**	NA	**Surveyed Location:**	**X:**	1275795.286
Screened Interval (ft bgs):	NA	**Boring Abandonment:**	Bentonite		**Y:**	195799.4743

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: JF-DGP2

Page 1 of 1

Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-001

Logged By: Jon Peterson

Date/Time Started: 3/29/12 0830
Date/Time Completed: 3/29/12 1030
Equipment: Geoprobe
Drilling Company: Cascade Drilling, LP
Drilling Foreman: Elijah Floyd
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): Auto
Depth of Water ATD (ft bgs): 6
Total Boring Depth (ft bgs): 40
Total Well Depth (ft bgs): NA

Depth (feet bgs.)	Lithologic Description	USCS	% Recovery	Blow Counts 8/8/8	PID (ppm)	Sample ID	Sample Analyzed	Boring/Well Construction Details
0	0-2' bgs: Well-graded SAND with silt and gravel, fine to medium sand, fine to coarse gravel, brown to black, moist, no odor, fine black substance*.	SW-SM	41	NA	0.6	JF-DGP2-SO-00-02, JF-DGP2-SO-02	x x	Bentonite Seal
5	5-6' bgs: Well-graded SAND with silt and gravel, fine to medium sand, fine to coarse gravel, brown to black, moist, no odor, fine black substance*.	SW-SM	30		0.3	JF-DGP2-SO-05-06.5	x	
	6-6.5' bgs: Sandy SILT with gravel, fine to coarse sand and gravel, orange to brown, wet, no odor.	ML				JF-DGP2-SO-00-10	x	
10	10-11.8' bgs: Sandy SILT with gravel, fine to coarse sand and gravel, orange to brown, wet, no odor, glass, low plasticity, inorganic.	ML	35		0.7	JF-DGP2-SO-10-11.8	x	
						JF-DGP2-SO-10-20	x	
15	15-19.8' bgs: Sandy SILT transitioning to poorly graded SAND with silt, fine sand, gray, wet, no odor, silt clasts. Soil below 18' bgs was field-identified as consistent with "Native soils" identified in the Boeing Phase 1 investigation.	ML/ SP-SM	97		0.5	JF-DGP2-SO-15-17, JF-DGP2-SO-16	x x	
					0.4	JF-DGP2-SO-17-19	x	
						JF-DGP2-SO-19-19.8	x	
20	20-24.8' bgs: Poorly graded SAND with silt grades to well-graded SAND with silt, fine to medium, gray, wet, no odor, wood.	SP-SM/ SW-SM	97		0.4	JF-DGP2-SO-20-22	x	
						JF-DGP2-SO-20-30	x	
					0.3	JF-DGP2-SO-22-24	x	
						JF-DGP2-SO-24-24.8	x	
25	25-26' bgs: Well-graded SAND with silt, fine to medium, gray, wet, no odor.	SW-SM	97		0.5	JF-DGP2-SO-25-27, JF-DGP2-SO-26	x x	
	26-27' bgs: Poorly graded SAND with silt, fine, gray, wet, no odor, wood at 26.5' bgs.	SP-SM			0.9	JF-DGP2-SO-27-29	x	
	27-29.8' bgs: Well-graded SAND with silt, fine to medium, gray, wet, no odor.	SW-SM				JF-DGP2-SO-29-29.8	x	
30	30-31' bgs: Well-graded SAND with silt, fine to medium, gray, wet, no odor.	SW-SM	25		0.7	JF-DGP2-SO-30-31.5	x	
	31-31.5' bgs: Poorly graded GRAVEL, coarse gravel, trace fine to medium sand, gray, wet, no odor.	GP						
35	35-38.8' bgs: Well-graded SAND with silt, fine to medium, gray, wet, no odor.	SW-SM	100					
40								

*** Fine substance used to describe an observed material that was not able to be classified as to soil type or origin.**

Well Construction Information

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

Filter Pack: NA
Surface Seal: Concrete
Annular Seal: NA
Boring Abandonment: Bentonite

Ground Surface Elevation (ft): NA
Top of Casing Elevation (ft): NA
Surveyed Location: **X:** 1275789.877
Y: 195806.697

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: JF-DGP3

Page 1 of 1

Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-001

Logged By: Jon Peterson

Date/Time Started:	3/28/12 1245	**Sampler Type:**	5' Macrocore
Date/Time Completed:	3/28/12 1400	**Drive Hammer (lbs.):**	Auto
Equipment:	Geoprobe	**Depth of Water ATD (ft bgs):**	10.5
Drilling Company:	Cascade Drilling, LP	**Total Boring Depth (ft bgs):**	35
Drilling Foreman:	Elijah Floyd	**Total Well Depth (ft bgs):**	NA
Drilling Method:	Direct Push		

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		0-3' bgs: Well-graded SAND with silt and gravel, fine to medium sand, fine to coarse gravel, black and gray, moist, no odor, fine black substance*. (Silt is undifferentiated from clay).	SW-SM		60	NA	1.0	JF-DGP3-SO-00-02	x	
							1.3	JF-DGP3-SO-02-03	x	Bentonite Seal
5		5-6' bgs: Well-graded SAND with gravel, fine to medium sand, fine to coarse gravel, black and gray, moist, no odor, yellow specks, fine black substance*.	SW		50		1.9	JF-DGP3-SO-05-07	x	
		6-7.5' bgs: Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown with black to red area past 7' bgs, moist, no odor.	SW-SM				3.4	JF-DGP3-SO-07-07.5	x	
10		10-12' bgs: Silty SAND with gravel, fine to medium sand, fine to coarse gravel, orange, wet, no odor.	SM		40		1.1	JF-DGP3-SO-10-12	x	▼
15		15-16.5' bgs: Silty SAND with gravel, fine to medium sand, fine and some coarse gravel, gray, wet, faint odor, sheen. (Silt is undifferentiated from clay).	SM		25		18.6	JF-DGP3-SO-15-16.5, JF-DGP3-SO-15	x x	
20		20-21' bgs: Well-graded SAND with gravel, fine to coarse sand, fine gravel, gray, wet, no odor, light sheen, glass, fine black substance*.	SW		20			JF-DGP3-SO-20-21	x	
25		25-29' bgs: Silty SAND, fine, gray, wet, no odor, light sheen, trace fine to coarse gravel at 27.5' bgs, wood. Soil below 25' bgs was field-identified as consistent with "Native soils" identified in the Boeing Phase 1 investigation.	SM		80		5.2	JF-DGP3-SO-25-27	x	
								JF-DGP3-SO-27-29, JF-DGP3-SO-27-29D	x x	
30		30-34.8' bgs: Well-graded SAND with silt, fine sand, dark gray, moist to wet, no odor, no sheen.	SW-SM		100		5.6	JF-DGP3-SO-30-32	x	
							2.3			
35										

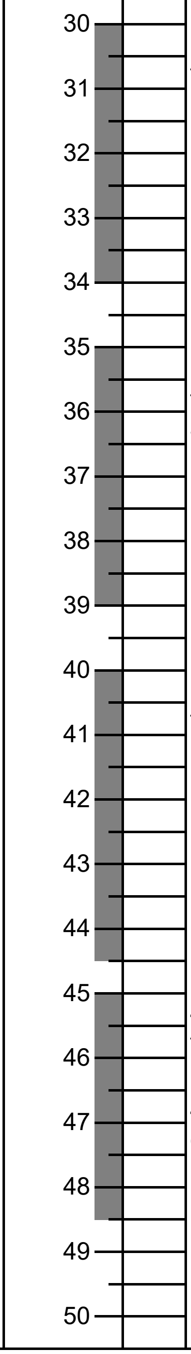
*** Fine substance used to describe an observed material that was not able to be classified as to soil type or origin.**

Well Construction Information

Monument Type:	NA	**Filter Pack:**	NA	**Ground Surface Elevation (ft):**	NA
Casing Diameter (inches):	NA	**Surface Seal:**	Concrete	**Top of Casing Elevation (ft):**	NA
Screen Slot Size (inches):	NA	**Annular Seal:**	NA	**Surveyed Location:**	**X:** 1275812.864
Screened Interval (ft bgs):	NA	**Boring Abandonment:**	Bentonite		**Y:** 195805.095

Boring Location: JFDGP3

Boring JFDGP3 Date 12/6/2012 Sheet 1 of 1
Job JFOS Job No. 010128-01.04
Logged By NS/LG Weather Rain
Drilled By Cascade Drilling
Drill Type/ Method Geoprobe
Sampling Method
Bottom of Boring 50'



PID	Sample Depth (feet) From	To	DESCRIPTION: Density, moisture, color, minor, MAJOR CONSTITUENT, non-soil substances: Odor, staining, sheen, slag, etc.
			Medium stiff, moist, grey, fine to medium well-graded SAND with few fines, no odor, no sheen (Sample ID: JFDGP3-32-34-121206)
0.0	32	34	
0.0	35	37	Medium stiff, moist, grey, fine to course well-graded SAND with few fines, no odor, no sheen (Sample IDs: JFDGP3-35-37-121206 and JFDGP3-37-39-121206)
0.0	37	39	
0.0	40	42	Medium stiff, moist, grey, fine to course well-graded SAND with few fines, no odor, no sheen (Sample ID: JFDGP3-40-42-121206)
			45 to 46 medium stiff, moist, grey, fine to medium silty SAND with few fines, no odor, no sheenm with decomposing wood debris.
0.0	47	48.5	46 to 48.5 Medium stiff, moist, grey, fine to course well-graded SAND, no odor, no sheen (Sample ID: JFDGP3-47-48.5-121206; not analyzed)

Notes:

1. No soils were collected at this location from 0 to 30 feet below ground surface.

ANCHOR QEA

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: JF-DGP4

Page 1 of 1

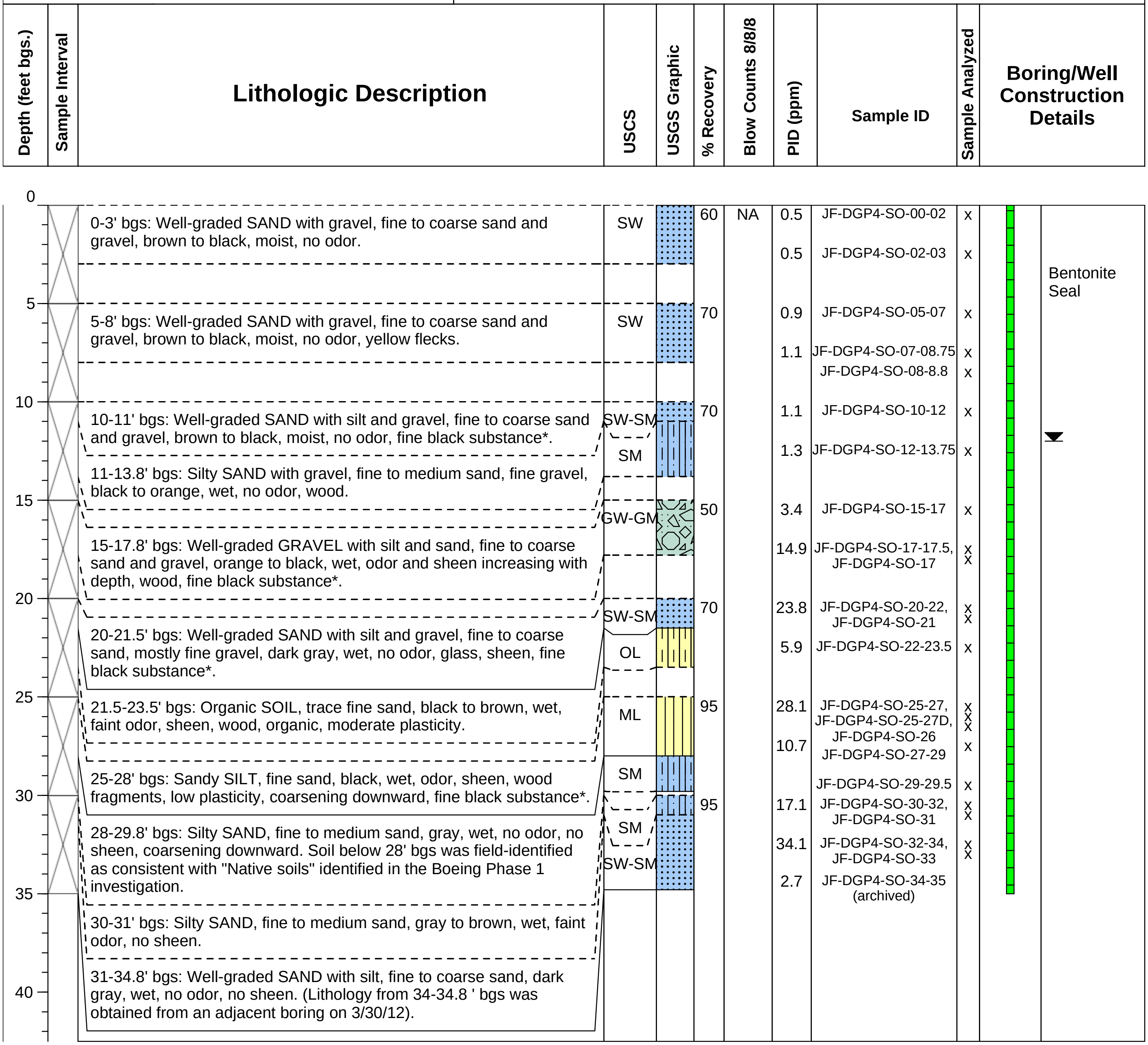
Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-001

Logged By: Jon Peterson

Date/Time Started: 3/28/12 1400
Date/Time Completed: 3/29/12 1200
Equipment: Geoprobe
Drilling Company: Cascade Drilling, LP
Drilling Foreman: Elijah Floyd
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): Auto
Depth of Water ATD (ft bgs): 12
Total Boring Depth (ft bgs): 35
Total Well Depth (ft bgs): NA



Lithologic Description	USCS
0-3' bgs: Well-graded SAND with gravel, fine to coarse sand and gravel, brown to black, moist, no odor.	SW
5-8' bgs: Well-graded SAND with gravel, fine to coarse sand and gravel, brown to black, moist, no odor, yellow flecks.	SW
10-11' bgs: Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown to black, moist, no odor, fine black substance*.	SW-SM
11-13.8' bgs: Silty SAND with gravel, fine to medium sand, fine gravel, black to orange, wet, no odor, wood.	SM
15-17.8' bgs: Well-graded GRAVEL with silt and sand, fine to coarse sand and gravel, orange to black, wet, odor and sheen increasing with depth, wood, fine black substance*.	GW-GM
20-21.5' bgs: Well-graded SAND with silt and gravel, fine to coarse sand, mostly fine gravel, dark gray, wet, no odor, glass, sheen, fine black substance*.	SW-SM
21.5-23.5' bgs: Organic SOIL, trace fine sand, black to brown, wet, faint odor, sheen, wood, organic, moderate plasticity.	OL
25-28' bgs: Sandy SILT, fine sand, black, wet, odor, sheen, wood fragments, low plasticity, coarsening downward, fine black substance*.	ML
28-29.8' bgs: Silty SAND, fine to medium sand, gray, wet, no odor, no sheen, coarsening downward. Soil below 28' bgs was field-identified as consistent with "Native soils" identified in the Boeing Phase 1 investigation.	SM
30-31' bgs: Silty SAND, fine to medium sand, gray to brown, wet, faint odor, no sheen.	SM
31-34.8' bgs: Well-graded SAND with silt, fine to coarse sand, dark gray, wet, no odor, no sheen. (Lithology from 34-34.8 ' bgs was obtained from an adjacent boring on 3/30/12).	SW-SM

% Recovery	Blow Counts 8/8/8	PID (ppm)	Sample ID	Sample Analyzed
60	NA	0.5	JF-DGP4-SO-00-02	x
		0.5	JF-DGP4-SO-02-03	x
70		0.9	JF-DGP4-SO-05-07	x
		1.1	JF-DGP4-SO-07-08.75	x
			JF-DGP4-SO-08-8.8	x
70		1.1	JF-DGP4-SO-10-12	x
		1.3	JF-DGP4-SO-12-13.75	x
50		3.4	JF-DGP4-SO-15-17	x
		14.9	JF-DGP4-SO-17-17.5, JF-DGP4-SO-17	x x
70		23.8	JF-DGP4-SO-20-22, JF-DGP4-SO-21	x x
		5.9	JF-DGP4-SO-22-23.5	x
95		28.1	JF-DGP4-SO-25-27, JF-DGP4-SO-25-27D, JF-DGP4-SO-26	x x x
		10.7	JF-DGP4-SO-27-29	x
			JF-DGP4-SO-29-29.5	x
95		17.1	JF-DGP4-SO-30-32, JF-DGP4-SO-31	x x
		34.1	JF-DGP4-SO-32-34, JF-DGP4-SO-33	x x
		2.7	JF-DGP4-SO-34-35 (archived)	

*** Fine substance used to describe an observed material that was not able to be classified as to soil type or origin.**

Well Construction Information

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

Filter Pack: NA
Surface Seal: Concrete
Annular Seal: NA
Boring Abandonment: Bentonite

Ground Surface Elevation (ft): NA
Top of Casing Elevation (ft): NA
Surveyed Location: **X:** 1275806.080
Y: 195798.570

FARALLON
consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: JF-DGP5

Page 1 of 1

Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-001

Logged By: Jon Peterson

Date/Time Started:	3/29/12 1015	**Sampler Type:**	5' Macrocore
Date/Time Completed:	3/29/12 1400	**Drive Hammer (lbs.):**	Auto
Equipment:	Geoprobe	**Depth of Water ATD (ft bgs):**	approx. 10
Drilling Company:	Cascade Drilling, LP	**Total Boring Depth (ft bgs):**	30
Drilling Foreman:	Elijah Floyd	**Total Well Depth (ft bgs):**	NA
Drilling Method:	Direct Push		

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		0-2' bgs: Well-graded SAND with gravel, fine to medium sand, fine to coarse gravel, brown, moist, no odor, rock fragments at 2' bgs.	SW		40	NA	0.6	JF-DGP5-SO-00-02, JF-DGP5-SO-02	x x	Bentonite Seal
5		5-7' bgs: Well-graded SAND with gravel, fine to medium sand, fine to coarse gravel, brown, moist, no odor.	SW		40		0.5	JF-DGP5-SO-05-07	x	
								JF-DGP5-SO-00-10	x	
10		10-11' bgs: Silty GRAVEL with sand, mostly fine gravel, fine to coarse sand, black, wet, no odor.	GM		90		0.8	JF-DGP5-SO-10-12	x	▼
		11-14.5' bgs: Silty SAND with gravel, fine to medium sand, fine gravel, gray, wet, no odor.	SM				0.8	JF-DGP5-SO-12-14	x	
								JF-DGP5-SO-14-14.5	x	
15		15-17' bgs: Silty GRAVEL with sand, mostly fine gravel, fine to coarse sand, black, wet, no odor, fine black substance*. (Silt is undifferentiated from clay).	GM		98		1.1	JF-DGP5-SO-15-17, JF-DGP5-SO-16	x x	
		17-19' bgs: Silty SAND with gravel, fine to medium sand, fine gravel, brown to black, wet, no odor, fine black substance*.	SM				0.9	JF-DGP5-SO-17-19	x	
								JF-DGP5-SO-10-20	x	
		19-19.8' bgs: Well-graded GRAVEL with silt and sand, fine to coarse gravel and sand, gray, wet, no odor, glass and wood.	GW					JF-DGP5-SO-19-19.8	x	
20		20-21' bgs: Well-graded SAND with silt and gravel, fine to coarse sand, fine gravel, gray, wet, no odor, light sheen.	SW-SM		23		2.4	JF-DGP5-SO-20-21.25	x	
		21-21.3' bgs: Silty GRAVEL with sand, coarse, black, wet, no odor, fine black substance*.	GM							
25		25-27.5' bgs: Well-graded SAND with silt, fine to medium sand, dark gray, wet, no odor, glass at 25.5' bgs. Soil below 26' bgs was field-identified as consistent with "Native soils" identified in the Boeing Phase 1 investigation.	SW-SM		50		2.5	JF-DGP5-SO-25-27, JF-DGP5-SO-26	x x	
							2.5	JF-DGP5-SO-27-27.5	x	
								JF-DGP5-SO-20-30	x	
30										

*** Fine substance used to describe an observed material that was not able to be classified as to soil type or origin.**

Well Construction Information

Monument Type:	NA	**Filter Pack:**	NA	**Ground Surface Elevation (ft):**	NA
Casing Diameter (inches):	NA	**Surface Seal:**	Concrete	**Top of Casing Elevation (ft):**	NA
Screen Slot Size (inches):	NA	**Annular Seal:**	NA	**Surveyed Location:**	**X:** 1275795.502
Screened Interval (ft bgs):	NA	**Boring Abandonment:**	Bentonite		**Y:** 195791.735

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: JF-DGP6

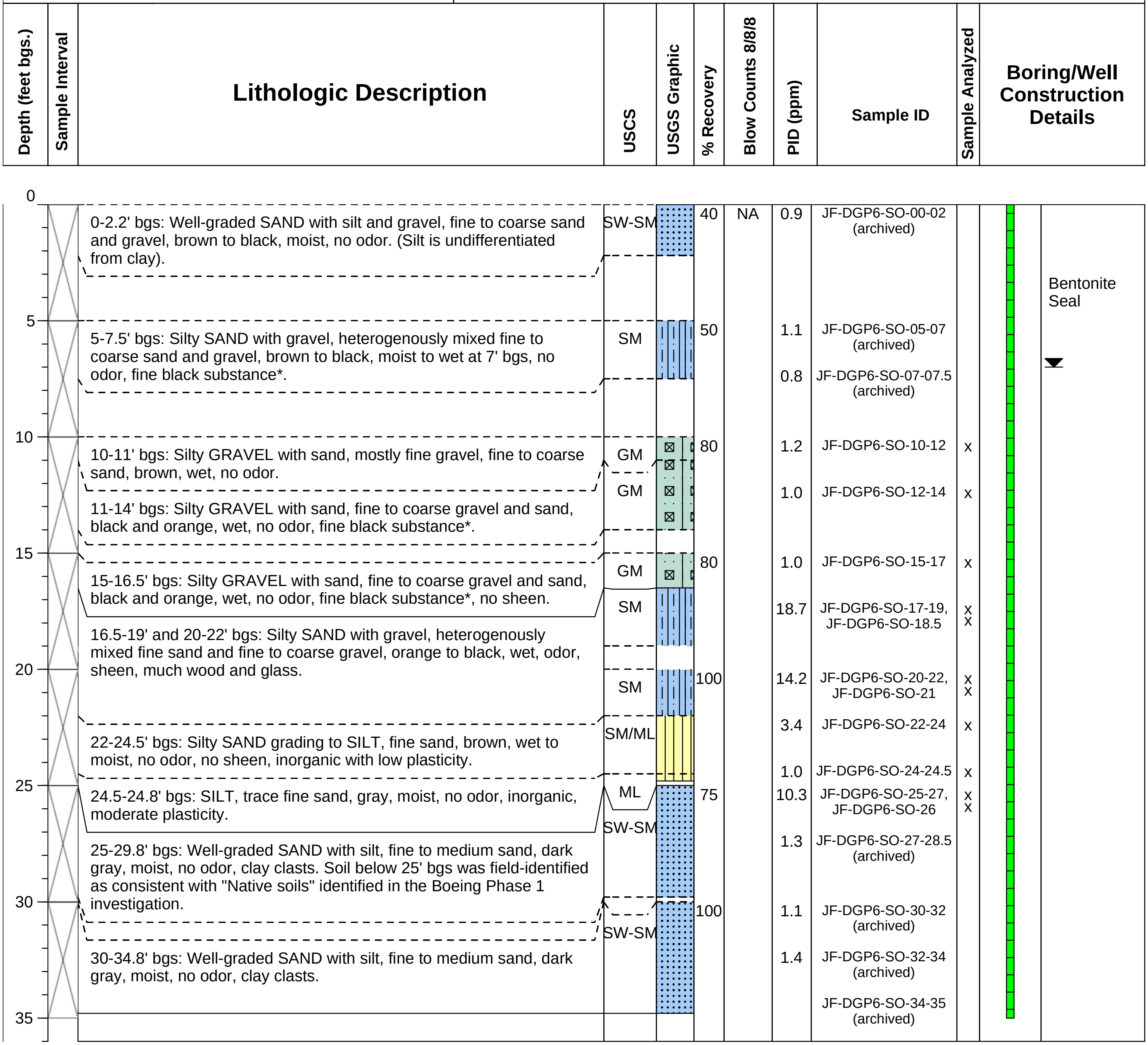
Page 1 of 1

Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-001

Logged By: Jon Peterson

Date/Time Started:	3/30/12 1000	**Sampler Type:**	5' Macrocore
Date/Time Completed:	3/30/12 1200	**Drive Hammer (lbs.):**	Auto
Equipment:	Geoprobe	**Depth of Water ATD (ft bgs):**	7
Drilling Company:	Cascade Drilling, LP	**Total Boring Depth (ft bgs):**	35
Drilling Foreman:	Elijah Floyd	**Total Well Depth (ft bgs):**	NA
Drilling Method:	Direct Push		



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		0-2.2' bgs: Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown to black, moist, no odor. (Silt is undifferentiated from clay).	SW-SM		40	NA	0.9	JF-DGP6-SO-00-02 (archived)		Bentonite Seal
5		5-7.5' bgs: Silty SAND with gravel, heterogenously mixed fine to coarse sand and gravel, brown to black, moist to wet at 7' bgs, no odor, fine black substance*.	SM		50		1.1 0.8	JF-DGP6-SO-05-07 (archived) JF-DGP6-SO-07-07.5 (archived)		▼
10		10-11' bgs: Silty GRAVEL with sand, mostly fine gravel, fine to coarse sand, brown, wet, no odor.	GM		80		1.2	JF-DGP6-SO-10-12	x	
		11-14' bgs: Silty GRAVEL with sand, fine to coarse gravel and sand, black and orange, wet, no odor, fine black substance*.	GM				1.0	JF-DGP6-SO-12-14	x	
15		15-16.5' bgs: Silty GRAVEL with sand, fine to coarse gravel and sand, black and orange, wet, no odor, fine black substance*, no sheen.	GM		80		1.0	JF-DGP6-SO-15-17	x	
		16.5-19' and 20-22' bgs: Silty SAND with gravel, heterogenously mixed fine sand and fine to coarse gravel, orange to black, wet, odor, sheen, much wood and glass.	SM				18.7	JF-DGP6-SO-17-19, JF-DGP6-SO-18.5	x x	
20			SM		100		14.2	JF-DGP6-SO-20-22, JF-DGP6-SO-21	x x	
		22-24.5' bgs: Silty SAND grading to SILT, fine sand, brown, wet to moist, no odor, no sheen, inorganic with low plasticity.	SM/ML				3.4 1.0	JF-DGP6-SO-22-24 JF-DGP6-SO-24-24.5	x x	
25		24.5-24.8' bgs: SILT, trace fine sand, gray, moist, no odor, inorganic, moderate plasticity.	ML		75		10.3	JF-DGP6-SO-25-27, JF-DGP6-SO-26	x x	
		25-29.8' bgs: Well-graded SAND with silt, fine to medium sand, dark gray, moist, no odor, clay clasts. Soil below 25' bgs was field-identified as consistent with "Native soils" identified in the Boeing Phase 1 investigation.	SW-SM				1.3	JF-DGP6-SO-27-28.5 (archived)		
30		30-34.8' bgs: Well-graded SAND with silt, fine to medium sand, dark gray, moist, no odor, clay clasts.	SW-SM		100		1.1 1.4	JF-DGP6-SO-30-32 (archived) JF-DGP6-SO-32-34 (archived) JF-DGP6-SO-34-35 (archived)		
35										

*** Fine substance used to describe an observed material that was not able to be classified as to soil type or origin.**

Well Construction Information

Monument Type:	NA	**Filter Pack:**	NA	**Ground Surface Elevation (ft):**	NA
Casing Diameter (inches):	NA	**Surface Seal:**	Concrete	**Top of Casing Elevation (ft):**	NA
Screen Slot Size (inches):	NA	**Annular Seal:**	NA	**Surveyed Location:**	**X:** 195795.6768
Screened Interval (ft bgs):	NA	**Boring Abandonment:**	Bentonite		**Y:** 1275795.03

FARALLON *consulting*
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: JF-DGS1

Page 1 of 1

Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA
Farallon PN: 394-001
Logged By: Jon Peterson

Date/Time Started: 3/27/12 1430
Date/Time Completed: 3/27/12 1600
Equipment: Geoprobe
Drilling Company: Cascade Drilling, LP
Drilling Foreman: Elijah Floyd
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): Auto
Depth of Water ATD (ft bgs): 12
Total Boring Depth (ft bgs): 35
Total Well Depth (ft bgs): NA

Depth (feet bgs.)	Lithologic Description	USCS	% Recovery	Blow Counts 8/8/8	PID (ppm)	Sample ID	Boring/Well Construction Details
0	0-0.3' bgs: Asphalt and gravel.		60	NA	0.6	JF-DGS1-SO-00-02 (archived)	
	0.3-3' bgs: Well-graded SAND with silt, fine to medium sand, mostly fine gravel, brown, moist, no odor, wood.	SW-SM			0.8	JF-DGS1-SO-02-03 (archived)	Bentonite Seal
5	5-6' bgs: Well-graded SAND with silt, fine to medium sand, mostly fine gravel, brown, moist, no odor. (Silt is undifferentiated from clay).	SW-SM	40		1.1	JF-DGS1-SO-05-07 (archived)	
	6-7' bgs: Silty SAND with gravel, fine sand, fine to coarse gravel, brown, moist, no odor, wood.	SM					
10	10-12' bgs: Silty SAND with gravel, fine to med sand, fine to coarse gravel, brown to orange, moist, no odor.	SM	40		1.1	JF-DGS1-SO-10-12 (archived)	▼
15	15-19.8' bgs: Well-graded SAND with silt, fine to coarse but fining downwards, dark brown to gray, wet, no odor.	SW-SM	100		1.2	JF-DGS1-SO-15-17 (archived)	
					0.9	JF-DGS1-SO-17-19 (archived)	
					1.0	JF-DGS1-SO-19-19.75 (archived)	
20	20-22.5' bgs: Silty SAND heterogenously mixed, fine to medium sand, dark gray to brown, wet, no odor, organics from 20-21' bgs.	SM	60		0.8	JF-DGS1-SO-20-22 (archived)	
25	25-27.8' bgs: Silty SAND heterogenously mixed, fine to medium sand, trace fine gravel, dark gray to brown, wet, no odor. Soil below approximately 25' bgs was field-identified as consistent with "Native soils" identified in the Boeing Phase 1 investigation.	SM	60		1.1	JF-DGS1-SO-25-27 (archived)	
30	30-34.8' bgs: Well-graded SAND, fine to medium, dark gray, wet, no odor.	SW	100		1.2	JF-DGS1-SO-30-32 (archived)	
35							

Well Construction Information

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

Filter Pack: NA
Surface Seal: Concrete
Annular Seal: NA
Boring Abandonment: Bentonite

Ground Surface Elevation (ft): NA
Top of Casing Elevation (ft): NA
Surveyed Location: **X:** 1275823.287
Y: 195807.707

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: JF-DGS2

Page 1 of 1

Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA
Farallon PN: 394-001
Logged By: Jon Peterson

Date/Time Started: 3/28/12 0940
Date/Time Completed: 3/28/12 1100
Equipment: Geoprobe
Drilling Company: Cascade Drilling, LP
Drilling Foreman: Elijah Floyd
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): Auto
Depth of Water ATD (ft bgs): 10
Total Boring Depth (ft bgs): 25
Total Well Depth (ft bgs): NA

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		0-0.2' bgs: Gravel and asphalt debris.			55	NA	1.0	JF-DGS2-SO-00-02 (archived)		Bentonite Seal
		0.2-2.8' bgs: Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown and black, moist, no odor, fine black substance*. (Silt is undifferentiated from clay).	SW-SM					JF-DGS2-SO-02-02.8 (archived)		
5		5-5.5' bgs: Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown and black, moist, no odor, fine black substance*.	SW-SM		55		1.0	JF-DGS2-SO-05-07 (archived)		
		5.5-7.8' bgs: Well-graded SAND with silt and gravel, fine to medium sand fining with depth, mostly fine gravel, brown, moist, no odor. (Silt is undifferentiated from clay).	SW-SM					JF-DGS2-SO-07-07.8 (archived)		
10		10-12' bgs: Silty SAND with gravel, fine to coarse sand and gravel, orange with black and brown, wet, no odor, fine black substance*.	SM		40		1.3	JF-DGS2-SO-10-12 (archived)		▼
15		15-19.8' bgs: Silty SAND with gravel, fine to medium sand, coarse gravel, brown, wet, no odor, clay clasts. Soil below approximately 17' bgs was field-identified as consistent with "Native soils" identified in the Boeing Phase 1 investigation.	SM		100		0.8	JF-DGS2-SO-15-17 (archived)		
							0.9	JF-DGS2-SO-17-19 (archived)		
								JF-DGS2-SO-19-19.8 (archived)		
20		20-24' bgs: Silty SAND with gravel, fine to medium sand, coarse gravel, brown, wet, no odor.	SM		100		0.8	JF-DGS2-SO-20-22 (archived)		
							0.9			
25		24-24.8' bgs: Well-graded SAND with silt, fine to medium, dark gray, wet, no odor.	SW-SM							

*** Fine substance used to describe an observed material that was not able to be classified as to soil type or origin.**

Well Construction Information

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

Filter Pack: NA
Surface Seal: Concrete
Annular Seal: NA
Boring Abandonment: Bentonite

Ground Surface Elevation (ft): NA
Top of Casing Elevation (ft): NA
Surveyed Location: **X:** 1275816.832
Y: 195791.096

FARALLON consulting
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: JF-DGS3

Page 1 of 1

Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA
Farallon PN: 394-001
Logged By: Jon Peterson

Date/Time Started: 3/28/12 1100
Date/Time Completed: 3/28/12 1240
Equipment: Geoprobe
Drilling Company: Cascade Drilling, LP
Drilling Foreman: Elijah Floyd
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): Auto
Depth of Water ATD (ft bgs): 15
Total Boring Depth (ft bgs): 35
Total Well Depth (ft bgs): NA

Depth (feet bgs.)	Lithologic Description	USCS	% Recovery	Blow Counts 8/8/8	PID (ppm)	Sample ID	Boring/Well Construction Details
0	0-2.5' bgs: Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown, moist, no odor. (Silt is undifferentiated from clay).	SW-SM	50	NA	0.8	JF-DGS3-SO-00-02 (archived) JF-DGS3-SO-02-02.5 (archived)	Bentonite Seal
5	5-7.8' bgs: Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown to black at 6' bgs, moist, no odor, fine black substance*.	SW-SM	55		0.9	JF-DGS3-SO-05-07 (archived) JF-DGS3-SO-07-07.8 (archived)	
10	10-14.8' bgs: Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown with black areas at 11.5 and 13' bgs, moist, no odor, fine black substance*.	SW-SM	100		1.1 1.1 0.9	JF-DGS3-SO-10-12 (archived) JF-DGS3-SO-12-14 (archived) JF-DGS3-SO-14-14.8 (archived)	
15	15-15.8' bgs: Poorly graded GRAVEL (1/2" minus), gray, wet, no odor.	GP	100		0.9	JF-DGS3-SO-15-17 (archived)	▼
	15.8-18.3' bgs: Well-graded SAND with silt and gravel, fine to coarse sand and gravel, brown and gray, wet, no odor.	SW-SM			1.0	JF-DGS3-SO-17-19, JF-DGS3-SO-18.3-19 (archived)	
	18.3-19.8' bgs: Well-graded SAND with silt, fine to medium sand, trace coarse gravel, black, wet, no odor, wood, sheen, fine black substance*.	SW-SM				JF-DGS3-SO-19-19.8 (archived)	
20	20-21.2' bgs: Silty SAND with gravel, fine to coarse sand and gravel, brown and gray, wet, no odor, wood fragments, light sheen.	SM	100		0.9	JF-DGS3-SO-20-22 (archived)	
	21.2-24' bgs: Silty SAND with gravel, fine to medium sand, fine to coarse gravel, gray, moist, no odor, wood, no sheen.	SM			0.8	JF-DGS3-SO-22-24 (archived)	
25	24-24.8' bgs: Well-graded SAND with silt, fine to medium sand, trace fine gravel, dark gray, wet, no odor. Soil below 24' bgs was field-identified as consistent with "Native soils" identified in the Boeing Phase 1 investigation.	SW-SM	0			JF-DGS3-SO-24-24.8 (archived)	
30	30-32' bgs: Well-graded SAND with silt fining to silty SAND, fine sand, dark gray, wet, no odor.	SW-SM	50		0.7	JF-DGS3-SO-30-32 (archived)	

*** Fine substance used to describe an observed material that was not able to be classified as to soil type or origin.**

Well Construction Information

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

Filter Pack: NA
Surface Seal: Concrete
Annular Seal: NA
Boring Abandonment: Bentonite

Ground Surface Elevation (ft): NA
Top of Casing Elevation (ft): NA
Surveyed Location: **X:** 1275805.772
Y: 195783.301

FARALLON *consulting*
975 5th Avenue Northwest
Issaquah, Washington 98027

Log of Boring: JF-DGT1

Page 1 of 1

Client: Jorgensen Forge Corporation
Project: Jorgensen Forge
Location: Seattle, WA

Farallon PN: 394-001

Logged By: Jon Peterson

Date/Time Started: 3/28/12 0830
Date/Time Completed: 3/28/12 0940
Equipment: Geoprobe
Drilling Company: Cascade Drilling, LP
Drilling Foreman: Elijah Floyd
Drilling Method: Direct Push

Sampler Type: 5' Macrocore
Drive Hammer (lbs.): Auto
Depth of Water ATD (ft bgs): 11
Total Boring Depth (ft bgs): 25
Total Well Depth (ft bgs): NA

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		0-0.3' bgs: Gravel and asphalt debris.			55	NA	0.6	JF-DGT1-SO-00-02 (archived)		
		0.3-2.7' bgs: Silty SAND, fine to medium sand, trace fine gravel, brown, moist, no odor. (Silt is undifferentiated from clay).	SM					JF-DGT1-SO-02-02.75 (archived)		Bentonite Seal
5		5-6.3' bgs: Silty SAND with gravel, fine to coarse sand and gravel, brown, moist, no odor. (Silt is undifferentiated from clay).	SM		25		0.8	JF-DGT1-SO-05-06.25 (archived)		
10		10-11' bgs: Silty SAND with gravel, fine to coarse gravel and sand fining downward, brown, moist, no odor. (Silt is undifferentiated from clay).	SM		58		0.8	JF-DGT1-SO-10-12 (archived)		▼
		11-13.8' bgs: Silty SAND, fine to medium sand, brown, moist to wet, gray, no odor, clay clast.	SM				0.7	JF-DGT1-SO-12-13.8 (archived)		
15		15-17.5' bgs: Silty SAND with gravel, fine to medium sand, coarse gravel, gray, wet, no odor. Soil below 15' bgs is consistent with "Native soils" identified in the Boeing Phase 1 investigation.	SM		100		0.6 0.7	JF-DGT1-SO-15-17 (archived) JF-DGT1-SO-17-19 (archived)		
		17.5-19.8' bgs: Sandy SILT, fine to medium sand fining downwards, gray, wet to moist, no odor, inorganic, low plasticity.	ML							
20		20-21' bgs: Well-graded SAND with silt, fine to medium, dark gray, wet, no odor.	SW-SM		100		0.8			
		21-23' bgs: Sandy SILT, fine, gray, wet to moist, no odor, inorganic, low plasticity.	ML				0.8			
		23-24.8' bgs: Well-graded SAND with silt, fine to medium, dark gray, wet, no odor.	SW-SM							
25										

Well Construction Information

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

Filter Pack: NA
Surface Seal: Concrete
Annular Seal: NA
Boring Abandonment: Bentonite

Ground Surface Elevation (ft): NA
Top of Casing Elevation (ft): NA
Surveyed Location: **X:** 1275829.189
Y: 195783.598

Sheet 1 of 1

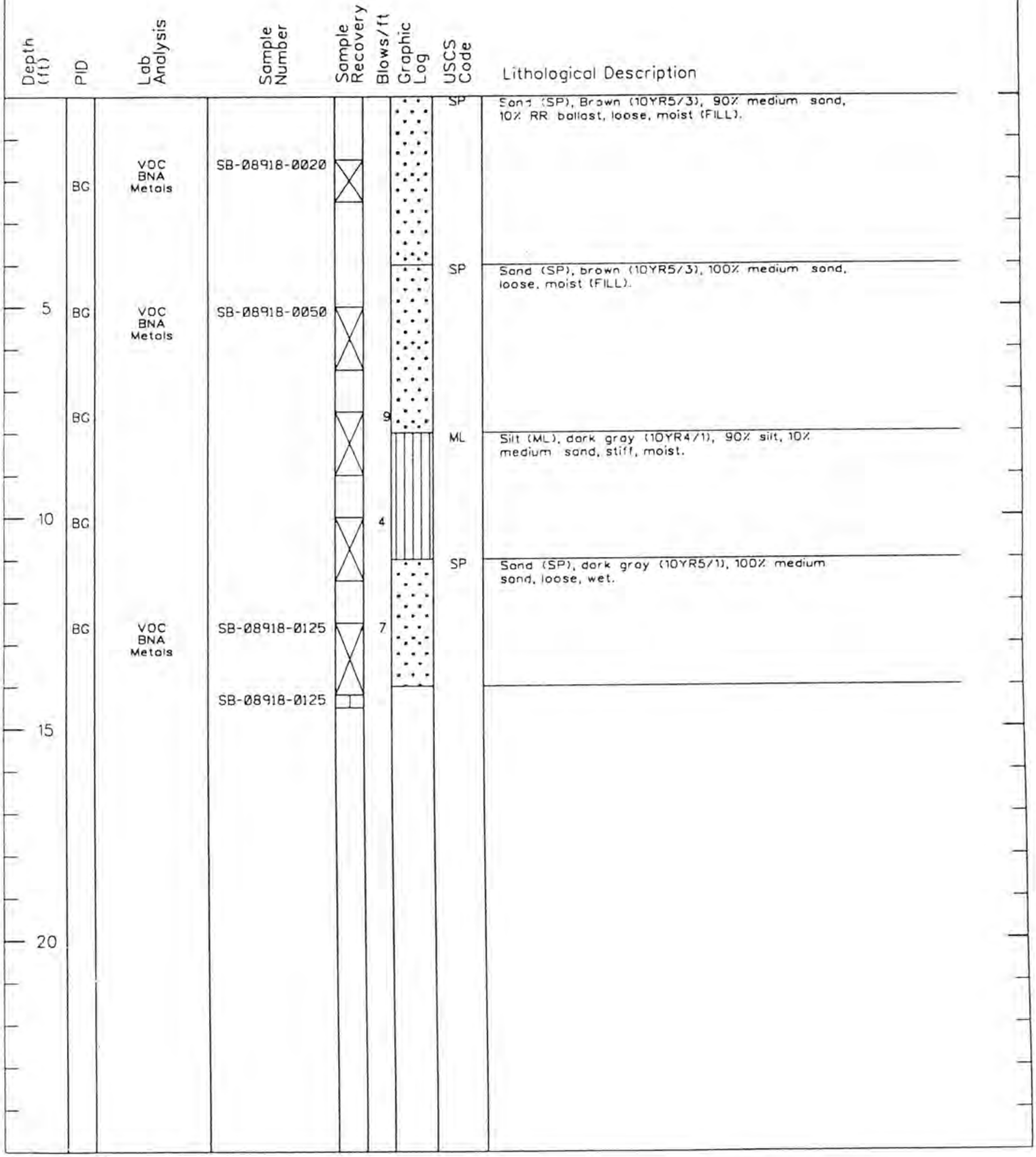
Boring SB-08918

Project Boeing Plant 2 RFI
Location Plant 2 Seattle, WA
Project No. 03709-034-300
Contractor Weston
Logged by Tim Fitzgerald

Start Date 09/13/94
Driller Clay Griffith
Drilling Method 4 in ID HSA
Sampling Method 3 in SPT, 140 lb hmr

Finish Date 09/13/94
Drilling Co. PTL

Boring Diam. (in) 10
Total Depth (ft) 14.00



Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
							SP	Sand (SP), Brown (10YR5/3), 90% medium sand, 10% RR ballast, loose, moist (FILL).
	BG	VOC BNA Metals	SB-08918-0020					
							SP	Sand (SP), brown (10YR5/3), 100% medium sand, loose, moist (FILL).
5	BG	VOC BNA Metals	SB-08918-0050					
	BG				9			
							ML	Silt (ML), dark gray (10YR4/1), 90% silt, 10% medium sand, stiff, moist.
10	BG				4			
							SP	Sand (SP), dark gray (10YR5/1), 100% medium sand, loose, wet.
	BG	VOC BNA Metals	SB-08918-0125		7			
			SB-08918-0125					
15								
20								

Boring_id 8012

Sheet 1 of 1

Boring SB-08921

Project Boeing Plant 2 RFI
Location Plant 2 Seattle, WA
Project No. 03709-034-300
Contractor Weston
Logged by Tim Fitzgerald

Start Date 09/13/94
Driller Clay Griffith
Drilling Method 4 in ID HSA
Sampling Method 3 in SPT, 140 lb hmr

Finish Date 09/13/94
Drilling Co. PTL

Boring Diam. (in) 10
Total Depth (ft) 14.00

Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
		VOC Metals	SB-08921-0020					
							SP	Sand (SP), brown (10YR5/3), 100% medium sand, medium dense, moist.
5		VOC Metals	SB-08921-0050					
							ML	Silt (ML), gray (10YR5/1), 90%silt, 10% sand, stiff, moist, trace twigs.
10			SB-08921-0125					
							SP	Sand (SP) brown (10YR5/3) 100% medium sand, medium dense, damp. Sand (SP), dark gray (10YR4/1), 100% medium sand, medium dense, wet.
		VOC Metals	SB-08921-0125					
							SP	Sand (SP) dark gray (10YR5/1) 100% medium sand, medium dense, wet. Sand (SP) dark gray (10YR5/1) 100% medium sand, medium dense, wet.
15							SP	Sand (SP) dark gray (10YR5/1) 100% medium sand, medium dense, wet.
20								

Boring_id 8013

Sheet 1 of 1

Boring SB-08923

Project Boeing Plant 2 RFI
Location Plant 2 Seattle, WA
Project No. 03709-034-300
Contractor Weston
Logged by Tim Fitzgerald

Start Date 09/13/94
Driller Clay Griffith
Drilling Method 4 in ID HSA
Sampling Method 3 in SPT, 140 lb hmr

Finish Date 09/13/94
Drilling Co. PTL
Boring Diam. (in) 10
Total Depth (ft) 14.00

Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
								Asphalt
							SP	Sand (SP), brown (10YR5/3), 90% medium sand, 10% gravel to 1.5 inches, medium dense, moist, trace chemical odor.
	2	VOC Metals	SB-08923-0020	☒	11			
							SP	Sand (SP), brown (10YR5/3), 100% medium sand, medium dense, moist.
5	BG	VOC Metals	SB-08923-0050	☒	13			
							ML	Silt (ML), gray (10YR5/1), 90% silt, 10% fine sand, stiff, moist, trace twigs.
	BG			☒	9			
10	BG			☒	8			
							SP	Sand (SP), dark gray (10YR4/1), 95% fine to medium sand, 5% silt, loose, wet.
	BG	VOC Metals	SB-08923-0125	☒	9			
15								
20								

Boring_id 8015

Sheet 1 of 1

Boring SB-09101

Project Boeing Plant 2 RFI
Location Plant 2 Seattle, WA
Project No. 03709-034-300
Contractor Weston
Logged by Tim Fitzgerald

Start Date 09/12/94
Driller Clay Griffith
Drilling Method 4 in ID HSA
Sampling Method 3 in SPT, 140 lb hmr

Finish Date 09/12/94
Drilling Co. PTL

Boring Diam. (in) 10
Total Depth (ft) 14.00

Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
								Gravel and sand - compacted adjacent to RR tracks
	BG	VOC PCB HCID Metals	SB-09101-0020				SP	Sand (SP), grayish brown (10YR5/2), 95% medium sand, 5% rounded gravel to 1/2 inch, loose, moist.
5	BG	VOC PCB HCID Metals	SB-09101-0050					
	BG				16		ML	Silt (ML), gray (10YR5/1), 90% silt, 10% fine sand, stiff, moist, some organics (grass and twigs) throughout , @ 12 ft - wet.
10	BG				16			
	BG	VOC PCB HCID Metals	SB-09101-0125		9			
15								
20								

Boring_id 8016

Sheet 1 of 1

Boring SB-09105

Project Boeing Plant 2 RFI
Location Plant 2 Seattle, WA
Project No. 03709-034-300
Contractor Weston
Logged by Tim Fitzgerald

Start Date 09/12/94
Driller Clay Griffith
Drilling Method 4 in ID HSA
Sampling Method 3 in SPT, 140 lb hmr

Finish Date 09/12/94
Drilling Co. PTL
Boring Diam. (in) 10
Total Depth (ft) 14.00

Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
							SP	Sand with gravel - compacted adjacent to RR tracks.
	BG	VOC PCB HCID Metals	SB-09105-0020	☒	11		SP	Sand (SP), brown(10YR5/3), 90% medium sand, 5% gravel to 1/2 inch, 5% silt, loose, moist, trace twigs.
5	BG	VOC PCB HCID Metals	SB-09105-0050	☒	8			
							ML	Silt (ML), gray (10YR5/1), 90% silt, 10% fine sand, stiff, moist, trace grass and twigs throughout.
	BG			☒	8			
10	BG			☒	7			
	BG	VOC PCB HCID Metals	SB-09105-0125	☒	7			
15								
20								

Boring_id 8017

Sheet 1 of 1

Boring SB-09106

Project Boeing Plant 2 RFI
Location Plant 2 Seattle, WA
Project No. 03709-034-300
Contractor Weston
Logged by Tim Fitzgerald

Start Date 09/12/94
Driller Clay Griffith
Drilling Method 4 in ID HSA
Sampling Method 3 in SPT, 140 lb hmr

Finish Date 09/12/94
Drilling Co. PTL

Boring Diam. (in) 10
Total Depth (ft) 14.00

Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
								Sand with gravel- compacted adjacent to RR track.
	BG	VOC PCB HCID Metals	SB-09106-0020	☒			SP	Sand (SP), brown (10YR5/3), 95% medium sand, 5% rounded gravel to 1/2 inch, trace silt, loose, moist.
5	BG	VOC PCB HCID Metals	SB-09106-0050	☒				
							SM	Silty sand(SM), dark gray (10YR4/1), 80% medium sand, 20% silt, medium dense, moist.
	BG			☒				
								Silt (ML), dark gray (10YR4/1), 90% silt, 5% fine sand, 5% twigs throughout, stiff, moist.
10	BG		SB-09106-0100	☒	9			
							SP	Sand (SP), dark gray (10YR4/1), 100% medium sand, trace silt, loose, wet.
	BG	VOC PCB HCID Metals	SB-09106-0125	☒	6			
15								
20								

Sheet 1 of 1

Boring SB-09107

Project Boeing RFI
Location Plant 2 Seattle, WA
Project No. 03709-034-300
Contractor Weston
Logged by Hose

Start Date 03/10/95
Finish Date 03/10/95
Driller
Drilling Co.
Drilling Method S. S. Hand Auger
Sampling Method S. S. Hand Auger
Boring Diam. (in) 3
Total Depth (ft) 9.00

Depth (ft)	PID	Lab Analysis	Sample Number	Sample Recovery	Blows/ft	Graphic Log	USCS Code	Lithological Description
								Concrete
							SP	Poorly graded sand (SP), dk brown (7.5YR3/2), 100% sand, loose, moist.
	N/A							
		TPH-418.1	SB-09107-0035	☒				
5							SM	Silty sand (SM), very dk gray (7.5YRN3/0), 75% sand, 25% silt, soft, wet.
	N/A	TPH-418.1	SB-09107-0055	☒				
							MH	Elastic silt (MH), very dk gray (7.5YRN3/0), 100% silt, soft, wet.
	N/A	TPH-418.1	SB-09107-0085	☒				
10								
15								
20								

BORING LOG SB-07220

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 10, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description	
0						SW SM	Gravelly SAND with SILT (SW-SM), Brown, 25% gravel, 70% sand, 5% silt, dry, (Fill).	
		JFO-SS-SB220-0000						
		JFO-SS-SB220-0020				SM	Silty SAND (SM), Grayish brown, 5% gravel, 60% sand, 35% silt. 4 inch thick sand lense at 3.2 feet, dry, (Alluvium).	
		JFO-SS-SB220-0040					Redish motling from 5.5 feet to 6 feet, damp.	
5								
		JFO-SS-SB220-0060					Brown, 5% gravel, 75% sand, 20% silt. 1.5 inch thick silty lenses at 7.2 feet and 7.5 feet, damp.	
		JFO-SS-SB220-0080					Grades to sand.	
10							Black, strong petroleum odor (9.5 feet to 10 feet).	
		JFO-SS-SB220-0100						
		JFO-SS-SB220-0120					Petroleum odor and sheen (12.5 feet to 13 feet).	
		JFO-SS-SB220-0140					3 inch silty lense at 15.2 feet and 0.5 inch silty lense at 5.8 feet, wet, slight petroleum odor no sheen.	∇
15								
							Bottom of hole @ 16 feet	

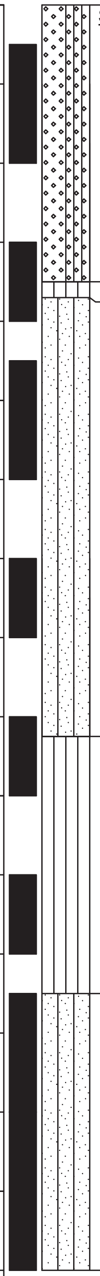
BOREHOLE LOG BOEING PL2 TRANSFORMER.GPJ RFW SEATTLE.GDT 7/24/03 14:29

Plate

A-10

BORING LOG SB-07228

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 10, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



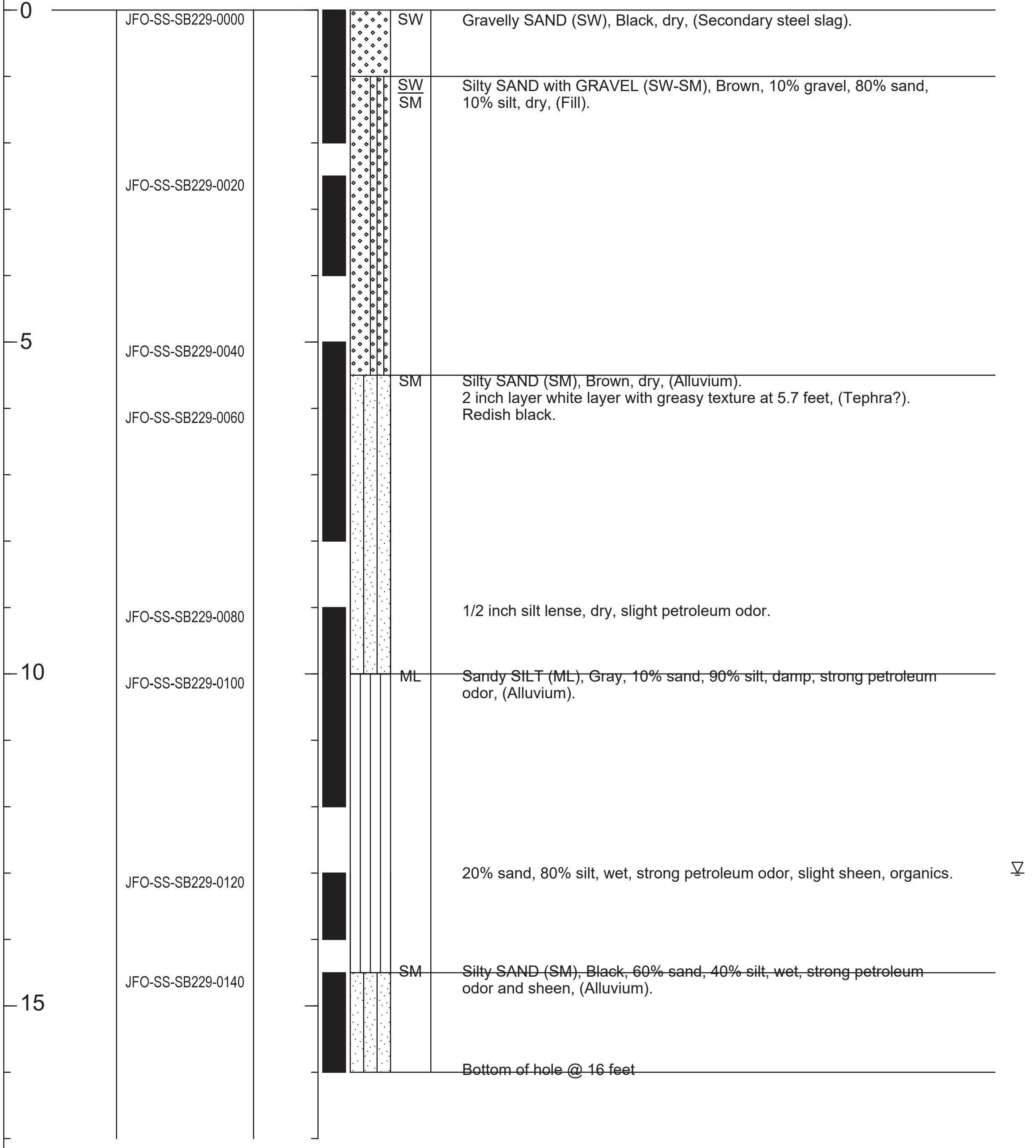
Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0				SW SM	Gravelly SAND with SILT (SW-SM), Brown, 35% gravel, 55% sand, 10% silt, dry, (Fill).
		JFO-SS-SB228-0000			
					Silty SAND with GRAVEL, Black, 10% gravel, 75% sand, 15% silt, dry, petroleum odor.
					Brown, no odor.
		JFO-SS-SB228-0020			
				ML	Sandy SILT (ML), Gray, 5% gravel, 35% sand, 60% silt, (Alluvium).
				SM	Silty SAND (SM), Black, 5% gravel, 75% sand, 20% silt, dry, slight petroleum odor, (Alluvium).
		JFO-SS-SB228-0040			
5					
					Grayish black, 35% sand, 65% silt, damp, petroleum odor, slight sheen, plant root fragments. Black, 65% sand, 35% silt, damp, strong petroleum odor, plant root fragments.
		JFO-SS-SB228-0060			
		JFO-SS-SB228-0080			
				ML	Sandy SILT (ML), Gray, 15% sand, 85% silt, damp, strong petroleum odor and sheen, (Alluvium).
10					
		JFO-SS-SB228-0100			
				SM	Silty SAND (SM), Black, 80% sand, 20% silt, wet, strong petroleum odor and sheen, (Alluvium). ⊽
		JFO-SS-SB228-0120			
		JFO-SS-SB228-0140			
15					
					Bottom of hole @ 16 feet

Plate

A-18

BORING LOG SB-07229

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 11, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0		JFO-SS-SB229-0000				SW	Gravelly SAND (SW), Black, dry, (Secondary steel slag).
						SW SM	Silty SAND with GRAVEL (SW-SM), Brown, 10% gravel, 80% sand, 10% silt, dry, (Fill).
		JFO-SS-SB229-0020					
5		JFO-SS-SB229-0040					
						SM	Silty SAND (SM), Brown, dry, (Alluvium). 2 inch layer white layer with greasy texture at 5.7 feet, (Tephra?). Redish black.
		JFO-SS-SB229-0060					
		JFO-SS-SB229-0080					1/2 inch silt lense, dry, slight petroleum odor.
10		JFO-SS-SB229-0100				ML	Sandy SILT (ML), Gray, 10% sand, 90% silt, damp, strong petroleum odor, (Alluvium).
		JFO-SS-SB229-0120					20% sand, 80% silt, wet, strong petroleum odor, slight sheen, organics. ∇
		JFO-SS-SB229-0140				SM	Silty SAND (SM), Black, 60% sand, 40% silt, wet, strong petroleum odor and sheen, (Alluvium).
15							
							Bottom of hole @ 16 feet

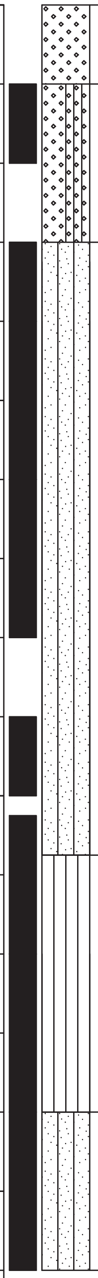
BOREHOLE LOG BOEING PL2 TRANSFORMER.GPJ RFW SEATTLE.GDT 7/24/03 13:27

Plate

A-19

BORING LOG SB-07230

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 11, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0				SW	Gravelly SAND (SW), Black, 35% gravel, 60% sand, 5% silt, dry, (Secondary steel slag).
		JFO-SS-SB230-0000		SW/SM	Gravelly SAND with SILT (SW-SM), Brown, 10% gravel, 85% sand, 5% silt, dry, (Fill).
		JFO-SS-SB230-0020		SM	Silty SAND (SM), Red, 5% gravel, 75% sand, 20% silt, dry, (Alluvium). Brown, 85% sand, 15% silt, dry.
		JFO-SS-SB230-0040			Redish black.
5					
		JFO-SS-SB230-0060			
		JFO-SS-SB230-0080			75% sand, 25% silt.
					50% sand, 40% silt.
10					
		JFO-SS-SB230-0100			
				ML	Sandy SILT (ML), Gray, 15% sand, 85% silt, wet, woody branch fragments, (Alluvium). ∇
		JFO-SS-SB230-0120			Grades to fine sand.
				SM	Silty SAND (SM), 65% sand, 35% silt, wet, interbedded with 3 inch lenses of sandy silt, (Alluvium).
		JFO-SS-SB230-0140			
15					
					Bottom of hole @ 16 feet

Plate

A-20

BORING LOG SB-07231

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 11, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							6 inch concrete slab.
		JFO-SS-SB231-0000				SM	Silty SAND (SM), Dark brown, 5% gravel, 85% sand, 10% silt, dry, (Fill).
		JFO-SS-SB231-0020				SM	Silty SAND (SM), Dark brown, 1/2 inch thick silt layer at 3.2 feet, dry, (Alluvium).
5		JFO-SS-SB231-0040				SW SM	Gravelly SAND with SILT (SW-SM), 15% gravel, 80% coarse sand, 5% silt, (Alluvium).
		JFO-SS-SB231-0060				SM	Silty SAND (SM), 5% gravel, 85% coarse sand, 10% silt, (Alluvium).
		JFO-SS-SB231-0080				SW SM	Gravelly SAND with SILT (SW-SM), 20% gravel, 70% coarse sand, 10% silt, (Alluvium).
10		JFO-SS-SB231-0100				SM	Silty SAND (SM), 75% coarse sand, 25% silt, (Alluvium). Gray, fine sand grades to silt, damp.
		JFO-SS-SB231-0120				ML	Sandy SILT (ML), Gray, 15% sand, 85% silt, damp, (Alluvium).
15		JFO-SS-SB231-0140				SW	Silty SAND (SW), Gray, Grades to fine sand, damp, (Alluvium).

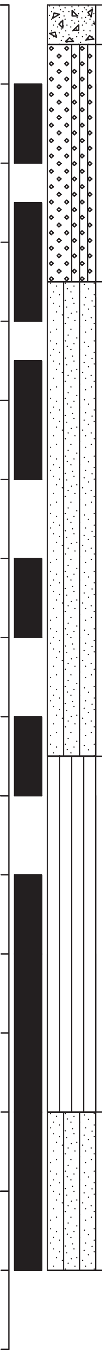
Bottom of hole @ 16 feet

Plate

A-21

BORING LOG SB-07232

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 11, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom

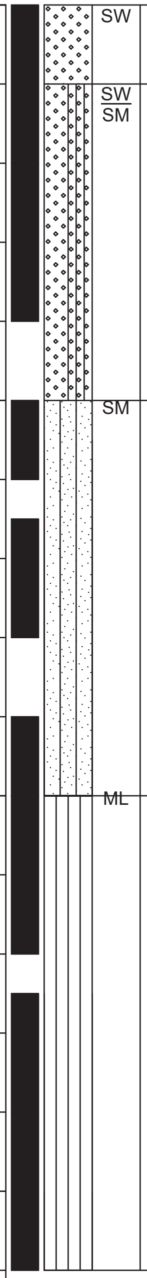


Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0					6 inch concrete slab.
				SW SM	Gravelly SAND with SILT (SW-SM), Black, 10% gravel, 85% sand, 5% silt, dry, (Secondary steel slag).
		JFO-SS-SB232-0000			Silty SAND with GRAVEL, Dark brown, 5% gravel, 85% sand, 10% silt, dry, (Fill).
		JFO-SS-SB232-0020			
				SM	Silty SAND (SM), Dark brown, dry, (Alluvium). 1/2 inch thick silty layer at 3.7 feet, (Paleosol).
		JFO-SS-SB232-0040			5% gravel, 90% medium sand, 5% silt.
5					
		JFO-SS-SB232-0060			
		JFO-SS-SB232-0080			
				ML	Sandy SILT (ML), Dark brown, 20% sand, 80% silt, dry, (Alluvium).
10					Gray, 10% sand, 90% silt, wet, petroleum odor and sheen, fine plant roots. ∇
		JFO-SS-SB232-0100			
		JFO-SS-SB232-0120			Strong petroleum odor.
		JFO-SS-SB232-0140		SM	Silty SAND (SM), Dark brown, 80% sand, 20% silt, wet, petroleum odor and sheen, (Alluvium).
15					
					Bottom of hole @ 16 feet

Plate
A-22

BORING LOG SB-07233

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 11, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0		JFO-SS-SB233-0000				SW	(SW), Black, dry, (Secondary steel slag).
						SW SM	Silty SAND with GRAVEL (SW-SM), Brown, 5% gravel, 80% sand, 15% silt, dry, (Fill).
		JFO-SS-SB233-0020					
5		JFO-SS-SB233-0040				SM	Silty SAND (SM), Gray, 65% fine sand, 35% silt, damp, (Alluvium).
							Redish brown, (5.25 to 5.5 feet). SAND, Gray, 80% sand, 20% silt, wet.
		JFO-SS-SB233-0060					2 inch thick white layer with greasy texture, (Tephra?).
							Black, petroleum odor.
		JFO-SS-SB233-0080					5% fine gravel, 75% sand, 20% silt.
							3 inch thick white layer with greasy texture, (Tephra?).
10		JFO-SS-SB233-0100				ML	Sandy SILT (ML), Gray, 10% sand, 90% silt, wet, petroleum odor, (Alluvium). ∇
		JFO-SS-SB233-0120					20% sand, 80% silt, fine plant roots.
		JFO-SS-SB233-0140					
15							Petroleum odor and sheen.
							Bottom of hole @ 16 feet

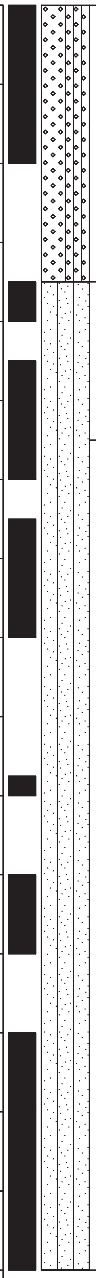
Plate

A-23

BORING LOG SB-07234

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 10, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0		JFO-SS-SB234-0000		SW SM	Gravelly SAND with SILT (SW-SM), 35% coarse, angular gravel, 60% sand, 5% silt, dry, (Fill).
					Silty SAND with GRAVEL, Brown, 10% gravel, 80% sand, 10% silt, dry, (Fill).
		JFO-SS-SB34-0020		SM	Silty SAND (SM), 85% sand, 15% silt, (Fill).
5		JFO-SS-SB234-0040			
				SM	Silty SAND (SM), Brown, dry, (Alluvium). 1 inch thick gray silty sand layer at 5.5 feet, (Paleosol?).
		JFO-SS-SB234-0060			Grayish brown, 70% sand, 30% silt, dry.
					Slight petroleum odor.
10		JFO-SS-SB234-0080			
		JFO-SS-SB234-0100			Petroleum odor.
		JFO-SS-SB234-0120			SAND, Black, 85% sand, 15% silt, damp.
		JFO-SS-SB234-0140			Petroleum odor and sheen.
15					
					Bottom of hole @ 16 feet



BOREHOLE LOG BOEING PL2 TRANSFORMER.GPJ RFW SEATTLE.GDT 7/24/03 13:32

Plate

A-24

BORING LOG SB-07235

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 11, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom

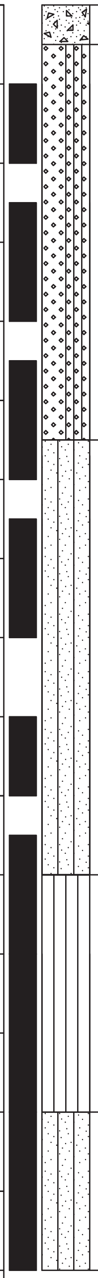
Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0		JFO-SS-SB235-0000				SW	Gravelly SAND (SW), Black, dry, (Secondary steel slag).
						SW SM	Silty SAND with GRAVEL (SW-SM), Dark brown, 5% gravel, 80% sand, 15% silt, dry, (Fill).
		JFO-SS-SB235-0020				SM	Silty SAND (SM), 85% sand, 15% silt, (Fill).
		JFO-SS-SB235-0040				ML	Sandy SILT (ML), Gray, dry, (Paleosol?).
5						SM	Silty SAND (SM), Dark brown, dry, (Alluvium).
		JFO-SS-SB235-0060					2 inch thick silty coarse sand, damp.
						ML	Sandy SILT (ML), Gray, 25% sand, 75% silt, grades to silty fine sand, damp, petroleum odor, (Alluvium).
		JFO-SS-SB235-0080					40% sand, 60% silt.
10							
		JFO-SS-SB235-0100				SM	Silty SAND (SM), Black, Grades to silty fine sand, damp, petroleum odor and sheen, (Alluvium).
		JFO-SS-SB235-0120					
						ML	Sandy SILT (ML), Gray, damp, petroleum odor and sheen, (Alluvium).
		JFO-SS-SB235-0140					Black, 35% sand, 65% silt, wet. ∇
15							
							Bottom of hole @ 16 feet

Plate

A-25

BORING LOG SB-07236

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 13, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0					6 inch concrete slab.
				SW SM	Gravelly SAND with SILT (SW-SM), Black, 30% gravel, 65% sand, 5% silt, dry, (Fill).
		JFO-SS-SB236-0000			Silty SAND with GRAVEL, Brown, 5% gravel, 85% sand, 10% silt, dry, (Fill).
		JFO-SS-SB236-0020			Dark brown.
		JFO-SS-SB236-0040			
5					
				SM	Silty SAND (SM), Gray, damp, (Alluvium). 1/2 inch thick silty sand layer at 5.7 feet, (Paleosol?).
		JFO-SS-SB236-0060			Dark brown.
					75% sand, 25% silt, strong petroleum odor.
		JFO-SS-SB236-0080			
10					
		JFO-SS-SB236-0100			
				ML	Sandy SILT (ML), Gray, 20% sand, 80% silt, damp, strong petroleum odor, (Alluvium).
		JFO-SS-SB236-0120			Strong petroleum odor, slight sheen.
				SM	Silty SAND (SM), Black, 65% sand, 35% silt, wet, slight petroleum odor, (Alluvium). ∇
		JFO-SS-SB236-0140			
15					
					Bottom of hole @ 16 feet

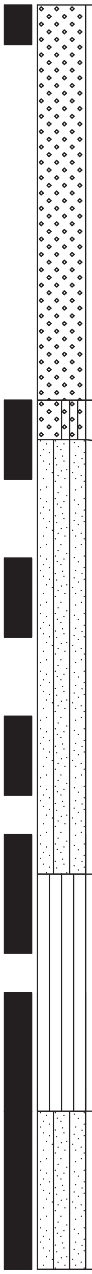
Plate

A-26

BORING LOG SB-07237

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 12, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						SW	Gravelly SAND (SW), Gray, 40% gravel, 60% sand, damp, (Fill).
5		JFO-SS-SB237-0040				SW/SM	Silty SAND with GRAVEL (SW-SM), Brown, 10% gravel, 80% sand, 10% silt, dry, (Fill).
						SM	Silty SAND (SM), Black, 90% sand, 10% silt, grades to fine sand, damp, (Alluvium).
		JFO-SS-SB237-0060					
		JFO-SS-SB237-0080					
10							
		JFO-SS-SB237-0100					Wet. ∇
						ML	Sandy SILT (ML), Gray, 10% sand, 90% silt, damp, petroleum odor and sheen, (Alluvium).
		JFO-SS-SB237-0120					Grades to silty fine sand.
							Redish orange.
		JFO-SS-SB237-0140				SM	Silty SAND (SM), Gray, 65% sand, 35% silt, wet, no odor or sheen, (Alluvium).
15							
							Bottom of hole @ 16 feet



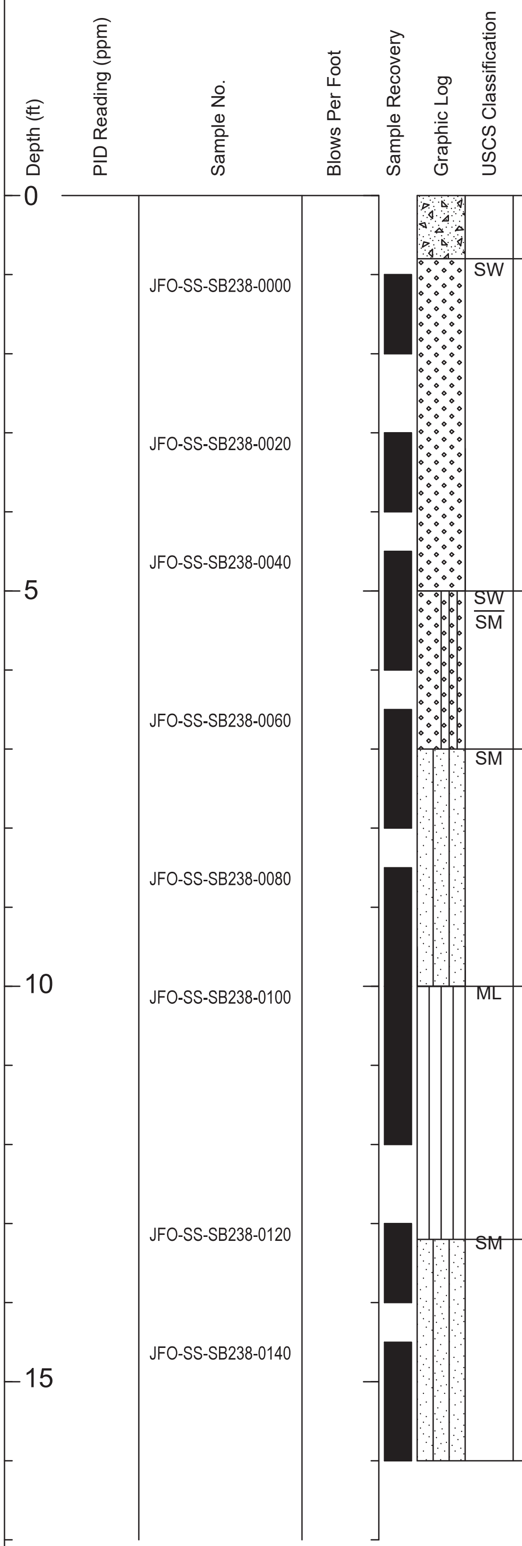
BOREHOLE LOG BOEING PL2 TRANSFORMER.GPJ RFW SEATTLE.GDT 7/24/03 13:34

Plate

A-27

BORING LOG SB-07238

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 13, 2003
DRILLING METHOD Direct Push-Limited Access
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Lithologic Description

10 inch concrete slab.

Gravelly SAND (SW), Brown, 15% gravel, 85% sand, dry, (Fill).

Coarse grained native wood debris at 3.2 feet, (Fill).
2 inch thick gravel layer at 3.5 feet.

Silty SAND with GRAVEL (SW-SM), 5% gravel, 90% sand, 5% silt, 1/2 inch thick layer of grayish fine sand, (Alluvium).

Silty SAND (SM), 95% sand, 5% silt, (Alluvium).

2 inch thick coarse sand lense, well worn glass fragments, possibly from bottle.
Gray, 80% sand, 20% silt.

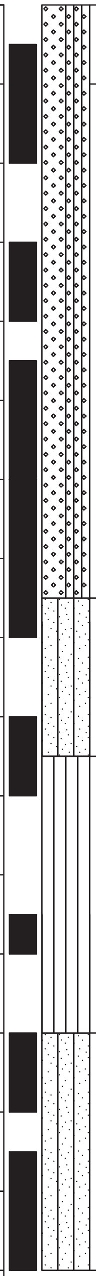
Sandy SILT (ML), Gray, 15% sand, 85% silt, damp, (Alluvium).

Silty SAND (SM), 75% sand, 25% silt, wet, (Alluvium). ∇

Bottom of hole @ 16 feet

BORING LOG SB-07239

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 12, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0				SW SM	Gravelly SAND with SILT (SW-SM), Black, 30% gravel, 65% sand, 5% silt, dry, (Fill).
		JFO-SS-SB239-0000			
				SW SM	Silty SAND with GRAVEL (SW-SM), Brown, 5% gravel, 85% sand, 10% silt, dry, (Alluvium).
		JFO-SS-SB239-0020			
		JFO-SS-SB239-0040			
5					
		JFO-SS-SB239-0060			
				SM	Silty SAND (SM), Brown, dry, (Alluvium). 1/2 inch thick layer of brown silt at 7.8 feet, (Paleosol?).
		JFO-SS-SB239-0080			
				ML	Sandy SILT (ML), Gray, 30% sand, 70% silt, damp, (Alluvium).
10					
		JFO-SS-SB239-0100			10% sand, 90% silt.
		JFO-SS-SB239-0120		SM	Silty SAND (SM), Grayish black, 80% sand, 20% silt, damp, (Alluvium).
		JFO-SS-SB239-0140			
15					
					Bottom of hole @ 16 feet

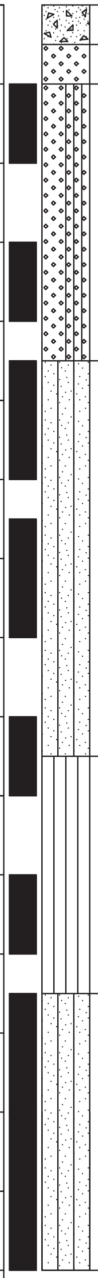
BOREHOLE LOG BOEING PL2 TRANSFORMER.GPJ RFW SEATTLE.GDT 7/24/03 13:36

Plate

A-29

BORING LOG SB-07240

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 12, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0					6 inch concrete slab.
				SW	Gravelly SAND (SW), 30% gravel, 70% sand, dry, (Fill).
		JFO-SS-SB240-0000		SW SM	Gravelly SAND with SILT (SW-SM), Brown, 10% gravel, 85% sand, 5% silt, dry, (Fill).
		JFO-SS-SB240-0020			
		JFO-SS-SB240-0040		SM	Silty SAND (SM), Redish brown, 85% sand, 15% silt, dry, (Alluvium).
5					
		JFO-SS-SB240-0060			
		JFO-SS-SB240-0080			
				ML	Sandy SILT (ML), Gray, 35% sand, 65% silt, damp, (Alluvium).
10					
		JFO-SS-SB240-0100			
				SM	Silty SAND (SM), Gray, 75% sand, 25% silt, damp, (Alluvium).
		JFO-SS-SB240-0120			
					Wet. ∇
		JFO-SS-SB240-0140			
15					
					Bottom of hole @ 16 feet

BORING LOG SB-07241

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 12, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom

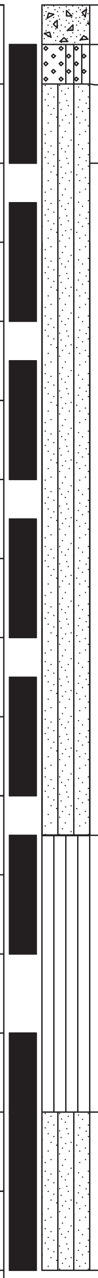
Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							6 inch concrete slab.
		JFO-SS-SB241-0000				SW SM	Gravelly SAND with SILT (SW-SM), Brown, 10% gravel, 85% sand, 5% silt, dry, (Fill).
						SM	Silty SAND (SM), Light brown, 70% sand, 30% silt, dry, (Fill).
		JFO-SS-SB241-0020				SW SM	Gravelly SAND with SILT (SW-SM), Brown, 15% gravel, 75% sand, 10% silt, dry, 1 inch clinker fragment at bottom of sampler, (Fill).
						SM	Silty SAND (SM), Brown, 85% sand, 15% silt, dry, (Alluvium).
		JFO-SS-SB241-0040					
5							5% gravel, 70% sand, 20% silt.
		JFO-SS-SB241-0060					
		JFO-SS-SB241-0080				ML	Sandy SILT (ML), Light brown, 35% sand, 65% silt, dry, (Alluvium).
							Gray, damp.
10							
		JFO-SS-SB241-0100					
							Brown.
						SM	Silty SAND (SM), Brown, damp, (Alluvium).
		JFO-SS-SB241-0120					
		JFO-SS-SB241-0140					70% sand, 30% silt, wet. ∇
15							
							Bottom of hole @ 16 feet

Plate

A-31

BORING LOG SB-07242

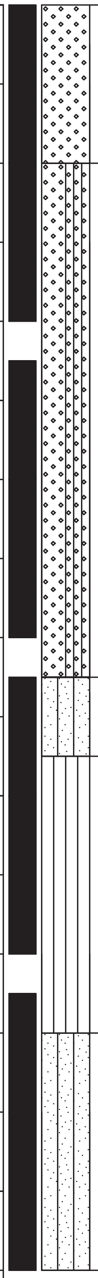
PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 13, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description	
0							6 inch concrete slab.	
		JFO-SS-SB242-0000				SW SM	Gravelly SAND with SILT (SW-SM), Black, 20% gravel, 75% sand, 5% silt, dry, (Fill).	
						SM	Silty SAND (SM), Brown, 80% sand, 15% silt, dry, (Fill).	
						SM	Silty SAND (SM), Dark brown, 80% sand, 15% silt, dry, (Alluvium).	
		JFO-SS-SB242-0020						
							Gray.	
							Black.	
		JFO-SS-SB242-0040					Brown.	
5								
		JFO-SS-SB242-0060					Black.	
		JFO-SS-SB242-0080						
10							Wet.	∇
		JFO-SS-SB242-0100				ML	Sandy SILT (ML), Gray, 35% sand, 65% silt, damp, (Alluvium).	
		JFO-SS-SB242-0120						
		JFO-SS-SB242-0140				SM	Silty SAND (SM), Black, 70% sand, 30% silt, wet, (Alluvium).	
15								
							Bottom of hole @ 16 feet	

BORING LOG SB-07243

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 12, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0		JFO-SS-SB243-0000		SW	Gravelly SAND (SW), Gray, dry, (Fill). SAND, Gray, 1 inch thick layer of black silty sand, dry, strong petroleum odor. Brown, no odor.
		JFO-SS-SB243-0020		SW/SM	Gravelly SAND with SILT (SW-SM), Brown, 20% gravel, 70% sand, 10% silt, dry, (Fill). Black, dry, slight petroleum odor, (Fill).
		JFO-SS-SB243-0040			Redish brown, dry, no odor.
5					Brown, 20% gravel, 70% sand, 10% silt, dry.
		JFO-SS-SB243-0060			Redish brown, 5% gravel, 80% sand, 10% silt.
		JFO-SS-SB243-0080		SM	Silty SAND (SM), Light brown, damp, petroleum sheen, (Alluvium). 1 inch thick sandy silt layer at 8.7 feet, (Paleosol?).
				ML	Sandy SILT (ML), Grayish black, 40% sand, 60% silt, damp, petroleum sheen, (Alluvium).
10		JFO-SS-SB243-0100			Redish brown, no sheen.
		JFO-SS-SB243-0120		SM	Silty SAND (SM), Brown, 85% sand, 15% silt, damp, (Alluvium).
		JFO-SS-SB243-0140			70% sand, 30% silt.
15					Bottom of hole @ 16 feet

BORING LOG SB-07244

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 11, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom

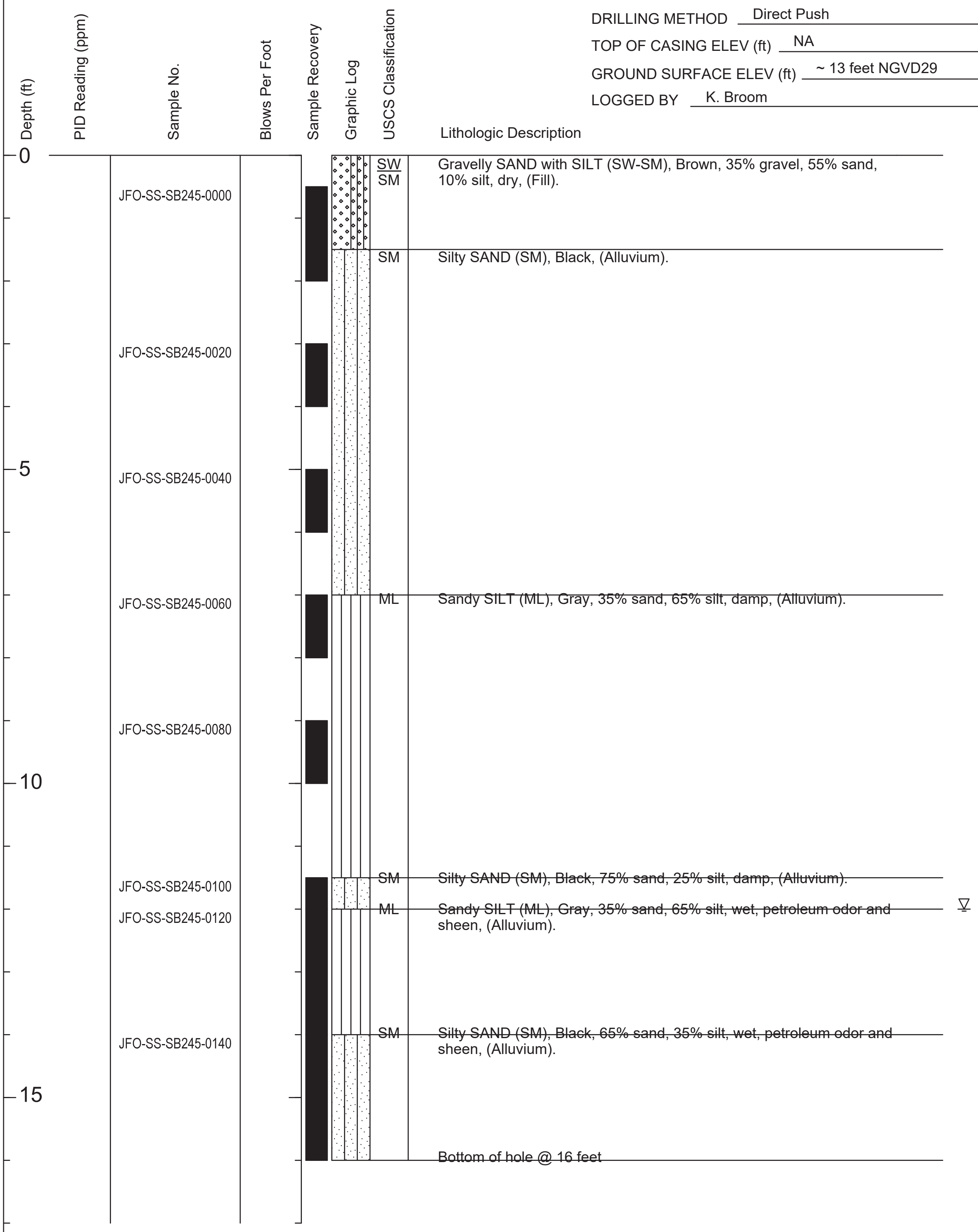
Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						SW SM	Gravelly SAND with SILT (SW-SM), Dark brown, 35% gravel, 60% sand, 5% silt, dry, (Secondary steel slag).
		JFO-SS-SB244-0000					
							Silty SAND with GRAVEL, Black, 10% gravel, 75% sand, 15% silt, dry, petroleum odor, (Alluvium).
		JFO-SS-SB244-0020				SM	Silty SAND (SM), 85% sand, 15% silt, no odor, (Alluvium).
5							
		JFO-SS-SB244-0040					
		JFO-SS-SB244-0060					Petroleum odor.
		JFO-SS-SB244-0080					No odor.
10							
		JFO-SS-SB244-0100					Gray, damp, slight petroleum odor.
		JFO-SS-SB244-0120				ML	Sandy SILT (ML), Gray, 40% sand, 60% silt, damp, no odor, (Alluvium).
		JFO-SS-SB244-0140				SM	Silty SAND (SM), Grayish black, 65% sand, 35% silt, wet, slight petroleum odor, (Alluvium). ∇
15							
							Bottom of hole @ 16 feet

Plate

A-34

BORING LOG SB-07245

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 10, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



JFO-SS-SB245-0000
JFO-SS-SB245-0020
JFO-SS-SB245-0040
JFO-SS-SB245-0060
JFO-SS-SB245-0080
JFO-SS-SB245-0100
JFO-SS-SB245-0120
JFO-SS-SB245-0140

USCS Classification	Lithologic Description
SW SM	Gravelly SAND with SILT (SW-SM), Brown, 35% gravel, 55% sand, 10% silt, dry, (Fill).
SM	Silty SAND (SM), Black, (Alluvium).
ML	Sandy SILT (ML), Gray, 35% sand, 65% silt, damp, (Alluvium).
SM	Silty SAND (SM), Black, 75% sand, 25% silt, damp, (Alluvium).
ML	Sandy SILT (ML), Gray, 35% sand, 65% silt, wet, petroleum odor and sheen, (Alluvium).
SM	Silty SAND (SM), Black, 65% sand, 35% silt, wet, petroleum odor and sheen, (Alluvium).
	Bottom of hole @ 16 feet

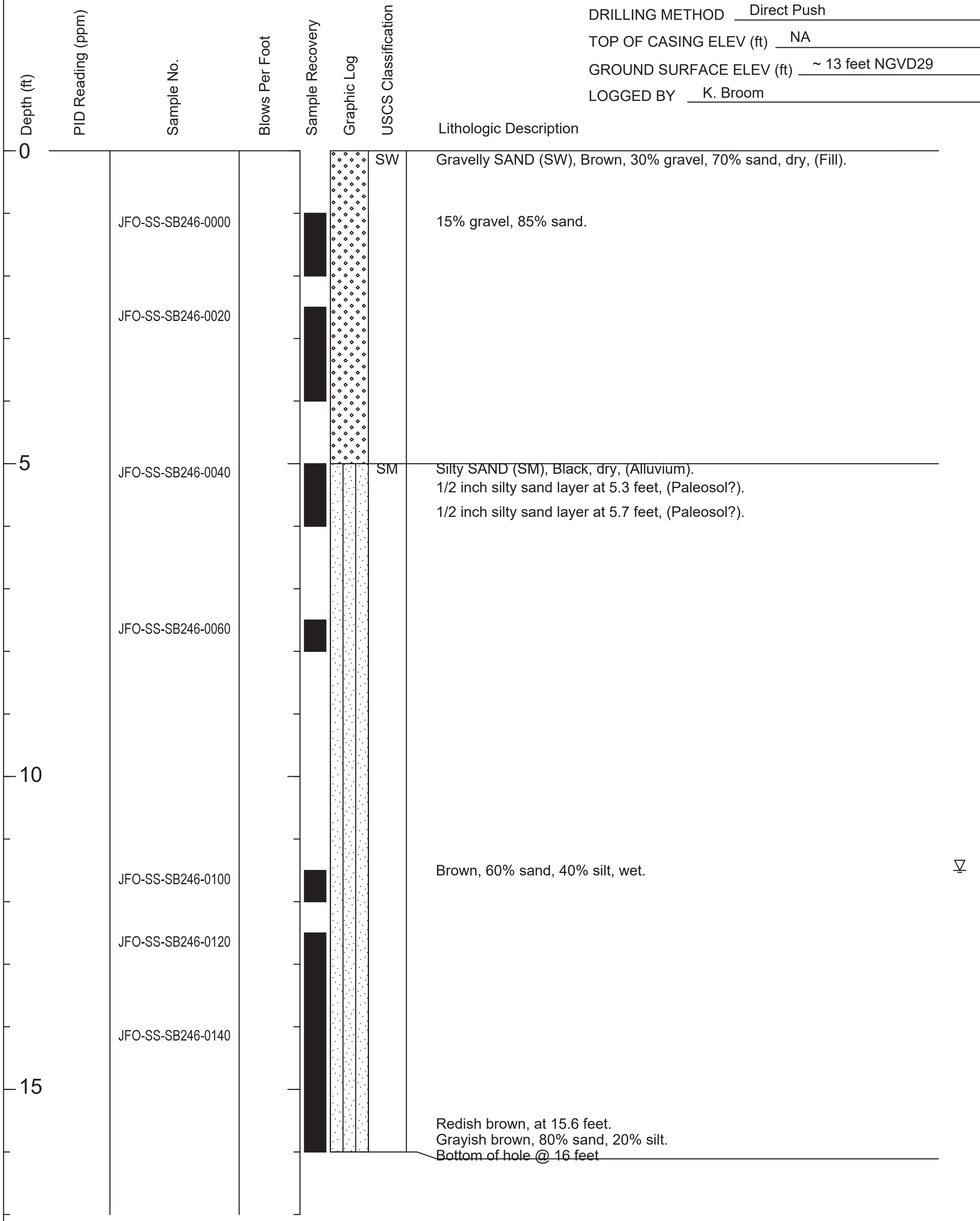
BOREHOLE LOG BOEING PL2 TRANSFORMER.GPJ RFW SEATTLE.GDT 7/24/03 13:41

Plate

A-35

BORING LOG SB-07246

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 10, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom



Lithologic Description

Gravelly SAND (SW), Brown, 30% gravel, 70% sand, dry, (Fill).

15% gravel, 85% sand.

Silty SAND (SM), Black, dry, (Alluvium).
1/2 inch silty sand layer at 5.3 feet, (Paleosol?).

1/2 inch silty sand layer at 5.7 feet, (Paleosol?).

Brown, 60% sand, 40% silt, wet.

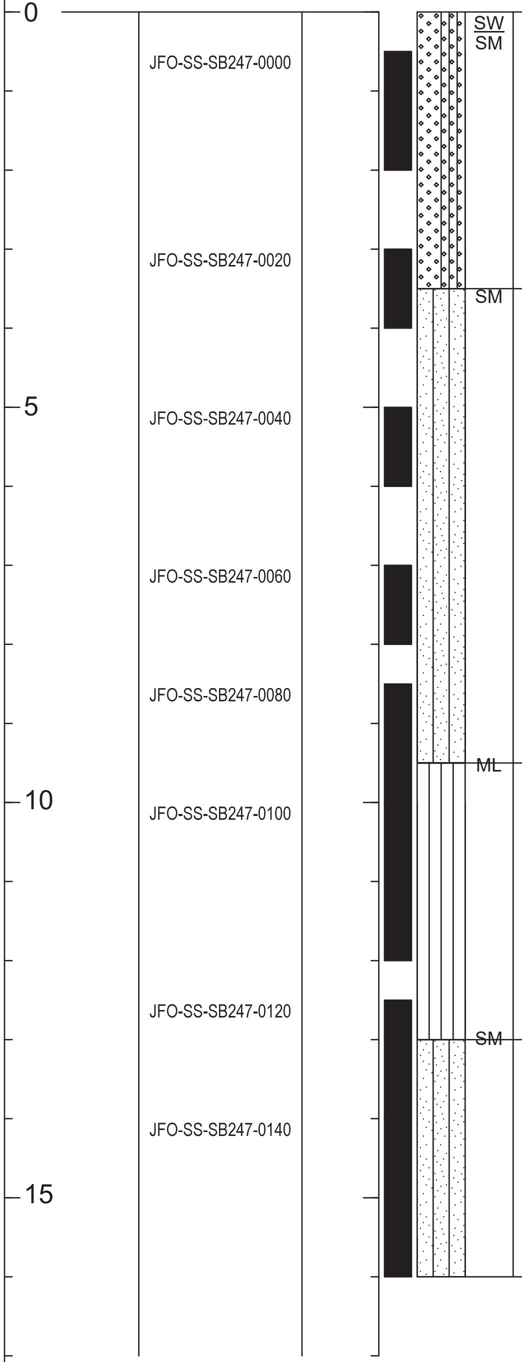
Redish brown, at 15.6 feet.
Grayish brown, 80% sand, 20% silt.
Bottom of hole @ 16 feet

Plate

A-36

BORING LOG SB-07247

PROJECT Transformer Pad PCB Investigation
JOB NUMBER 03709-079-001-0002
DATE COMPLETED June 10, 2003
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) NA
GROUND SURFACE ELEV (ft) ~ 13 feet NGVD29
LOGGED BY K. Broom

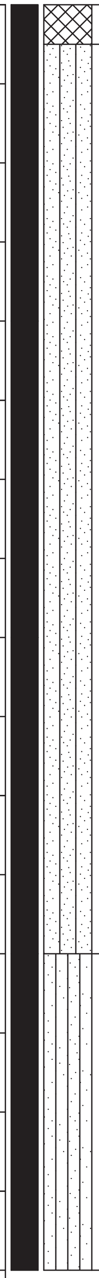


Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0		JFO-SS-SB247-0000				SW SM	Gravelly SAND with SILT (SW-SM), Brown, 35% gravel, 60% sand, 5% silt, dry, (Fill). Silty SAND with GRAVEL, Brown, 10% gravel, 65% sand, 25% silt.
		JFO-SS-SB247-0020					Brown, 5% gravel, 75% sand, 20% silt.
						SM	Silty SAND (SM), Brown, dry, (Alluvium). 1 inch thick silty layer at 3.7 feet, (Paleosol?).
5		JFO-SS-SB247-0040					Gray, 65% sand, 35% silt, damp, petroleum odor, (Alluvium).
		JFO-SS-SB247-0060					Black.
		JFO-SS-SB247-0080					
						ML	Sandy SILT (ML), Gray, 40% sand, 60% silt, damp, petroleum odor, (Alluvium). wet, slight petroleum odor, (Alluvium). ∇
10		JFO-SS-SB247-0100					
		JFO-SS-SB247-0120					Strong petroleum odor and sheen.
						SM	Silty SAND (SM), Black, 85% sand, 15% silt, wet, strong petroleum odor and sheen, (Alluvium).
		JFO-SS-SB247-0140					
15							
							1 inch thick silty layer, slight petroleum odor, no sheen.
							Bottom of hole @ 16 feet

BORING LOG SB-07229r

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.312 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						GW	(GW), Black, Fractured rock, (slag).
						SM	Silty SAND (SM), Brown, 85% sand, 15% fines, dry, (alluvium).
5							
		P2ST-SB-PP029-0080 PCBs & TPH					
10		P2ST-SB-PP029-0100 PCBs & TPH					
		P2ST-SB-PP029-0120 PCBs & TPH				ML SM	Gray, Powdery substance, wet, (ash). ∇ Sandy SILT (ML-SM), Grayish brown, 20% sand, 80% fines, (alluvium).
		P2ST-SB-PP029-0140 PCBs & TPH					
15							Slight petroleum odor.
		P2ST-SB-PP029-0160 PCBs & TPH					Bottom of hole @ 16 feet

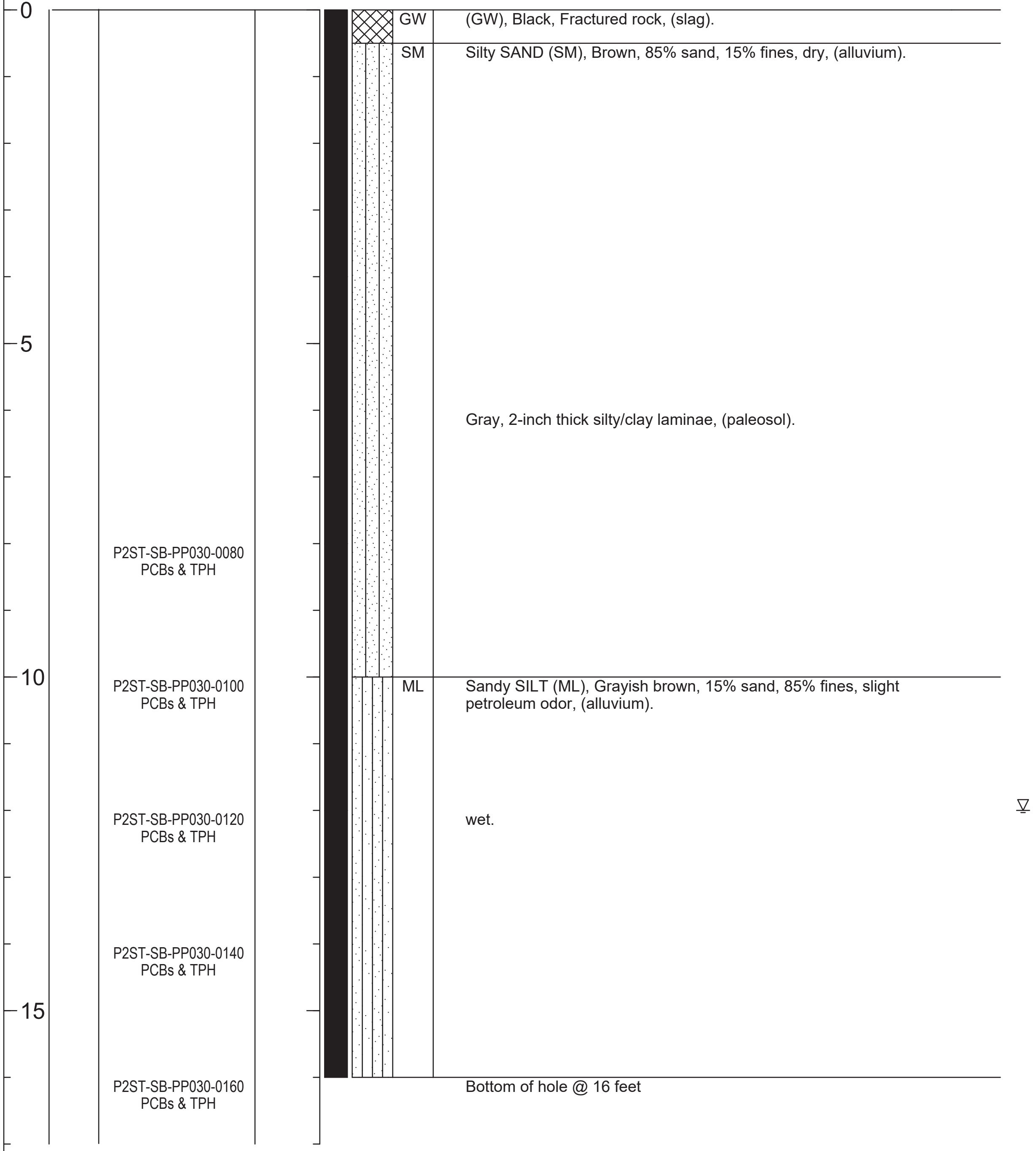


BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-4

BORING LOG SB-07230r

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.277 feet NGVD29
LOGGED BY K. Broom (Weston)



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						GW	(GW), Black, Fractured rock, (slag).
						SM	Silty SAND (SM), Brown, 85% sand, 15% fines, dry, (alluvium).
5							
							Gray, 2-inch thick silty/clay laminae, (paleosol).
		P2ST-SB-PP030-0080 PCBs & TPH					
10		P2ST-SB-PP030-0100 PCBs & TPH				ML	Sandy SILT (ML), Grayish brown, 15% sand, 85% fines, slight petroleum odor, (alluvium).
		P2ST-SB-PP030-0120 PCBs & TPH					wet.
		P2ST-SB-PP030-0140 PCBs & TPH					
15							
		P2ST-SB-PP030-0160 PCBs & TPH					Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-5

BORING LOG SB-07231r

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.655 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						GW	(GW), Black, Fractured rock.
						SM	Silty SAND (SM), Dark brown, 85% sand, 15% fines, dry, (alluvium).
5							
		P2ST-SB-PP031-0080 PCBs & TPH					
10		P2ST-SB-PP031-0100 PCBs & TPH					
							wet. ▽
		P2ST-SB-PP031-0120 PCBs & TPH					
		P2ST-SB-PP031-0140 PCBs & TPH					
15							
		P2ST-SB-PP031-0160 PCBs & TPH					Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-6

BORING LOG SB-07232r

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.343 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						GW	(GW), Black, Fractured rock.
						SM	Silty SAND (SM), Dark brown, 80% sand, 20% fines, dry, (alluvium).
5							
		P2ST-SB-PP032-0080 PCBs & TPH					
10		P2ST-SB-PP032-0100 PCBs & TPH					
							Gray, Fractured rock/soft material, dry, (ash).
						ML	Sandy SILT (ML), Gray, 15% sand, 85% fines, wet, petroleum odor, (alluvium).
							∇
		P2ST-SB-PP032-0120 PCBs & TPH					
		P2ST-SB-PP032-0140 PCBs & TPH					
15						SM	Silty SAND (SM), Black, 60% sand, 40% fines, wet, slight petroleum odor, (alluvium).
		P2ST-SB-PP032-0160 PCBs & TPH					Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-7

BORING LOG SB-07233r

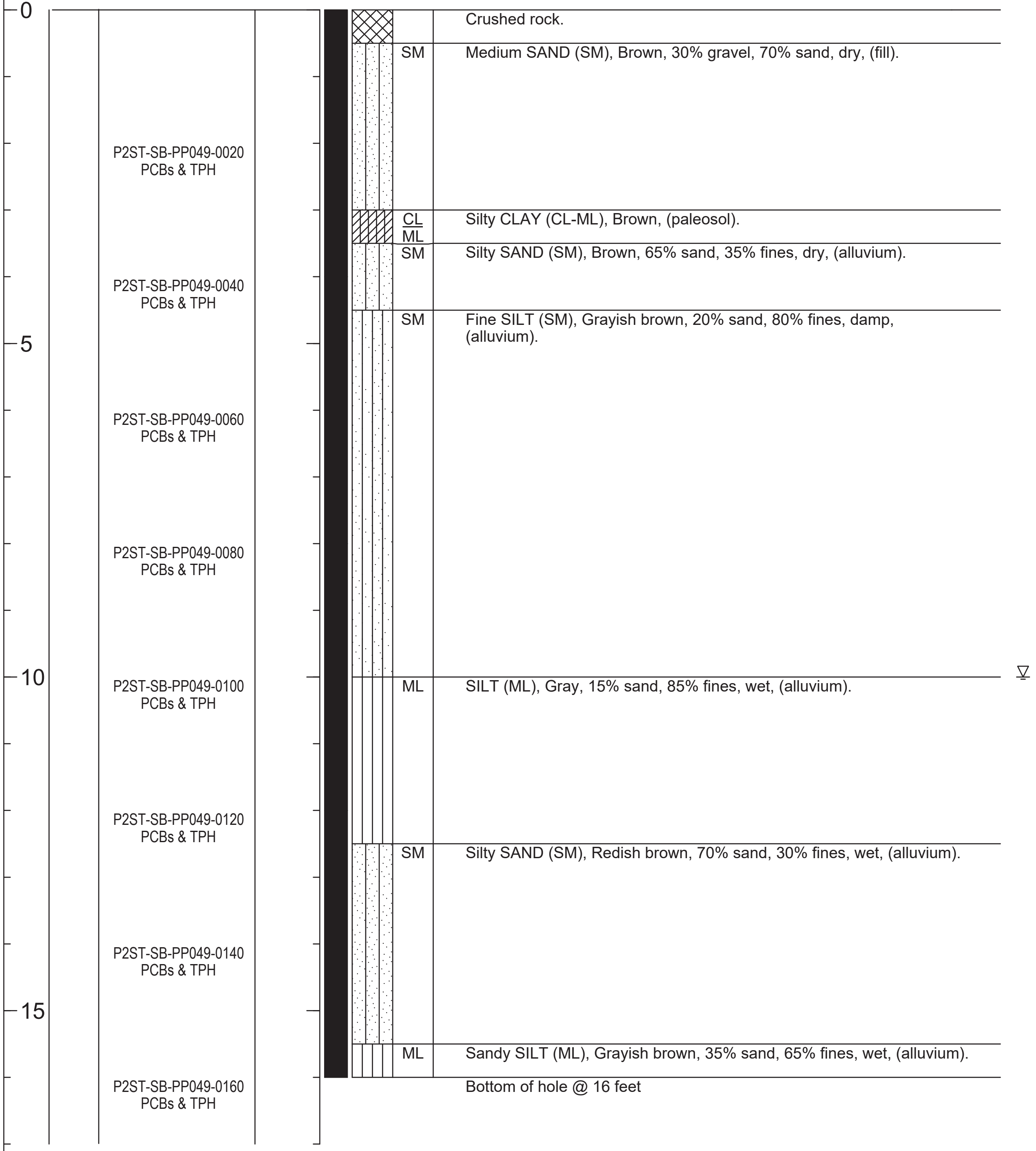
PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.349 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						GW	(GW), Black, Fractured rock.
						SM	Silty SAND (SM), Dark brown, 80% sand, 20% fines, damp, (alluvium).
5						SM	Sandy SILT (SM), Dark brown, 35% sand, 65% fines, wet, (alluvium).
						SM	Silty SAND (SM), Dark brown, 30% sand, 70% fines, wet, (alluvium).
		P2ST-SB-PP033-0080 PCBs & TPH					
10		P2ST-SB-PP033-0100 PCBs & TPH					
							Green, damp, petroleum odor.
						ML	Sandy SILT (ML), Grayish brown, 25% sand, 75% fines, wet, (alluvium). ▽
		P2ST-SB-PP033-0120 PCBs & TPH					
		P2ST-SB-PP033-0140 PCBs & TPH					
15							45% sand, 55% fines, petroleum odor and sheen.
		P2ST-SB-PP033-0160 PCBs & TPH					Bottom of hole @ 16 feet

Plate
A-8

BORING LOG SB-07249

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 15, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 13.958 feet NGVD29
LOGGED BY K. Broom (Weston)



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							Crushed rock.
						SM	Medium SAND (SM), Brown, 30% gravel, 70% sand, dry, (fill).
		P2ST-SB-PP049-0020 PCBs & TPH					
						CL ML	Silty CLAY (CL-ML), Brown, (paleosol).
						SM	Silty SAND (SM), Brown, 65% sand, 35% fines, dry, (alluvium).
		P2ST-SB-PP049-0040 PCBs & TPH					
						SM	Fine SILT (SM), Grayish brown, 20% sand, 80% fines, damp, (alluvium).
5							
		P2ST-SB-PP049-0060 PCBs & TPH					
		P2ST-SB-PP049-0080 PCBs & TPH					
10		P2ST-SB-PP049-0100 PCBs & TPH				ML	SILT (ML), Gray, 15% sand, 85% fines, wet, (alluvium). ▽
		P2ST-SB-PP049-0120 PCBs & TPH					
						SM	Silty SAND (SM), Redish brown, 70% sand, 30% fines, wet, (alluvium).
		P2ST-SB-PP049-0140 PCBs & TPH					
15							
						ML	Sandy SILT (ML), Grayish brown, 35% sand, 65% fines, wet, (alluvium).
		P2ST-SB-PP049-0160 PCBs & TPH					Bottom of hole @ 16 feet

Plate
A-11

BORING LOG SB-07250

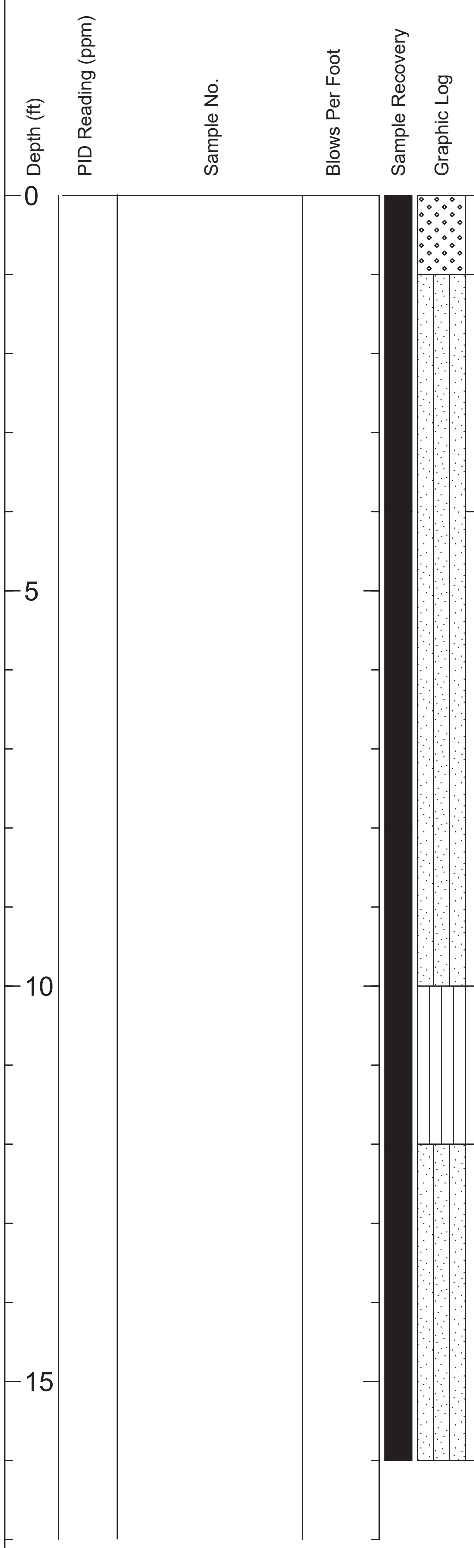
PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 13.993 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							Crushed rock.
						SM	Medium SAND (SM), Brown, 30% gravel, 70% sand, dry, (fill).
		P2ST-SB-PP050-0020 PCBs & TPH					
						CL ML	Silty CLAY (CL-ML), Brown, (paleosol).
						SM	Silty SAND (SM), Brown, 65% sand, 35% fines, dry, (alluvium).
		P2ST-SB-PP050-0040 PCBs & TPH					
5						SM	Fine SILT (SM), Grayish brown, 20% sand, 80% fines, damp, (alluvium).
		P2ST-SB-PP050-0060 PCBs & TPH					
		P2ST-SB-PP050-0080 PCBs & TPH					
10		P2ST-SB-PP050-0100 PCBs & TPH					
						ML	SILT (ML), Gray, 15% sand, 85% fines, wet, (alluvium). ∇
		P2ST-SB-PP050-0120 PCBs & TPH					
						SM	Silty SAND (SM), Redish brown, 70% sand, 30% fines, wet, (alluvium).
		P2ST-SB-PP050-0140 PCBs & TPH					
15							
						ML	Sandy SILT (ML), Gray, 35% sand, 65% fines, wet, (alluvium).
		P2ST-SB-PP050-0160 PCBs & TPH					Bottom of hole @ 16 feet

Plate
A-12

BORING LOG SB-07251

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 15, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.244 feet NGVD29
LOGGED BY K. Broom (Weston)



USCS Classification	Lithologic Description
SW	Gravelly SAND (SW), Blackish brown, 40% gravel, 60% sand, dry, (fill).
SM	Silty SAND (SM), Brown, 80% sand, 20% fines, dry, (fill).
SM	Silty SAND (SM), Dark brown, dry, (alluvium).
ML	Sandy SILT (ML), Grayish brown, 35% sand, 65% fines, damp, (alluvium).
SM	Silty SAND (SM), Black, 70% sand, 30% fines, wet, (alluvium).

∇ 2/15/2005/0930

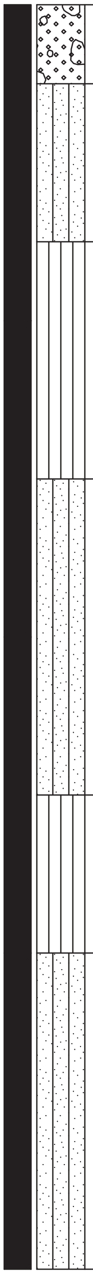
Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-13

BORING LOG SB-07252

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 15, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.235 feet NGVD29
LOGGED BY K. Broom (Weston)

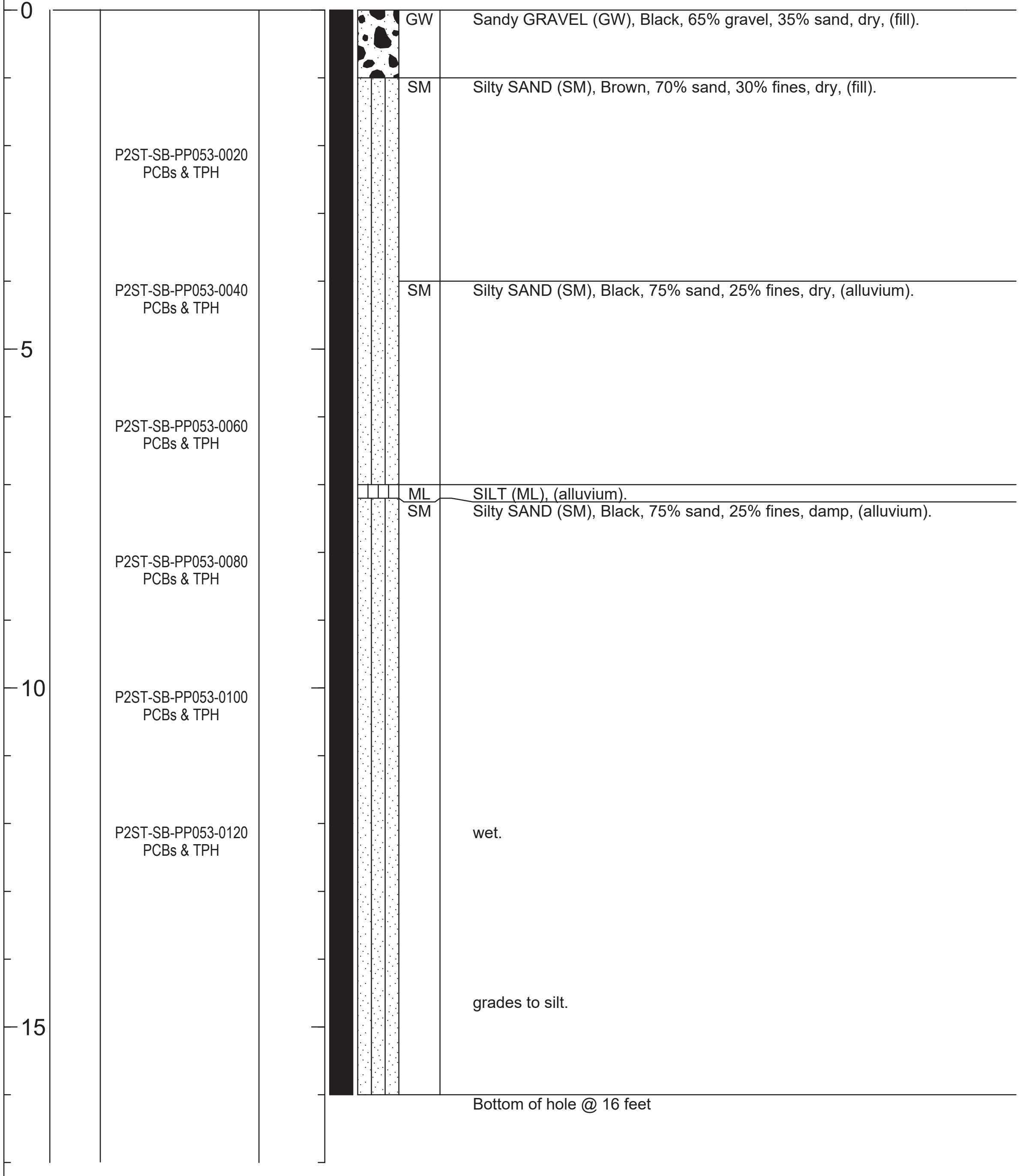


Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description	
0						SM	Gravelly SAND with SILT (SM), Black, 35% gravel, 60% sand, 5% fines, dry, (fill).	
						SM	Silty SAND (SM), Brown, 75% sand, 25% fines, dry, (fill).	
		P2ST-SB-PP052-0020 PCBs & TPH						
						ML	Sandy SILT (ML), Gray, 20% sand, 80% fines, damp, (alluvium).	
		P2ST-SB-PP052-0040 PCBs & TPH						
5								
						SM	Silty SAND (SM), Dark brown, 75% sand, 25% fines, damp, (alluvium).	
10						ML	Sandy SILT (ML), Gray, 15% sand, 85% fines, damp, (alluvium).	
						SM	Silty SAND (SM), Dark brown, 70% sand, 30% fines, wet, (alluvium).	▽ 2/15/2005/0830
15								
							Bottom of hole @ 16 feet	

Plate
A-14

BORING LOG SB-07253

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 15, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.315 feet NGVD29
LOGGED BY K. Broom (Weston)



Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	USCS Classification	Lithologic Description
0				GW	Sandy GRAVEL (GW), Black, 65% gravel, 35% sand, dry, (fill).
				SM	Silty SAND (SM), Brown, 70% sand, 30% fines, dry, (fill).
		P2ST-SB-PP053-0020 PCBs & TPH			
		P2ST-SB-PP053-0040 PCBs & TPH		SM	Silty SAND (SM), Black, 75% sand, 25% fines, dry, (alluvium).
5					
		P2ST-SB-PP053-0060 PCBs & TPH			
				ML	SILT (ML), (alluvium).
				SM	Silty SAND (SM), Black, 75% sand, 25% fines, damp, (alluvium).
		P2ST-SB-PP053-0080 PCBs & TPH			
10		P2ST-SB-PP053-0100 PCBs & TPH			
		P2ST-SB-PP053-0120 PCBs & TPH			wet. ⊻ 2/15/2005/1030
					grades to silt.
15					
					Bottom of hole @ 16 feet

Plate
A-15

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

ATTACHMENT 4: PER- AND POLYFLUOROALKYL SUBSTANCES

Attachment 4

Per- and Polyfluoroalkyl Substances

Reference Document

RD-B74

PFAS

TABLE OF CONTENTS

1.0 SCOPE AND APPLICABILITY

The procedures described herein define per- and polyfluoroalkyl substances (PFAS) specific sampling and handling techniques for various media, outline special considerations for communications about PFAS to clients and the general public, and provide additional guidance for projects involving PFAS. These techniques are necessary to prevent cross-contamination of water and soil samples collected for PFAS analysis and to navigate a rapidly changing and controversial regulatory environment.

This reference document (RD) is subject to change as new information becomes available. This RD is supplemental to current Shannon and Wilson, Inc. (SWI) RDs as befits the project. Additional RDs are listed in Section 8.0.

This RD defines a standard set of procedures applicable to a range of site conditions and projects. These procedures may be modified according to equipment limitations or project needs. Modifications to this RD will be described in a project-specific Work Plan or other document, and documented in the field notes, as applicable.

2.0 RESPONSIBILITY

The *Project Manager* (PM) is responsible for overseeing and ensuring that analytical samples are collected at required locations and with the appropriate frequency. The PM will ensure environmental samples are collected in accordance with this RD and any site-specific or project specific planning documents (e.g. approved Work Plan or Scope of Work).

It is the responsibility of the *Field Technician* (FT) to request the appropriate laboratory containers, coordinate with the analytical laboratory, and collect analytical water samples in accordance with this RD.

3.0 DEFINITIONS

PFAS are a group of man-made chemicals that include PFOA, PFOS, PFHxS, PFHpA, GenX, and many other compounds. These chemicals are considered an emerging contaminant.

4.0 REQUIRED MATERIALS / EQUIPMENT

The materials needed for this RD are project dependent. Materials may include but are not limited to the following:

- Field note paper and notebook
- Camera
- Residential Well Sampling Log (project specific)
- Well survey (project specific)
- Field Activities Daily Log
- Conversation record documents
- Business cards
- Chain of custody records (COCs)
- Sample cooler
- Gel ice packs
- YSI
- Nitrile gloves
- Sample labels
- Residential sampling bucket (green)
- Purge cup
- Ziploc baggies
- Paper towels
- Filter wrench(es)
- Plastic cups
- Extra buckets
- Garden hose
- Trash bags
- Toolbox (optional)
- Project specific sample jars or bottles
- Cell phone
- Public information packets, if applicable
- Clipboard
- Water sample bottles containing Trizma* (drinking-water samples)
- Water sample bottles without preservative (groundwater)
- Soil sample jars
- Plastic spoons (or other soil collection tool)
- PFAS-free water for field or equipment blanks
- Spare batteries
- Headlamp
- Peri-pump or whale pump and controller box
- Pump tubing
- Battery for pumps
- Water sounder
- Measuring tap
- Decontamination set-up

*see specific project details for water sample preservation requirements. Requirements may vary by state regulations and analyses requested.

4.1 Special considerations for materials when sampling for the presences of PFAS

Investigations of the presence of PFAS in consumer products are ongoing. Future testing may change the general cautions outlined in this section. This list is not comprehensive. See *Special Considerations for PFAS Sampling* document.

4.1.1 Sunblock and insect repellant ingredients should be verified PFAS-free prior to use during sampling.

4.1.2 Clothing and personal protective equipment (PPE) treated for water, fire, or stain resistance, or UV protection should not be worn during sampling. Clothing should not be new or recently washed with fabric softeners.

4.1.3 Food and food packaging should be avoided during sampling or near sampling areas.

4.1.4 Do not use waterproof paper or notebooks.

4.1.5 Use aluminum clipboards and ball point pens that are known to be PFAS free. Some felt-tip pens are known to have PFAS. Confirm Sharpie or other felt tip, erasable, or waterproof pens are PFAS free prior to use.

4.1.6 Glues may contain PFAS, sticky type note pads (Post-it), adhesive labels, and tape should be verified PFAS free prior to use.

4.1.7 Chemical ice packs should be verified PFAS free and placed in liner bags for use in sample coolers. Sample jars and/or bottles should not be allowed to touch the ice packs.

4.1.8 Disposable, powderless, nitrile gloves should be worn during sampling and handling activities. Gloves should be changed frequently especially when potential contamination has occurred (i.e. touching clothing, skin, hair, or consumer products in the sampling area).

4.1.9 If sampling during rain, snow, or cold, confirm that weather-protection gear is PFAS free or take extra care to avoid touching clothing and shoes.

4.1.10 Pumps and pump tubing should be verified PFAS free.

5.0 PROCEDURES

5.1 General Sampling Procedures

5.1.1 All sample containers should be provided by the laboratory and made of polypropylene (PP) or high-density polyethylene (HDPE). PFAS are known to attach to the sample containers made of glass and other materials.

5.1.2 Any required sample preservatives should be laboratory provided and stored in PFAS-free containers.

5.1.3 If reusable equipment is used for sampling, proper decontamination is necessary before and after each sample. See *RD-B13- Equipment Decontamination.*

5.1.3.1 Decontamination reagents must be PFAS free.

5.1.3.2 Water used for final decontaminations rinse should be certified PFAS free by the laboratory, or a source water sample should be submitted for analysis.

5.1.3.3 Verify decontamination reagents are effective at removing PFAS. See project manager to confirm effective decontamination agent.

5.1.4 Personal body products such as shampoos, moisturizers and cosmetics may contain PFAS. Limit or avoid use of such products on sampling days.

5.1.5 Equipment blanks should be used at the frequency described in the work plan or scope of work. Water used to collect equipment and field blanks should be certified PFAS-free water, provided by a laboratory.

5.1.6 Care should be taken to avoid cross contamination in PFAS samples, where samples for other analytes are also being collected. Gloves should be changed prior to collecting PFAS samples and PFAS samples should be bagged separately to avoid touching other sample jars and/or bottles.

5.1.7 Only handle sample containers while wearing gloves. Samples labels should be filled out prior to donning gloves for sample collection.

5.1.8 Avoid touching clothing, skin, hair, and/or consumer products while wearing gloves. Gloves should be changed frequently. A fresh pair should be donned immediately prior to collecting PFAS samples.

5.1.9 Sample containers should be stored in closed boxes or coolers when not in use. Storage boxes should be labeled as containing PFAS sampling equipment. Storing sample containers in plastic baggies is recommended to prevent inadvertent exposure to potential contaminants. If leaving a storage container for long periods of time, a custody seal should be added.

5.1.10 Laboratory provided sample containers do not need to be and should not be rinsed prior to collection.

5.2 Groundwater Sampling Procedures

See *RD-B41 Analytical Water Sample Collection*, *RD-B42- Monitoring Well Sampling*, or *RD-B44- Potable Water (Private) Well Sampling* for general groundwater sample collection techniques.

5.2.1 Confirm purging requirements (e.g. three well volumes versus parameter stabilization) prior to collecting samples.

5.2.2 If a monitoring well has permanent fixtures that may contain PFAS, the sample results may need to be flagged or rejected in the analytical database at the discretion of the project manager.

5.2.2.1 If dedicated tubing or fixtures that may contain PFAS can be removed from a monitoring well, extra precautions should be taken. This may include removal of equipment fourteen days prior to sample, or doubling purge requirements. Please confirm procedures with a project manager prior to sampling.

5.2.3 Do not filter samples prior to PFAS analysis.

5.2.4 Do not collect a sample through a hose or reusable tubing. Note on the sampling sheet if a sample was collected through a hose. Results may need to be flagged in the analytical database at the discretion of the project manager.

5.2.5 When collecting samples from private or public water-supply wells, note any fixtures or hardware that may contain PFAS that cannot be removed or bypassed for sample collection (Teflon plumbing tape, piping of unknown material, etc.). In residential/public spaces, it can be difficult or impossible to remove products that may contain PFAS from the sampling area. Take extra precautions to avoid touching products in the area and note any potential contamination sources in the sampling area. Where possible, locate a different sampling location.

5.2.6 If transfer containers are necessary, use PFAS-free plastic cups. Thoroughly rinse the transfer container with the water source being sampled prior to filling the sample bottles.

5.2.7 For private well samples, collect samples upstream of water treatment such as water softeners, chlorine systems, and filtration units. For some projects, we do not consider small (i.e., less than 18 inches in height) particulate filters to be treatment. Discuss with your project manager prior to sample collection.

5.2.7.1 If a pre-treatment location cannot be accessed, samples results may need to be flagged in the analytical database at the discretion of the project manager.

5.3 Surface Water Sampling Procedures

See *RD-B45-Surface-Water Sampling* for general surface water sample collection techniques.

5.3.1 If transfer bottles are necessary to collect surface water, they must be PFAS-free and made of the same material as laboratory provided containers. Transfer bottles should be rinsed in the water to be sampled prior to filling the sample containers.

5.3.2 Avoid standing in the water you are sampling. If necessary, stand downstream of your sample collection point (in flowing water), and wait for disturbed sediment to settle prior to collecting the sample.

5.3.3 If collecting from a boat, wearing waders or waterproof footwear, using water column samplers or other equipment that may contain PFAS, sample results may need to be flagged in the analytical database at the discretion of the project manager. You should note on the sample log when these items are used.

5.4 Soil Sampling Procedures

Techniques may vary. See *RD-B31- Analytical Soil Sample Collection* for general soil sample collection techniques.

5.4.1 Surface soil samples should be collected using decontaminated stainless steels spoons, shovels, laboratory-provided sampling tools, or disposable PFAS free plastic spoons.

5.4.2 Equipment used for subsurface sampling or soil borings should be PFAS free.

5.4.3 Samples should be collected near the surface immediately below vegetation, where present.

6.0 HEALTH AND SAFETY

A Site Safety & Health Plan (SSHP) and/or Job Safety Analysis worksheet (JSA) will be prepared for each project and will discuss safety issues involved. Any staff working on the project must read and abide by the SSHP and sign the SSHP acknowledgement form.

Personnel using this procedure will utilize PPE in accordance with these plans.

The SSHP will provide Safety Data Sheets (SDSs) for any chemicals that will be used on the project or that are known possible exposure risks for the site. Personnel using this procedure must be trained on the information contained in the SDSs, any engineering controls, and any required PPE.

7.0 QUALITY ASSURANCE / QUALITY CONTROL

QC activities are designed to allow self-verification of the quality and consistency of the work.

7.1 Interferences and Potential Problems

7.1.1 Inability to locate or access pre-treatment sampling location.

7.1.2 Presence of PFAS or PFAS-containing products in sampling area, monitoring well structure, drilling equipment, plumbing, pumps, or other equipment. In these cases, a field blank may need to be collected along with the project sample.

7.1.3 Inability to achieve stable parameters in residential well sampling situations.

7.2 Applicable Quality Assurance Manual procedures:

7.2.1 QP 05 Preparation of Field Activity Reports

7.2.2 QP 13 Document Control and Retention

8.0 OTHER REFERENCES

- *RD-A11- Field notes and Documentation*
- *RD-A12- Field Instrument Calibration*
- *RD-B11- Environmental Sample Handling*
- *RD-B13- Equipment Decontamination*
- *RD-B15- Environmental Database Operations*
- *RD-B25- Equipment Use - YSI-SW*
- *RD-B31- Analytical Soil Sample Collection*
- *RD-B34-Contaminated Soil Stockpiling and Sampling*
- *RD-B41-Analytical Water Sample Collection*
- *RD-B42- Monitoring-Well Sampling*
- *RD-B43-Well-Point Sampling*

- *RD-B44- Potable Water (Private) Well Sampling*
- *RD-B45-Surface-Water Sampling*
- *RD-B46- Pore-Water Sampling*
- *RD-B51-Monitoring Well Installation*
- *RD-B52- Monitoring Well Maintenance*
- *RD-B54- Water Supply Well Decommissioning*
- *RD-B72- Sediment Sampling*
- *Special Considerations for PFAS Sampling*
- Denly E, Occhialini J, Bassignani P, Eberle M, Rabah N. Per- and polyfluoroalkyl substances in environmental sampling products: Fact or fiction? *Remediation.* 2019;29:65–76. *https://doi.org/10.1002/rem.21614*

9.0 DOCUMENTATION

9.1 Review

The Project Manager will review the field-work records pertaining to the activities under their supervision. The elements of this review will include technical content, consistency, and compliance with the project plans, and RDs.

9.2 Archive

At the completion of the project, all original field logbooks and records will be stored in the project files in accordance with project procedures. Project file lifetime is established according to standard Shannon & Wilson file-retention procedures, or sometimes controlled and spelled out in contractual agreements with clients.

Correspondence (including email, telephone, and in-person conversations) with the clients, sub-contractors, and the public will be documented and stored in accordance with project procedures.

10.0 TRAINING AND PREREQUISITES

In order to perform sampling activities without supervision, the Field Technician must accomplish the following:

- Read this RD.
- Familiarize themselves with the applicable QAM procedures (listed in Section 7.2) as well as the references applicable to the project (Section 8.0).
- Complete supervised, on-the-job instruction with experienced field technicians or

project managers. Number of hours and days will differ for each individual, determined by a project manager or experienced field technicians.

- Residential sampling program training prior to sampling alone.

Environmental sampling will be performed by a State of Alaska Qualified Sampler (18 AAC 75.333[c] and 18 AAC 78.088[c]) and/or Qualified Environmental Professional (18 AAC 75.333[b], 18 AAC 78.088[b]), or a supervised individual in training to become a Qualified Sampler. Per ADEC, a Qualified Sampler will, at a minimum, hold a "completed degree in environmental science or another related scientific field… [and have] at least three months of experience in environmental sampling under the direct supervision of a qualified environmental professional."

Before performing this procedure, field staff will also be trained in analytical sample collection by an experienced staff member. Training will entail at least one day of supervised, on-the-job instruction.

11.0 ATTACHMENTS

A selection of relevant forms as of the publication date of this RD and are included here for reference only. Always obtain necessary forms from the project folder or project manager.

- Chain-of-Custody Form
- Well sampling log
- Field Activity Daily Log
- Monitoring well log
- Soil sample collection log

12.0 DOCUMENT HISTORY AND VERSION CONTROL

Version: 1.0 Date: 03/25/2020 Approved by:KRF

Version	Date	Reason/Description of Change(s)	Author	Reviews
1.0	3/25/2020	New.	ARM	KRF

APPENDIX F: QUALITY ASSURANCE PROJECT PLAN – REMEDIAL INVESTIGATION

Appendix F

Quality Assurance Project Plan – Remedial Investigation

Jorgensen Forge Corporation Property, Tukwila, Washington

PREPARED FOR:

Earle M. Jorgensen
Company
10650 S. Alameda Street
Lynwood, CA 90262

BY:

Shannon & Wilson
400 N, 34th Street, Suite 100
Seattle, WA 98103

(206) 632-8020
www.shannonwilson.com

QUALITY ASSURANCE PROJECT PLAN - REMEDIAL INVESTIGATION

Jorgensen Forge Corporation Property

TUKWILA, WASHINGTON

SHANNON & WILSON

April 15, 2020

Shannon & Wilson No: 21-1-12596-013

CONTENTS

Exhibits

Attachments

1,1-DCE	1,1-dichloroethene
ADEC	Alaska Department of Environmental Conservation
AO	Agreed Order
ARI	Analytical Resources, Inc.
BTEX	benzene, toluene, ethylbenzene, and xylenes
CCV	continuing calibration verification
cis-1,2-DCE	cis-1,2-dichloroethene
COC	chain-of-custody
DL	detection limit
DQO	data-quality objectives
Ecology	Washington State Department of Ecology
EDD	electronic data deliverables
EIM	Environmental Information Management
EM	Engineering Manual
EMJ	Earle M. Jorgensen Company
EPA	U.S. Environmental Protection Agency
HSA	hollow-stem auger
HVOCs	halogenated volatile organic compounds
ICV	initial calibration verification
JFC	Jorgensen Forge Corporation
LCS/LCSD	laboratory-control sample/laboratory-control sample duplicate
LL	low level
LNAPL	light non-aqueous phase liquid
LOD	limit of detection
LOQ	limit of quantitation
MRL	method reporting limit
MS/MSD	matrix spike/matrix spike duplicate
MTCA	Model Toxics Control Act
NELAP	National Environmental Laboratories Accreditation Program
NFG	EPA National Functional Guidelines
NSZD	natural source zone depletion
NWTPH	Northwest Total Petroleum Hydrocarbons
PAHs	polycyclic aromatic hydrocarbons
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PC	Project Coordinator
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PFAS	per- and polyfluoroalkyl substances

PM	Project Manager
PQL	practical quantitation limit
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
%R	percent recovery
RI	Remedial Investigation
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SIM	selected ion monitoring
Site	8231 East Marginal Way South
SOP	standard operating procedure
SRF	sample receipt form
SVOCs	semi-volatile organic compounds
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TPH-Dx	total petroleum hydrocarbons as diesel and residual range organics
TPH-Gx	total petroleum hydrocarbons as gasoline range organics
trans-1,2-DCE	trans-1,2-dichcloroethene
USACE	U.S. Army Corps of Engineers
VOCs	volatile organic compounds
work plan	Remedial Investigation Work Plan
°C	degrees Celsius
<	less than
≤	less than or equal to

1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared to accompany the Remedial Investigation (RI) Work Plan (the work plan) and Sampling and Analysis Plan (SAP) associated with remedial investigation (groundwater, soil, and soil vapor) activities to be completed at the Jorgensen Forge Corporation (JFC) facility, located at 8531 East Marginal Way South, Tukwila, Washington (Site). This QAPP, the associated SAP, and the Health and Safety Plan are included as appendices to the work plan.

This QAPP has been revised in response to Washington State Department of Ecology (Ecology) comments dated December 20, 2019 (Ecology, 2019), on the draft RI work plan dated January 31, 2019 (Shannon & Wilson, 2019).

The purpose of the QAPP is to describe project organization and responsibilities, project-specific data-quality objectives (DQOs), sample-handling methods, analytical procedures, and data-quality control (QC) review and reporting requirements for the groundwater, soil, soil vapor, and light non-aqueous phase liquid (LNAPL) monitoring investigation. The RI is being conducted to characterize the nature and extent of contaminants at the Site and to collect further information about the physical characteristics of the Site.

This document has been prepared per the Ecology *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology, 2016) and the U.S. Environmental Protection Agency (EPA) publication *EPA Requirements for Quality Assurance Project Plans QA/R-5* (EPA, 2001). This QAPP describes the process for qualifying analytical data based on quality assurance (QA)/QC review of Level II laboratory reports and electronic data deliverables (EDDs). This QAPP is intended to provide guidance for conducting what the EPA refers to as a Stage 2a Validation (EPA, 2009). A more critical level of validation is beyond the scope of this QAPP, but the QAPP does present guidance for determining whether additional review should be conducted, based on information received from the laboratory. This QAPP also assesses the quality of the analytical data using precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters.

This QAPP provides information about references we use during the data-validation process and presents data qualifiers used to “flag” analytical data. Methods for applying data qualifiers are referenced primarily from the following EPA guidance documents:

- EPA National Functional Guidelines (NFG) for Organic Superfund Methods Data Review, January 2017 (EPA, 2017b) and
- EPA NFG for Inorganic Superfund Methods Data Review, January 2017 (EPA, 2017a).

In some cases, we also reference the following U.S. Army Corps of Engineers (USACE) guidance document as well to formulate our opinions when EPA guidance documents recommend exercising professional judgment:

- USACE Engineering Manual (EM) 200-1-10, Guidance for Evaluating Performance-Based Chemical Data, June 2005 (USACE, 2005).

In general, most data-review guidelines presented in this QAPP are drawn from federal guidance documents. However, in some cases, federal guidance is not consistent, is outdated, or does not account for specific issues addressed in this QAPP; in these cases, the guidance presented in the QAPP is based on standard industry practice or site-specific considerations, which are in turn based on Shannon & Wilson chemists' years of professional experience. When non-federal guidance documents are used, they are cited within the text and listed in Section 6.

Most QAPPs specify DQOs for items such as laboratory-control sample (LCS) recovery and target reporting limits. This document does not present such limits, but instead defers to internal laboratory-control limits that are statistically derived, frequently updated, and within the requirements of the laboratory's national certification, and thus compliant with federal requirements.

1.1 Background

The approximately 20-acre Site was a steel and aluminum forge and mill that produced custom steel and aluminum parts forged and machined to high precision specifications for various industrial clients. Operations remained relatively unchanged since the property was developed in the 1940s; however, melt operations were discontinued in 2015. Facility operations were discontinued in October 2018.

The Site is developed with an approximately 124,000-square-foot prefabricated steel building (main building), which is generally divided into the Hollowbore Area, the Machine Shop Area, the Heat Treat Area, the Forge Shop Area, and the Former Melt Shop Area.

Investigations began at the Site in 1990 and are described within the RI Work Plan. Investigations have included the completion of numerous borings and the installation of 52 groundwater monitoring wells, numbered MW-1 through MW-52, at the Site. Several additional wells were installed in the northwest corner of the Site by consultants for The Boeing Company, numbered as PL2-JF01A, PL2-JF01AR, PL2-JF01B, PL2-JF01C, PL2-JF02A, PL2-JF03A, and PL2-JF04A. The current groundwater monitoring network includes 44 monitoring wells.

In August 2017, Shannon & Wilson completed groundwater monitoring well repair activities and conducted a comprehensive groundwater monitoring and sampling event. A second, less comprehensive, monitoring and sampling event was completed in February 2018. The findings from the August 2017 and February 2018 events have been incorporated into the RI Work Plan.

LNAPL plumes are present in Site Areas 1 and 2. The potential contaminants of concern for the Site include benzene, toluene, ethylbenzene, and xylenes (BTEX), halogenated volatile organic compounds (HVOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), and metals.

1.2 Project Description and Schedule

The RI is being undertaken to characterize the nature and extent of contaminants and to collect further information about the physical characteristics of the Site. Results from the investigation will be used to inform the selection of potential remedial approaches, as necessary, within the feasibility study.

Investigation activities will target data gaps identified within the RI Work Plan. The scope of work is broken into three major sections: LNAPL investigations, soil investigation, and groundwater investigations. A comprehensive SAP detailing field procedures is provided as a separate document. LNAPL investigations may include using laser-induced fluorescence technology to achieve vertical and horizontal LNAPL and residual soil contamination delineation within Areas 1 and 2, completing transmissivity tests within three wells (two within Area 1 and one within Area 2), and completing natural source zone depletion (NSZD) evaluations for each plume. The NSZD evaluation will consider the saturated zone and will include the collection of groundwater samples. The soil investigation will include completion of and soil sampling from 48 direct-push borings and up to 27 hollow-stem auger (HSA) borings that will be completed as permanent groundwater monitoring wells. Groundwater investigations will include installation of the groundwater monitoring wells, hydraulic conductivity testing at up to six wells, and completion of four quarterly groundwater monitoring and sampling events.

In advance of selecting a laboratory for the project, the detection and reporting limits of three laboratories (Fremont Analytical, Inc., ALS Environmental, and Analytical Resources, Inc. [ARI]) were compared against the most stringent groundwater screening levels provided by Ecology (potable) (Attachment 1). ARI in Tukwila, Washington, was selected as the project laboratory. ARI is best able to achieve the project screening levels.

Soil samples will be analyzed for TPH as gasoline range organics (TPH-Gx); TPH as diesel and residual range organics (TPH-Dx); volatile organic compounds (VOCs) analysis for BTEX and HVOCs, including 1,1-dichloroethene (1,1-DCE), cis-1,2-dichcloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride; PAHs; SVOCs (full list); PCBs as aroclors; metals, including arsenic, barium, cadmium, chromium, hexavalent chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, vanadium, and zinc; total organic carbon; porosity; and for selected physical parameters including grain size analysis.

Groundwater samples will be analyzed for TPH-Gx; TPH-Dx; VOCs analysis for BTEX and HVOCs, including 1,1-DCE, cis-1,2-DCE, PCE, TCE, and vinyl chloride; PAHs; PCBs as aroclors; SVOCs (full list); limited SVOCs, including bis(2-ethylhexyl phthalate), dibutyl phthalate, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dimethyphenol, benzoic acid, butyl benzyl phthalate, n-nitrosodiphenylamine, and pentachlorophenol; total and dissolved metals, including arsenic, barium, cadmium, total chromium, hexavalent chromium (dissolved only), cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc; and for natural attenuation indicators, including nitrate, nitrite, sulfate, sulfite, ferrous iron, manganese, and methane. Samples for dissolved metals will be filtered in the laboratory and then preserved with nitric acid.

Select soil and groundwater samples will be analyzed for full list SVOCs analysis to provide additional confirmation that SVOCs (other than those eliminated during chemical of potential concern evaluations) are not present at levels of concern.

During one groundwater sampling event, select wells will be sampled for per- and polyfluoroalkyl substances (PFAS). PFAS-specific procedures are provided within a separate data-validation program plan, provided in Attachment 4.

1.3 Project Organization and Responsibilities

The project organization is described in the following subsections, including duties and responsibilities of key personnel. Key personnel will review the approved QAPP prior to beginning work on the Site and will implement and adhere to the appropriate procedures described herein.

1.3.1 Earle M. Jorgensen Company (EMJ)

EMJ owned the Site property from 1965 to 1992 and has assumed responsibility for taking remedial actions at the Site under the oversight of Ecology pursuant to an Agreed Order (AO) under Washington’s Model Toxics Control Act (MTCA) and MTCA’s implementing regulations. The EMJ project manager (PM) is Gil Leon. Deliverables will be directed to the EMJ PM.

The EMJ PM or his representative is responsible for authorizing changes to the scope of services and implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements.

1.3.2 Washington State Department of Ecology (Ecology)

The Ecology Project Coordinator (PC) is currently Maureen Sanchez. The Ecology PC is responsible for reviewing and approving the work performed during the investigation and ensuring successful completion of the AO requirements. Ecology requires seven days' notice of any sampling activities.

1.3.3 Star Forge LLC /Jorgensen Forge Corporation (JFC)

The Site is currently owned by Star Forge doing business as JFC. Star Forge has granted EMJ, Ecology, and any consultant or contractor EMJ engages, non-exclusive access to the Site for the purpose of completing investigations and remedial actions. The Star Forge PM is Matteo Sanesi, the Supply Chain Manager for the facility. He can be reached at (253) 878-6415. Star Forge requires at least 24 hours' notice prior to entering the Site.

As described in the work plan, it is our understanding that the property will be sold. When the sale occurs, the facility representative will change.

1.3.4 Shannon & Wilson

Shannon & Wilson is providing environmental consulting services to EMJ and will conduct monitoring and reporting as specified in the current scope of work. Key personnel titles and responsibilities include the following:

Project Coordinator (PC) – The Shannon & Wilson PC is currently Meg Strong. The PC will serve as EMJ's and Ecology's principal point of contact for the project. The PC is responsible for overseeing the implementation of the AO. To the maximum extent possible, communications between Ecology and EMJ, and documents, including reports, approvals, and other correspondence, will be directed through the PC.

Project Manager (PM) – The Shannon & Wilson PM is currently Shoshana Howard. The Shannon & Wilson PM will be responsible for coordinating the project's planning and implementation, and will oversee field sampling, data interpretation, and reporting activities. The PM will work with technical staff to implement the program's scope and schedule in accordance with project requirements and the approved QAPP. Additionally, the PM will conduct initial management review of statistical analysis results and supervise preparation of the technical document submittals.

Quality Assurance (QA) Officer – The QA Officer is currently David Randall. The QA Officer has overall responsibility to independently review whether planning, implementation, and reporting fulfill the objectives for data use, and to check if data quality is sufficient to support data used in the initial Site investigation. The QA Officer is responsible for seeing established data-validation procedures are followed, field and laboratory activities are conducted in accordance with the QAPP, and corrective actions are implemented. Preparing QAPP revisions or addenda, and communication with the other contractors, EMJ, or regulatory agencies regarding data-quality issues, are also the responsibility of the QA Officer. The QA Officer will review reports to check whether project objectives have been met.

Field Monitoring Personnel – Field monitoring personnel responsibilities will include arranging Site access, collecting project samples, measuring field parameters, and completing field-sampling forms. They will also conduct statistical analysis and database management of analytical data and prepare reports based on data from field forms, analytical laboratory results, and other relevant data collected during monitoring events.

Support Staff – Support staff will be available to provide support in data validation, statistical analysis, hydrology, technical engineering, and site-specific chemical issues, if the need arises.

1.3.5 Analytical Laboratory

ARI of Tukwila, Washington (an Ecology and National Environmental Laboratories Accreditation Program [NELAP]-certified laboratory) will provide analytical testing services for water and soil samples except water samples to be tested for PFAS. Eurofins TestAmerica of Sacramento, California (a NELAP-certified laboratory), will provide analytical testing services for PFAS. The current laboratory certifications for the requested analyses will be requested by Shannon & Wilson prior to collecting project samples. If the samples are to be analyzed by a laboratory other than ARI or Eurofins TestAmerica, Shannon & Wilson will also request laboratory certifications for the requested analyses from the alternative laboratory.

Laboratory Project Manager (PM) – The laboratory PMs will coordinate laboratory services and be the point of contact for this project. Laboratory QA staff will be responsible for oversight and QC review of laboratory analyses.

Laboratory personnel can be contacted at the following address and telephone number:

Ms. Amanda Volgardsen Johnson
Analytical Resources, Inc.
4611 S. 134th Place, Suite 100
Tukwila, WA 981168-3240
Telephone: (206) 695-6200

Eurofins TestAmerica
880 Riverside Parkway
West Sacramento, CA 95605
Telephone: (916) 373-5600

1.3.6 Soils Laboratory

The Shannon & Wilson Seattle Soils Laboratory, an American Association of State Highway and Transportation Officials Accreditation Program-accredited laboratory, will test selected soil samples for physical parameters.

Laboratory Project Manager (PM) – The Shannon & Wilson Seattle Soils Laboratory Manager will coordinate and be the point of contact for physical testing services.

Laboratory personnel can be contacted at the following address and telephone number:

Mr. Joe Laprade
Shannon & Wilson Seattle Soils Laboratory
400 N. 34th Street, Suite 100
Seattle, WA 98103
Telephone: (206) 695-6713

1.4 Special Training Requirements/Certifications

Shannon & Wilson field staff used for this project are fully trained to collect, process, and handle groundwater, soil, and soil vapor samples; decontamination procedures; visual inspections; chain-of-custody (COC) procedures; and data validation. All sampling personnel will have completed the 40-hour Hazardous Waste Operations training course and eight-hour refresher courses, as necessary, to meet the Occupational Safety and Health Administration regulations (29 Code of Federal Regulations 1910.120).

1.5 Documentation and Records

The format for data reporting packages will be consistent with the requirements and procedures used for data validation and data assessment described in this QAPP. A summary report will be provided for each monitoring event. The recording media for the project will be both paper and electronic. The project will implement proper document control procedures for both media, consistent with Shannon & Wilson's QA Manual. For instance, hand-recorded data records will be taken with indelible ink, and changes to such data records will be made by drawing a single line through the error with an initial by the responsible person. The Shannon & Wilson PC will have ultimate responsibility for any changes to records and documents. Similar controls will be put in place for electronic records.

The Shannon & Wilson QA Officer will retain updated versions of the QAPP and be responsible for distribution of the current version of the QAPP. The Shannon & Wilson QA Officer and the EMJ PM or their representative will approve any necessary updates. The Shannon & Wilson PC will retain copies of management reports, memoranda, and correspondence between Ecology and project-necessary personnel.

1.5.1 Field Records

Shannon & Wilson field staff will keep accurate written records of their daily activities on field-sampling forms. Form entries will be legible, written in waterproof ink, and contain accurate and inclusive documentation of sampling activities, including, but not limited to

- Project name;
- Field personnel on Site;
- Facility visitors;
- Weather conditions;
- Field observations;
- Notes on maps and/or drawings;
- Date and time sample collected;
- Sampling method and description of activities;
- Identification or serial numbers of instruments or equipment used;
- Deviations from the Work Plan, SAP, and QAPP; and
- Any additional information that may be pertinent.

Samples will be collected into labeled containers. The labels will include date and time the sample was collected, location of the sample, name of the person who collected the sample, unique sample identification number, analytical method, and any chemical preservative used. Sample jars will not be individually sealed with a custody seal.

1.5.2 Analytical Reports

A Level II laboratory report will be requested from the laboratory. A Level II laboratory report is required by EPA to provide a case narrative to document any QC or sample-handling problems, a signed copy of the COC, a summary of sample concentrations in proper units, dates for sample preparation and analysis, a summary of sample preparation QC samples (method blanks, LCS/laboratory-control sample duplicate [LCSD], matrix spike/matrix spike duplicate [MS/MSD], and laboratory duplicates), and sample receipt information.

1.5.3 Data Report

The laboratory will provide electronic data deliverables in a format consistent with Ecology's Environmental Information Management (EIM) database requirements. The laboratory analysis data from the proposed scope of work will be provided to Ecology, uploaded to EIM, and incorporated into the RI Report. Refer to Section 5 for reporting requirements.

2 QUALITY OBJECTIVES AND DATA VALIDATION

The DQOs for the current scope of work will be defined in this section to provide procedures to assess the quality of the data collected during this investigation. As mentioned in Section 1, this QAPP will assesses the DQOs of the analytical data using PARCCS parameters (precision, accuracy, representativeness, comparability, completeness, and sensitivity).

The analytical data will be validated by Shannon & Wilson to assess if the required DQOs have been achieved. As mentioned in Section 1, a Stage 2a Validation will be performed. The various stages of validation are briefly described below. A more detailed description of each stage is provided in EPA's Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA, 2009).

- Stage 1: Stage 1 Validation focuses on confirming consistency and completeness of the laboratory analytical package (such as confirming that documentation is complete, requested analyses were performed and reported, and sample receipt conditions are documented).
- Stage 2a: Includes validation performed during Stage 1 and includes review of sample-related quality control procedures. This level of validation includes steps such as confirming that sample-related quality control data and acceptance criteria are provided, appropriate spikes have been added, holding times were followed, and the QC-sample

frequency is appropriate. Stage 2a Validation also includes a comparison of holding times and QC results to guidelines with the objective of evaluating sample results.

- Stage 2b: Includes validation performed during Stage 2a and includes review of instrument-related QC procedures (such as review of initial calibration verification [ICV] and continuing calibration verification [CCV] sample results).
- Stage 3: Includes validation performed during Stage 2b and includes recalculation of instrument and sample results using instrument responses and comparison of the recalculated results to the laboratory reported results.
- Stage 4: Includes validation performed during Stage 3 and includes evaluation of instrument outputs (such as chromatograms and mass spectra).

As mentioned in Section 1, the data will be qualified based on recommendations from the NFG (EPA, 2017a and 2017b) and the EM 200-1-10 (USACE, 2005). The following sections provide the criteria used to qualify the data based on these guidance documents.

2.1 Analytical Sensitivity

Analytical sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected or quantified (USACE, 2005). For this project, analytical sensitivity is evaluated by comparing the appropriate reporting limit (typically, the limit of detection [LOD]) for not-detected results to project-specific screening levels (Attachment 2), where such standards exist. Analytical sensitivity of the reporting limits may be affected by contaminants identified in the quality control blank samples, which are discussed in this section.

2.1.1 Reporting Limit Comparison to Screening Levels

The laboratory LODs are compared to the project-specific screening levels to assess if the analytical results reported by the laboratory are sufficiently sensitive for the project. Some laboratories define the reporting limit as limits of quantitation (LOQs), practical quantitation limits (PQLs), or method reporting limits (MRLs). In general, laboratory reporting limits used to check analytical sensitivity are less than the project screening levels, with some exceptions (Attachment 2).

In cases where the reporting limit (LOD, LOQ, PQL, etc.) exceeds the screening levels, a note will be added to the NFG data-review checklist. Associated results tables will include shading to indicate that the reporting limit exceeds the screening level. Reporting limits that exceed project screening levels should be identified using the following criteria listed in Exhibit 2-1.

Exhibit 2-1: Elevated Reporting Limit Actions

Analysis	Criteria	Action
All	LOD ≤ Screening Level	No note.
	LOD > Screening Level	Note/shading should be added to the Checklist/Result Tables.

NOTES:
≤ = less than or equal to; > = greater than

Exhibit 2-2, below, illustrates the relationship between the detection limit (DL), the LOD, and the LOQ, with a summary of laboratory result flags applied to each range and an example of acceptable and unacceptable (elevated) reporting limits.

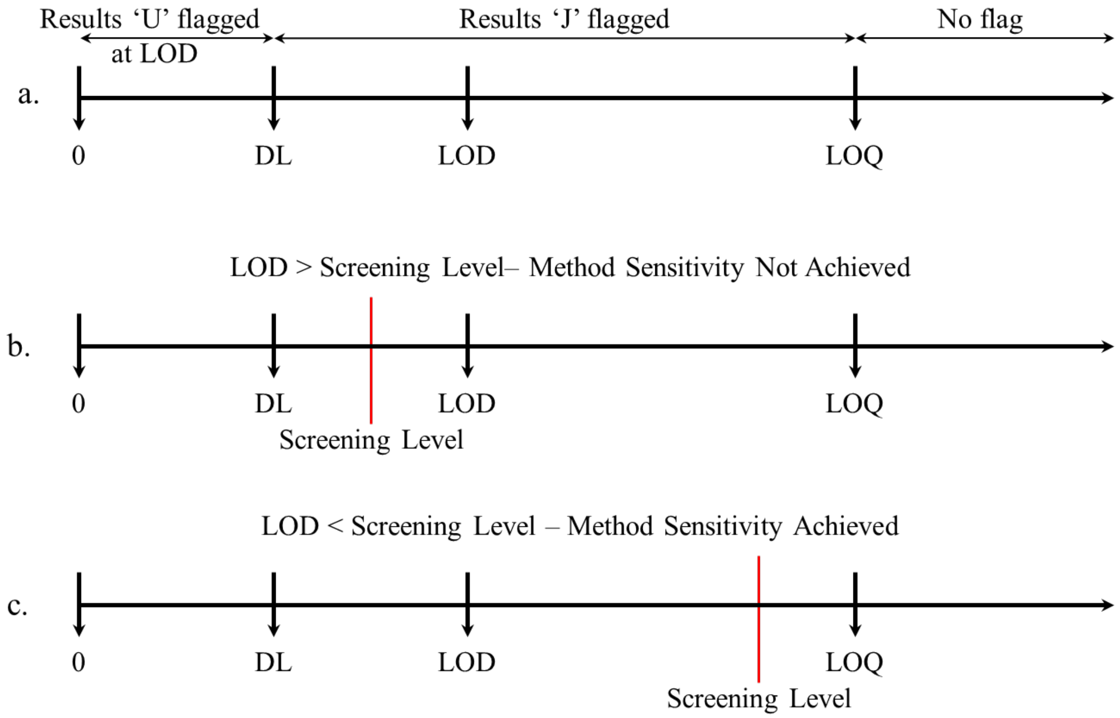


Exhibit 2-2: Relationship Between DL, LOD, LOQ, and Corresponding Laboratory Result Flags and Screening Levels. Detection limit (DL), limit of detection (LOD), and limit of quantitation (LOQ) and screening level diagram with (a) result flags assigned to results by laboratory, (b) unacceptable LOD-to-screening-level relationship, and (c) acceptable LOD-to-screening-level relationship.

2.1.2 Blank Samples

Blank samples are analyzed to check for possible contributions to the analytical results from cross-contamination between samples or from sample contamination from an outside source. Typically, the following blank samples are reviewed in conjunction with project samples:

- Method blanks,
- Trip blanks (volatile analytes only), and
- Equipment blanks.

In addition to those listed above, additional method-specific blank samples may be analyzed by the laboratory (e.g., leaching blanks for toxic characteristic leaching potential samples); additional blanks should be evaluated on a case-by-case basis. Each of these blanks checks for sample-contamination issues at various steps between sample collection and analysis. Detections in blanks higher up on this list can cause related detections in blanks lower on this list; one can think of this list as a hierarchy of blanks. For example, a detection in a method blank (contamination at the extraction step) can cause detections in corresponding trip blanks or equipment blanks. Therefore, it is important to investigate blank detections to determine at what step sample contamination was first introduced; data qualification should proceed beginning at this level.

Instrument blanks are not discussed here as they are part of the analytical batch and are better addressed with a Level IV data validation. Any instrument blank detections that would be expected to affect data quality may also show up in the method blanks. Therefore, blank evaluation for purposes of this QAPP (Level II data review) should proceed using the following hierarchy:

1. Method blank,
2. Trip blank, and
3. Equipment blank.

Additional details are provided in individual blank sections below.

Data-qualification procedures are identical between blank types within a given matrix; however, the list of affected samples varies. In general, if an analyte that was detected in a blank is detected in a corresponding project sample within a factor of five of the concentration in the blank, it is considered not detected and flagged “UB” at the LOQ or the concentration in the sample, whichever is higher. If the analyte is detected in a corresponding project sample fivefold greater than the concentration in the blank, but within a factor of ten of the concentration, the result is considered estimated, biased high (flagged “JH”) to indicate the potential contribution of the blank-identified contamination to the sample results. The following exhibit presents data-qualification criteria for samples affected by detections in blank samples; these criteria are generally consistent with those presented in EM 200-1-10 (USACE, 2005).

Exhibit 2-3: Actions for Blank Detections

Concentration in Blank (y)	Concentration in Corresponding Sample (z)	Action
DL < y ≤ LOQ	Not detected	No qualification
	z ≤ LOQ	UB at the LOQ
	LOQ < z ≤ 5y	UB at the detected result (z)
	5y < z ≤ 10y	JH
	10y < z	No qualification
LOQ < y	Not detected	No qualification
	z ≤ LOQ	UB at the LOQ
	LOQ < z ≤ 5y	UB at the detected result (z)
	5y < z ≤ 10y	JH
	10y < z	No qualification

NOTES:
y = concentration in blank; z = concentration in corresponding sample

The following exhibit is a visual representation of example flagging criteria for a blank detection below the LOQ.

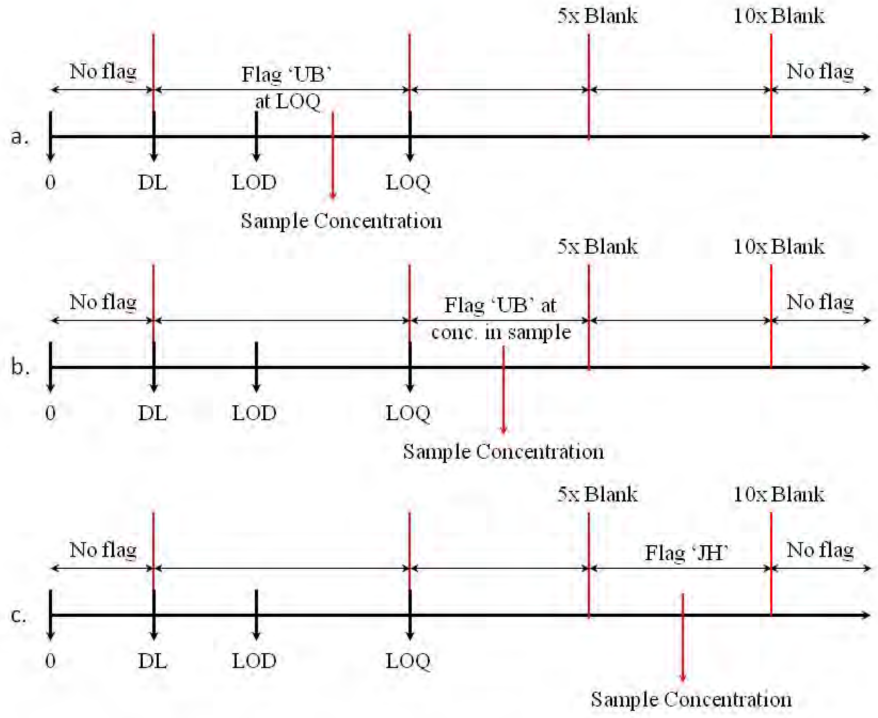


Exhibit 2-4: Example Qualification Criteria for Blank Detections Below LOQ. Example qualification criteria for blank detections. Project-sample results would be qualified as follows: (a) flagged "UB" at the limit of quantitation (LOQ), (b) flagged "UB" at the concentration detected in the sample, and (c) flagged "JH" at the concentration detected in the sample.

2.1.2.1 Method Blanks

Method blank samples are prepared by the laboratory with every preparatory batch (extraction batch), at a minimum rate of one method blank per 20 samples. Method blanks are samples of clean media (soil, water, etc.) that are subjected to the same procedures as project samples to extract a given analyte(s). Method blanks are evaluated to determine if the method of extraction, cleanup, or analysis introduces any contamination during the process.

A Shannon & Wilson chemist qualified to perform QA/QC review and data validation (the reviewer) will check that method blanks were prepared and analyzed by the laboratory at the required frequency and that no analytes were reported in the method blanks. If an analyte is reported in a method blank, all samples in the corresponding preparatory batch should be evaluated for that analyte. Data qualifiers should be applied per (above).

2.1.2.2 Trip Blanks

Trip blank samples are prepared by the laboratory and one trip blank should accompany each cooler containing samples for volatile analysis and stay with the samples at all times. A trip blank is not required for semi-volatile or non-volatile analytes. Trip blanks serve to check for cross-contamination or contamination from an outside source during sample collection, storage, transportation, and processing by the laboratory.

The reviewer will check that trip blanks were prepared, transported, and analyzed with any samples analyzed for VOCs, and that no analytes were reported in the trip blank. A minimum of one trip blank per cooler is required; the cooler containing the trip blank and samples for VOC analysis should be clearly identified on the COC. If an analyte is reported in a trip blank, all samples in the corresponding cooler should be evaluated for the detected analyte and, if necessary, qualified based on the criteria presented in Exhibit 2-3 (above). If the sampler did not document which cooler contained the trip blank, and there is more than one cooler containing samples for VOC analysis, all VOC samples in the work order should be considered potentially affected.

2.1.2.3 Equipment Blanks

Equipment blank samples are collected in the field by the sampling personnel. The equipment blank is used to determine if decontamination of reusable sampling equipment between sampling locations is sufficient. The project SAP requires a minimum collection frequency of one equipment blank for every 20 samples collected with reusable equipment. Because some of the screening levels for the project are lower than drinking water standards, an equipment blank will be collected from the water source used for decontamination. This sample will be collected in advance of the field activities to evaluate whether the source is adequate for the project. An equipment blank is not required for samples collected with non-reusable equipment (i.e., disposable bailers) or if dedicated equipment is used. Equipment blank samples are also collected to evaluate if sampling equipment is a potential source of contaminants to the samples. Equipment blanks will be collected on two occasions from the tubing used for sample collection.

The reviewer will check that equipment blanks were collected at the required frequency and that no analytes were reported in the equipment blanks. If an analyte is reported in an equipment blank, all samples collected using the same sampling equipment on the same day will be evaluated (determined based on field-sampling logs), and if necessary, qualified based on the criteria presented in Exhibit 2-3 (above).

2.2 Accuracy

Accuracy is evaluated at multiple levels throughout the analytical process using a variety of techniques. It is assessed at the preparatory-batch level using recovery information from LCS and LCSD, MS and MSD, and analyte surrogates. MS/MSD and surrogate-recovery information is used to determine whether there is interference from the sample matrix that affects the accuracy of the reported results. Accuracy is also assessed at the analytical-batch level using recovery information from ICV and CCV samples.

2.2.1 Laboratory-Control Samples (LCSs)

LCSs (also referred to as blank spikes) are prepared by the laboratory with every preparatory batch, at a minimum of one LCS per 20 samples, where required. In some cases, analytical protocol requires the laboratory also analyze an LCSD. LCSs and LCSDs are blank samples that are spiked with a known amount of analyte(s) and prepared using the same method that is applied to field samples to extract the analyte(s). The laboratory reports a percent recovery (%R) of the spiked amount for each analyte added to the blank sample. The laboratory maintains acceptance limits for LCS/LCSD recovery; these limits are reported in the Level II laboratory report for comparison.

The reviewer will check that LCSs were reported at the required frequency and that LCS/LCSD recoveries are within laboratory-control limits. An LCS or LCSD recovery failure affects all corresponding samples in the same preparatory batch for the affected analyte(s). The following guidelines will be used for qualifying sample results associated with LCS/LCSD-recovery failures.

Exhibit 2-5: Actions for LCS/LCSD and MS/MSD Recovery Failures

	Action	
LCS Results	Detected Analytes	Analytes Not Detected
%R < Control Limits	JL	UJ
%R within Control Limits	No qualification	
%R > Control Limits	JH	No qualification

NOTES:
JL = estimated with a low bias; UJ = not detected, results considered estimated

The reviewer should consider rejecting results for not-detected analytes where gross low-recovery failures are observed. In general, gross low-recovery failures, as defined in the NFGs (EPA, 2017a and 2017b), are less than (<) 20% for VOC analyses, <10% for SVOC analyses, <40% for LCS/LCSD metals analyses, and <30% for MS/MSD metals analyses. The NFG should be referenced when considering a gross low-recovery failure for metals, because there are exceptions to these limits.

In addition, the NFGs recommend rejecting results for not-detected PCB analytes for low-recovery failures for LCS/LCSD samples. This qualification is specific to PCB and herbicide analyses, although herbicide analysis is not being requested for the current project.

2.2.2 Matrix Spike (MS) Samples

For certain methods, the laboratory analyzes an MS/MSD in addition to the LCS. MS/MSDs are prepared and analyzed on a preparatory-batch basis and are analyzed with every 20 samples when used. MS/MSD samples are field (native) samples that are spiked with a known concentration of analyte(s) and prepared using the same method that is applied to project samples to extract the analyte(s). The MS and MSD are used to determine the presence of matrix interferences and evaluate the analytical accuracy for a given method and matrix, expressed as a percent recovery of the spiked amount added to the field sample.

The reviewer will check to make sure that MS/MSDs were analyzed at the frequency required by analytical methods or project-specific requirements. The reviewer will check that percent recovery for each analyte is within laboratory-control limits. If there is a recovery failure, only the field sample utilized for the MS/MSD is typically considered affected; however, the reviewer should use professional judgment whether other samples in the same preparatory batch have sufficiently similar matrices to be considered affected as well (for inorganic analyses only). For example, if an MS/MSD recovery failure is reported for one of two duplicate samples, it should be assumed there were similar matrix effects in the duplicate, and corresponding results should also be qualified.

Before MS/MSD recovery is evaluated, two important factors must be considered:

1. Verify that the field sample chosen for the MS/MSD is part of the project-sample set currently being reviewed. The laboratory may run samples from other projects in the same preparatory batch and it is possible that the original sample selected for the MS/MSD may not be from the work order reviewed. In this case, recovery failures do not affect data quality for the project-sample set.
2. Verify that the spiking concentration is high relative to the native concentration of the analyte in accordance with EM 200-1-10 (USACE, 2005).

If the native concentration of a target analyte is high relative to the spiking concentration, then this may contribute a significant uncertainty to the recovery calculations; the MS recovery may not be representative of actual method performance for the matrix. In the absence of other guidance, *evaluate the MS recovery when the spiking concentration is at least two times greater than the native analyte concentration*.

Specifically, if the native concentration is greater than one-half the spiking concentration, the results are considered unaffected.

If the above criteria are met, then results associated with the failures in the original field sample should be qualified using the criteria listed in Exhibit 2-5.

However, for metals analysis where MS/MSD recovery failures occur, different criteria are used. For metals analysis by most analytical methods, if a matrix spike recovery failure occurs and the sample concentration is greater than the spike concentration, the laboratory is required to conduct a post-digestion spike. A post-digestion spike is where the original sample is spiked at twice the native concentration so that recovery can be evaluated. In this case, refer to the data-qualification criteria in the spike sample analysis section for the relevant analytical technique in the NFG for Inorganic Superfund Methods Data Review (EPA, 2017a).

2.2.3 Surrogates

Surrogates are organic compounds that are similar to the analytes being evaluated by a given method (often a deuterated version of the one of the analytes). They are used to identify matrix interferences and inefficiencies in sample extraction for organic analyses. The surrogates are introduced into a field- or laboratory-QC sample prior to sample preparation and analysis. Accuracy is expressed as a percent recovery of the spiked amount added to the sample.

The reviewer will check that surrogates and/or internal standards were analyzed for each sample for each organic analysis (including laboratory-QC samples) and that recoveries were reported within laboratory-control limits. If there is a reported surrogate-recovery failure, it is considered to affect only analytes associated with the surrogate in the sample with the failure. However, there are a few special considerations when qualifying data based on surrogate-recovery failures:

1. **Matrix interference:** Recovery failures due to matrix interference (coelution of an interfering analyte or other matrix interactions) are considered to affect data quality, and results should be qualified as described in Exhibit 2-6 (below). The laboratory typically documents in the case narrative whether a surrogate-recovery failure was due to matrix interference or dilution.
2. **Dilution:** Recovery failures may be observed due to "diluting out" of the surrogates and are not considered to affect the data (USACE, 2005).
3. **Surrogate-recovery failure in laboratory-QC samples:** Surrogate-recovery failures in an LCS, LCSD, MS, or MSD are not considered to affect the data if the recovery of individual analytes associated with that surrogate are within the laboratory-control limits for the QC sample. However, gross or systematic surrogate-recovery failures should be considered along with all other QC information for the preparatory batch and the results evaluated according to professional judgment.

Excluding the exceptions listed above, data affected by surrogate-recovery failures should be qualified using the following criteria listed in Exhibit 2-6.

Exhibit 2-6: Actions for Surrogate- or Internal Standard-Recovery Failures

		Action	
Analysis	Criteria	Detected Analytes	Analytes Not Detected
Other organic analyses	%R < range	JL[b]	UJ[a]
	%R within range	No qualification	
	%R > range	JH[b]	No qualification

NOTES:

a. Use professional judgment when evaluating gross recovery failures. The reviewer should consider rejecting the results where analytes are not detected if the associated surrogate recovery is below 20% (USACE, 2005).

b. Use professional judgment when the bias is poorly defined. Only impart a bias to the qualified data if the bias is well defined (i.e., if there is more than one surrogate in the analysis, where recovery failures are in the same direction). Otherwise, it may be more conservative to simply qualify the results as estimated ("J"; USACE, 2005).

2.2.4 Calibration-Verification Samples

Calibration-verification samples are not reported in the Level II data reports provided by the laboratory (aside from appearing in the EDD), and review of such samples is outside the scope of this QAPP. Additionally, the laboratory has requirements to re-calibrate the instrument if calibration-verification fails. However, this is not always possible, and occasionally calibration-verification failures occur and are reported in the case narrative or the Level IV laboratory report. Calibration-verification samples are described briefly below.

ICV samples are clean extraction solvent spiked with a known analyte concentration, using a different source than that of the primary calibration standards, and analyzed immediately following instrument calibration. Similarly, CCV samples are calibration standards that are analyzed at the beginning of each analytical batch and periodically throughout the run.

The laboratory evaluates ICV and CCV recovery information based on their internal acceptance criteria; in some cases, they also evaluate relative percent difference between CCVs to determine if drift is occurring. As stated above, calibration-level data review is beyond the scope of this QAPP and may be conducted as part of a Level IV data validation if calibration issues are identified in the case narrative. Professional judgment should dictate whether any samples in an analytical batch with unresolved CCV failures should be considered preliminary pending further investigation.

2.3 Precision

Precision refers to the repeatability of measurements (USACE, 2005). Precision is evaluated using laboratory QA/QC and field-duplicate samples. The following sections describe the duplicate-sample information that is commonly used to assess precision. However, this is not an exhaustive list and the laboratory may occasionally analyze other duplicate samples that should also be considered. For most analyses, at least one laboratory-QC-sample duplicate must be analyzed; this can include an LCSD, MSD, or laboratory duplicate of a project sample.

Each type of duplicate is evaluated in the same manner. A relative percent difference (RPD) is calculated between the duplicate results for a given analyte using the following formula, where R_1 is the primary result and R_2 is the duplicate result:

Formula 1. $$RPD = \left(\frac{|R_1 - R_2|}{(R_1 + R_2)/2}\right) \times 100\%$$

The resulting RPD is compared to laboratory-control limits (for laboratory-QC samples) or project or regulatory DQOs for field duplicates. Water- and soil-sample DQOs of 30 and 50%, respectively, are used for this project (Alaska Department of Environmental Conservation [ADEC], 2017).

The following guidelines will be used for qualifying sample results associated with duplicate-sample RPD failures. The treatment of a failure is the same across types of duplicate samples, but the samples that are affected vary. Refer to the following sections for details.

Exhibit 2-7: Actions for Duplicate-Sample RPD Failures

	Action	
Criteria	Detected Analytes	Analytes Not Detected
RPD ≤ Control Limit or DQO	No qualification	
RPD > Control Limit or DQO	J	UJ

2.3.1 Laboratory-Control Sample Duplicates (LCSDs)

Precision can be evaluated between LCS and LCSD results for a given analyte. The laboratory calculates the RPD using Formula 1 (above) for each analyte. The reviewer will check that each RPD is within the laboratory-control limits. RPD failures for specific analytes in the LCS/LCSD are considered to affect the precision of that analyte in each sample in the preparatory batch. Affected results should be flagged according to the criteria presented in Exhibit 2-7.

2.3.2 Matrix Spike Duplicates (MSDs)

Precision can be evaluated between the MS and the MSD results for a given analyte. The laboratory calculates the RPD for each analyte. The reviewer will check that each RPD is within the laboratory-control limits. RPD failures for specific analytes in the MS/MSD are considered to affect the precision of that analyte in the field sample spiked for the MS/MSD. As noted in Section 2.2.2, professional judgment should be used to determine whether additional samples should be qualified (based on similarity of sample matrix, and only when inorganic analyses are being performed).

RPD failures should be considered to affect the data regardless of the concentration spiked as long as the laboratory calculates the RPD based on the total analyte concentration quantified in the MS/MSD. If the laboratory calculates the RPD based only on what was recovered of the spike, it should be treated as for MS/MSD recovery, with failures only considered to affect data quality if the spiking concentration is at least double the native concentration of the analyte. Affected results should be flagged according to the criteria presented in Exhibit 2-7.

2.3.3 Laboratory Duplicates

For select analyses, or when insufficient volume is submitted for analysis of an MS and MSD, the laboratory may analyze a project sample twice (referred to as a laboratory duplicate). The laboratory calculates an RPD between the original result and the duplicate-sample result for each analyte. The reviewer will check that each RPD is within the laboratory-control limits. As with MS/MSDs, laboratory-duplicate RPD failures are considered to affect the precision of the affected analyte only in the field sample used for the duplicate analysis.

2.3.4 Field-Duplicate Samples

Field-duplicate samples are duplicate samples collected from the same location and submitted to the laboratory performing the requested analysis. The duplicate sample will have a "dummy" sample number and be submitted to the laboratory as a regular sample (i.e., the duplicate is submitted "blind"). These field duplicates are used to determine the reproducibility of the sampling technique as well as the subsequent laboratory analysis. Sample homogeneity is necessary to obtain acceptable values for the RPD and any heterogeneity should be noted during sampling.

For field-duplicate pairs, the reviewer will calculate an RPD using Formula 1 (above). An RPD will only be calculated if at least one of the sample results is above the LOQ. The calculated RPD will be compared to the standard DQOs of 30% for water samples and 50% for soil samples (ADEC, 2017). Field-duplicate RPD failures are considered to affect only the results of the duplicate pair; affected data will be qualified based on the criteria in Exhibit 2-7 (above).

In the event that one of the results is above the LOQ but the other result is below the DL (not detected), this may be evidence of samples having been mislabeled (in the field or the laboratory); further investigation may be warranted.

2.4 Representativeness

Sample log sheets will be reviewed to ensure the samples were collected according to the SAP, and the results, therefore, represent the location and depth sampled. In addition, where possible, the analytical result for each sample will be compared to the historical results to check that the result is consistent with the broader data set for that location.

2.5 Comparability

The reviewer and data users should qualitatively assess the comparability between historical and current data sets and use caution in combining data sets if the quality of the data is uncertain. For example, current analytical methods used to analyze for BTEX may not be comparable to historical BTEX methods where the MRL was elevated.

2.6 Completeness

The overall data set from a sampling event will be evaluated to determine if the completeness goal of 90% useable data was achieved. Completeness is calculated by comparing the amount of useable data to the overall number of samples. A completeness value below 90% may be cause for collecting additional analytical samples.

3 DATA GENERATION AND ACQUISITION

This section describes the procedures and DQOs for sample handling and custody, analytical methods, instrument/equipment calibration, instrument/equipment inspection and maintenance, inspection/acceptance of supplies and consumables, and data management. Procedures for sample-collection methods are presented in the SAP.

3.1 Sample Handling and Custody Quality Control (QC)

Field activities will be conducted in accordance with the procedures outlined in the Ecology-reviewed SAP. Laboratory activities will be conducted in accordance with the procedures outlined in the laboratory's QAPP. By conducting these activities in this manner, the data should meet the specified DQOs for the project and be legally defensible. Sample containers, preservatives, and method holding times are presented in Attachment 3.

3.1.1 Field Quality Control (QC)

This section identifies the field QC DQOs, including proper containers for sample collection, sample custody, sample condition, and hold times for requested analyses.

3.1.1.1 Sample Containers

Sample containers will be provided by the laboratory and pre-preserved with appropriate compounds, if required. Groundwater samples for volatile analyses will be filled first and inspected to check that zero headspace is present in the container. Soil samples for volatile analyses will be collected in accordance with EPA 5035 procedures into methanol-preserved vials. The sample containers for metals and other non-volatile parameters will be filled close to the top of the containers.

Sample containers will be labeled to include date and time the sample was collected, location of the sample, name of the person who collected the sample, unique sample identification number, analytical method, and any chemical preservative used. Sample jars will not be individually sealed with a custody seal.

3.1.1.2 Chain-of-Custody (COC)

Evidence of sample custody from the time of collection to the time of receipt by the laboratory is documented via the COC record. If the samples are transferred to a reference laboratory, ARI begins a new COC record that documents sample custody from their laboratory through receipt at the reference laboratory. Additionally, each laboratory maintains an internal COC document through disposal of the project samples, including, but not limited to analysis. A COC contains the signatures of individuals collecting, shipping, and receiving each sample. The COC is reviewed to verify it is signed and dated by the sampler, the local receiving staff (unless shipped directly), and the laboratory's receiving staff. Carriers who are only involved in the transport of sealed coolers are not required to sign the COC. However, shipping documents will be included in the project files if a carrier is used to transport the project samples. A sample is in custody if it is:

- In a person's actual possession,
- In view, after being in physical possession,
- Sealed so no one can tamper with it, after having been in physical custody, or
- In a secured area, restricted to authorized personnel.

If the COC record is not complete and accurate (e.g., signatures missing, date/time discrepancies, lack of custody seals), professional judgment may be used as to whether to qualify the data. The reviewer should consider rejecting data and recollecting the samples, if possible, if it is suspected that custody was intentionally breached and the samples may have been tampered with. However, if there is a simple omission or minor discrepancy, the data may be usable without qualification as long as the source of the omission or discrepancy is known, accounted for, and documented.

The COC also specifies the requested analyses for each documented sample. COCs are reviewed to check that the correct analyses were requested and that sample names match those on the sample-collection logs. Where discrepancies are noted, the laboratory will coordinate with the sampling team to check that the correct sample names are used in reporting the results.

3.1.1.3 Sample Preservation

Evidence of sample condition and preservation is documented on the laboratory's sample receipt form (SRF) upon delivery. SRFs document QC non-conformance issues during sample handling, where such information exists. SRFs are reviewed to verify samples are received within the acceptable temperature range; temperature of the coolers and/or temperature blanks are documented at each receiving location. Samples are considered to be within the acceptable temperature range if received between 0 degree Celsius (°C) and 6°C, when temperature preservation is required. This range is based primarily on the less than or equal to ≤6°C temperature cutoff in SW-846 (EPA, 2007) and the understanding that water samples below this cutoff are acceptable in the absence of ice. Furthermore, the

Federal Register (EPA, 2012) states that the ≤6°C limit supersedes the 4°C or <4°C requirement of some individual SW-846 methods and that aqueous samples "should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority." This citation is interpreted to mean the acceptable temperature range is 0°C to 6°C in the absence of ice.

Data qualification based on temperatures outside the acceptable criteria may vary for different analyses and sample matrices. For example, soil samples collected frozen (<-7°C) may be maintained frozen until sub-sampled and preserved, if allowed by the project work plan. Also, depending on the matrix and analytical method, certain sample results may be acceptable at higher temperatures (e.g., PCBs in oil [EPA, 2007]). Exhibit 3-1 (below) provides general guidelines for qualifying results for samples received outside the acceptable temperature range; however, the individual extraction or analytical methods should be consulted and professional judgment used.

Exhibit 3-1: Sample-Temperature Actions

		Action	
Matrix	Criteria	Detected Analytes	Analytes Not Detected
Water	0°C – 6°C	No qualification	
	0°C – 6°C; ice in samples	J	UJ
	<0°C; no ice in samples	No qualification	
	<0°C; ice in samples	J	UJ
	>6°C	JL	UJ[a]
Soil	0°C – 6°C	No qualification	
	<0°C	No qualification[b]	
	>6°C	JL	UJ[a]

NOTES:

a. Use professional judgment when qualifying sample results based on temperature exceedance, taking into account the volatility of the analyte. If temperatures are higher than 10°C or are suspected to have been above 6°C for an extended period of time (e.g., over 24 hours), reviewer should consider rejecting sample results for volatile analytes that were not detected.

b. Use professional judgment and refer to method-specific requirements for non-standard analyses and matrices.

Some analyses require addition of sample preservatives in addition to maintaining the samples within the acceptable temperature range. Various guidance documents and individual EPA extraction methods list sample-preservation requirements for individual methods and matrices; ARI has condensed this information into one concise table in their bottle guide. The laboratory SRF documents whether samples were received with proper preservative and within relevant pH limits. Laboratory-filtered samples for metals analysis will be preserved with nitric acid.

In most cases where sample preservation is inadequate, sample results should be considered estimated with a low bias; results where analytes are not detected should be flagged "UJ" and detections flagged "JL." However, not all data are affected the same way by failure to properly preserve the samples. For inorganic analytes in aqueous samples, if the pH is outside method requirements upon receipt but the laboratory adjusts the pH immediately upon receipt at the laboratory and allows the method-specified time for the sample to equilibrate prior to digestion, the sample results are considered not affected (EPA, 2017a). In the case where one analyte is the degradation byproduct of another analyte, the degraded species may increase in a sample following storage with inadequate preservation (USACE, 2005); the same may occur if holding times are exceeded (see below). Furthermore, adding preservative where it is not required can have unforeseen effects on data for certain analytes. For example, if metals speciation is being performed (e.g., Fe^{2+} vs. Fe^{3+}) acidification can result in an increase in the reduced form and a decrease in the oxidized form. Professional judgment should be used for qualifying data for any samples with preservation issues.

3.1.1.4 Sample Condition

Sample condition is documented on the laboratory's SRF(s). Professional judgment should be used to determine if qualification of analytical results is necessary for cases where sample condition is compromised. Some common circumstances that may affect sample results are listed below:

1. **Broken container**: When the samples are received in broken containers, it is important to note which samples were received as such. Sometimes, 1-L bottle lids crack upon tightening but no liquid is lost; as long as the lid is replaced prior to sample shipment (e.g., the lid may be replaced by the laboratory sample-receiving office), results are not considered affected. Most water analyses require at least a duplicate bottle to be filled. If only one of the bottles is broken and the analysis is performed with the intact bottle, no qualification is required other than noting the broken container on the NFG laboratory data-review checklist. However, if the sample with the broken container was used for analysis, the analytes in question could oxidize, volatilize, degrade, or react, causing the concentration to be biased low; professional judgment should be used to determine if the analyses are affected by the addition of air. Affected sample results for detected analytes should be flagged "JL" and sample results for analytes not detected should be flagged "UJ" or "R" (rejected), depending on the analyte and professional judgment of the reviewer (i.e., take into account how much sample leaked, if any, and the volatility of the analyte).
2. **Headspace in volatile organic analysis vial**: For the analysis of VOCs in water samples, the absence of headspace is necessary to prevent the volatile analyte from partitioning out of the aqueous phase. Bubbles larger than 6 millimeters in diameter are considered

an unacceptable level of headspace (EPA, 2007). When unacceptable headspace is present, detections should be flagged "JL" and non-detections should be flagged "R."

Any other sample-condition anomalies should be addressed using the reviewer's professional judgment.

3.1.1.5 Hold Times

Samples are required to be extracted and/or analyzed within method-specific holding times following collection. Holding times are presented in the same reference documents listed above for sample preservation; again, the ARI bottle guide is referenced for holding times for standard analyses. Holding times are calculated on a per-day basis, with the exception of short-holding-time analyses (where the technical holding time is measured in hours, typically 72 hours or less).

The way holding times are evaluated varies based on the matrix and method. Certain methods list a collection-to-analysis holding time (e.g., analysis of VOCs in soil, where extraction occurs at the time of collection), while others list separate holding times for collection to extraction and for extraction to analysis (e.g., analysis of SVOCs in water).

Where holding times are exceeded, sample results shall be qualified using the following criteria listed in Exhibit 3-2. Hold-time exceedances can be differentiated between a *marginal* exceedance and a *gross* exceedance, and different qualifications may be applied depending on the circumstance. This differentiation is similar to guidelines in EM 200-1-10 (USACE, 2005), as presented below.

Exhibit 3-2: Holding-Time Actions

	Action	
Criteria	Detected Analytes	Analytes Not Detected
t ≤ HT	No qualification	
HT < t ≤ 2xHT (marginal exceedance)	JL	UJ
t > 2xHT (gross exceedance)	JL	R

NOTES:
HT = method (technical) holding time; t = actual holding time; 2x = two times

As with sample preservation, professional judgment must be used when qualifying data based on holding-time exceedances, as there can be situations where certain analytes are affected differently than others (such as in the case of analytes that are degradation products of one another). Also, sample-preservation failures coupled with a marginal holding-time exceedance may warrant rejection of results for analytes that were not detected.

3.1.2 Laboratory Quality Control (QC)

The data quality for this project will be assessed by comparing QC-sample results to pre-established numerical DQOs defined in Section 2.

3.2 Analytical Methods

Analytical samples will be submitted to the contract laboratory ARI of Tukwila, Washington. The laboratory is Ecology and NELAP certified for the requested analyses. Groundwater samples for PFAS analysis will be submitted to Eurofins TestAmerica of Sacramento, California. Groundwater samples will be submitted for the following analyses:

- TPH-Gx by Method Northwest Total Petroleum Hydrocarbons-Gasoline (NWTPH-Gx)
- TPH-Dx by Method NWTPH-Dx
- HVOCs, MTBE, and BTEX by Method EPA 8260C
- PAHs and SVOCs by EPA Method 8270D
- PCBs as aroclors by EPA Method 8082A
- Total and dissolved metals by EPA Method 200.8
- Total and dissolved mercury by EPA Method 7470A
- Dissolved hexavalent chromium by EPA Standard Method 3500
- PFAS, including EPA’s third Unregulated Contaminant Monitoring rule list of six perfluorinated compounds (perfluorooctanesulfonic acid, perfluorooctanoic acid, perfluorobutanesulfonic acid, perfluorohexanesulfonic acid, perfluoroheptanoic acid, and perfluorononanoic acid) by Method 537 (modified);
- Ferrous iron by EPA Standard Method 3500
- Nitrate and nitrite as nitrogen by EPA Method 300.0
- Sulfate and sulfite by EPA Method 300.0 and EPA Standard Method 4500
- Manganese ion by EPA Method 200.8
- Methane by RSK-175

The soil samples will be analyzed for the following analyses:

- TPH-Gx by NWTPH-Gx
- TPH-Dx NWTPH-Dx
- HVOCs and BTEX by EPA Method 8260C
- PAHs and SVOCs by EPA Method 8270D
- PCB aroclors by EPA Method 8082A

- Metals by EPA Method 200.8
- Mercury by EPA Method 7471B
- Hexavalent chromium by EPA Method 7196A
- Total organic carbon by EPA Method 9060A

SVOCs and PAHs are analyzed using EPA Method 8270D. Method 8270D includes the standard method, a low level (LL) version, and selected ion monitoring (SIM). SIM, which provides the lowest detection limits, is not available for the full suite of analytes on the EPA 8270D analyte list; the available SIM analyte list mainly includes PAHs. Similarly, the LL method does not include the full suite of analytes on the EPA 8270D analyte list. For the included analytes, the LL method provides lower detection limits than the standard method but less stringent than the SIM method. The standard method has been selected when the reporting limits are sufficient to meet the screening level requirements or if the analyte is not included within the SIM or LL methods. The LL method has been selected when it is required to achieve the screening level requirements or when it can get closer to the screening levels and SIM is not available. SIM has been selected when it is available and required to achieve or get closer to the screening levels.

Select soil samples will be submitted to the Shannon & Wilson Seattle Soils Laboratory for physical parameters, including:

- Grain size analysis by ASTM D6913 and ASTM D1140
- Porosity analysis by ASTM D72633-09 and calculation

3.3 Instrument/Equipment Inspection, Maintenance, and Calibration

Instrument and equipment inspection, maintenance, and calibration allows for collection of accurate and reliable measurements. Field instruments and equipment are inspected prior to each sampling event for damage, wear, and missing parts by experienced Shannon & Wilson field staff. Maintenance of field instruments and equipment will be documented in the instrument/equipment maintenance log. Field instrument and equipment will be calibrated and adjusted to operate within the manufacturer’s specifications at a frequency of not less than the manufacturer’s recommendation. Calibration measurements will be documented in the field activity log for the project.

Calibration of the temperature, pH, conductivity, and dissolved oxygen meters may be performed prior to arrival on the Site. Calibration will be valid for field conditions. The equipment or instruments will be calibrated with standards recommended or approved by the manufacturer. Calibration standards that have reached their expiration dates will not be used for calibration and will be discarded in accordance with the manufacturer's recommendation or local, state, and federal regulations.

Laboratory instrument and equipment will be inspected, maintained, and calibrated in accordance with the laboratory's standard operating procedures (SOPs) or QA program. The laboratory is required to maintain logs of inspections, maintenance, and calibration of all instruments and equipment. The laboratory QC PM is responsible for verification that inspections, maintenance, and calibrations are performed and documented at the frequency established in the laboratory SOP or QA program.

3.4 Inspection/Acceptance of Supplies and Consumables

Field supplies and consumables will be inspected by experienced Shannon & Wilson field staff. All supplies and consumables will be traceable to documented, reliable, commercial sources. The supplies and consumables will be inspected upon receipt and stored according to manufacturer's instructions. Any discrepancies will be documented in the project daily field form.

3.5 Data Management

Field forms will be reviewed for completeness and accuracy by the Shannon & Wilson PM or QA manager. The field forms will be maintained in paper and electronic form in the project files. Laboratory analytical results will be stored in the project database and submitted in the summary report along with the laboratory report.

4 ASSESSMENT AND CORRECTIVE ACTIONS

A QC review of the field data and analytical laboratory data will be performed to assess data quality. The QC review will use the DQOs established in Section 2 and procedures described in Section 3 to assess the data quality. Any deviations from these DQOs and procedures will be documented and appropriate corrective actions will be taken and documented in the summary report.

The laboratory is required to comply with their SOPs and the QA Program. The laboratory QA manager is responsible for ensuring that any deviations from laboratory SOPs and the QA Program are documented and appropriate corrective actions are implemented. The laboratory QA Manager is required to notify the Shannon & Wilson PM in the event of corrective actions. This is typically documented in the laboratory report's case narrative and any affect to the data quality is reported in the NFG laboratory data-review checklist.

5 REPORTING

Shannon & Wilson will submit the laboratory analytical results to the Ecology PC and EMJ PM within two weeks of receipt and validation and will upload the data to the EIM database. The findings will be incorporated into the RI Report.

6 REFERENCES

Alaska Department of Environmental Conservation (ADEC), Division of Spill Prevention and Response, Contaminated Sites Program, 2017, Field sampling guidance: Juneau, Alaska, ADEC, 92 p., August.

Shannon & Wilson, 2019, Draft remedial investigation work plan, Jorgensen Forge Corporation Property, Tukwila, Washington: Report prepared by Shannon & Wilson, Seattle, Wash.., 21-1-12596-010, for Earle M. Jorgensen Company, Lynwood, Calif., January 31.

U.S. Army Corps of Engineers (USACE), 2005, Engineering Manual 200-1-10, Guidance for Evaluating Performance-Based Chemical Data, 2005.

U.S. Environmental Protection Agency (EPA), 2001, EPA Requirements for Quality Assurance Project Plans, March.

U.S. Environmental Protection Agency (EPA), 2007, SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

U.S. Environmental Protection Agency (EPA), 2009, Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, January 13.

U.S. Environmental Protection Agency (EPA), 2012, Federal Register – Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Analysis and Sampling Procedures; Final Rule, May 18, 2012, v. 77. no. 97.

U.S. Environmental Protection Agency (EPA), 2017a, National Functional Guidelines for Inorganic Superfund Methods Data Review, January.

U.S. Environmental Protection Agency (EPA), 2017b, National Functional Guidelines for Organic Superfund Methods Data Review, January.

Washington State Department of Ecology (Ecology), 2016, Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, December 2016.

Washington State Department of Ecology (Ecology), 2019, Ecology comments on the draft remedial investigation work plan, Jorgensen Forge Corporation property, Tukwila, Washington, dated October 25, 2017 for: Name: Jorgensen Forge Corp Site, Address: 8531 East Marginal Way South, Tukwila, WA 98106, Facility/Site No.: 2382, Cleanup Site ID No.: 3689, Agreed Order No.: 14143: Commenced prepared by Ecology, Bellevue, Wash., for Shannon & Wilson, Seattle, Wash., December 20.

Attachment 1

Comparison of Laboratory Detection Limits Against Screening Levels

CONTENTS

Attachment 1A - Comparison of Laboratory Detection Limits Against Screening Levels - Groundwater

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
Metals											
Aluminum	7429-90-5	1.60E+04	200.8	2.18E+01	1.00E+02	6020A	9.60E+00	5.00E+01	EPA 6010C	8.50E-03	5.00E-02
Antimony	7440-36-0	9.00E+01	200.8	7.95E-02	1.00E+00	6020A	1.10E-01	1.00E+00	--	--	--
Arsenic (total)	7440-38-2	8.00E+00	200.8	5.89E-01	1.75E+00	6020A	1.50E-01	1.00E+00	EPA 6010C	4.70E-03	5.00E-02
Barium	7440-39-3	2.00E+02	200.8	1.66E-01	2.50E+00	6020A	2.20E-01	1.00E+00	EPA 6010C	7.00E-04	3.00E-03
Beryllium	7440-41-7	4.38E+00	200.8	1.09E-02	2.00E-01	6020A	1.00E-01	1.00E+00	EPA 6010C	2.00E-04	1.00E-03
Cadmium	7440-43-9	1.19E+00	200.8	1.36E-02	2.00E-01	6020A	1.20E-01	1.00E+00	EPA 6010C	3.00E-04	2.00E-03
Chromium, total (or III)	7440-47-3	6.05E-02	200.8	2.00E-01	1.00E+00	6020A	1.00E-01	2.00E+00	EPA 6010C	1.30E-03	5.00E-03
Chromium (VI)	18540-29-9	5.00E+01	200.8	--	--	7196	1.80E+00	1.00E+01	SM 3500-Cr B-09	1.00E-02	1.00E-02
Cobalt	7440-48-4	4.80E+00	200.8	1.28E-01	1.00E+00	6020A	8.00E-02	1.00E+00	EPA 6010C	2.00E-04	3.00E-03
Copper	7440-50-8	3.10E+00	200.8	2.03E-01	1.00E+00	6020A	2.70E-01	2.00E+00	EPA 6010C	7.00E-04	2.00E-03
Iron	7439-89-6	3.20E+04	200.8	2.44E+01	1.00E+02	6020A	5.76E+00	5.00E+01	EPA 6010C	1.30E-03	5.00E-02
Lead	7439-92-1	8.10E+00	200.8	6.52E-02	5.00E-01	6020A	9.00E-02	1.00E+00	EPA 6010C	1.90E-03	2.00E-02
Manganese	7439-96-5	1.00E+02	200.8	1.45E-01	2.00E+00	6020A	1.10E-01	2.00E+00	EPA 6010C	3.00E-04	1.00E-03
Mercury (elemental)	7439-97-6	2.50E-02	245.1	7.53E-03	1.00E-01	7470	3.63E-02	2.00E-01	EPA 7470A	1.30E-05	1.00E-04
Methylmercury	16056-34-1	3.00E-02	--	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	8.00E+01	200.8	5.24E-01	5.00E+00	6020A	9.00E-02	1.00E+00	EPA 6010C	6.00E-04	5.00E-03
Nickel	7440-02-0	8.20E+00	200.8	1.90E-01	2.50E+00	6020A	5.10E-01	2.00E+00	EPA 6010C	2.80E-03	1.00E-02
Selenium	7782-49-2	7.10E+01	200.8	1.24E+00	5.00E+00	6020A	1.14E+00	4.00E+00	EPA 6010C	5.00E-03	5.00E-02
Silver	7440-22-4	1.90E+00	200.8	1.71E-02	2.50E-01	6020A	7.00E-02	1.00E+00	EPA 6010C	5.00E-04	3.00E-03
Thallium	7440-28-0	6.19E-02	200.8	2.71E-03	2.00E-01	6020A	2.40E-01	1.00E+00	EPA 6010C	3.70E-03	5.00E-02
Tin	7440-31-5	9.60E+03	200.8	6.13E-01	5.00E+00	6020A	3.00E-01	2.00E+00	EPA 6010C	1.50E-03	1.00E-02
Vanadium	7440-62-2	8.00E+01	200.8	2.68E-01	1.00E+00	6020A	3.40E-01	2.00E+00	EPA 6010C	4.00E-04	3.00E-03
Zinc	7440-66-6	8.10E+01	200.8	4.75E-01	2.50E+00	6020A	7.40E-01	2.50E+00	EPA 6010C	2.10E-03	1.00E-02
Polychlorinated Biphenyls (PCBs)											
PCB - Aroclor 1016	12674-11-2	7.00E-06	8082 or 608	1.44E-02	1.00E-01	8082	2.22E-02	1.00E-01	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1221	11104-28-2	7.00E-06	8082 or 608	1.44E-02	1.00E-01	8082	2.22E-02	1.00E-01	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1232	11141-16-5	7.00E-06	8082 or 608	1.44E-02	1.00E-01	8082	2.22E-02	1.00E-01	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1242	53469-21-9	7.00E-06	8082 or 608	1.44E-02	1.00E-01	8082	2.22E-02	1.00E-01	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1248	12672-29-6	7.00E-06	8082 or 608	8.84E-03	1.00E-01	8082	2.22E-02	1.00E-01	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1254	11097-69-1	7.00E-06	8082 or 608	8.84E-03	1.00E-01	8082	2.22E-02	1.00E-01	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1260	11096-82-5	7.00E-06	8082 or 608	8.84E-03	1.00E-01	8082	2.22E-02	1.00E-01	8082A	2.76E-03	1.00E-02
Volatile Organic Compounds (VOCs)											
Acetone	67-64-1	7.20E+03	8260 or 624	7.72E-01	5.00E+00	8260	2.25E-01	2.50E+01	8260C	2.06E+00	5.00E+00
Acrolein	107-02-8	1.10E+00	--	--	--	--	--	--	8260C	2.48E+00	5.00E+00
Acrylonitrile	107-13-1	2.80E-02	8260 or 624	1.37E-01	1.00E+00	8260	1.91E-02	1.00E+01	8260C	6.00E-01	1.00E+00
Benzaldehyde	100-52-7	8.00E+02	--	--	--	--	--	--	--	--	--
Benzene	71-43-2	1.60E+00	8260 or 624	7.47E-02	1.00E+00	8260	9.35E-03	2.00E+00	8260C	3.00E-02	2.00E-01
Bromobenzene	108-86-1	6.40E+01	8260 or 624	4.60E-02	1.00E+00	8260	1.36E-02	2.00E+00	8260C	6.00E-02	2.00E-01
Bromochloromethane	74-97-5	NE	8260 or 624	8.79E-02	1.00E+00	8260	3.82E-02	2.00E+00	8260C	6.00E-02	2.00E-01
Bromodichloromethane	75-27-4	1.80E+00	8260 or 624	6.09E-02	1.00E+00	8260	1.97E-02	2.00E+00	8260C	5.00E-02	2.00E-01
Bromoethane	74-96-4	NE	--		--	--	--	--	8260C	4.00E-02	2.00E-01
Bromoform	75-25-2	1.20E+01	8260 or 624	8.58E-01	1.00E+00	8260	1.76E-02	2.00E+00	8260C	6.00E-02	2.00E-01
Bromomethane	74-83-9	1.29E+01	8260 or 624	1.18E-01	1.00E+00	8260	4.81E-02	2.00E+00	8260C	2.50E-01	1.00E+00
2-Butoxyethanol	111-76-2	8.00E+02	--	--	--	--	--	--	--	--	--
n-Butylbenzene	104-51-8	4.00E+02	8260 or 624	7.94E-02	1.00E+00	8260	1.75E-02	2.00E+00	8260C	2.00E-02	2.00E-01
sec-Butylbenzene	135-98-8	8.00E+02	8260 or 624	8.22E-02	1.00E+00	8260	6.26E-03	2.00E+00	8260C	2.00E-02	2.00E-01
tert-Butylbenzene	98-06-6	8.00E+02	8260 or 624	6.07E-02	1.00E+00	8260	1.69E-02	2.00E+00	8260C	3.00E-02	2.00E-01
Carbon disulfide	75-15-0	3.99E+02	8260 or 624	1.05E-01	1.00E+00	8260	1.81E-02	2.00E+00	8260C	4.00E-02	2.00E-01

Attachment 1A - Comparison of Laboratory Detection Limits Against Screening Levels - Groundwater

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
Carbon tetrachloride	56-23-5	3.50E-01	8260 or 624	5.34E-01	1.00E+00	8260	8.32E-03	2.00E+00	8260C	4.00E-02	2.00E-01
Chlorobenzene	108-90-7	2.00E+02	8260 or 624	7.02E-02	1.00E+00	8260	7.98E-03	2.00E+00	8260C	2.00E-02	2.00E-01
Chlorodibromomethane / Dibromochloromethane	124-48-1	2.20E+00	8260 or 624	5.28E-02	1.00E+00	8260	2.48E-02	2.00E+00	8260C	5.00E-02	2.00E-01
Chloroethane	75-00-3	1.85E+04	8260 or 624	1.99E-01	1.00E+00	8260	3.87E-02	2.00E+00	8260C	9.00E-02	2.00E-01
2-Chloroethyl vinyl ether	110-75-8	NE	--	--	--	--	--	--	8260C	2.50E-01	1.00E+00
Chloroform	67-66-3	1.19E+00	8260 or 624	1.10E-01	1.00E+00	8260	4.62E-02	2.00E+00	8260C	3.00E-02	2.00E-01
Chloromethane	74-87-3	1.53E+02	8260 or 624	7.89E-01	1.00E+00	8260	7.69E-02	2.00E+00	8260C	9.00E-02	5.00E-01
3-Chloro- 1-propene	107-05-1	2.08E+00	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	95-49-8	1.60E+02	8260 or 624	7.29E-02	1.00E+00	8260	1.06E-02	2.00E+00	8260C	2.00E-02	2.00E-01
4-Chlorotoluene	106-43-4	NE	8260 or 624	7.73E-02	1.00E+00	8260	1.33E-02	2.00E+00	8260C	2.00E-02	2.00E-01
Dibromochloromethane	124-48-1	2.20E+00	8260 or 624	5.28E-02	1.00E+00	8260	2.48E-02	2.00E+00	8260C	5.00E-02	2.00E-01
1,2-Dibromo-3-Chloropropane	96-12-8	2.00E-01	8260 or 624	2.87E-01	1.00E+00	8260	3.32E-02	1.00E+01	8260C	3.70E-01	5.00E-01
Dibromomethane	74-95-3	8.00E+01	8260 or 624	9.88E-02	1.00E+00	8260	2.36E-02	2.00E+00	8260C	1.40E-01	2.00E-01
1,2-Dibromoethane	106-93-4	5.00E-02	8260 or 624	8.61E-02	6.00E-02	8260	7.89E-03	1.00E-02	8260C	7.00E-02	2.00E-01
Dichlorobromomethane	75-27-4	1.82E+00	8261 or 624	6.09E-02	1.00E+00	8260	1.97E-02	2.00E+00	--	--	--
trans-1, 4-Dichloro-2-butene	110-57-6	NE	8260 or 624	7.86E-01	2.00E+00	--	--	--	8260C	3.20E-01	1.00E+00
1,2-Dichlorobenzene	95-50-1	4.61E+00	8260 or 624	6.00E-02	1.00E+00	8260	9.45E-03	2.00E+00	8260C	4.00E-02	2.00E-01
1,3-Dichlorobenzene	541-73-1	2.00E+00	8260 or 624	7.00E-02	1.00E+00	8260	1.38E-02	2.00E+00	8260C	4.00E-02	2.00E-01
1,4-Dichlorobenzene	106-46-7	4.93E+00	8260 or 624	3.80E-02	1.00E+00	8260	1.50E-02	2.00E+00	8260C	4.00E-02	2.00E-01
Dichlorodifluoromethane (CFC-12)	75-71-8	5.65E+00	8260 or 624	1.09E-01	1.00E+00	8260	3.14E-02	2.00E+00	8260C	5.00E-02	2.00E-01
1,1-Dichloroethane	75-34-3	1.11E+01	8260 or 624	9.00E-02	1.00E+00	8260	9.94E-03	2.00E+00	8260C	5.00E-02	2.00E-01
1,2-Dichloroethane (EDC)	107-06-2	4.22E+00	8260 or 624	8.30E-02	1.00E+00	8260	4.71E-03	2.00E+00	8260C	7.00E-02	2.00E-01
1,1-Dichloroethylene	75-35-4	1.29E+02	8260 or 624	2.07E-01	1.00E+00	8260	4.58E-03	2.00E+00	8260C	5.00E-02	2.00E-01
cis-1,2-Dichloroethylene	156-59-2	NE	8260 or 624	7.90E-02	1.00E+00	8260	2.27E-02	2.00E+00	8260C	4.00E-02	2.00E-01
trans-1,2-Dichloroethylene	156-60-5	1.00E+03	8260 or 624	9.90E-02	1.00E+00	8260	3.23E-02	2.00E+00	8260C	5.00E-02	2.00E-01
1,2-Dichloroethylene (mixed isomers)	540-59-0	NE	8260 or 624	2.07E-01	1.00E+00	--	--	--	--	--	--
1,2-Dichloropropane	78-87-5	3.10E+00	8260 or 624	7.00E-02	1.00E+00	8260	2.12E-02	2.00E+00	8260C	4.00E-02	2.00E-01
1,1-Dichloropropene	563-58-6	NE	8260 or 624	1.13E-01	1.00E+00	8260	2.24E-02	2.00E+00	8260C	3.00E-02	2.00E-01
1,3-Dichloropropane	142-28-9	NE	8260 or 624	7.80E-02	1.00E+00	8260	2.21E-02	2.00E+00	8260C	6.00E-02	2.00E-01
cis-1,3-Dichloropropene	10061-01-5	2.00E+00	8260 or 624	1.02E-01	1.00E+00	8260	1.59E-02	2.00E+00	8260C	6.00E-02	2.00E-01
trans-1,3-Dichloropropene	10061-02-6	2.00E+00	8260 or 624	1.00E-01	1.00E+00	8260	1.92E-02	2.00E+00	8260C	8.00E-02	2.00E-01
2,2-Dichloropropane	594-20-7	NE	8260 or 624	7.82E-01	2.00E+00	8260	1.38E-02	2.00E+00	8260C	5.00E-02	2.00E-01
Ethane	74-84-0	NE	RSK175	4.06E+00	1.62E+01	RSK-175	1.30E-03	1.00E-02	RSK-175	3.90E-01	1.23E+00
Ethylbenzene	100-41-4	3.10E+01	8260 or 624	8.70E-02	1.00E+00	8260	9.73E-03	2.00E+00	8260C	4.00E-02	2.00E-01
Ethylene	74-85-1	NE	RSK175	4.18E+00	1.51E+01	RSK-175	2.30E-03	1.00E-02	RSK-175	2.40E-01	1.14E+00
Ethyl ether	60-29-7	1.60E+03	--	--	--	--	--	--	--	--	--
Ethylene dibromide (EDB)	106-93-4	2.71E-01	8011	3.00E-03	1.00E-02	8260	7.89E-03	1.00E-02	--	--	--
Formaldehyde	50-00-0	1.60E+03	--	--	--	--	--	--	--	--	--
2-Hexanone	591-78-6	4.00E+01	8260 or 624	5.39E-01	1.00E+00	8260	3.12E-01	1.00E+01	8260C	9.00E-01	5.00E+00
Hexachloro-1,3-butadiene	87-68-3	1.00E-02	8260 or 624	1.97E-01	4.00E+00	8260	2.31E-02	2.00E+00	8260C	7.00E-02	5.00E-01
Hexane; n-	110-54-3	4.80E+02	8260 or 624	1.75E-01	1.00E+00	--	--	--	8260C	1.00E-01	2.00E-01
Iodomethane	74-88-4	NE	8260 or 624	1.01E-01	1.00E+00	--	--	--	8260C	2.30E-01	1.00E+00
Isopropylbenzene (Cumene)	98-82-8	7.15E+02	8260 or 624	5.88E-02	1.00E+00	8260	1.27E-02	2.00E+00	8260C	2.00E-02	2.00E-01
p-Isopropyltoluene/4-Isopropyltoluene	99-87-6	NE	8261 or 624	7.98E-02	1.00E+00	8260	1.15E-02	2.00E+00	8260C	3.00E-02	2.00E-01
Methyl ethyl ketone/2-Butanone (MEK)	78-93-3	1.75E+06	8260 or 624	9.05E-01	5.00E+00	8260	4.72E-01	1.00E+01	8260C	8.10E-01	5.00E+00
Methylene iodide	74-88-4	NE	See Iodomethane	--	--	--	--	--	--	--	--
Methylene chloride	75-09-2	1.00E+02	8260 or 624	3.96E-01	1.00E+00	8260	2.26E-01	5.00E+00	8260C	4.80E-01	1.00E+00
Methyl isobutyl ketone/4-Methyl-2-pentanone (MIBK)	108-10-1	4.70E+05	8260 or 624	3.04E-01	5.00E+00	8260	1.14E-01	1.00E+01	8260C	9.70E-01	5.00E+00
Methyl tert-butyl ether (MTBE)	1634-04-4	6.05E+02	8260 or 624	5.70E-02	1.00E+00	8260	1.14E-02	2.00E+00	8260C	7.00E-02	5.00E-01
Naphthalene	91-20-3	1.40E+00	8260 or 624	2.05E-01	1.00E+00	8260	1.84E-02	2.00E+00	8260C	1.20E-01	5.00E-01
2-Pentanone	107-87-9	NE	--	--	--	--	--	--	8260C	5.00E+00	5.00E+00

Attachment 1A - Comparison of Laboratory Detection Limits Against Screening Levels - Groundwater

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
n-Propylbenzene	103-65-1	8.00E+02	8260 or 624	6.20E-02	1.00E+00	8260	1.20E-02	2.00E+00	8260C	2.00E-02	2.00E-01
Styrene	100-42-5	8.19E+03	8260 or 624	5.10E-02	1.00E+00	8260	6.65E-03	2.00E+00	8260C	5.00E-02	2.00E-01
1,1,1,2-Tetrachloroethane	630-20-6	7.36E+00	8260 or 624	5.40E-02	1.00E+00	8260	2.92E-02	2.00E+00	8260C	4.00E-02	2.00E-01
1,1,2,2-Tetrachloroethane	79-34-5	3.00E-01	8260 or 624	1.10E-01	1.00E+00	8260	9.63E-03	2.00E+00	8260C	6.00E-02	2.00E-01
Tetrachloroethene (PCE)	127-18-4	2.90E+00	8260 or 624	8.50E-02	1.00E+00	8260	7.77E-03	2.00E+00	8260C	5.00E-02	2.00E-01
Toluene	108-88-3	1.30E+02	8260 or 624	9.10E-02	1.00E+00	8260	5.09E-03	2.00E+00	8260C	4.00E-02	2.00E-01
1,2,3-Trichlorobenzene	87-61-6	NE	8260 or 624	7.70E-02	4.00E+00	8260	1.51E-02	2.00E+00	8260C	1.10E-01	5.00E-01
1,2,4-Trichlorobenzene	120-82-1	3.70E-02	8260 or 624	6.30E-02	2.00E+00	8260	1.56E-02	2.00E+00	8260C	1.10E-01	5.00E-01
1,1,1-Trichloroethane	71-55-6	5.46E+03	8260 or 624	8.40E-02	1.00E+00	8260	1.97E-02	2.00E+00	8260C	4.00E-02	2.00E-01
1,1,2-Trichloroethane	79-00-5	9.00E-01	8260 or 624	1.07E-01	1.00E+00	8260	1.73E-02	2.00E+00	8260C	1.30E-01	2.00E-01
Trichloroethene (TCE)	79-01-6	7.00E-01	8260 or 624	9.50E-02	5.00E-01	8260	1.78E-02	2.00E+00	8260C	5.00E-02	2.00E-01
Trichlorofluoroethane	27154-33-2	NE	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane (CFC-11)	75-69-4	2.40E+03	8260 or 624	1.27E-01	1.00E+00	8260	1.49E-02	2.00E+00	8260C	4.00E-02	2.00E-01
1,2,3-Trichloropropane	96-18-4	1.46E-03	8260 or 624	2.53E-01	1.00E+00	8260	7.59E-03	2.00E+00	8260C	1.30E-01	5.00E-01
Trichlorotrifluoroethane (CFC-113)	76-13-1	1.83E+02	8261 or 624	1.73E-01	1.00E+00	--	--	--	--	--	--
1,2,3-Trimethylbenzene	526-73-8	8.00E+01	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	95-63-6	2.39E+02	8260 or 624	6.10E-02	1.00E+00	8260	1.79E-02	2.00E+00	8260C	2.00E-02	2.00E-01
1,3,5-Trimethylbenzene	108-67-8	8.00E+01	8260 or 624	6.10E-02	1.00E+00	8260	1.37E-02	2.00E+00	8260C	2.00E-02	2.00E-01
Vinyl Acetate	108-05-4	7.81E+03	8260 or 624	1.11E-01	1.00E+00	--	--	--	8260C	7.00E-02	2.00E-01
Vinyl chloride	75-01-4	1.80E-01	8260 or 624	8.20E-02	2.00E-02	8260	1.05E-02	2.00E-01	8260C	6.00E-02	2.00E-01
m-Xylenes	179601-23-1	3.03E+02	8260 or 624	1.73E-01	1.00E+00	8260	3.52E-02	4.00E+00	8260C	5.00E-02	4.00E-01
m,p-Xylenes	179601-23-1	1.60E+03	8260 or 624	1.73E-01	1.00E+00	8260	3.52E-02	4.00E+00	8260C	5.00E-02	4.00E-01
o-Xylene	136777-61-2	4.32E+02	8260 or 624	6.88E-02	1.00E+00	8260	2.31E-02	2.00E+00	8260C	3.00E-02	2.00E-01
Xylenes, Total	1330-20-7	3.32E+02	—	—	--	--	--	--	8260C	9.00E-02	6.00E-01
Polycyclic Aromatic Hydrocarbons (PAHs)											
Acenaphthene	83-32-9	5.34E+00	8270	3.10E-02	5.00E-01	8270-SIM	3.64E-03	2.00E-02	8270D	3.00E-01	1.00E+00
Acenaphthylene	208-96-8	NE	8270	2.40E-02	5.00E-01	8270-SIM	2.46E-03	2.00E-02	8270D	3.00E-01	1.00E+00
Anthracene	120-12-7	2.15E+00	8270	2.00E-02	5.00E-01	8270-SIM	2.72E-03	2.00E-02	8270D	3.00E-01	1.00E+00
Benzo(a)anthracene	56-55-3	1.60E-04	8270 SIM	1.59E-02	1.00E-01	8270-SIM	1.02E-03	2.00E-02	8270D-SIM-LL	8.00E-04	1.00E-02
Benzo(b)fluoranthene	205-99-2	1.60E-04	8270 SIM	2.16E-02	1.00E-01	8270-SIM	3.04E-03	2.00E-02	8270D-SIM-LL	5.00E-04	1.00E-02
Benzo(k)fluoranthene	207-08-9	1.60E-03	8270 SIM	4.11E-02	1.00E-01	8270-SIM	4.87E-03	2.00E-02	8270D-SIM-LL	3.00E-03	1.00E-02
Total Benzofluoranthenes	E	NE	--	--	--	--	--	--	8270D	8.00E-01	2.00E+00
Benzo(g,h,i)perylene	191-24-2	NE	8270	4.30E-02	5.00E-01	8270-SIM	1.99E-03	2.00E-02	8270D	5.00E-01	1.00E+00
Benzo(a)pyrene	50-32-8	1.60E-05	8270 SIM	9.57E-03	1.00E-01	8270-SIM	2.29E-03	2.00E-02	8270D-SIM-LL	2.00E-03	1.00E-02
Chrysene	218-01-9	1.60E-02	8270 SIM	2.20E-02	1.00E-01	8270-SIM	2.06E-03	2.00E-02	8270D-SIM-LL	9.00E-04	1.00E-02
Dibenz(a,h)anthracene	53-70-3	1.60E-05	8270 SIM	2.74E-03	1.00E-01	8270-SIM	3.56E-03	2.00E-02	8270D-SIM-LL	1.00E-03	1.00E-02
Dibenzofuran	132-64-9	1.60E+01	8270	3.50E-02	1.00E+00	--	--	--	8270D	3.00E-01	1.00E+00
Fluoranthene	206-44-0	1.82E+00	8270	2.50E-02	5.00E-01	8270-SIM	6.10E-04	2.00E-02	8270D	4.00E-01	1.00E+00
Fluorene	86-73-7	3.67E+00	8270	3.20E-02	5.00E-01	8270-SIM	1.09E-03	2.00E-02	8270D	3.00E-01	1.00E+00
Indeno(1,2,3-cd)pyrene	193-39-5	1.60E-04	8270 SIM	7.11E-03	1.00E-01	8270-SIM	1.85E-03	2.00E-02	8270D-SIM-LL	1.00E-03	1.00E-02
Methyl isopropyl phenanthrene	483-65-8	NE	--	--	--	--	--	--	--	--	--
1-Methylnaphthalene	90-12-0	1.50E+00	8270	1.70E-02	5.00E-01	8270-SIM	1.01E-03	2.00E-02	8270D	3.00E-01	1.00E+00
2-Methylnaphthalene	91-57-6	3.20E+01	8270	1.50E-02	5.00E-01	8270-SIM	1.74E-03	2.00E-02	8270D	2.00E-01	1.00E+00
Naphthalene	91-20-3	1.40E+00	8270	1.70E-02	5.00E-01	8270-SIM	7.84E-04	2.00E-02	8270D	2.00E-01	1.00E+00
Phenanthrene	85-01-8	NE	8270	2.50E-02	5.00E-01	8270-SIM	2.11E-03	2.00E-02	8270D	2.00E-01	1.00E+00
Pyrene	129-00-0	2.01E+00	8270	1.40E-02	5.00E-01	8270-SIM	1.26E-03	2.00E-02	8270D	3.00E-01	1.00E+00
Semivolatile Organic Compounds (SVOCs) - Other											
Aniline	62-53-3	7.70E+00	8270	1.74E-02	2.00E+00	8270D	8.61E-01	2.00E+00	8270D	9.00E-01	1.00E+00
Azobenzene	103-33-3	8.00E-01	8270	1.42E-02	1.00E+00	8270D	5.45E-01	2.00E+00	8270D	2.00E-01	1.00E+00
Benzidine	92-87-5	2.30E-05	--	--	--	--	--	--	--	5.00E+00	1.00E+01

Attachment 1A - Comparison of Laboratory Detection Limits Against Screening Levels - Groundwater

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
Benzoic Acid	65-85-0	5.90E+02	8270	4.47E-02	2.00E+00	8270D	8.14E-01	1.00E+01	8270D	3.00E+00	2.00E+01
Benzyl Alcohol	100-51-6	8.00E+02	8270	2.33E-02	1.00E+00	8270D	3.43E-01	2.00E+00	8270D	6.00E-01	2.00E+00
Carbazole	86-74-8	NE	8270	2.49E-02	5.00E+00	8270D	5.54E-01	2.00E+00	8270D	4.00E-01	1.00E+00
4-Chloroaniline	106-47-8	2.20E-01	8270	3.35E-02	5.00E+00	8270D	6.28E-01	2.00E+00	8270D-LL	4.00E-02	1.00E+00
Bis(2-chlorethoxy)methane	111-91-1	NE	8270	1.93E-02	1.00E+00	8270D	3.50E-01	2.00E+00	8270D	3.00E-01	1.00E+00
Bis(2-chloroethyl)ether	111-44-4	6.00E-02	8270	2.35E-02	2.00E+00	8270D	3.13E-01	2.00E+00	8270D-LL	3.00E-02	2.00E-01
Bis(2-chloroisopropyl)ether/2,2'-Oxybis(1-	108-60-1	9.00E+02	8270	3.95E-02	1.00E+00	--	--	--	--	2.00E-01	1.00E+00
4-Bromophenyl-phenylether	101-55-3	NE	8270	6.54E-02	1.00E+00	8270D	2.62E-01	2.00E+00	8270D	3.00E-01	1.00E+00
2-Chloronaphthalene	91-58-7	1.00E+02	8270	2.10E-02	1.00E+00	8270D	3.01E-01	2.00E+00	8270D	3.00E-01	1.00E+00
4-Chlorophenyl-phenylether	7005-72-3	NE	8270	3.01E-02	1.00E+00	8270D	2.45E-01	2.00E+00	8270D	3.00E-01	1.00E+00
3,3-Dichlorobenzidine	91-94-1	3.30E-03	--	--	--	8270D	1.50E+00	2.00E+00	8270D-LL	3.00E-01	1.00E+00
2,4-Dinitrotoluene	121-14-2	1.80E-01	8270	3.51E-02	1.00E+00	8270D	2.59E-01	2.00E+00	8270D-LL	1.00E-01	1.00E+00
2,6-Dinitrotoluene	606-20-2	2.97E+02	8270	3.79E-02	1.00E+00	8270D	6.07E-01	2.00E+00	8270D	1.20E+00	3.00E+00
Hexachlorobenzene	118-74-1	5.00E-06	8270	4.16E-02	1.00E+00	8270D	2.11E-01	2.00E+00	8270D-LL	4.00E-02	2.00E-01
Hexachlorobutadiene	87-68-3	1.00E-02	--	--	--	8270D	6.54E-01	2.00E+00	8270D-LL	4.00E-02	2.00E-01
Hexachlorocyclopentadiene	77-47-4	1.00E+00	8270	4.40E-02	1.00E+00	8270D	9.80E-01	2.00E+00	8270D-LL	1.00E-01	1.00E+00
Hexachloroethane	67-72-1	2.00E-02	8270	3.83E-02	1.00E+00	8270D	6.67E-01	2.00E+00	8270D-LL	4.00E-02	2.00E-01
Isophorone	78-59-1	1.10E+02	8270	1.08E-02	1.00E+00	8270D	3.91E-01	2.00E+00	8270D	2.00E-01	1.00E+00
Nitrobenzene	98-95-3	1.00E+02	8270	3.82E-02	2.00E+00	8270D	3.96E-01	2.00E+00	8270D	2.00E-01	1.00E+00
n-Nitrosodimethylamine	62-75-9	3.40E-01	8270	2.57E-02	1.00E+00	8270D	5.02E-01	2.00E+00	8270D-LL	4.00E-02	4.00E-01
n-Nitrosodiphenylamine	86-30-6	6.90E-01	8270	7.97E-03	1.00E+00	8270D	3.08E-01	2.00E+00	8270D-LL	2.00E-02	2.00E-01
n-Nitrosodi-n-propylamine	621-64-7	5.80E-02	8270	3.26E-02	1.00E+00	8270D	7.02E-01	2.00E+00	8270D-LL	4.00E-02	2.00E-01
Butyl benzyl phthalate	85-68-7	1.30E-02	8270	3.84E-02	1.00E+00	8270D	2.22E-01	2.00E+00	8270D-LL	7.00E-02	2.00E-01
Butyl diphenyl phosphate	2752-95-6	NE	--	--	--	--	--	--	--	2.00E-01	1.00E+00
2,6-Bis(1,1-dimethylethyl) phenol	128-39-2	NE	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	117-81-7	4.60E-02	8270	4.12E-02	2.00E-01	8270D	2.69E-01	2.00E+00	8270D-LL	2.00E-01	2.00E-01
Dibutyl phthalate	84-74-2	8.00E+00	8270	1.39E-02	1.00E+00	8270D	2.77E-01	2.00E+00	8270D	3.00E-01	1.00E+00
Diethyl phthalate	84-66-2	9.26E+01	8270	2.89E-02	1.00E+00	8270D	2.65E-01	2.00E+00	8270D	3.00E-01	1.00E+00
Dimethyl phthalate	131-11-3	6.00E+02	8270	1.14E-02	1.00E+00	8270D	2.29E-01	2.00E+00	8270D	4.00E-01	1.00E+00
Di-n-octyl phthalate	117-84-0	3.92E-03	8270	2.34E-02	1.00E+00	8270D	2.91E-01	2.00E+00	8270D-LL	4.00E-02	2.00E-01
1,2,4-Trichlorobenzene	120-82-1	3.70E-02	8270	5.04E-02	1.00E+00	8270D	3.74E-01	2.00E+00	8270D-LL	3.00E-02	2.00E-01
4-Chloro-3-methylphenol	59-50-7	3.60E+01	8270	3.41E-02	5.00E+00	8270D	3.96E-01	2.00E+00	8270D	1.00E+00	3.00E+00
2-Chlorophenol	95-57-8	1.70E+01	8270	1.69E-02	1.00E+00	8270D	2.84E-01	2.00E+00	8270D	3.00E-01	1.00E+00
Dibutyl phenyl phosphate	2528-36-1	NE	--	--	--	--	--	--	--	1.00E-01	1.00E+00
1,2-Dichlorobenzene	95-50-1	4.61E+00	8270	1.95E-02	1.00E+00	8260	4.78E-01	2.00E+00	8260	2.00E-01	1.00E+00
1,3-Dichlorobenzene	541-73-1	2.00E+00	8270	1.95E-02	1.00E+00	8260	4.57E-01	2.00E+00	8260	2.00E-01	1.00E+00
1,4-Dichlorobenzene	106-46-7	4.93E+00	8270	3.09E-02	1.00E+00	8260	3.42E-01	2.00E+00	8260	2.00E-01	1.00E+00
2,4-Dichlorophenol	120-83-2	1.00E+01	8270	2.79E-02	2.00E+00	8270D	2.62E-01	2.00E+00	8270D	8.00E-01	3.00E+00
2,4-Dimethylphenol	105-67-9	6.34E+00	8270	2.66E-02	1.00E+00	8270D	2.91E-01	2.00E+00	8270D	4.00E-01	3.00E+00
4,6-Dinitro-2-methylphenol	534-52-1	7.00E+00	8270	4.70E-02	5.00E+00	8270D	8.32E-01	2.00E+00	8270D-LL	4.00E-01	2.00E+00
2,4-Dinitrophenol	51-28-5	1.00E+02	8270	1.69E-01	2.00E+00	8270D	9.78E-01	1.00E+01	8270D	4.20E+00	2.00E+01
1,4-Dioxane	123-91-1	4.38E-01	8260SIM	9.00E-02	3.00E+00	--	--	--	8270D	2.00E-01	4.00E-01
1,2-Diphenylhydrazine	122-66-7	2.00E-02	--	--	--	--	--	--	--	--	--
2-Methoxynaphthalene	93-04-9	NE	--	--	--	--	--	--	--	--	--
2-Methylphenol (o-Cresol)	95-48-7	2.70E+01	8270	1.69E-02	1.00E+00	8270D	4.31E-01	2.00E+00	8270D	2.00E-01	1.00E+00
4-Methylphenol (p-Cresol)	106-44-5	8.00E+02	8270	1.61E-02	1.00E+00	8270D	--	--	8270D	4.00E-01	2.00E+00
2-Nitroaniline	88-74-4	1.60E+02	8270	3.80E-02	5.00E+00	8270D	2.54E-01	2.00E+00	8270D	1.60E+00	3.00E+00
3-Nitroaniline	99-09-2	NE	8270	3.69E-02	5.00E+00	8270D	4.51E-01	5.00E+00	8270D	1.70E+00	3.00E+00
4-Nitroaniline	100-01-6	NE	8270	1.95E-02	5.00E+00	8270D	7.52E-01	2.00E+00	8270D	1.90E+00	3.00E+00
2-Nitrophenol	88-75-5	NE	8270	1.66E-02	2.00E+00	8270D	3.81E-01	2.00E+00	8270D	5.00E-01	3.00E+00
4-Nitrophenol	100-02-7	NE	8270	1.08E-01	5.00E+00	8270D	1.51E+00	2.00E+00	8270D	9.00E-01	1.00E+01

Attachment 1A - Comparison of Laboratory Detection Limits Against Screening Levels - Groundwater

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
Pentachlorophenol	87-86-5	2.00E-03	8270	5.72E-02	2.00E+00	8270D	1.23E+00	5.00E+00	8270D-LL	1.00E-01	1.00E+00
Phenol	108-95-2	3.65E+02	8270	1.41E-02	2.00E+00	8270D	3.50E-01	2.00E+00	8270D	2.00E-01	1.00E+00
Pyridine	110-86-1	8.00E+00	8270	3.04E-02	1.00E+00	8270D	1.10E+00	2.00E+00	8270D	1.30E+00	5.00E+00
2,4,5-Trichlorophenol	95-95-4	6.00E+02	8270	3.48E-02	2.00E+00	8270D	5.11E-01	2.00E+00	8270D	1.00E+00	5.00E+00
2,4,6-Trichlorophenol	88-06-2	2.80E-01	8270	3.90E-02	2.00E+00	8270D	2.99E-01	2.00E+00	8270D-LL	2.00E-01	1.00E+00
Total Petroleum Hydrocarbon Compounds											
Gasoline	--	8.00E+02	NWTPH-Gx	7.24E+00	5.00E+01	NWTPH-Gx	4.58E+00	5.00E+01	NWTPH-Gx	5.74E+01	2.50E+02
Gasoline (w/benzene)	--	8.00E+02	NWTPH-Gx	7.24E+00	5.00E+01	8021	1.16E-01	1.00E+00	NWTPH-Gx	5.74E+01	2.50E+02
Diesel range organics	--	5.00E+02	NWTPH-Dx	8.40E+00	5.00E+01	NWTPH-Dx	3.95E+01	1.30E+02	NWTPH-Dx	2.17E+01	1.00E+02
Heavy Oil	--	5.00E+02	NWTPH-Dx	6.67E+00	1.00E+02	NWTPH-Dx	3.62E+01	2.50E+02	NWTPH-Dx	4.43E+01	2.00E+02

NOTES:

1 Laboratory reporting limits were compared to the most stringent groundwater preliminary cleanup level (PCUL) for nonpotable groundwater provided by Ecology (June 2018).

2 The RL represents the level of the lowest calibration standard (i.e., the laboratory practical quantitation limit [PQL]); the RL may not always be achievable

Units are micrograms per liter.

Blue shading indicates that there is no PCUL established for nonpotable groundwater; the highlighted PCUL is for potable groundwater

Grey shading indicates that there is no PCUL established for nonpotable groundwater, the highlighted value is the background concentration

Green shading indicates an RL or MDL exceeds the PCUL.

Analytical method selections may be modified to best meet objective of reaching screening levels.

-- = not available

CAS = Chemical Abstracts Service; Ecology PCUL = Ecology Preliminary Cleanup Level; MDL = method detection limit; NE = not established; NWTPH = Northwest Total Petroleum Hydrocarbons; SIM = selected ion monitoring

Attachment 1B - Comparison of Laboratory Detection Limits Against Screening Levels - Soil

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
Metals											
Aluminum	7429-90-5	3.30E+04	200.8	1.25E+00	5.50E+00	6020A	1.61E+00	1.00E+01	6010C	8.00E-04	5.00E+00
Antimony	7440-36-0	4.10E+00	200.8	1.40E-02	2.00E-01	6020A	1.60E-02	1.00E-01	6010C	4.00E-04	5.00E+00
Arsenic (total)	7440-38-2	7.30E+00	200.8	7.80E-02	2.50E-01	6020A	4.90E-02	2.00E-01	6010C	5.00E-04	5.00E+00
Barium	7440-39-3	8.30E+00	200.8	2.20E-02	5.00E-01	6020A	9.00E-03	1.00E-01	6010C	7.00E-05	3.00E-01
Beryllium	7440-41-7	3.50E+00	200.8	1.00E-03	2.00E-01	6020A	2.30E-02	1.00E-01	6010C	2.00E-05	1.00E-01
Cadmium	7440-43-9	7.70E-01	200.8	1.00E-03	3.00E-01	6020A	1.50E-02	1.00E-01	6010C	3.00E-05	2.00E-01
Chromium, total (or III)	7440-47-3	4.80E+01	200.8	2.60E-02	1.00E-01	6020A	2.50E-02	1.00E-01	6010C	1.00E-04	5.00E-01
Chromium (VI)	18540-29-9	9.60E-01	200.8	3.20E-02	5.00E-01	7196	9.00E-01	5.00E+00	7196A	4.00E-01	4.00E-01
Cobalt	7440-48-4	2.00E+01	200.8	9.00E-03	5.00E-01	6020A	2.00E-02	1.00E-01	6010C	2.00E-05	3.00E-01
Copper	7440-50-8	3.60E+01	200.8	2.70E-02	2.00E-01	6020A	1.60E-02	1.00E-01	6010C	7.00E-05	2.00E-01
Iron	7439-89-6	5.60E+04	200.8	1.60E+00	5.50E+00	6020A	2.24E+00	1.00E+01	6010C	1.00E-04	5.00E+00
Lead	7439-92-1	5.00E+01	200.8	4.00E-03	2.00E-01	6020A	1.60E-02	1.00E-01	6010C	2.00E-04	2.00E+00
Manganese	7439-96-5	1.10E+03	200.8	1.60E-02	5.00E-01	6020A	1.90E-02	1.00E-01	6010C	3.00E-05	1.00E-01
Mercury (elemental)	7439-97-6	7.00E-02	245.1	4.00E-04	2.50E-01	7471	1.36E-03	2.00E-02	7471B	5.25E-03	2.50E-02
Methylmercury	16056-34-1	4.00E-01	--	--	--	--	--	--	--	--	--
Molybdenum	7439-98-7	2.00E+00	200.8	5.00E-02	2.50E-01	6020A	2.80E-02	1.00E-01	6010C	6.00E-05	5.00E-01
Nickel	7440-02-0	4.80E+01	200.8	2.50E-02	5.00E-01	6020A	2.90E-02	1.00E-01	6010C	3.00E-04	1.00E+00
Selenium	7782-49-2	3.00E-01	200.8	8.80E-02	5.00E-01	6020A	2.14E-01	1.00E+00	6010C	5.00E-04	5.00E+00
Silver	7440-22-4	1.60E-02	200.8	1.00E-03	1.00E-01	6020A	1.50E-02	1.00E-01	6010C	5.00E-05	3.00E-01
Thallium	7440-28-0	4.40E-03	200.8	4.80E-04	2.00E-01	6020A	2.90E-01	--	6010C	4.00E-04	5.00E+00
Tin	7440-31-5	5.00E+01	200.8	3.42E-01	1.00E+00	6020A	--	2.00E-01	6010C	2.00E-04	1.00E+00
Vanadium	7440-62-2	2.00E+00	200.8	1.10E-02	1.00E-01	6020A	8.00E-02	2.50E-01	6010C	4.00E-05	3.00E-01
Zinc	7440-66-6	8.50E+01	200.8	6.10E-02	5.00E-01	6020A	1.68E-01	5.00E-01	6010C	1.60E-01	1.00E+00
Polychlorinated Biphenyls (PCBs)											
PCB - Aroclor 1016	12674-11-2	2.20E-06	8082 or 608	1.49E-03	1.00E-01	8082	3.90E-04	1.00E-01	8082A	1.60E-03	2.00E-02
PCB - Aroclor 1221	11104-28-2	2.20E-06	8082 or 608	1.49E-03	1.00E-01	8082	3.90E-04	1.00E-01	8082A	1.60E-03	2.00E-02
PCB - Aroclor 1232	11141-16-5	2.20E-06	8082 or 608	1.49E-03	1.00E-01	8082	3.90E-04	1.00E-01	8082A	1.60E-03	2.00E-02
PCB - Aroclor 1242	53469-21-9	2.20E-06	8082 or 608	1.49E-03	1.00E-01	8082	3.90E-04	1.00E-01	8082A	1.60E-03	2.00E-02
PCB - Aroclor 1248	12672-29-6	2.20E-06	8082 or 608	2.61E-03	1.00E-01	8082	3.90E-04	1.00E-01	8082A	1.60E-03	2.00E-02
PCB - Aroclor 1254	11097-69-1	2.20E-06	8082 or 608	2.61E-03	1.00E-01	8082	3.90E-04	1.00E-01	8082A	1.60E-03	2.00E-02
PCB - Aroclor 1260	11096-82-5	2.20E-06	8082 or 608	2.61E-03	1.00E-01	8082	3.90E-04	1.00E-01	8082A	6.00E-04	2.00E-02
Volatile Organic Compounds (VOCs)											
Acetone	67-64-1	7.20E+04	8260 or624	8.80E-02	2.50E-01	8260	4.30E-04	5.00E-02	8260C	4.80E-04	5.00E-03
Acrolein	107-02-8	4.00E+01	--	--	--	--	--	--	8260C	3.81E-03	5.00E-03
Acrylonitrile	107-13-1	1.90E+00	8260 or624	2.00E-03	2.50E-02	8260	2.38E-04	5.00E-02	8260C	1.03E-03	5.00E-03
Benzaldehyde	100-52-7	8.00E+03	--	--	--	--	--	--	--	--	--
Benzene	71-43-2	5.60E-04	8260 or624	7.00E-03	2.00E-02	8260	7.40E-06	5.00E-03	8260C	3.00E-04	1.00E-03
Bromobenzene	108-86-1	6.40E+02	8260 or624	8.00E-03	2.00E-02	8260	2.56E-04	1.00E-02	8260C	1.50E-04	1.00E-03
Bromochloromethane	74-97-5	NE	8260 or624	2.00E-03	2.00E-02	8260	3.95E-04	1.00E-02	8260C	3.20E-04	1.00E-03
Bromodichloromethane	75-27-4	NE	8260 or624	1.00E-03	2.00E-02	8260	2.31E-04	1.00E-02	8260C	2.50E-04	1.00E-03
Bromoethane	74-96-4	NE	--	--	--	--	--	--	8260C	4.40E-04	2.00E-03
Bromoform	75-25-2	5.00E-03	8260 or624	2.00E-03	5.00E-02	8260	2.64E-04	1.00E-02	8260C	3.00E-04	1.00E-03
Bromomethane	74-83-9	7.90E-02	8260 or624	1.50E-02	5.00E-02	8260	1.85E-04	1.00E-02	8260C	1.90E-04	1.00E-03
2-Butoxyethanol	111-76-2	8.00E+03	--	--	--	--	--	--	--	--	--
n-Butylbenzene	104-51-8	4.00E+03	8260 or624	7.00E-03	2.50E-02	8260	1.92E-04	1.00E-02	8260C	2.60E-04	1.00E-03
sec-Butylbenzene	135-98-8	8.00E+03	8260 or624	5.00E-03	5.00E-02	8260	2.16E-04	1.00E-02	8260C	2.40E-04	1.00E-03
tert-Butylbenzene	98-06-6	8.00E+03	8260 or624	9.00E-03	2.50E-02	8260	2.37E-04	1.00E-02	8260C	3.10E-04	1.00E-03
Carbon disulfide	75-15-0	8.00E+03	8260 or624	4.00E-03	2.50E-02	8260	2.27E-04	1.00E-02	8260C	5.60E-04	1.00E-03

Attachment 1B - Comparison of Laboratory Detection Limits Against Screening Levels - Soil

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
Carbon tetrachloride	56-23-5	1.50E-04	8260 or624	1.80E-02	2.50E-02	8260	2.33E-04	1.00E-02	8260C	2.10E-04	1.00E-03
Chlorobenzene	108-90-7	1.00E-01	8260 or624	1.00E-02	2.50E-02	8260	2.46E-04	1.00E-02	8260C	2.20E-04	1.00E-03
Chlorodibromomethane / Dibromochloromethane	124-48-1	NE	8260 or624	1.00E-03	2.50E-02	8260	3.55E-04	1.00E-02	8260C	2.70E-04	1.00E-03
Chloroethane	75-00-3	NE	8260 or624	1.20E-02	5.00E-02	8260	2.22E-04	1.00E-02	8260C	4.60E-04	1.00E-03
2-Chloroethyl vinyl ether	110-75-8	NE	--	--	--	--	--	--	8260C	2.80E-04	5.00E-03
Chloroform	67-66-3	5.20E-02	8260 or624	5.00E-03	2.00E-02	8260	2.28E-04	1.00E-02	8260C	2.30E-04	1.00E-03
Chloromethane	74-87-3	NE	8260 or624	3.00E-03	5.00E-02	8260	2.31E-04	1.00E-02	8260C	2.60E-04	1.00E-03
3-Chloro- 1-propene	107-05-1	4.80E+01	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	95-49-8	1.60E+03	8260 or624	9.00E-03	2.50E-02	8260	2.55E-04	1.00E-02	8260C	3.00E-04	1.00E-03
4-Chlorotoluene	106-43-4	NE	8260 or624	8.00E-03	2.50E-02	8260	3.67E-04	1.00E-02	8260C	2.80E-04	1.00E-03
Dibromochloromethane	124-48-1	7.70E-04	8260 or624	1.37E-03	2.50E-02	8260	3.55E-04	1.00E-02	8260C	2.70E-04	1.00E-03
1,2-Dibromo-3-Chloropropane	96-12-8	1.30E+00	8260 or624	1.10E-02	5.00E-01	8260	3.04E-04	5.00E-02	8260C	5.90E-04	5.00E-03
Dibromomethane	74-95-3	8.00E+02	8260 or624	4.00E-03	2.00E-02	8260	2.61E-04	1.00E-02	8260C	1.50E-04	1.00E-03
1,2-Dibromoethane	106-93-4	NE	8260 or624	3.00E-03	5.00E-03	8260	7.70E-06	5.00E-03	8260C	1.80E-04	1.00E-03
Dichlorobromomethane	75-27-4	9.60E-04	8261 or624	1.37E-03	2.00E-02	8260	2.31E-04	1.00E-02	--	--	--
trans-1, 4-Dichloro-2-butene	110-57-6	NE	8260 or624	7.00E-03	2.50E-02	--	--	--	8260C	4.40E-04	5.00E-03
1,2-Dichlorobenzene	95-50-1	NE	8260 or624	8.00E-03	2.00E-02	8260	2.59E-04	1.00E-02	8260C	2.90E-04	1.00E-03
1,3-Dichlorobenzene	541-73-1	NE	8260 or624	7.00E-03	2.00E-02	8260	2.59E-04	1.00E-02	8260C	2.30E-04	1.00E-03
1,4-Dichlorobenzene	106-46-7	NE	8260 or624	9.00E-03	2.00E-02	8260	2.40E-04	1.00E-02	8260C	2.30E-04	1.00E-03
Dichlorodifluoromethane (CFC-12)	75-71-8	1.60E+04	8260 or624	5.00E-03	2.00E-02	8260	3.68E-04	1.00E-02	8260C	2.10E-04	1.00E-03
1,1-Dichloroethane	75-34-3	1.80E+02	8260 or624	4.00E-03	2.00E-02	8260	2.23E-04	1.00E-02	8260C	3.40E-04	1.00E-03
1,2-Dichloroethane (EDC)	107-06-2	2.40E-02	8260 or624	3.00E-03	2.00E-02	8260	5.80E-06	1.00E-02	8260C	1.90E-04	1.00E-03
1,1-Dichloroethylene	75-35-4	1.40E+00	8260 or624	8.00E-03	2.00E-02	8260	9.90E-06	1.00E-02	8260C	3.40E-04	1.00E-03
cis-1,2-Dichloroethylene	156-59-2	1.60E+02	8260 or624	3.00E-03	2.00E-02	8260	2.40E-04	1.00E-02	8260C	2.40E-04	1.00E-03
trans-1,2-Dichloroethylene	156-60-5	3.20E-01	8260 or624	4.00E-03	2.00E-02	8260	2.20E-04	1.00E-02	8260C	2.70E-04	1.00E-03
1,2-Dichloroethylene (mixed isomers)	540-59-0	7.20E+02	8260 or624	3.48E-03	2.00E-02	--	--	--	--	--	--
1,2-Dichloropropane	78-87-5	1.00E-03	8260 or624	3.00E-03	2.00E-02	8260	2.06E-04	1.00E-02	8260C	1.60E-04	1.00E-03
1,1-Dichloropropene	563-58-6	NE	8260 or624	1.60E-02	2.00E-02	8260	2.05E-04	1.00E-02	8260C	3.10E-04	1.00E-03
1,3-Dichloropropane	142-28-9	NE	8260 or624	5.00E-03	2.50E-02	8260	2.39E-04	1.00E-02	8260C	2.10E-04	1.00E-03
cis-1,3-Dichloropropene	10061-01-5	6.30E-04	8260 or624	2.00E-03	2.00E-02	8260	2.38E-04	1.00E-02	8260C	2.30E-04	1.00E-03
trans-1,3-Dichloropropene	10061-02-6	6.30E-04	8260 or624	2.00E-03	2.00E-02	8260	2.45E-04	1.00E-02	8260C	2.20E-04	1.00E-03
2,2-Dichloropropane	594-20-7	NE	8260 or624	1.00E-03	1.00E-01	8260	2.28E-04	1.00E-02	8260C	2.90E-04	1.00E-03
Ethane	74-84-0	NE	RSK175	--	--	RSK-175	--	--	--	--	--
Ethylbenzene	100-41-4	1.50E-02	8260 or624	1.00E-02	2.50E-02	8260	2.41E-04	1.00E-02	8260C	2.00E-04	1.00E-03
Ethylene	74-85-1	NE	RSK175	--	--	RSK-175	--	--	--	--	--
Ethyl ether	60-29-7	1.60E+04	--	--	--	--	--	--	--	--	--
Ethylene dibromide (EDB)	106-93-4	5.00E-01	8011	2.99E-03	5.00E-03	8260	7.70E-06	5.00E-03	--	--	--
Formaldehyde	50-00-0	1.60E+04	--	--	--	--	--	--	--	--	--
2-Hexanone	591-78-6	4.00E+02	8260 or624	2.80E-02	2.50E-01	8260	1.58E-04	5.00E-02	8260C	4.40E-04	5.00E-03
Hexachloro-1,3-butadiene	87-68-3	NE	8260 or624	1.50E-02	5.00E-02	8260	2.67E-04	1.00E-02	8260C	4.10E-04	5.00E-03
Hexane; n-	110-54-3	NE	8260 or624	1.90E-02	5.00E-02	--	--	--	8260C	1.00E-03	1.00E-03
Iodomethane	74-88-4	NE	8260 or624	2.50E-02	5.00E-02	--	--	--	8260C	2.20E-04	1.00E-03
Isopropylbenzene (Cumene)	98-82-8	8.00E+03	8260 or624	9.00E-03	2.50E-02	8260	2.02E-04	1.00E-02	8260C	2.30E-04	1.00E-03
p-Isopropyltoluene/4-Isopropyltoluene	99-87-6	NE	8261 or624	5.00E-03	5.00E-02	8260	1.77E-04	1.00E-02	8260C	2.40E-04	1.00E-03
Methyl ethyl ketone/2-Butanone (MEK)	78-93-3	4.80E+04	8260 or624	--	2.50E-01	8260	3.26E-04	5.00E-02	8260C	5.10E-04	5.00E-03
Methylene iodide	74-88-4	NE	See Iodomethane			--	--	--	--	--	--
Methylene chloride	75-09-2	3.00E-02	8260 or624	2.50E-02	2.00E-02	8260	4.60E-04	2.00E-02	8260C	6.40E-04	2.00E-03
Methyl isobutyl ketone/4-Methyl-2-pentanone (MIBK)	108-10-1	6.40E+03	8260 or624	3.30E-02	2.50E-01	8260	2.27E-04	5.00E-02	8260C	4.20E-04	5.00E-03
Methyl tert-butyl ether (MTBE)	1634-04-4	5.60E+02	8260 or624	1.10E-02	5.00E-02	8260	2.30E-04	1.00E-02	8260C	2.30E-04	1.00E-03
Naphthalene	91-20-3	NE	8260 or624	6.00E-03	5.00E-02	8260	2.54E-04	1.00E-02	8260C	4.30E-04	5.00E-03
2-Pentanone	107-87-9	NE	--	--	--	--	--	--	8260C	5.00E-03	5.00E-03

Attachment 1B - Comparison of Laboratory Detection Limits Against Screening Levels - Soil

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
n-Propylbenzene	103-65-1	8.00E+03	8260 or624	9.00E-03	2.50E-02	8260	2.46E-04	1.00E-02	8260C	2.70E-04	1.00E-03
Styrene	100-42-5	3.00E+02	8260 or624	4.00E-03	2.50E-02	8260	1.86E-04	1.00E-02	8260C	1.40E-04	1.00E-03
1,1,1,2-Tetrachloroethane	630-20-6	3.80E+01	8260 or624	2.00E-03	2.50E-02	8260	1.91E-04	1.00E-02	8260C	2.30E-04	1.00E-03
1,1,2,2-Tetrachloroethane	79-34-5	1.10E-04	8260 or624	2.00E-03	2.00E-02	8260	2.54E-04	1.00E-02	8260C	2.50E-04	1.00E-03
Tetrachloroethene (PCE)	127-18-4	1.60E-03	8260 or624	9.00E-03	2.50E-02	8260	1.53E-05	1.00E-02	8260C	2.60E-04	1.00E-03
Toluene	108-88-3	5.50E-02	8260 or624	2.00E-03	2.00E-02	8260	2.36E-04	1.00E-02	8260C	1.50E-04	1.00E-03
1,2,3-Trichlorobenzene	87-61-6	2.00E+01	8260 or624	4.00E-03	2.00E-02	8260	2.41E-04	1.00E-02	8260C	3.00E-04	5.00E-03
1,2,4-Trichlorobenzene	120-82-1	NE	8260 or624	5.00E-03	2.50E-02	8260	2.25E-04	1.00E-02	8260C	3.30E-04	5.00E-03
1,1,1-Trichloroethane	71-55-6	2.10E+01	8260 or624	2.00E-03	2.50E-02	8260	2.05E-04	1.00E-02	8260C	2.30E-04	1.00E-03
1,1,2-Trichloroethane	79-00-5	3.30E-04	8260 or624	5.00E-03	2.00E-02	8260	2.46E-04	1.00E-02	8260C	2.90E-04	1.00E-03
Trichloroethene (TCE)	79-01-6	2.70E-04	8260 or624	2.00E-03	2.00E-02	8260	1.59E-05	1.00E-02	8260C	2.10E-04	1.00E-03
Trichlorofluoroethane	27154-33-2	NE	--	--	--	--	--	--	--	--	--
Trichlorofluoromethane (CFC-11)	75-69-4	2.40E+04	8260 or624	4.00E-03	2.00E-02	8260	1.95E-04	1.00E-02	8260C	2.70E-04	1.00E-03
1,2,3-Trichloropropane	96-18-4	3.30E-02	8260 or624	3.00E-03	2.50E-02	8260	2.68E-04	1.00E-02	8260C	5.20E-04	2.00E-03
Trichlorotrifluoroethane (CFC-113)	76-13-1	2.40E+06	8261 or624	--	--	--	--	--	--	--	--
1,2,3-Trimethylbenzene	526-73-8	8.00E+02	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	95-63-6	8.00E+02	8260 or624	5.00E-03	2.00E-02	8260	1.99E-04	1.00E-02	8260C	2.30E-04	1.00E-03
1,3,5-Trimethylbenzene	108-67-8	8.00E+02	8260 or624	7.00E-03	2.50E-02	8260	1.84E-04	1.00E-02	8260C	2.50E-04	1.00E-03
Vinyl Acetate	108-05-4	8.00E+04	8260 or624	7.00E-03	5.00E-02	--	--	--	8260C	3.80E-04	5.00E-03
Vinyl chloride	75-01-4	5.50E-05	8260 or624	9.00E-03	2.50E-02	8260	9.50E-06	1.00E-02	8260C	2.40E-04	1.00E-03
m-Xylenes	179601-23-1	1.60E+04	8260 or624	--	--	8260	4.34E-04	2.00E-02	8260C	3.90E-04	2.00E-03
p-Xylenes	179601-23-1	1.60E+04	8260 or624	4.00E-03	5.00E-02	8260	4.34E-04	2.00E-02	8260C	3.90E-04	2.00E-03
o-Xylene	136777-61-2	1.60E+04	8260 or624	7.00E-03	2.50E-02	8260	2.08E-04	1.00E-02	8260C	2.20E-04	1.00E-03
Xylenes, Total	1330-20-7	1.60E+04	—	--	--	--	--	--	8260C	6.20E-04	2.00E-03
Polycyclic Aromatic Hydrocarbons											
Acenaphthene	83-32-9	2.80E-02	8270-SIM	8.94E-01	4.00E+01	8270-SIM	8.81E-04	2.00E-02	8270D	5.10E-03	2.00E-02
Acenaphthylene	208-96-8	1.30E+00	8270-SIM	1.73E+00	4.00E+01	8270-SIM	9.48E-04	2.00E-02	8270D	4.80E-03	2.00E-02
Anthracene	120-12-7	5.10E-02	8270-SIM	8.41E-01	4.00E+01	8270-SIM	1.45E-03	2.00E-02	8270D	5.90E-03	2.00E-02
Benzo(a)anthracene	56-55-3	5.70E-05	8270-SIM	4.87E+00	4.00E+01	8270-SIM	1.10E-03	2.00E-02	8270D-SIM-LL	7.00E-05	5.00E-04
Benzo(b)fluoranthene	205-99-2	2.00E-04	8270-SIM	6.80E+00	4.00E+01	8270-SIM	1.46E-03	2.00E-02	8270D-SIM-LL	7.00E-05	5.00E-04
Benzo(k)fluoranthene	207-08-9	2.00E-03	8270-SIM	7.75E+00	4.00E+01	8270-SIM	1.21E-03	2.00E-02	8270D-SIM-LL	1.00E-04	5.00E-04
Total Benzofluoranthenes	E	3.20E+00	--	--	--	--	--	--	8270D	1.02E-02	4.00E-02
Benzo(g,h,i)perylene	191-24-2	6.70E-01	8270-SIM	3.33E+00	4.00E+01	8270-SIM	1.88E-03	2.00E-02	8270D	5.80E-03	2.00E-02
Benzo(a)pyrene	50-32-8	1.60E-05	8270-SIM	8.52E+00	4.00E+01	8270-SIM	1.18E-03	2.00E-02	8270D-SIM-LL	9.00E-05	5.00E-04
Chrysene	218-01-9	6.40E-03	8270-SIM	3.75E+00	4.00E+01	8270-SIM	1.49E-03	2.00E-02	8270D	5.20E-03	2.00E-02
Dibenz(a,h)anthracene	53-70-3	2.90E-05	8270-SIM	5.12E+00	4.00E+01	8270-SIM	1.66E-03	2.00E-02	8270D-SIM-LL	1.00E-04	5.00E-04
Dibenzofuran	132-64-9	5.40E-01	8270-SIM	5.90E+00	7.50E+01	--	--	--	8270D	4.60E-03	2.00E-02
Fluoranthene	206-44-0	9.00E-02	8270-SIM	5.73E+00	4.00E+01	8270-SIM	1.38E-03	2.00E-02	8270D	4.50E-03	2.00E-02
Fluorene	86-73-7	2.90E-02	8270-SIM	7.53E-01	4.00E+01	8270-SIM	1.28E-03	2.00E-02	8270D	5.00E-03	2.00E-02
Indeno(1,2,3-cd)pyrene	193-39-5	5.60E-04	8270-SIM	6.18E+00	4.00E+01	8270-SIM	1.41E-03	2.00E-02	8270D-SIM-LL	9.00E-05	5.00E-04
Methyl isopropyl phenanthrene	483-65-8	NE	8270-SIM	--	--	--	--	--	--	--	--
1-Methylnaphthalene	90-12-0	2.90E+01	8270-SIM	8.79E+00	4.00E+01	8270-SIM	1.06E-03	2.00E-02	8270D	6.00E-03	2.00E-02
2-Methylnaphthalene	91-57-6	6.70E-01	8270-SIM	3.55E+00	4.00E+01	8270-SIM	1.29E-03	2.00E-02	8270D	5.70E-03	2.00E-02
Naphthalene	91-20-3	2.10E-03	8270-SIM	7.65E+00	4.00E+01	8270-SIM	1.06E-03	2.00E-02	8270D	2.00E-04	1.00E-03
Phenanthrene	85-01-8	1.50E+00	8270-SIM	2.02E+00	4.00E+01	8270-SIM	1.70E-03	2.00E-02	8270D	5.20E-03	2.00E-02
Pyrene	129-00-0	1.40E-01	8270-SIM	4.65E+00	4.00E+01	8270-SIM	1.49E-03	2.00E-02	8270D	5.60E-03	2.00E-02
Semivolatile Organic Compounds (SVOCs)											
Aniline	62-53-3	1.50E+02	8270	6.24E+00	1.00E+02	8270D	1.92E-02	1.00E-01	8270D	1.69E-02	1.00E-01
Azobenzene	103-33-3	7.80E+00	8270	7.06E+00	1.00E+02	8270D	1.83E-02	1.00E-01	8270D	4.60E-03	2.00E-02
Benzidine	92-87-5	3.70E-03	--	--	--	--	--	--	8270D	1.00E-01	2.00E-01

Attachment 1B - Comparison of Laboratory Detection Limits Against Screening Levels - Soil

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
Benzoic Acid	65-85-0	1.70E-01	8270	2.00E+01	5.00E+02	8270D	2.96E-01	1.00E+00	8270D-SIM	1.34E-02	1.00E-01
Benzyl Alcohol	100-51-6	5.70E-02	8270	1.53E+01	1.00E+02	8270D	2.12E-02	1.00E-01	8270D	1.49E-02	2.00E-02
Carbazole	86-74-8	NE	8270	1.21E+01	7.50E+01	8270D	4.46E-02	2.50E-01	8270D	7.40E-03	2.00E-02
4-Chloroaniline	106-47-8	8.10E-01	8270	6.73E+00	7.50E+01	8270D	2.35E-01	1.00E+00	8270D	3.37E-02	1.00E-01
Bis(2-chlorethoxy)methane	111-91-1	NE	8270	5.90E+00	7.50E+01	8270D	5.01E-02	2.50E-01	8270D	6.30E-03	2.00E-02
Bis(2-chloroethyl)ether	111-44-4	2.20E-05	8270	1.15E+01	1.00E+02	8270D	4.00E-02	2.50E-01	8270D	6.80E-03	2.00E-02
Bis(2-chloroisopropyl)ether/2,2'-Oxybis(1-	108-60-1	NE	8270	1.21E+01	1.00E+02	--	--	--	8270D	5.70E-03	2.00E-02
4-Bromophenyl-phenylether	101-55-3	NE	8270	1.79E+01	7.50E+01	8270D	1.51E-02	1.00E-01	8270D	6.10E-03	2.00E-02
2-Chloronaphthalene	91-58-7	6.40E+03	8270	1.73E+01	7.50E+01	8270D	1.32E-02	1.00E-01	8270D	4.40E-03	2.00E-02
4-Chlorophenyl-phenylether	7005-72-3	NE	8270	7.80E+00	7.50E+01	8270D	1.72E-02	1.00E-01	8270D	7.00E-03	2.00E-02
3,3-Dichlorobenzidine	91-94-1	3.30E-06	--	--	--	8270D	7.11E-02	2.50E-01	8270D	3.12E-02	1.00E-01
2,4-Dinitrotoluene	121-14-2	6.90E-05	8270	1.83E+01	1.00E+02	8270D	8.95E-03	1.00E-01	8270D	2.29E-02	1.00E-01
2,6-Dinitrotoluene	606-20-2	1.10E-01	8270	1.71E+01	1.00E+02	8270D	1.54E-02	1.00E-01	8270D	2.67E-02	1.00E-01
Hexachlorobenzene	118-74-1	4.00E-07	8270	1.95E+01	7.50E+01	8270D	1.49E-02	1.00E-01	8270D-SIM	7.00E-04	5.00E-03
Hexachlorobutadiene	87-68-3	5.40E-04	--	--	--	8270D	5.41E-02	5.00E-01	8270D-SIM	7.00E-04	5.00E-03
Hexachlorocyclopentadiene	77-47-4	2.00E-01	8270	2.16E+01	1.00E+02	8270D	1.03E-02	1.00E-01	8270D	4.13E-02	1.00E-01
Hexachloroethane	67-72-1	4.10E-05	8270	1.31E+01	1.00E+02	8270D	8.48E-03	1.00E-01	8270D	5.60E-03	2.00E-02
Isophorone	78-59-1	3.70E-02	8270	7.12E+00	1.00E+02	8270D	2.92E-02	1.00E-01	8270D	7.80E-03	2.00E-02
Nitrobenzene	98-95-3	4.10E-02	8270	1.30E+01	1.00E+02	8270D	8.08E-03	1.00E-01	8270D	8.00E-03	2.00E-02
n-Nitrosodimethylamine	62-75-9	1.70E-02	8270	1.18E+01	1.00E+02	8270D	1.11E-02	1.00E-01	8270D-SIM	3.00E-03	2.50E-02
n-Nitrosodiphenylamine	86-30-6	1.10E-03	8270	2.00E+01	1.00E+02	8270D	1.41E-02	1.00E-01	8270D-SIM	1.30E-03	5.00E-03
n-Nitrosodi-n-propylamine	621-64-7	1.80E-05	8270	1.37E+01	1.00E+02	8270D	3.88E-02	2.50E-01	8270D-SIM	1.70E-03	2.00E-02
Butyl benzyl phthalate	85-68-7	1.80E-04	8270	9.91E+00	--	8270D	9.33E-03	1.00E-01	8270D-SIM	7.00E-04	5.00E-03
Butyl diphenyl phosphate	2752-95-6	NE	--	--	--	--	--	--	8270D	2.40E-02	6.70E-02
2,6-Bis(1,1-dimethylethyl) phenol	128-39-2	NE	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	117-81-7	5.10E-03	8270	1.61E+01	1.00E+02	8270D	9.15E-03	1.00E-01	8270D	2.88E-02	5.00E-02
Di-n-butyl phthalate	84-74-2	1.50E-02	8270	--	1.00E+02	8270D	1.41E-02	1.00E-01	8270D	5.30E-03	2.00E-02
Diethyl phthalate	84-66-2	3.40E-02	8270	1.21E+01	1.00E+02	8270D	1.75E-02	1.00E-01	8270D	1.77E-02	2.00E-02
Dimethyl phthalate	131-11-3	7.10E-02	8270	1.03E+01	1.00E+02	8270D	1.75E-02	1.00E-01	8270D	6.40E-03	2.00E-02
Di-n-octyl phthalate	117-84-0	3.30E-01	8270	1.13E+01	1.00E+02	8270D	9.03E-03	1.00E-01	8270D	8.70E-03	2.00E-02
1,2,4-Trichlorobenzene	120-82-1	7.20E-05	8270	9.10E+00	7.50E+01	8270D	2.94E-02	1.00E-01	8270D-SIM	2.70E-03	5.00E-03
4-Chloro-3-methylphenol	59-50-7	NE	8270	7.87E+00	2.00E+02	8270D	1.34E-01	5.00E-01	8270D	2.89E-02	1.00E-01
2-Chlorophenol	95-57-8	1.10E-02	8270	1.17E+01	1.00E+02	8270D	4.05E-02	2.50E-01	8270D	6.50E-03	2.00E-02
Dibutyl phenyl phosphate	2528-36-1	NE	--	--	--	--	--	--	8270D	2.90E-02	6.70E-02
1,2-Dichlorobenzene	95-50-1	3.10E-03	8270	1.05E+01	7.50E+01	8260	9.78E-03	1.00E-01	8270D-SIM	7.00E-04	5.00E-03
1,3-Dichlorobenzene	541-73-1	NE	8270	1.69E+01	7.50E+01	8260	1.09E-02	1.00E-01	8270D	5.10E-03	2.00E-02
1,4-Dichlorobenzene	106-46-7	8.10E-03	8270	6.99E+00	7.50E+01	8260	9.86E-03	1.00E-01	8270D-SIM	4.40E-03	2.00E-02
2,4-Dichlorophenol	120-83-2	4.30E-03	8270	9.31E+00	1.00E+02	8270D	1.02E-01	5.00E-01	8270D	3.20E-02	1.00E-01
2,4-Dimethylphenol	105-67-9	3.10E-03	8270	4.41E+00	1.00E+02	8270D	2.66E-02	1.00E-01	8270D-SIM	2.20E-03	2.50E-02
4,6-Dinitro-2-methylphenol	534-52-1	NE	8270	2.30E+01	2.00E+02	8270D	1.18E-02	1.00E-01	8270D	5.05E-02	2.00E-01
2,4-Dinitrophenol	51-28-5	2.90E-02	8270	3.44E+01	5.25E+02	8270D	2.19E-02	1.00E-01	8270D	4.13E-02	2.00E-01
1,4-Dioxane	123-91-1	8.50E+00	8260SIM	2.40E-04	7.20E-04	--	--	--	8270D	1.70E-02	3.35E-01
1,2-Diphenylhydrazine	122-66-7	1.10E+00	--	--	--	--	--	--	--	--	--
2-Methoxynaphthalene	93-04-9	NE	--	--	--	--	--	--	--	--	--
2-Methylphenol (o-Cresol)	95-48-7	1.00E-02	8270	7.75E+00	1.00E+02	8270D	1.41E-02	1.00E-01	8270D-SIM	1.10E-03	5.00E-03
4-Methylphenol (p-Cresol)	106-44-5	6.70E-01	8270	5.94E+00	1.00E+02	8270D	--	--	8270D-SIM	9.00E-04	5.00E-03
2-Nitroaniline	88-74-4	8.00E+02	8270	1.29E+01	1.00E+02	8270D	7.84E-03	1.00E-01	8270D	3.02E-02	1.00E-01
3-Nitroaniline	99-09-2	NE	8270	9.65E+00	1.00E+02	8270D	2.41E-01	1.00E+00	8270D	3.77E-02	1.00E-01
4-Nitroaniline	100-01-6	NE	8270	9.61E+00	1.00E+02	8270D	5.27E-02	2.50E-01	8270D	3.49E-02	1.00E-01
2-Nitrophenol	88-75-5	NE	8270	1.51E+01	1.00E+02	8270D	1.28E-02	1.00E-01	8270D	6.90E-03	2.00E-02
4-Nitrophenol	100-02-7	7.00E+00	8270	1.45E+01	5.00E+02	8270D	2.26E-02	1.00E-01	8270D	4.44E-02	1.00E-01

Attachment 1B - Comparison of Laboratory Detection Limits Against Screening Levels - Soil

			Fremont Analytical			ALS Environmental			Analytical Resources, Inc.		
Analyte	CAS	Ecology PCUL[1]	Method	MDL	RL[2]	Method	MDL	RL[2]	Method	MDL	RL[2]
Pentachlorophenol	87-86-5	1.80E-06	8270	1.17E+01	1.00E+02	8270D	6.03E-02	5.00E-01	8270D-SIM	2.10E-03	2.00E-02
Phenol	108-95-2	1.20E-01	8270	1.41E+01	1.00E+02	8270D	1.65E-02	1.00E-01	8270D	8.20E-03	2.00E-02
Pyridine	110-86-1	8.00E+01	8270	1.61E+01	2.00E+02	8270D	1.83E-02	2.00E-01	8270D	8.66E-02	1.00E-01
2,4,5-Trichlorophenol	95-95-4	1.10E+00	8270	1.15E+01	1.00E+02	8270D	1.63E-02	1.00E-01	8270D	2.69E-02	1.00E-01
2,4,6-Trichlorophenol	88-06-2	1.90E-04	8270	1.41E+01	1.00E+02	8270D	1.65E-02	1.00E-01	8270D	2.54E-02	1.00E-01
Total Petroleum Hydrocarbon Compounds											
Gasoline	na	3.00E+01	NWTPH-Gx	7.70E-01	5.00E+00	NWTPH-Gx	2.91E-01	3.00E+00	NWTPH-Gx	2.50E+00	5.00E+00
Gasoline (w/benzene)	na	3.00E+01	NWTPH-Gx	7.70E-01	5.00E+00	8021	5.70E-03	3.00E-02	NWTPH-Gx	2.50E+00	5.00E+00
Diesel range organics	na	2.60E+02	NWTPH-Dx	4.06E+00	2.00E+01	NWTPH-Dx	3.93E+00	2.50E+01	NWTPH-Dx	2.50E+01	5.00E+01
Heavy Oil	na	2.00E+03	NWTPH-Dx	7.25E+00	5.00E+01	NWTPH-Dx	7.63E+00	5.00E+01	NWTPH-Dx	5.00E+01	1.00E+02

NOTES:

1 Laboratory reporting limits were compared to the most stringent soil preliminary cleanup level (PCUL) for nonpotable groundwater provided by Ecology (June 2018).

2 The RL represents the level of the lowest calibration standard (i.e., the laboratory practical quantitation limit [PQL]); the RL may not always be achievable

Units are milligrams per kilogram.

Green shading indicates an RL or MDL exceeds the PCUL.

Analytical method selections may be modified to best meet objective of reaching screening levels.

-- = not available

CAS = Chemical Abstracts Service; Ecology PCUL = Ecology Preliminary Cleanup Level; MDL = method detection limit; NE = not established; NWTPH = Northwest Total Petroleum Hydrocarbons; SIM = selected ion monitoring

ATTACHMENT 2: ANALYTICAL LIMITS OF DETECTION AND PROJECT SCREENING LEVELS

Attachment 2

Analytical Limits of Detection and Project Screening Levels

CONTENTS

Attachment 2A - Analytical Limits of Detection and Project Screening Levels - Groundwater

		Ecology	Analytical Resources, Inc.		
Analyte	CAS	PCUL[1]	Method	MDL	RL[2]
Metals					
Arsenic (total)	7440-38-2	8.00E+00	EPA 6010C	4.70E-03	5.00E-02
Barium	7440-39-3	2.00E+02	EPA 6010C	7.00E-04	3.00E-03
Cadmium	7440-43-9	1.19E+00	EPA 6010C	3.00E-04	2.00E-03
Chromium, total (or III)	7440-47-3	6.05E-02	EPA 6010C	1.30E-03	5.00E-03
Chromium (VI)	18540-29-9	5.00E+01	SM 3500-Cr B-09	1.00E-02	1.00E-02
Cobalt	7440-48-4	4.80E+00	EPA 6010C	2.00E-04	3.00E-03
Copper	7440-50-8	3.10E+00	EPA 6010C	7.00E-04	2.00E-03
Lead	7439-92-1	8.10E+00	EPA 6010C	1.90E-03	2.00E-02
Manganese	7439-96-5	1.00E+02	EPA 6010C	3.00E-04	1.00E-03
Mercury (elemental)	7439-97-6	2.50E-02	EPA 7470A	1.30E-05	1.00E-04
Nickel	7440-02-0	8.20E+00	EPA 6010C	2.80E-03	1.00E-02
Selenium	7782-49-2	7.10E+01	EPA 6010C	5.00E-03	5.00E-02
Silver	7440-22-4	1.90E+00	EPA 6010C	5.00E-04	3.00E-03
Vanadium	7440-62-2	8.00E+01	EPA 6010C	4.00E-04	3.00E-03
Zinc	7440-66-6	8.10E+01	EPA 6010C	2.10E-03	1.00E-02
Polychlorinated Biphenyls (PCBs)					
PCB - Aroclor 1016	12674-11-2	7.00E-06	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1221	11104-28-2	7.00E-06	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1232	11141-16-5	7.00E-06	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1242	53469-21-9	7.00E-06	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1248	12672-29-6	7.00E-06	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1254	11097-69-1	7.00E-06	8082A	2.48E-03	1.00E-02
PCB - Aroclor 1260	11096-82-5	7.00E-06	8082A	2.76E-03	1.00E-02
Volatile Organic Compounds (VOCs)					
Benzene	71-43-2	1.60E+00	8260C	3.00E-02	2.00E-01
1,1-Dichloroethylene	75-35-4	1.29E+02	8260C	5.00E-02	2.00E-01
cis-1,2-Dichloroethylene	156-59-2	NE	8260C	4.00E-02	2.00E-01
Ethylbenzene	100-41-4	3.10E+01	8260C	4.00E-02	2.00E-01
Methyl tert-butyl ether (MTBE)	1634-04-4	6.05E+02	8260C	7.00E-02	5.00E-01
Tetrachloroethene (PCE)	127-18-4	2.90E+00	8260C	5.00E-02	2.00E-01
Toluene	108-88-3	1.30E+02	8260C	4.00E-02	2.00E-01
Trichloroethene (TCE)	79-01-6	7.00E-01	8260C	5.00E-02	2.00E-01
Vinyl chloride	75-01-4	1.80E-01	8260C	6.00E-02	2.00E-01
m-Xylenes	179601-23-1	3.03E+02	8260C	5.00E-02	4.00E-01
m,p-Xylenes	179601-23-1	1.60E+03	8260C	5.00E-02	4.00E-01
o-Xylene	136777-61-2	4.32E+02	8260C	3.00E-02	2.00E-01
Xylenes, Total	1330-20-7	3.32E+02	8260C	9.00E-02	6.00E-01
Polycyclic Aromatic Hydrocarbons (PAHs)					
Acenaphthene	83-32-9	5.34E+00	8270D	3.00E-01	1.00E+00
Acenaphthylene	208-96-8	NE	8270D	3.00E-01	1.00E+00
Anthracene	120-12-7	2.15E+00	8270D	3.00E-01	1.00E+00
Benzo(a)anthracene	56-55-3	1.60E-04	8270D-SIM-LL	8.00E-04	1.00E-02
Benzo(b)fluoranthene	205-99-2	1.60E-04	8270D-SIM-LL	5.00E-04	1.00E-02
Benzo(k)fluoranthene	207-08-9	1.60E-03	8270D-SIM-LL	3.00E-03	1.00E-02
Total Benzofluoranthenes	E	NE	8270D	8.00E-01	2.00E+00
Benzo(g,h,i)perylene	191-24-2	NE	8270D	5.00E-01	1.00E+00
Benzo(a)pyrene	50-32-8	1.60E-05	8270D-SIM-LL	2.00E-03	1.00E-02

Attachment 2A - Analytical Limits of Detection and Project Screening Levels - Groundwater

Analyte	CAS	Ecology PCUL¹	Analytical Resources, Inc. Method	MDL	RL²
Chrysene	218-01-9	1.60E-02	8270D-SIM-LL	9.00E-04	1.00E-02
Dibenz(a,h)anthracene	53-70-3	1.60E-05	8270D-SIM-LL	1.00E-03	1.00E-02
Dibenzofuran	132-64-9	1.60E+01	8270D	3.00E-01	1.00E+00
Fluoranthene	206-44-0	1.82E+00	8270D	4.00E-01	1.00E+00
Fluorene	86-73-7	3.67E+00	8270D	3.00E-01	1.00E+00
Indeno(1,2,3-cd)pyrene	193-39-5	1.60E-04	8270D-SIM-LL	1.00E-03	1.00E-02
Methyl isopropyl phenanthrene	483-65-8	NE	--	--	--
1-Methylnaphthalene	90-12-0	1.50E+00	8270D	3.00E-01	1.00E+00
2-Methylnaphthalene	91-57-6	3.20E+01	8270D	2.00E-01	1.00E+00
Naphthalene	91-20-3	1.40E+00	8270D	2.00E-01	1.00E+00
Phenanthrene	85-01-8	NE	8270D	2.00E-01	1.00E+00
Pyrene	129-00-0	2.01E+00	8270D	3.00E-01	1.00E+00
Semivolatile Organic Compounds (SVOCs) - Other					
Benzoic Acid	65-85-0	5.90E+02	8270D	3.00E+00	2.00E+01
n-Nitrosodiphenylamine	86-30-6	6.90E-01	8270D-LL	2.00E-02	2.00E-01
Butyl benzyl phthalate	85-68-7	1.30E-02	8270D-LL	7.00E-02	2.00E-01
Bis(2-ethylhexyl)phthalate	117-81-7	4.60E-02	8270D-LL	2.00E-01	2.00E-01
Dibutyl phthalate	84-74-2	8.00E+00	8270D	3.00E-01	1.00E+00
1,2-Dichlorobenzene	95-50-1	4.61E+00	8260	2.00E-01	1.00E+00
1,4-Dichlorobenzene	106-46-7	4.93E+00	8260	2.00E-01	1.00E+00
2,4-Dimethylphenol	105-67-9	6.34E+00	8270D	4.00E-01	3.00E+00
Pentachlorophenol	87-86-5	2.00E-03	8270D-LL	1.00E-01	1.00E+00
Total Petroleum Hydrocarbon Compounds					
Gasoline	--	8.00E+02	NWTPH-Gx	5.74E+01	2.50E+02
Diesel range organics	--	5.00E+02	NWTPH-Dx	2.17E+01	1.00E+02
Heavy Oil	--	5.00E+02	NWTPH-Dx	4.43E+01	2.00E+02

NOTES:

1 Laboratory reporting limits were compared to the most stringent groundwater preliminary cleanup level (PCUL) for nonpotable groundwater provided by Ecology (June 2018).

2 The RL represents the level of the lowest calibration standard (i.e., the laboratory practical quantitation limit [PQL]); the RL may not always be achievable

Units are in micrograms per liter.

Blue shading indicates that there is no PCUL established for nonpotable groundwater; the highlighted PCUL is for potable groundwater

Grey shading indicates that there is no PCUL established for nonpotable groundwater, the highlighted value is the background concentration

Green shading indicates an RL or MDL exceeds the PCUL.

Analytical method selections may be modified to best meet objective of reaching screening levels.

-- = not available

CAS = Chemical Abstracts Service; Ecology PCUL = Ecology Preliminary Cleanup Level; MDL = method detection limit; NE = not established; NWTPH = Northwest Total Petroleum Hydrocarbons; SIM = selected ion monitoring

Attachment 2B - Analytical Limits of Detection and Project Screening Levels - Soil

		Ecology	Analytical Resources, Inc.		
Analyte	CAS	PCUL[1]	Method	MDL	RL[2]
Metals					
Arsenic (total)	7440-38-2	7.30E+00	6010C	5.00E-04	5.00E+00
Barium	7440-39-3	8.30E+00	6010C	7.00E-05	3.00E-01
Cadmium	7440-43-9	7.70E-01	6010C	3.00E-05	2.00E-01
Chromium, total (or III)	7440-47-3	4.80E+01	6010C	1.00E-04	5.00E-01
Chromium (VI)	18540-29-9	9.60E-01	7196A	4.00E-01	4.00E-01
Cobalt	7440-48-4	2.00E+01	6010C	2.00E-05	3.00E-01
Copper	7440-50-8	3.60E+01	6010C	7.00E-05	2.00E-01
Lead	7439-92-1	5.00E+01	6010C	2.00E-04	2.00E+00
Mercury (elemental)	7439-97-6	7.00E-02	7471B	5.25E-03	2.50E-02
Nickel	7440-02-0	4.80E+01	6010C	3.00E-04	1.00E+00
Selenium	7782-49-2	3.00E-01	6010C	5.00E-04	5.00E+00
Silver	7440-22-4	1.60E-02	6010C	5.00E-05	3.00E-01
Vanadium	7440-62-2	2.00E+00	6010C	4.00E-05	3.00E-01
Zinc	7440-66-6	8.50E+01	6010C	1.60E-01	1.00E+00
Polychlorinated Biphenyls (PCBs)					
PCB - Aroclor 1016	12674-11-2	2.20E-06	8082A	8.00E-03	2.00E-02
PCB - Aroclor 1221	11104-28-2	2.20E-06	8082A	8.00E-03	2.00E-02
PCB - Aroclor 1232	11141-16-5	2.20E-06	8082A	8.00E-03	2.00E-02
PCB - Aroclor 1242	53469-21-9	2.20E-06	8082A	8.00E-03	2.00E-02
PCB - Aroclor 1248	12672-29-6	2.20E-06	8082A	8.00E-03	2.00E-02
PCB - Aroclor 1254	11097-69-1	2.20E-06	8082A	8.00E-03	2.00E-02
PCB - Aroclor 1260	11096-82-5	2.20E-06	8082A	8.00E-03	2.00E-02
Volatile Organic Compounds (VOCs)					
Benzene	71-43-2	5.60E-04	8260C	3.00E-04	1.00E-03
1,1-Dichloroethylene	75-35-4	1.40E+00	8260C	3.40E-04	1.00E-03
cis-1,2-Dichloroethylene	156-59-2	1.60E+02	8260C	2.40E-04	1.00E-03
Ethylbenzene	100-41-4	1.50E-02	8260C	2.00E-04	1.00E-03
Tetrachloroethene (PCE)	127-18-4	1.60E-03	8260C	2.60E-04	1.00E-03
Toluene	108-88-3	5.50E-02	8260C	1.50E-04	1.00E-03
Trichloroethene (TCE)	79-01-6	2.70E-04	8260C	2.10E-04	1.00E-03
Vinyl chloride	75-01-4	5.50E-05	8260C	2.40E-04	1.00E-03
m-Xylenes	179601-23-1	1.60E+04	8260C	3.90E-04	2.00E-03
p-Xylenes	179601-23-1	1.60E+04	8260C	3.90E-04	2.00E-03
o-Xylene	136777-61-2	1.60E+04	8260C	2.20E-04	1.00E-03
Xylenes, Total	1330-20-7	1.60E+04	8260C	6.20E-04	2.00E-03
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	83-32-9	2.80E-02	8270D	5.10E-03	2.00E-02
Acenaphthylene	208-96-8	1.30E+00	8270D	4.80E-03	2.00E-02
Anthracene	120-12-7	5.10E-02	8270D	5.90E-03	2.00E-02
Benzo(a)anthracene	56-55-3	5.70E-05	8270D-SIM-LL	7.00E-05	5.00E-04
Benzo(b)fluoranthene	205-99-2	2.00E-04	8270D-SIM-LL	7.00E-05	5.00E-04
Benzo(k)fluoranthene	207-08-9	2.00E-03	8270D-SIM-LL	1.00E-04	5.00E-04
Total Benzofluoranthenes	E	3.20E+00	8270D	1.02E-02	4.00E-02
Benzo(g,h,i)perylene	191-24-2	6.70E-01	8270D	5.80E-03	2.00E-02
Benzo(a)pyrene	50-32-8	1.60E-05	8270D-SIM-LL	9.00E-05	5.00E-04
Chrysene	218-01-9	6.40E-03	8270D	5.20E-03	2.00E-02
Dibenz(a,h)anthracene	53-70-3	2.90E-05	8270D-SIM-LL	1.00E-04	5.00E-04

Attachment 2B - Analytical Limits of Detection and Project Screening Levels - Soil

		Ecology	Analytical Resources, Inc.		
Analyte	CAS	PCUL[1]	Method	MDL	RL[2]
Dibenzofuran	132-64-9	5.40E-01	8270D	4.60E-03	2.00E-02
Fluoranthene	206-44-0	9.00E-02	8270D	4.50E-03	2.00E-02
Fluorene	86-73-7	2.90E-02	8270D	5.00E-03	2.00E-02
Indeno(1,2,3-cd)pyrene	193-39-5	5.60E-04	8270D-SIM-LL	9.00E-05	5.00E-04
Methyl isopropyl phenanthrene	483-65-8	NE	--	--	--
1-Methylnaphthalene	90-12-0	2.90E+01	8270D	6.00E-03	2.00E-02
2-Methylnaphthalene	91-57-6	6.70E-01	8270D	5.70E-03	2.00E-02
Naphthalene	91-20-3	2.10E-03	8270D	2.00E-04	1.00E-03
Phenanthrene	85-01-8	1.50E+00	8270D	5.20E-03	2.00E-02
Pyrene	129-00-0	1.40E-01	8270D	5.60E-03	2.00E-02
Total Petroleum Hydrocarbon Compounds					
Gasoline	na	3.00E+01	NWTPH-Gx	2.50E+00	5.00E+00
Diesel range organics	na	2.60E+02	NWTPH-Dx	2.50E+01	5.00E+01
Heavy Oil	na	2.00E+03	NWTPH-Dx	5.00E+01	1.00E+02

NOTES:

1 Laboratory reporting limits were compared to the most stringent soil preliminary cleanup level (PCUL) for nonpotable groundwater provided by Ecology (June 2018).

2 The RL represents the level of the lowest calibration standard (i.e., the laboratory practical quantitation limit [PQL]); the RL may not always be achieva

Units are in milligrams per kilogram

Green shading indicates an RL or MDL exceeds the PCUL.

Analytical method selections may be modified to best meet objective of reaching screening levels.

-- = not available

CAS = Chemical Abstracts Service; Ecology PCUL = Ecology Preliminary Cleanup Level; MDL = method detection limit; NE = not established; NWTPH = Northwest Total Petroleum Hydrocarbons; SIM = selected ion monitoring

Attachment 3

Sample Containers, Preservatives, and Holding Times

ATTACHMENT 3: SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES

Attachment 3 - Sample Containers, Preservatives, and Holding Times

Method	Analysis	Container[a] Type	Size	Preservation	Holding Time
Soil Samples					
EPA 8082A	PCB aroclors	Glass	8 oz.	Cool 0 - 6°C	14 days
EPA 200.8	Metals[b]	Glass	4 oz.	Cool 0 - 6°C	180 days
EPA 7471B	Mercury	Glass	4 oz.	Cool 0 - 6°C	28 days
EPA SM3500	Hexavalent Chromium	Glass	4 oz.	Cool 0 - 6°C	28 days
EPA 8270D	SVOCs	Glass	8 oz.	Cool 0 - 6°C	14 days
EPA 8260C	VOCs	Glass	8 oz./3 x 40 ml	MeOH(1); NaHSO4(2), Cool 0 - 6°C	14 days
NWTPH-G	TPH - Gasoline	Glass	8 oz./2 x 40 ml	MeOH, Cool 0 - 6°C	14 days
NWTPH-Dx	TPH - Diesel and Residual Range	Glass	8 oz.	Cool 0 - 6°C	14 days
9060A	Total Organic Carbon	Glass	4 oz.	Cool 0 - 6°C	14 days
Groundwater Samples					
EPA 200.8	Total Metals[b]	HDPE	500 mL	HNO3, Cool 0 - 6°C	180 days
EPA 7470A	Total Mercury	HDPE	500 mL	HNO3, Cool 0 - 6°C	28 days
EPA 200.8	Dissolved Metals[b]	HDPE	500 mL	HNO3, Cool 0 - 6°C	180 days
EPA 7470A	Dissolved Mercury	HDPE	500 mL	HNO3, Cool 0 - 6°C	28 days
EPA SM3500	Dissolved Hexavalent Chromium	Glass	250 mL	Cool 0 - 6°C[c]	28 days
EPA 8082A	PCB aroclors	Amber Glass	2 x 500 mL	Cool 0 - 6°C	7 days
EPA 8260C	VOCs	Glass Vial	3 x 40 mL	HCL, Cool 0 - 6°C	14 days
EPA 8270D	SVOCs/PAHs	Amber Glass	2 x 500 mL	Cool 0 - 6°C	7 days
NWTPH-G	TPH - Gasoline	Glass Vial	2 x 40 mL	HCL, Cool 0 - 6°C	14 days
NWTPH-Dx	TPH - Diesel and Residual Range	Amber Glass	2 x 500 mL	Cool 0 - 6°C	7 days
EPA 300.0	Nitrate, nitrite, sulfate	Glass	250 mL	Cool 0 - 6°C	24 hours
EPA SM4500	Sulfite	Glass	250 mL	EDTA, Cool 0 - 6°C	6 hours
EPA SM3500	Ferrous iron	Amber Glass	250 mL	HCL, Cool 0 - 6°C	24 hours
EPA 200.8	Manganese ion	HDPE	500 mL	HNO3, Cool 0 - 6°C	180 days
RSK-175	Methane	Glass Vial	2 x 40 mL	Cool 0 - 6°C	7 days

NOTES:

a The size and number of containers may be modified by the analytical laboratories.

b Metals include arsenic, cadmium, chromium, cobalt, copper, iron (groundwater only), lead, manganese (groundwater only), nickel, selenium, silver, and zinc.

c Dissolved metals and hexavalent chromium collected in unpreserved bottles. Upon receipt at lab, samples to be filtered and preserved.

°C = degrees Celsius; Dx = diesel-extended; EDTA = ethylenediaminetetraacetic acid; EPA = U.S. Environmental Protection Agency; G = gasoline; HCL = hydrochloric acid; HDPE = high density polyethylene; HNO3 = nitric acid; MeOH = methanol; mL = milliliters; NAHSO4 = sodium bisulfate; NaOH = sodium hydroxide; NWTPH = Northwest Total Petroleum Hydrocarbons; oz. = ounce; PAH = polycyclic aromatic hydrocarbons; PCB = polychlorinated biphenyls; SVOCs = semi-volatile organic compounds; TPH = total petroleum hydrocarbons; VOCs = volatile organic compounds

Attachment 4

PFAS Data-Validation Program Plan

ATTACHMENT 4: PFAS DATA-VALIDATION PROGRAM PLAN

SUBMITTED FOR:
PFAS-Sampling Projects

BY:
Shannon & Wilson, Inc.
2355 Hill Road
Fairbanks, Alaska 99709

(907) 479-0600
www.shannonwilson.com

DATA-VALIDATION PROGRAM PLAN

S&W PFAS Validation

VARIOUS SITES

SHANNON & WILSON

April 2020

Shannon & Wilson No: 21-1-12596-013

PAGE INTENTIONALLY LEFT BLANK FOR DOUBLE-SIDED PRINTING

CONTENTS

Exhibits

Appendix

CCV	continuing calibration verification
COC	chain-of-custody
°C	degrees Celsius
DQO	data quality objective
EB	equipment blank
EDD	electronic data deliverable
FB	field blank
GRO	gasoline range organics
ICV	initial calibration verification
IDA	isotope dilution analyte
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
MB	method blank
mm	millimeter
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
%R	percent recovery
PFAS	per- and polyfluoroalkyl substances
PQL	practical quantitation limit
QAPP	quality assurance program plan
QA	quality assurance
QC	quality control
RPD	relative percent difference
SDG	sample delivery group
SGS	SGS North America, Inc.
SOP	standard operating procedure
SRF	sample receipt form
USACE	US Army Corps of Engineers
USEPA	US Environmental Protection Agency
VOC	volatile organic compound
WO	work order

Exhibit 1-1: Definition of Flags

Flag	Displayed as	Description
U	< [reporting limit]	The analyte was not detected; the result is listed as less than the reporting limit.
UJ	< [reporting limit] J*	The analyte was not detected; the listed reporting limit may not represent the true reporting limit due to sample-handling or laboratory quality-control (QC) failures (i.e., the listed reporting limit may be inaccurate or imprecise).
UB	< [LOQ or reported concentration] B*	The analyte is considered not detected due to sample-contamination identified in a blank; the result is listed as less than the limit of quantitation (LOQ) or the concentration originally reported in the sample (higher of the two values).
J	[Result] J – Flag applied by laboratory [Result] J* – Flag applied by reviewer	The result is an estimated quantity. The analyte was detected below the LOQ or was affected by QC failures.
JL	[Result] JL*	The result is an estimated quantity and may be biased low due to QC failures.
JH	[Result] JH*	The result is an estimated quantity and may be biased high due to QC failures.
JN	[Result] JN*	The analyte was tentatively identified, and the result is an estimated quantity.
R	R*	The results are unusable. The sample results are rejected due to severe QC deficiencies. The analyte may or may not be present in the sample.

NOTES:

* Flag applied by reviewer.

LOQ = limit of quantitation, QC = quality control

1 INTRODUCTION

This per- and polyfluoroalkyl substances (PFAS) Data-Validation Program Plan (the Plan) was prepared to describe the procedures used by Shannon & Wilson staff for reviewing and qualifying analytical PFAS data in an objective and consistent manner.

This Plan describes the process for qualifying analytical data based on quality assurance/quality control (QA/QC) review of Level II laboratory reports and electronic data deliverables (EDDs). This Plan is intended to provide guidance for generally conducting what the US Environmental Protection Agency (USEPA) refers to as a Stage 2a Validation (USEPA 2009). A more critical level of validation is beyond the scope of this Plan, but the Plan does present guidance for determining whether additional review should be conducted, based on information received from the laboratory. This Plan also assesses the quality of the analytical data using PARCCS parameters (precision, accuracy, representativeness, comparability, completeness, and sensitivity).

This Plan provides information about references we use during the data-validation process and presents data qualifiers used to "flag" analytical data. The standard set of flags we use to validate analytical data along with their definitions are presented in Exhibit 1-1. Methods for applying data qualifiers are referenced primarily from the following USEPA guidance documents:

- USEPA National Functional Guidelines for Organic Methods Data Review, January 2017 (USEPA 2017b); and
- USEPA Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537, November 2018 (USEPA 2018a).

In some cases, we also reference the following US Army Corps of Engineers (USACE) guidance document to formulate our opinions when USEPA guidance documents recommend exercising professional judgment:

- USACE Engineering Manual 200-1-10, Guidance for Evaluating Performance-Based Chemical Data, June 2005 (USACE 2005).

Additional references are listed in Section 12.0 and cited throughout the text.

In general, most data-review guidelines presented in this Plan are drawn from federal guidance documents. However, in some cases federal guidance is not consistent, is outdated, or does not account for specific issues addressed in this Plan; in these cases, the guidance presented in the Plan is based on standard industry practice or site-specific considerations, which are based on Shannon & Wilson chemists' years of professional experience.

Most quality assurance program plans (QAPPs) specify data quality objectives (DQOs) for items such as laboratory control sample (LCS) recovery and target reporting limits. This document does not present such limits, but instead defers to internal laboratory control limits that are statistically derived, frequently updated, and within the requirements of the laboratory's national certification, and thus compliant with federal requirements.

2 LABORATORY CERTIFICATION AND DELIVERABLES

2.1 Laboratory Certification

Prior to submitting samples to a laboratory, we will request the laboratory certifications for the requested analyses. In cases where the original laboratory subcontracts analysis to a network or referral laboratory ("ref lab"), the referral laboratory must be certified for the requested analyses.

2.2 Laboratory Deliverables

Laboratory Level II reports and EDDs are obtained directly from the laboratory via e-mail or laboratory data websites. The laboratory reports and EDDs are reviewed for completeness and revised reports are requested where there is missing or incorrect information. Laboratory reports are provided in Adobe Acrobat (.pdf) format, while EDDs are provided in extensible markup language (.xml) format, or another similar format. It may be necessary to engage with the laboratory regarding a database compatible EDD format.

Laboratory reports and EDDs are grouped by the work order (WO) number assigned when the laboratory receives the sample delivery group (SDG). SDGs are determined by the samples and analyses listed on the chain-of-custody (COC) record.

3 CHAIN-OF-CUSTODY

Evidence of sample custody from the time of collection to the time of receipt by the laboratory is documented via the COC record. A COC contains the signatures of individuals collecting, shipping, and receiving each sample. The COC is reviewed to verify it is signed and dated by the sampler, the local receiving staff (unless shipped directly), and the laboratory's receiving staff. Carriers who are only involved in the transport of sealed coolers (e.g., Lynden Transport, Inc.) are not required to sign the COC. A sample is considered to be in custody if it is:

- in a person's actual possession;

- in view, after being in physical possession;
- sealed so no one can tamper with it, after having been in physical custody; or
- in a secured area, restricted to authorized personnel.

If the COC record is not complete and accurate (e.g., signatures missing, date/time discrepancies, lack of custody seals), professional judgment must be used as to whether to qualify the data. The reviewer should consider rejecting data and recollecting the samples, if possible, if it is suspected that custody was intentionally breached, and the samples may have been tampered with. If instead there is a simple omission or minor discrepancy, the data may be usable without qualification if the source of the omission or discrepancy is known and accounted for.

The COC also provides the requested analyses for each documented sample. COCs are reviewed to verify the correct analyses were requested, and that sample names match those on the sample-collection logs. Where discrepancies are noted, the laboratory will coordinate with the sampling team to confirm the correct sample names are used in reporting the results.

4 SAMPLE HANDLING, CONDITION, PRESERVATION, AND HOLDING TIMES

Evidence of sample condition is documented on the laboratory's sample receipt form (SRF) upon delivery. SRFs document QC non-conformance issues during sample handling, where such information exists. In some cases, samples are delivered to a local sample-receiving office prior to transport to the analytical laboratory; SRFs are completed at each location.

The following sections generally apply to soil and water. For sample-handling requirements for other media besides soil and water sample, we will refer to the individual USEPA sampling and analysis methods and/or laboratory sampling guides. In general, data qualification based on sample-handling failures is the same for other media as for soil and water samples; however, the sample-handling requirements may be different and must be assessed on a method-specific basis.

4.1 Acceptable Temperatures

SRFs are reviewed to verify samples are received within the acceptable temperature range. Temperature of the coolers and/or temperature blanks should be documented at each receiving location. Samples are considered to be within the acceptable temperature range if received between 0 degrees Celsius (°C) and 6 °C, where temperature preservation is required. This range is referenced in multiple guidance (e.g. USEPA 2017a, 2017b, 2018b) noting that water samples received below this cutoff are acceptable in the absence of ice.

Data qualification based on temperatures outside the acceptable criteria may vary for different analyses and sample matrices. For example, PFAS analysis for samples exceeding 6 °C is unlikely to have the same reduction in concentration as a sample submitted for volatile organic compound (VOC) analysis. Another notable exception to the temperature range criteria is for samples that collected frozen (<-7 °C). These samples may be maintained frozen until sub-sampled and preserved, if allowed by the project work plan.

Exhibit 4-1 provides general guidelines for qualifying results for samples received outside the acceptable temperature range; however, the individual extraction or analytical methods should be consulted, and professional judgment used.

Exhibit 4-1: Sample-Temperature Actions

		Action	
Matrix	Criteria	Detected Analytes	Analytes Not Detected
Water	0 °C – 6 °C	No qualification	
	0 °C – 6 °C; ice in samples	J	UJ
	< 0 °C; no ice in samples	No qualification	
	< 0 °C; ice in samples	J	UJ
	> 6 °C	JL	UJ[1]
Soil	0 °C – 6 °C	No qualification	
	< 0 °C	No qualification[2]	
	> 6 °C	JL	UJ[1]
PFAS Impacted Soil and Water	0 °C – 10 °C[3]	No qualification	
	< 0 °C	No qualification[2]	
	> 10 °C	JL	UJ

NOTES:

1 Use professional judgment when qualifying sample results based on temperature exceedance, considering the volatility of the analyte. If temperatures are higher than 10 °C or are suspected to have been above 6 °C for an extended period (e.g., over 24 hours), reviewer should consider rejecting sample results for volatile analytes that were not detected.

2 Use professional judgment and refer to method-specific requirements for non-standard analyses and matrices.

3 Samples shall be protected from light and refrigerated at ≤ 6°C (but not frozen) from the time sample collection until receipt at the laboratory.

°C = degrees Celsius, PFAS = per- and polyfluoroalkyl substances

4.2 Sample Preservation

Some analyses require addition of sample preservatives in addition to maintaining the samples within the acceptable temperature range. Various guidance documents (USEPA

2018b; USACE 2005) and individual USEPA extraction methods list sample-preservation requirements for individual methods and matrices. The laboratory SRF documents whether samples were received with proper preservative and in good condition. Requirements for groundwater samples collected for PFAS analysis are shown in Exhibit 4-2a below.

Exhibit 4-2a: PFAS Groundwater Preservation Requirements

Analyte	Matrix	Containers	Preservation Requirements	Preparation Holding Time	Analytical Holding Time
PFAS	Groundwater	2 x 250 mL HDPE Bottles	4 ± 2 °C	14 days	40 days

Not all data are affected the same way by failure to properly preserve samples, therefore, individual extraction or analytical methods should be consulted, and professional judgement used. For example:

- In the case where one analyte is the degradation byproduct of another analyte, the degraded species may increase in a sample following storage with inadequate preservation (USACE 2005); the same may occur if holding times are exceeded (see Section 4.3, below).

In most cases where sample preservation is inadequate, sample results should be considered estimated and qualified using the criteria listed in Exhibit 4-2b below.

Exhibit 4-2b: Preservation Actions

	Action	
Criteria	Detected Analytes	Analytes Not Detected
Adequate Preservation[1,2]	No qualification	
Inadequate Preservation[1,2]	JL	UJ

NOTES:

1 Per regulatory guidance and/or method specific or preservation requirements.

2 Use professional judgment and refer to method-specific requirements for non-standard analyses and matrices.

4.3 Holding Times

Samples are required to be extracted and/or analyzed within method-specific holding times. The holding time begins immediately following sample collection. Holding times for PFAS groundwater samples are listed in Exhibit 4-2a above. Holding times are calculated on a per-day basis, except for short-holding-time analyses where the holding time is measured in hours (typically for analyses listed with a holding time of 72 hours or less).

Holding times are evaluated based on the matrix and method. Certain methods list a collection-to-analysis holding time (e.g., analysis of volatile organic compounds in soil, where extraction occurs in the field at the time of collection), while others list separate holding times for collection to extraction and for extraction to analysis.

In general, where holding times are exceeded, sample results shall be qualified using the criteria listed in Exhibit 4-3.

Exhibit 4-3: Holding-Time Actions

Analysis	Criteria	Action	
		Detected Analytes	Analytes Not Detected
PFAS	t ≤ HT	No qualification	
	t > HT	J	UJ
	t > 2x HT (gross exceedance)	J	R
All Others[1]	t ≤ HT	No qualification	
	HT < t ≤ 2 x HT (marginal exceedance)	JL	UJ
	t > 2x HT (gross exceedance)	JL	R

NOTES:

1 Use professional judgment and refer to method-specific requirements for non-standard analyses and matrices.

HT = method (technical) holding time; t = actual holding time

As with sample preservation, professional judgment must be used when qualifying data based on holding-time exceedance, as there can be situations where certain analytes are affected differently than others (such as in the case of analytes that are degradation products of one another). Also, preservation failures coupled with a marginal holding-time exceedance may warrant rejection of results for analytes that were not detected.

4.4 Sample Condition

Sample condition is documented on the laboratory's SRF(s). Professional judgment should be used to determine if qualification of analytical results is necessary for cases where sample condition is compromised. Some common circumstances that may affect sample results are listed below:

1. **Broken Container**: Sometimes lids crack upon tightening, but no liquid is lost. As long as the lid is replaced prior to sample shipment (may be replaced by the laboratory sample-receiving office), results are not considered affected. Most water analyses require at least one duplicate bottle to be filled. If only one of the bottles is broken and the analysis is performed with the intact bottle, no qualification is required other than noting the broken container on the data-review checklist. However, if the sample with the broken container was used for analysis, professional judgment should be used to

determine if the analyses are affected by the addition of air. Affected sample results shall be qualified using the criteria listed in Exhibit 4-4.

2. **Soil analysis reported using "wet weight"**: When collecting soil samples an additional jar is provided for the laboratory to determine the percent solids. In the absence of the additional percent-solids jar, the laboratory may report soil concentrations using the "wet weight." The overall concentration of the analyte is determined by dividing the mass of the analyte by the mass of the soil. In cases where a dry weight was not determined, the concentration may be reported using a wet weight. The results for samples reported using the wet weight shall be qualified using the criteria listed in Exhibit 4-4.

Other sample-condition anomalies than those listed above may occur. These anomalies should be addressed using available guidance, individual extraction or analytical methods, and the reviewer's professional judgement.

Exhibit 4-4: Sample Condition Actions

	Action	
Criteria	Detected Analytes	Analytes Not Detected
Broken Container	JL	UJ[1]
Soil Analysis Reporting "Wet Weight"	JL	UJ

NOTES:

1 Use professional judgement and consider rejecting data depending on how much sample leaked or the volatility of the analyte.

mm = millimeter

5 ANALYTICAL SENSITIVITY

Analytical sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected or quantified (USACE 2005). Analytical sensitivity is evaluated by comparing the appropriate reporting limit (generally the limit of detection [LOD]) for not-detected results to the relevant cleanup level or action limit, where such standards exist. Where LODs are not available, limits of quantitation (LOQs), practical quantitation limits (PQLs), or method reporting limits (MRLs) may be used. We note the LOQ, PQL and MRL are interchangeable terms and depends on the laboratory for which term is used in reporting the results. For the purposes of this data validation plan, we reference the LOQ.

In general, regulatory limits used to check analytical sensitivity are provided by state or federal agencies for soil and water; analytes without regulatory limits are compared to the relevant, project-specific or analyte-specific action limit at the time of comparison.

In cases where the reporting limit (LOD, LOQ, PQL, etc.) exceeds the regulatory limit, a note will be added to the data-review checklist and associated results tables noting the reporting limit is elevated. Reporting limits that exceed regulation limits should be identified using the following criteria listed in Exhibit 5-1.

Exhibit 5-1: Elevated Reporting Limit Actions

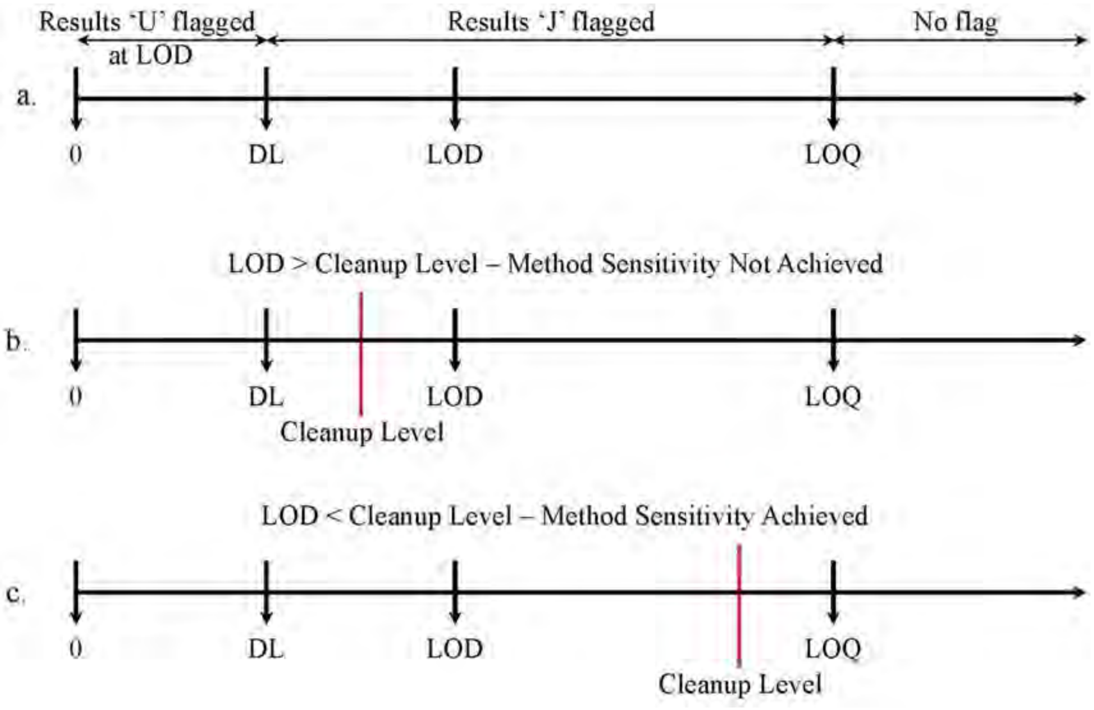
Criteria	Action
Reporting Limit[1] ≤ Cleanup Level / Action Level	No note
Reporting Limit[1] > Cleanup Level / Action Level	Note should be added to the Checklist and Results Tables

NOTES:

1 The reporting limit used for the analytical sensitivity comparison should be described in the DEC data-review checklist.

Exhibit 5-2 illustrates the relationship between the DL, LOD, and LOQ, with a summary of laboratory result flags applied to each range and an example of acceptable and unacceptable (elevated) reporting limits.

Exhibit 5-2: Relationship between DL, LOD, LOQ, and Corresponding Laboratory Result Flags and Cleanup Levels.



NOTES:

a. Results flagged "J" by laboratory where analyte is detected above the DL, but below the LOQ.

b. Unacceptable LOD-to-cleanup-level relationship.

c. Acceptable LOD-to-cleanup-level relationship.

Note that these are example scenarios; not all data are compared using the LOD, and therefore this figure does not apply to data received from all laboratories.

DL = detection limit; LOD = limit of detection; LOQ = limit of quantitation.

6 BLANK SAMPLES

Blank samples are analyzed to check for possible contributions to the analytical results from cross-contamination between samples, or from sample-contamination from an outside source. Typically, the following blank samples are reviewed in conjunction with project samples, where appropriate:

- method blanks;
- trip blanks (volatile analytes only);
- field blanks; and
- equipment blanks.

Each of these blanks check for sample-contamination issues at various steps between sample collection and analysis. Detections in one blank can cause related detections in other blank samples. For example, a detection in a method blank can cause detections in corresponding trip blanks or equipment blanks. Therefore, it is important to investigate blank detections to determine at what step sample-contamination was first introduced; data-qualification should proceed beginning at this level.

For the purposes of this Plan (Level II data review), blank detection evaluation should proceed using the following hierarchy:

1. method blank;
2. field blank; and
3. equipment blank

Additional details regarding these types of blanks are provided in sections 6.1 through 6.4 below.

Additional blanks collected or analyzed by the lab for method-specific requirements should be evaluated on a case-by-case basis.

Data-qualification procedures are identical between blank types within a given matrix; however, the list of affected project samples vary. Exhibit 6-1 presents data-qualification criteria for samples affected by detections in a blank sample; these criteria are generally consistent with those presented in EM 200-1-10 (USACE 2005).

Exhibit 6-1: Actions for Blank Detections

Analysis	Concentration in blank (y)	Concentration in corresponding project sample (z)	Action
PFAS	DL < y < 2x LOQ	z = Not Detected	No qualification
		z < LOQ	UB at the LOQ
		LOQ ≤ z < 10y	UB at the detected result (z)
		z ≥ 10y	No qualification
	y ≥ 2x LOQ[2] (gross contamination)	z = Not Detected	No qualification
		z = Detect	R

NOTES:

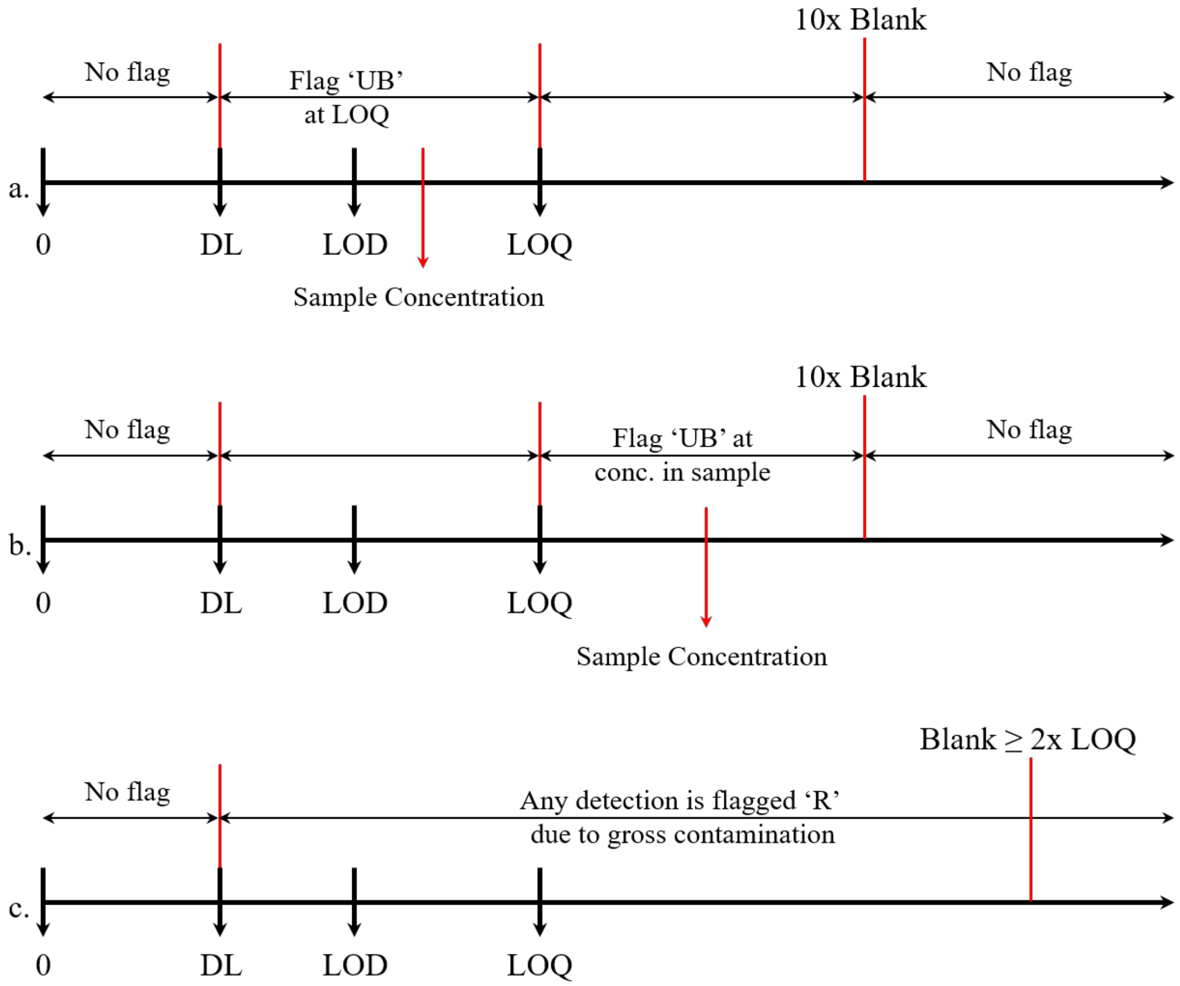
1 Use professional judgment and refer to method-specific requirements for non-standard analyses and matrices.

2 Use professional judgment to assess the reported LOQ. If elevated, reference a typical LOQ for a non-detect result.

DL = detection limit, LOQ = limit of quantitation (also known as PQL or MRL), y = concentration in blank, z = concentration in corresponding sample

Exhibits 6-2 and 6-3 presents a visual example of flagging criteria for a blank detection for PFAS and all other analyses, respectively.

Exhibit 6-2: Example Qualification Criteria for PFAS Blank Detections



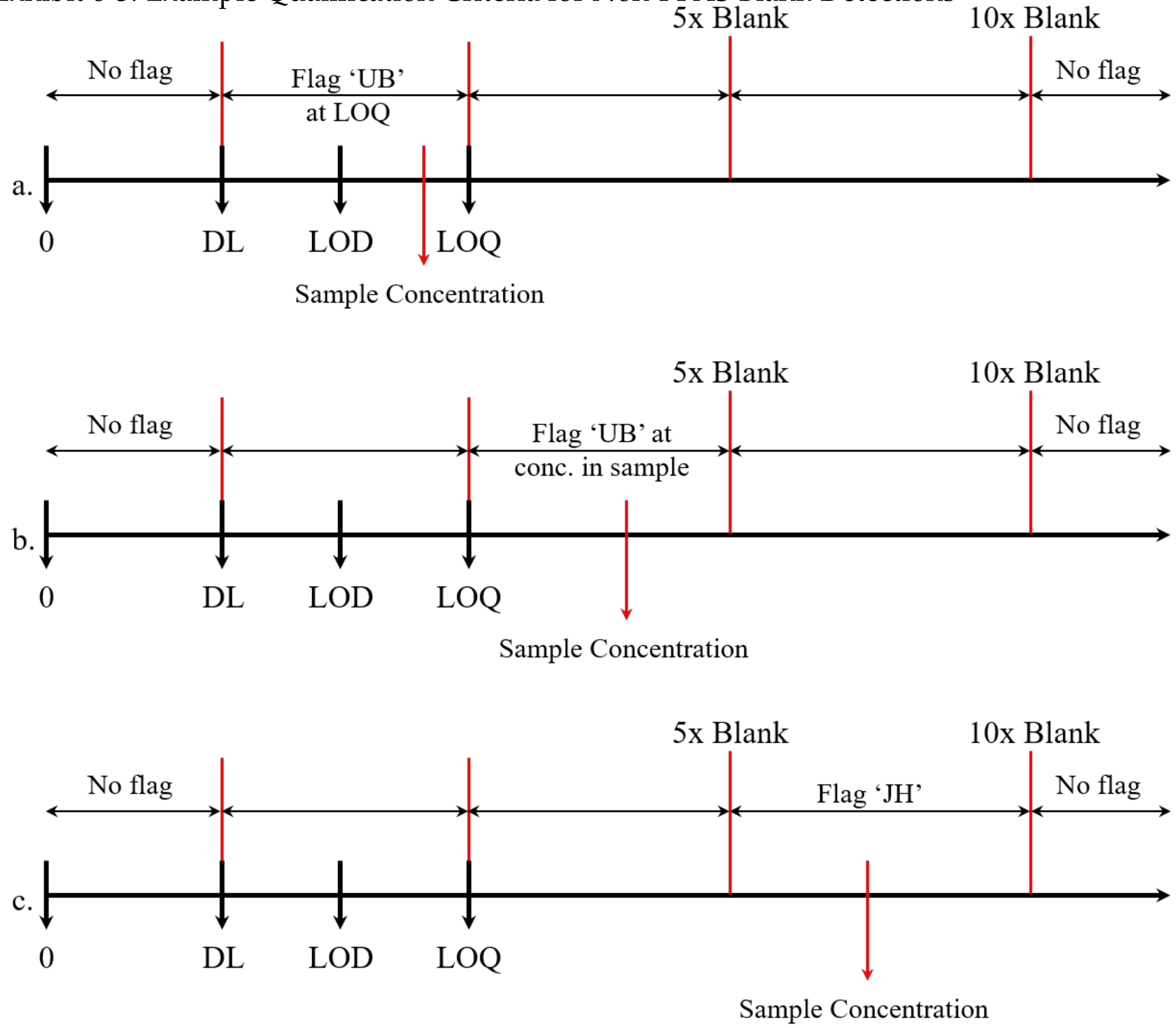
NOTES:

Project-sample results would be qualified as follows:

a) Flag ‘UB’ at the LOQ.
b) Flag ‘UB’ at the concentration detected in the sample.
c) Flag ‘R’ for any detection in the sample.

DL = detection limit; LOD = limit of detection; LOQ = limit of quantitation (also known as PQL or MRL).

Exhibit 6-3: Example Qualification Criteria for Non-PFAS Blank Detections



NOTES:

Project-sample results would be qualified as follows:

a) Flag 'UB' at the LOQ.
b) Flag 'UB' at the concentration detected in the sample.
c) Flag 'JH' at the concentration detected in the sample.

DL = detection limit; LOD = limit of detection; LOQ = limit of quantitation (also known as PQL or MRL).

6.1 Method Blanks

Method blank (MB) samples are prepared by the laboratory with every preparatory batch, at a minimum rate of one MB per 20 samples. MBs are samples of clean media (soil, water, etc.) that are subjected to the same procedures as project samples to extract a given analyte(s). MBs are evaluated to determine if the method of extraction, cleanup, or analysis introduces any contamination during the process.

The reviewer will check that MBs were prepared and analyzed by the laboratory at the required frequency, and that no analytes were reported in the MBs. If an analyte is reported in an MB, all samples in the corresponding preparatory batch should be evaluated for that analyte. Data qualifiers should be applied according to Exhibit 6-1, above.

6.2 Field Blanks

Field blank (FB) samples are collected in the field by sample personnel. The sampler opens a sample bottle in the same air space as the corresponding project sample and collects the field blank by filling the bottle with laboratory provided deionized water. The FB is used to assess for possible contamination from the sampling site. If an analyte is reported in the FB, the corresponding sample should be evaluated for the detected analytes and, if necessary, qualified based on the criteria presented in Exhibit 6-1, above.

6.3 Equipment Blanks

Equipment blank (EB) samples are collected in the field by the sampling personnel. The EB is used to determine if decontamination of reusable sampling equipment between sampling locations is sufficient. The reviewer will check that EBs were collected at the required frequency, and that no analytes were reported in the EBs. If an analyte is reported in an EB, all samples collected using the same sampling equipment on the same day will be evaluated (determined based on field sampling logs, and if necessary, qualify based on the criteria presented in Exhibit 6-1, above.

7 ACCURACY

Accuracy is evaluated at multiple levels throughout the analytical process, using a variety of techniques. It is assessed at the preparatory batch level using recovery information from LCS and laboratory control sample duplicates (LCSDs), matrix spike samples (MSs) and matrix spike duplicates (MSDs), and surrogates or isotope dilution analytes (IDAs). MS/MSD and surrogate or IDA recovery information are used to determine whether there is interference from the sample matrix that affects the accuracy of the reported results. The following sections discuss these QC samples in association with the preparatory batch. However, we note there are some analytical methods for inorganics that do not require a preparatory batch and the LCS, LCSD, MS, and MSD QC sample are assessed at the analytical-batch level. Accuracy is also assessed at the analytical-batch level using recovery information from initial calibration verification (ICV) and continuing calibration verification (CCV) samples, where information is available in the Level II data deliverable.

7.1 Laboratory Control Samples

LCSs (also referred to as blank spikes) are prepared by the laboratory with every preparatory batch, at a minimum of one LCS per 20 samples, where required. In some cases, analytical protocol requires the laboratory also analyze an LCSD to assess laboratory precision (see Section 8.1 for assessment of laboratory precision). LCSs and LCSDs are prepared using the same extraction method that is applied to the project samples using laboratory-grade, blank-matrix samples spiked with a known concentration of analyte(s). The laboratory reports a percent recovery (%R) of the spiked amount for each analyte added to the blank sample. The laboratory maintains acceptance limits for LCS/LCSD recovery; these limits are reported in the Level II laboratory report for comparison.

The reviewer will check that LCSs were reported at the required frequency, and that LCS/LCSD recoveries are within laboratory control limits. An LCS or LCSD recovery failure affects all corresponding samples in the same preparatory batch for the affected analyte(s). The following guidelines in Exhibit 7-1 will be used for qualifying sample results associated with LCS/LCSD-recovery failures.

Exhibit 7-1: Actions for LCS/LCSD and MS/MSD Recovery Failures

Analysis	LCS/LCSD or MS/MSD Results	Action	
		Detected Analytes	Analytes Not Detected
PFAS	%R < 10%	JL	R
	10% ≤ %R < LCL	JL	UJ
	%R > UCL[2]	JH	No qualification

NOTES:

1 Use professional judgment and refer to method-specific requirements for non-standard analyses and matrices.

2 If LCS/LCSD recovery is grossly outside control limits (recoveries less than 10% or greater than 250%) the reviewer should use professional judgment when qualifying the data. The reviewer should consider rejecting results for analytes not detected where the recovery was below 10% (USACE 2005).

LCL = lower control limit, %R = percent recovery, UCL = upper control limit

7.2 Matrix Spike Samples

For certain methods, the laboratory analyzes an MS/MSD in addition to the LCS. MS/MSDs are prepared and analyzed on a preparatory batch basis and are analyzed with every 20 samples when used. They consist of project (native) samples spiked with a known concentration of analyte(s) and prepared using the same method that is applied to project samples to extract the analyte(s). The MS and MSD are used to determine the presence of matrix interferences and evaluate the analytical accuracy for a given method and matrix, expressed as a %R of the spiked amount added to the field sample.

The reviewer will check to make sure that MS/MSDs were analyzed at the frequency required by analytical methods or project-specific requirements. Some methods may require the analysis of an MS/MSD pair, but insufficient sample volume may prevent the laboratory from providing these QC samples. The laboratory's standard operating procedures (SOPs) may allow for an LCSD instead of an MS/MSD for these cases.

The reviewer will check that %R for each analyte is within laboratory control limits. If there is a recovery failure, only the field sample utilized for the MS/MSD (the parent sample) is typically considered affected; however, the reviewer should use professional judgment whether other samples in the same preparatory batch have sufficiently similar matrices to be considered affected as well. For example, if an MS/MSD recovery failure is reported for one of two field duplicate samples, it should be assumed there were similar matrix effects in the duplicate, and corresponding results should also be qualified.

Before MS/MSD recovery is evaluated, two important factors must be considered:

1. Verify that the field sample chosen for the MS/MSD is part of the project-sample set currently being reviewed. The laboratory may run samples from other projects in the same preparatory batch and it is possible that the original sample selected for the MS/MSD may not be from the work order reviewed. In this case, we cannot confirm that the parent sample matrix is similar to the matrix in our project samples and the recovery failures do not affect data quality for the project-sample set.
2. Verify that the spiking concentration is high relative to the native concentration of the analyte. In accordance with EM 200-1-10 (USACE 2005):

   If the native concentration of a target analyte is high relative to the spiking concentration, then this may contribute a significant uncertainty to the recovery calculations; the MS recovery may not be representative of actual method performance for the matrix. In the absence of other guidance, evaluate the MS recovery when the spiking concentration is at least two times greater than the native analyte concentration (USACE 2005).

If the above criteria are met, then results associated with the failures in the original project sample should be qualified using the criteria listed in Exhibit 7-1.

7.3 Surrogates and Isotope Dilution Analytes

Surrogates are organic compounds that are similar to the analytes being evaluated by a given method (often a deuterated version of the one of the analytes). They are used to identify matrix interferences and inefficiencies in sample extraction for organic analyses. The surrogates are introduced into a field- or laboratory-QC sample prior to sample preparation and analysis. Accuracy is expressed as a %R of the spiked amount added to the sample.

Some methods, including PFAS by USEPA Method 537, require analysis using an isotope-dilution method, which uses IDAs instead of a surrogate, and corrects raw data of the associated analyte concentration based on the recovery of the IDA.

The reviewer will check that surrogates and/or IDAs were analyzed for each sample for each organic analysis (including laboratory QC samples), and that recoveries were reported within laboratory-control limits. If there is a reported recovery failure, it is considered to affect only the analytes associated with the surrogate/IDA (see Appendix A for a surrogate/IDA association list) for the corresponding project with the reported failure. However, there are a few special considerations when qualifying data based on surrogate-recovery failures:

1. Matrix interference: Recovery failures due to matrix interference (coelution of an interfering analyte or other matrix interactions) are considered to affect data quality, and results should be qualified as described in Exhibit 7-2. The laboratory typically documents in the case narrative whether a surrogate/IDA recovery failure was due to matrix interference.
2. Dilution: Recovery failures may be observed due to dilution of the surrogates and are not considered to affect the data (USACE 2005). The laboratory typically documents surrogate failures due to dilution in the case narrative. Refer to number 4 for IDA recovery failure assessments.
3. Surrogate/IDA recovery failures in laboratory QC samples: Surrogate/IDA failures in an LCS, LCSD, MS, or MSD are not considered to affect the project sample data as long as the recovery of individual analytes associated with that surrogate/IDA are within the laboratory control limits for the LCS/LCSD/MS/MSD sample. However, gross or systematic surrogate/IDA recovery failures should be considered along with all other QC information for the preparatory batch and the results evaluated according to professional judgment.
4. IDA recovery in project samples: As part of the analytical procedure for isotope-dilution methods, a given analyte concentration is corrected based on the recovery of the associated IDA. Therefore, recovery inefficiencies are somewhat self-correcting and one would expect less inaccuracy due to slight matrix effects. However, recovery outside the recovery limits may indicate there are significant matrix effects that the method is unable to adequately correct for. Results should be qualified as described in Exhibit 7-2.

Excluding the exceptions listed above, data affected by surrogate/IDA recovery failures should be qualified using the following criteria listed in Exhibit 7-2.

Exhibit 7-2: Actions for Surrogate or Isotope Dilution Analyte Recovery Failures

		Action	
Type	Criteria	Detected Analytes	Analytes Not Detected
IDA	%R < 10%	J	R
	10% ≤ %R < LCL	J	UJ
	%R < LCL (diluted sample)	Use professional judgement	N/A[1]
	%R > UCL	J	No qualification
	%R within range	No qualification	
Surrogate	%R < range	JL[2]	UJ[3]
	%R within range	No qualification	
	%R > range	JH[2]	No qualification

NOTES:

1 Non-detects should be reported from the undiluted analysis.

2 Use professional judgment when the bias is poorly defined. Only impart a bias to the qualified data if the bias is well defined (i.e., if there is more than one surrogate in the analysis, where recovery failures are in the same direction). Otherwise, it may be more conservative to simply qualify the results as estimated ('J'; USACE 2005).

3 Use professional judgment when evaluating gross recovery failures. The reviewer should consider rejecting the results where analytes are not detected if the associated surrogate recovery is below 20% (USACE 2005).

LCL = lower control limit, %R = percent recovery, UCL = upper control limit

7.4 Calibration Verification Samples

Calibration verification samples are not typically reported in the Level II data reports provided by the laboratory (aside from appearing in the EDD), and review of such samples is outside the scope of this Plan. The laboratory may have requirements to re-calibrate the instrument if calibration verification fails or other corrective action. However, this is not always possible, and occasionally calibration verification failures occur and are reported in the case narrative of the Level II laboratory report. Calibration verification samples are described briefly below.

ICV samples are clean extraction solvent spiked with a known analyte concentration, using a different source than that of the primary calibration standards, and analyzed immediately following instrument calibration. Similarly, CCV samples are calibration standards that are analyzed at the beginning of each analytical batch and periodically throughout the run.

The laboratory evaluates ICV and CCV recovery information based on their internal acceptance criteria; in some cases, they also evaluate relative percent difference between CCVs to determine if drift is occurring. As stated above, calibration-level data review is beyond the scope of this Plan and may be conducted as part of a Level IV data-validation, if calibration issues are identified in the case narrative. Professional judgment should dictate whether any samples in an analytical batch with unresolved CCV failures should be considered preliminary pending further investigation. For these circumstances, contact the laboratory for more direction and ask the Senior Laboratory Analyst to provide justification for using the data and any bias resulting from these QC failures. Request that the laboratory report be revised to include the justification.

8 PRECISION

Precision refers to the repeatability of measurements (USACE 2005). Precision is evaluated using laboratory QA/QC and field-duplicate samples. The following sections describe the duplicate-sample information that is commonly used to assess precision. However, this is not an exhaustive list and the laboratory may occasionally analyze other duplicate samples that should also be considered. For most analyses, at least one laboratory QC-sample duplicate must be analyzed; this can include a LCSD, MSD, or a laboratory duplicate.

Each type of duplicate is evaluated in the same manner (LCS/LCSD, MS/MSD, laboratory duplicate and field duplicates). A relative percent difference (RPD) is calculated between the duplicate results for a given analyte using the following equation presented in Exhibit 8-1.

Exhibit 8-1: RPD Calculation

Equation	Variable and Definition	
$RPD = \frac{\lvert R_1 - R_2 \rvert}{(R_1 + R_2)/2} \times 100\%$	RPD	Relative Percent Difference
	R1	Primary Result
	R2	Duplicate Result

The resulting RPD is compared to laboratory control limits (for laboratory QC samples), or project or regulatory DQOs for field duplicates. For purposes of this Plan, the recommended water-sample DQO of 30% and soil-sample DQO of 50% are used.

The guidelines presented in Exhibit 8-2 will be used for qualifying sample results associated with duplicate-sample RPD failures. The treatment of a failure is the same across types of duplicate samples, but the samples that are affected vary. Refer to the following sections for details.

Exhibit 8-2: Actions for Duplicate-Sample RPD Failures

	Action	
Criteria	Detected Analytes	Analytes Not Detected
RPD ≤ Control Limit or DQO	No qualification	
RPD > Control Limit or DQO	J	UJ

DQO = data quality objective, RPD = relative percent difference

8.1 Laboratory Control Sample Duplicates

Precision can be evaluated between LCS and LCSD results for a given analyte. The laboratory calculates the RPD using the equation presented in Exhibit 8-1 for each analyte. The reviewer will check that each RPD is within the laboratory control limits. RPD failures for specific analytes in the LCS/LCSD are considered to affect the precision of that analyte in each corresponding project sample in the same preparatory batch. Affected results should be flagged according to the criteria presented in Exhibit 8-2.

8.2 Matrix Spike Duplicates

Precision can be evaluated between the MS and the MSD results for a given analyte. The laboratory calculates the RPD for each analyte. The reviewer will check that each RPD is within the laboratory control limits. RPD failures for specific analytes in the MS/MSD are considered to affect the precision of that analyte in the parent sample spiked for the MS/MSD. Professional judgment should be used to determine whether additional samples should be qualified (based on similarity of sample matrix).

RPD failures should be considered to affect the data regardless of the concentration spiked, as long as the laboratory calculates the RPD based on the total analyte concentration quantified in the MS/MSD. If the laboratory calculates the RPD based only on what was recovered of the spike, it should be treated as for MS/MSD recovery, with failures only considered to affect data quality if the spiking concentration is at least double the native concentration of the analyte. Affected results should be flagged according to the criteria presented in Exhibit 8-2.

8.3 Laboratory Duplicates

For select analyses, or when insufficient volume is submitted for analysis of an MS and MSD, the laboratory may analyze a project sample twice (referred to as a laboratory duplicate). The laboratory calculates an RPD between the original result and the duplicate-sample result for each analyte. The reviewer will check that each RPD is within the laboratory control limits. As with MS/MSDs, laboratory duplicate RPD failures are considered to affect the precision of the affected analyte only in the parent sample used for the duplicate analysis. Affected results should be flagged according to the criteria presented in Exhibit 8-2.

8.4 Field-Duplicate Samples

Field-duplicate samples are duplicate samples collected from the same location and submitted to the laboratory performing the requested analysis. The duplicate sample will have a “dummy” sample number and submitted to the laboratory as a regular sample (i.e., the duplicate is submitted “blind”). These field duplicates are used to determine the reproducibility of the sampling technique, as well as the subsequent laboratory analysis. Sample homogeneity is necessary to obtain acceptable values for the RPD and any heterogeneity should be noted during sampling.

For field-duplicate pairs, the reviewer will calculate an RPD using the equation presented in Exhibit 8-1. An RPD will only be calculated if both sample results are detected above the detection limit. The calculated RPD will be compared to the standard DQOs of 30% for water or 50% for soil. Field-duplicate RPD failures are considered to affect only the results of the duplicate pair; affected data will be qualified based on the criteria in Exhibit 8-2.

In the event that one of the results is above the LOQ but the other result is below the detection limit (not detected) and J-flag detections are reported for the project, the reviewer should use professional judgment and consider qualifying the detected and non-detect result as estimated even though an RPD cannot be calculated. This may be evidence of samples having been mislabeled (in the field or the laboratory), sample heterogeneity, or some other issue; further investigation may be warranted.

9 REPRESENTATIVENESS

Representativeness is defined in Chapter One of the USEPA SW-846 Update V Revision 2 (USEPA 2014) as the degree to which data accurately and precisely represents a characteristic of a population for a sampling point. Representativeness is dependent on proper execution of the approved sampling program. To assess sample representativeness, sample-log sheets will be reviewed to ensure the samples were collected according to the approved sampling program and the results therefore represent the location and depth sampled. In addition, where possible, the analytical result for each sample will be compared to the historical results to check that the result is consistent with the broader data set for that location.

There are instances where sample collection procedures deviate from the sampling program and may affect the sample representativeness. Professional judgement is used to assess the data usability based on these deviations. Some of these infrequent instances are presented in Exhibit 9-1 along with qualifications to the data.

Exhibit 9-1: Actions for Deviations from Sampling Program

Sampling Type	Description of Deviation	Action	
		Detected Analytes	Analytes Not Detected
Monitoring Well Sampling	Purging/stabilization criteria not met	J	UJ

NOTES:

1 Use professional judgment. The reviewer should consider rejecting the results where organic analytes are not detected and samples were collected post carbon filter. At minimum, the non-detect results should be considered estimated and flagged 'UJ' to identify the sample collection discrepancy.

10 LABORATORY APPLIED FLAGS

The laboratory is required to qualify data that does not meet laboratory QC standards. The data qualifiers, flagging criteria, and flagging procedures are detailed in the laboratory's SOPs. The lab does not interpret the impact of an applied flag on the data, rather the flags are meant to draw the attention of the reviewer to an area where laboratory QC criteria is not met. When we review and validate the data, we take the information the laboratory reported and evaluate the effect of the QC deficiency on the data and apply appropriate flags as defined in this document.

In some cases, laboratory applied flags are not needed and may be removed for reporting. For example:

> When an MS and/or MSD sample has a %R failure, but the spiking concertation is not high relative to the native parent sample concentration, then the %R failure is not applicable. The flag the lab applies to the data is therefore not necessary and is removed the analytical reporting table.

In some cases, laboratory applied flags are overwritten by flags applied by Shannon & Wilson. For example:

> When a sample result exceeds the calibration range, the lab may flag the affected data with an 'E'. We flag calibration exceedances with a 'J' in the analytical reporting table overwriting the 'E' flag.

In either case listed above, laboratory applied flags are maintained in the laboratory report for reference.

See Exhibit 10-1 for common laboratory applied flags that are either overwritten by a S&W applied flag or are removed from the analytical reporting tables because they are deemed unnecessary after our data-validation process. The flags remain in the laboratory report for reference.

Exhibit 10-1: Actions for Common Laboratory Applied Flags

Laboratory Applied Flag[1]	Flag Description	Shannon & Wilson Applied Flag
I	Value is the estimated maximum possible concentration. Case Narrative flag description: The "I" qualifier means the transition mass ratio for the indicated analyte was outside of the established ratio limits. The qualitative identification of the analyte has some degree of uncertainty. However, analyst judgement was used to positively identify the analyte.	J
E	Result exceeded calibration range.	J
B	Compound was found in the blank sample	See Exhibit 6-1 for flagging criteria
*	LCS or LCSD is outside acceptance limits.	See Exhibit 7-1 for flagging criteria
*	Isotope dilution analyte is outside acceptance limits	See Exhibit 7-2 for flagging criteria
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.	See Exhibit 7-2 for flagging criteria
F1	MS and/or MSD recovery is outside acceptance limits.	See Exhibit 7-2 for flagging criteria
F2	MS/MSD RPD exceeds control limits	See Exhibit 8-2 for flagging criteria

NOTES:

1 This is not meant to be a comprehensive list of flags applied by the laboratory, but rather a list of the most encountered laboratory flags that are often not applicable after data-validation. Labs do not always use identical flags for the same QC failure; therefore, this information will be extrapolated to address the specific flags used by each laboratory and applied to each data set on a case-by-case basis.

LCS = laboratory control sample, LCSD = laboratory control sample duplicate, MS = matrix spike, MSD = matrix spike duplicate, RPD = relative percent difference.

11 COMPARABILITY

Chapter One of the USEPA SW-846 Update V Revision 2 (USEPA 2014) defines comparability as the expression of the degree of confidence with which one data set can be compared to another. Per the EPA SW-846 Update V Revision 2, a measurement is considered to be valid if they are unqualified or qualified as estimated data during validation. The reviewer and data users should qualitatively assess the comparability between historical and current data sets and use caution in combining data sets if the quality of the data is uncertain. For example, current analytical methods may not be comparable to historical methods where the MRL was elevated.

12 COMPLETENESS

Chapter One of the USEPA SW-846 Update V Revision 2 (USEPA 2014) defines completeness as the measure of valid data collected compared to the amount planned. The SW-846 defines a valid datum as a measurement that is “unqualified or qualified as estimated [biased high, low, or no direction] during (data) validation.” The overall data set from a sampling event will be evaluated to determine if the completeness goal of 85-percent useable data was achieved. Completeness is calculated by comparing the amount of useable (valid) data to the overall number of samples planned. A completeness value below 85-percent may be cause for collecting additional analytical samples.

13 DATA-VALIDATION PLAN UPDATES

This Data-Validation Program Plan will be reviewed and updated as necessary.

14 REFERENCES

DoD. "Quality Systems Manual for Environmental Laboratories v5.3," by the United States Department of Defense, May 2019.

USACE. Engineering Manual (EM) 200-1-10, Guidance for Evaluating Performance-Based Chemical Data. Guidance document, United States Army Corps of Engineers, June 2005.

USEPA. "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use." OSWER No. 9200.1-85 EPA 540-R-08-005, by Environmental Protection Agency, January 13, 2009.

USEPA. "Chapter One – Quality Control." In SW-846 Update V – Revision 2 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, by United States Environmental Protection Agency, July 2014.

USEPA. National Functional Guidelines for High Resolution Superfund Methods Data Review, by United States Environmental Protection Agency, Guidance document. EPA-542-B-16-001. April 2016.

USEPA. National Functional Guidelines for Inorganic Methods Data Review. Guidance document, by United States Environmental Protection Agency, EPA-540-R-2017-001. January 2017a

USEPA. National Functional Guidelines for Organic Methods Data Review. Guidance document, by United States Environmental Protection Agency, EPA-540-R-2017-002. January 2017b.

USEPA. Data Review and Validation Guidelines for Perfluoroalkyl Substances (PFASs) Analyzed Using EPA Method 537, November 2018a.

USEPA. "Chapter Four - Organic Analytes." In SW-846 Update VI – Revision 6 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, by United States Environmental Protection Agency, December 2018b.

APPENDIX A: SURROGATE AND ISOTOPE DILUTION ANALYTE ASSOCIATIONS

Appendix A

Surrogate and Isotope Dilution Analyte Associations

Table 1 - Surrogate and Isotope Dilution Analyte Association

Analytical Method	Surrogate/ IDA	Surrogate/ IDA CAS No.	Associated Analyte	Associated Analyte CAS No.
Modified EPA 537 (PFAS)	18O2-PFHxS	---	Perfluorohexansulfonic acid (PFHxS)	355-46-4
	13C2-PFHxA	---	Perfluorohexanoic acid (PFHxA)	307-24-4
	13C4-PFHpA	---	Perfluoroheptanoic acid (PFHpA)	375-85-9
	13C5-PFNA	---	Perfluorononanoic acid (PFNA)	375-95-1
	13C3-PFBS	---	Perfluorobutanesulfonic acid (PFBS)	375-73-5
	13C2-PFDA	---	Perfluorodecanoic acid (PFDA)	335-76-2
	13C2-PFUdA	---	Perfluoroundecanoic acid (PFUnA)	2058-94-8
	13C2-PFDoA	---	Perfluorododecanoic acid (PFDoA)	307-55-1
			Perfluorotridecanoic acid (PFTrDA)	72629-94-8
	13C2-PFTeDA	---	Perfluorotetradecanoic acid (PFTeA)	376-06-7
	13C3-HFPO-DA	---	Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6
	13C4-PFOS	---	Perfluorooctanesulfonic acid (PFOS)	1763-23-1
			4,8-Dioxa-3H-perfluorononanoic acid (DONA)	919005-14-4
			9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	756426-58-1
			11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	83329-89-9
	d3-MeFOSAA	---	N-Methyl perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	2355-31-9
	d5-EtFOSAA	---	N-Ethyl perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	2991-50-6
	13C4-PFOA	---	Perfluorooctanoic acid (PFOA)	335-67-1

NOTES:
Surrogate associations for PFAS are based on information received February 2020 from Eurofins TestAmerica, Inc. and may not be representative of all laboratories.
PFAS analytes are associated with isotope dilution standards.
CAS No. = Chemical Abstract Service Number; PFAS = per- and poly-fluorinated alkyl substances

APPENDIX G: HEALTH AND SAFETY PLAN – REMEDIAL INVESTIGATION

Appendix G

Health and Safety Plan – Remedial Investigation

Jorgensen Forge Corporation Property, Tukwila, Washington

PREPARED FOR:
Earle M. Jorgensen
Company
10650 S. Alameda Street
Lynwood, CA 90262

BY:
Shannon & Wilson
400 N. 34th Street, Suite 100
Seattle, WA 98103

(206) 632-8020
www.shannonwilson.com

HEALTH AND SAFETY PLAN – REMEDIAL INVESTIGATION

Jorgensen Forge Corporation Property

TUKWILA, WASHINGTON

March 31, 2020

Shannon & Wilson No: 21-1-12596-013

SHANNON & WILSON

CONTENTS

Exhibits

Attachments

HEALTH AND SAFETY PLAN
SITE HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

Shannon & Wilson, Inc.

I understand and agree to abide by the provisions as detailed in the Shannon & Wilson, Inc. Health and Safety Plan detailed in this document. Failure to comply with these provisions may lead to disciplinary action, which may include dismissal from the work site and termination of employment.

We, the undersigned, have reviewed this plan, are familiar with its contents, and agree to abide by all the provisions herein:

Signature	Date
Signature	Date
Signature	Date
Signature	Date
Signature	Date
Signature	Date
Signature	Date
Signature	Date

CFR	Code of Federal Regulations
CRC	Contamination Reduction Corridor
CRZ	Contamination Reduction Zone
dBA	decibels
DOSH	Washington State Department of Occupational Safety and Health
EMJ	Earle M. Jorgensen Company
EZ	Exclusion Zone
F	Fahrenheit
HASP	health and safety plan
HRI	Heat-Related Illness
IDW	investigation-derived waste
JFC	Jorgensen Forge Corporation
LNAPL	light nonaqueous phase liquid
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PDS	Personnel Decontamination Station
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
SSO	Site Safety Officer
SZ	Support Zone
the Site	8531 East Marginal Way South, Tukwila, Washington
WAC	Washington Administrative Code

HEALTH AND SAFETY CONTACT INFORMATION

SITE LOCATION:	Star Forge, LLC (Star Forge) doing business as Jorgensen Forge Corporation (JFC) 8531 East Marginal Way South Tukwila, WA
PROJECT COORDINATOR:	Meg Strong, Shannon & Wilson, Inc. (206) 695-6787 (office) (425) 864-2096 (mobile)
PROJECT MANAGER:	Shoshana Howard, Shannon & Wilson, Inc. (206) 695-6811 (office) (206) 900-2720 (mobile)
HEALTH AND SAFETY MANAGER:	Joe Laprade, Shannon & Wilson, Inc. (206) 695-6713 (office) (206) 852-6754 (mobile)
SITE SAFETY OFFICER:	Christian Canfield, Shannon & Wilson, Inc. (206) 695-6716 (office) (206) 714-7637 (mobile)
FACILITY REPRESENTATIVE:	Matteo Sanesi (253) 878-6415
NEAREST WALK-IN CLINIC:	U.S. HealthWorks 3223 1st Avenue South, Seattle, WA (206) 624-3651
NEAREST HOSPITAL:	Harborview Medical Center 325 9th Avenue, Seattle, WA (206) 744-3000

1 INTRODUCTION

This health and safety plan (HASP) has been prepared to address health and safety considerations for the proposed activities outlined within the Remedial Investigation Work Plan (the work plan). This HASP, a Sampling and Analysis Plan (SAP), and a Quality Assurance Project Plan (QAPP), are included as appendices to the work plan.

This HASP addresses the conduct of Shannon & Wilson's employees. Contractors procured by Shannon & Wilson for the project will provide their own HASP, which will be reviewed by us for compliance with site requirements. Shannon & Wilson employees will also adhere to the health and safety rules required by Jorgensen Forge Corporation (JFC) for entry onto the property.

The proposed activities are to be conducted at the JFC facility located at 8531 East Marginal Way South, Tukwila, Washington (the Site). The site is owned and operated by Star Forge doing business as JFC. The activities are being completed on behalf of Earle M. Jorgensen Company (EMJ).

If required, we will implement appropriate steps to address Coronavirus Disease 2019 (COVID-19) distancing and hygiene requirements during field activities. Due to the fluid nature of the COVID-19 pandemic, the appropriate steps to protect workers will be determined upon scheduling of the field activities using the current (at the time of field activities) government recommendations.

2 SCOPE OF WORK

The scope of work, as outlined in Section 10 of the work plan, consists of a light non-aqueous phase liquid (LNAPL) investigation, a soil investigation, and a groundwater investigation. Activities will include completion of soil borings using direct-push methods; completion of borings and installation of groundwater monitoring wells using hollow-stem auger methods, groundwater monitoring and sampling, LNAPL plume delineation using direct-push drilling and laser-induced fluorescence technology, LNAPL monitoring, soil sampling, completion of LNAPL permeability tests, and completion of hydraulic conductivity tests. Investigative activities may be completed within an area of suspected polychlorinated biphenyl (PCB) contamination. Procedures for work within this area are discussed in Section 12.

This HASP will cover activities outlined within the work plan. This HASP will be revised to address the specific health and safety concerns related to activities outside the scope of work. Such work cannot be initiated until a revised HASP has been updated and approved.

3 SITE CHARACTERISTICS

The Site occupies approximately 20 acres between Slips 4 and 6 on the east bank of the Lower Duwamish Waterway. A site map is provided as Attachment A.

The Site was used as a steel and aluminum forge and mill that produced custom steel and aluminum parts forged and machined to high-precision specifications for various industrial clients. Operations remained relatively unchanged since the property was developed in the 1940s; however, melt operations were discontinued in 2015. The facility was shut down in October of 2018 and the plant commenced decommissioning in late 2018.

Currently, the structures on the Site remain. Asphalt, concrete paving, and buildings cover most the property. Portions of the ground surface along the western and northwestern areas of the property are covered with gravel that was placed in approximately 1990. The Site is developed with an approximately 124,000-square-foot prefabricated steel building (main building) that is generally divided into the Hollowbore Area, the Machine Shop Area, the Heat Treat Area, the Forge Shop Area, and the Former Melt Shop Area. Much of the facility machines/features have been removed from the main building, leaving exposed vaults and pits. These vaults and pits, which once housed equipment or tanks, or provided maintenance access to the overlying machines, are now fall hazards. A wood-frame office building is located on the northeastern section of the Site. A stormwater treatment system is in the center of the property just north of the Former Melt Shop area. A wood-frame laboratory used for physical testing of metal products and an office building are near the treatment system. In the southwestern section of the Site lies the Former Metals Storage Area that was used to store slag, chips, and swarf. The shoreline along the southwestern boundary is composed of a sloped embankment with riprap and on the southern portion of the property, a concrete panel bulkhead.

4 PERSONNEL ASSIGNMENTS

4.1 Project Manager (PM)

The PM is responsible for the overall management of the project, including safety, quality, and production. He/She is responsible to schedule, review, certify, and manage all submittals, including those of subcontractors, fabricators, suppliers, and purchasing agents, with attention to safety and health aspects of performance and procurement. The PM oversees the environmental/industrial hygiene and atmospheric testing performed by field personnel and outside testing laboratories. The PM has full authority to stop work due to health and safety deficiencies.

4.2 Site Safety Officer (SSO)

The SSO will be responsible for implementation of the HASP during all investigation activities. The SSO will ensure that field teams utilize all safety practices, and that during emergency situations, appropriate procedures are immediately and effectively initiated. He/She will also be responsible for the control of specific field operations and all related activities such as personnel decontamination, monitoring of worker heat or cold stress, distribution of safety equipment, and conformance with all other procedures established by the HASP. The SSO has full stop-work authority due to safety and health deficiencies. The SSO's primary responsibility is to provide the appropriate monitoring to ensure the safe conduct of field operations.

4.3 Field Team Members

The field team members (field personnel) are responsible for conducting their assigned work duties in a safe and healthy manner and following the procedures established in the site-specific HASP. Field personnel have full authority to stop work due to safety and health deficiencies.

5 TRAINING REQUIREMENTS

All personnel conducting site work involving intrusive activities where the potential exists for exposure to contaminated soils or groundwater (drilling, sampling, excavation, etc.) shall have completed 40 hours of classroom-style health and safety training and three days of on-site training, as required by the Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120 and Washington Administrative Code (WAC) 296-843.

All supervisory personnel, including the Health and Safety Manager, will have received an additional eight hours of training as required for management of personnel and activities associated with hazardous waste site activities covering at a minimum the following topics: the employer's health and safety program, personal protective equipment (PPE) program, spill containment program, and health hazard monitoring procedures and techniques. Employees will also receive a minimum of eight hours' refresher training annually. Copies of current training certificates will be maintained in the Shannon & Wilson Corporate office.

5.1 Site-Specific Training

All on-site personnel will complete a site-specific initial training session or briefing, conducted by the SSO, prior to commencement of the project and/or entering the site. The training session should be of sufficient duration to ensure that they are familiar with site-specific hazards, protective equipment, site control, decontamination, emergency procedures, and security procedures. Elements to be covered as part of the site-specific training include:

- Personnel responsibilities;
- Site hazards and controls;
- Use of PPE;
- Action levels for upgrading/downgrading levels of PPE;
- Work practices by which the employee can minimize risks from hazards;
- Safe use of engineering controls and equipment on site;
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazards;
- Site-specific hazardous procedures (i.e., intrusive activities, etc.);
- Emergency information, including local emergency response team phone numbers, route to nearest hospital, and emergency response procedures; and
- Content and implementation of the HASP.

All training will be documented as to the contents of the training and personnel in attendance and kept in the project files.

5.2 Daily Safety Meeting

In addition to the initial site briefing conducted at the commencement of the project, supplemental brief safety meetings shall be conducted by the SSO to discuss potential health and safety hazards associated with upcoming tasks, and necessary precautions to be taken. Daily safety meetings will be completed prior to the beginning of each day’s work and documented on a Daily Safety Meeting Log, provided as Attachment B.

5.3 Visitor Training

All visitors to the site will be required to check in with the PM/SSO. Depending on the purpose of their visit, the visitors will receive an orientation briefing from the PM/SSO, which will include site-specific hazards, ways to protect themselves from these hazards, locations of first aid and emergency equipment, and the emergency response procedures.

6 MEDICAL SURVEILLANCE

All field personnel must meet the medical monitoring requirements of 29 CFR 1910.120. The regulations require that employers implement a medical monitoring program consistent with paragraph (f) of this standard, which states that a medical examination will be completed for each employee prior to employment, annually thereafter (minimum), and as a follow-up to injuries or overexposures, and upon termination of their employment with the company. Employees who must receive medical examinations include those who wear a respirator for 30 or more days a year, and those who are or may be exposed to hazardous substances at or above permissible exposure levels, regardless of respirator use, for 30 days or more a year.

Any personnel injured or suspected of being injured as a result of an uncontrolled release of a hazardous substance or energy, or other emergency situation, will be given a medical evaluation as soon as possible thereafter.

Shannon & Wilson's employee medical records are available upon request from the Human Resources Manager, with the employee's permission. The SSO will confirm medical certification to work and wear respiratory protection and keep a copy of the certification (containing certifying physician's signature) in the personnel files in the Seattle office. Physical examination forms shall be released only with the individual employee's approval.

7 HAZARD ASSESSMENT AND RISK ANALYSIS

A summary of the activity hazard analysis is provided as Exhibit 7-1.

Exhibit 7-1: Activity Hazard Analyses

Activity		Potential Hazards	Recommended Controls
1.	Driving to, on, and from the site	Vehicle breakdown/flat tire Getting lost Rough terrain Accident Severe weather	Equip vehicle with emergency supplies/spare tire. Have a map with directions to the site. Wear appropriate clothing for the weather. Wear seat belts at all times while vehicle is in motion Only licensed drivers allowed to operate vehicles. Obey all traffic rules. Do not drive over large holes, rocks, or down steep embankments. Avoid driving in severe weather, if possible. If not, reduce speed and turn on headlights.

Activity	Potential Hazards	Recommended Controls
2. Site reconnaissance	Severe weather Slips, trips, and falls Contact with dead animals Bites from snakes or insects	Wear appropriate clothing for the weather. Avoid site reconnaissance during severe weather conditions. Stop work if potential for thunderstorms or winter storms. Be aware of surroundings and use caution when moving around the site. Stay away from snake or insect breeding habitats. Wear proper PPE and insect repellant. Stay away from animal carcasses unless wearing proper PPE. Use proper hygiene.
3. Vegetation Clearing	Contact with rotating machinery and sharp blades from scythe Contact with potentially contaminated soil Noise Fires and/or explosions Electrical hazards Trips and falls	Personnel should not wear rings, loose-fitting clothes, straps, draw strings, etc. Safety guard for "weed-eater" should be in place. Emergency shut-off should be inspected daily to ensure proper functioning. Site personnel must wear appropriate PPE, including heavy gloves and safety glasses to protect from blackberries. Hearing protection must be used. Fuel will be stored in approved containers. A 2A10BC fire extinguisher must be in the vehicle. A first aid kit must be at the site. Wear appropriate clothing for the weather. Stop work if potential for thunderstorms or winter storms. Be aware of surroundings and use caution when moving around the site. Site personnel will exercise care when working next to a hill slope.
4. Collect surface and subsurface soil samples	Contact with potentially contaminated soil Inhalation of volatile gases Bites from insects Contact with dead animals Severe weather Back injury	Wear appropriate PPE, including nitrile gloves, work clothes, and safety glasses. Conduct air monitoring and remain upwind whenever possible. Wear appropriate clothing for the weather. Stop work if potential for thunderstorms or winter storms. Be aware of surroundings and use caution when moving around the site. Stay away from snake or insect breeding habitats. Wear proper PPE and insect repellant. Stay away from animal carcasses unless wearing proper PPE. Use proper hygiene. Use proper lifting techniques or request assistance.

Activity	Potential Hazards	Recommended Controls
5. Collect water samples	Contact with potentially contaminated water Inhalation of volatile gases Bites from insects Contact with dead animals Severe weather Potential fire or explosion hazards	Wear appropriate PPE, including nitrile gloves, work clothes, and safety glasses. Conduct air monitoring and remain upwind whenever possible. Wear appropriate clothing for the weather. Stop work if potential for thunderstorms or winter storms. Be aware of surroundings and use caution when moving around the site. Stay away from snake or insect breeding habitats. Wear proper PPE and insect repellant. Stay away from animal carcasses unless wearing proper PPE. Use proper hygiene. When using the generator, do not stage it in an area of dry vegetation or if elevated PID measurements are being detected.
6. Decontaminate equipment	Contact with potentially contaminated decontamination solutions	Wear appropriate PPE, including nitrile gloves, work clothes, and safety glasses.
7. Field screening of samples	Contact with potentially contaminated soil or sediment	Wear appropriate PPE, including nitrile gloves, work clothes, and safety glasses.
8. Sample packaging	Back strain	When possible, two people will handle heavy sample coolers, or multiple coolers containing fewer sample containers will be used.
9. Handle investigation-derived waste drums	Back strain	Use proper drum handling procedures and equipment.
10. Mobilize drill rig	General health and safety Trips and falls Contact with equipment Traffic control zones	Ensure that subcontractor employees have been informed of the contents of the site-specific Health and Safety Plan. Communicate drilling hazards to all field personnel. Assure that qualified drillers are operating rig. Assure that drillers have a written rig inspection program. Assure that drillers have another required written program. Provide adequate storage for tools, augers, pipe, etc. Keep platforms free of tools, debris, and slick substances such as mud and grease. Drillers must not climb the mast/derrick unless they wear fall protection. Keep clear from the rear and sides of the rig or equipment (except drillers). Lower and level the jack pods before raising the mast/derrick. Lock the mast/derrick into place before drilling. Make sure traffic control zones are established and personnel are aware of perimeter distances.

Activity	Potential Hazards	Recommended Controls
11. Perform drilling operations	Contact with rotating machinery, cables, pulleys, etc. Contact with potentially contaminated soil, groundwater, or free product Noise Fires and/or explosions Electrical hazards Trips and falls	Drillers should not wear rings, loose-fitting clothes, straps, draw strings, etc. Broken, cut, or frayed wires on the rig should be replaced. Pulleys must operate freely, and cable guards must be in place. Pulleys will be proper size for cable diameter. Emergency shut-off should be inspected daily to ensure proper functioning. Site personnel must wear appropriate PPE, including nitrile gloves and safety glasses. Monitor breathing and perimeter zones with a PID. Remain upwind of activities. Hearing protection must be used. Fuel will be stored in approved containers. A 2A10BC fire extinguisher must be on the rig. A first aid kit must be at the site. All utilities must be located prior to drilling operations. In the event of an electrical storm, drilling operations must be shut down and workers must move to a safe location. Mast/derrick must be kept a minimum of 15 feet from overhead power lines at all times. Borings will be placed a minimum of 2 feet from hill slope. Site personnel will exercise care when working next to a hill slope.

NOTES:
PID = photoionization detector; PPE = personal protective equipment; XRF = X-ray fluorescence

Hazards associated with this HASP can be grouped into three main categories: (a) chemical, (b) physical, and (c) biological.

7.1 Chemical Hazards

Chemical hazards identified for the subject property include the following:

- Metals (represented by arsenic, chromium VI, and mercury);
- Petroleum hydrocarbons;
- Volatile organic compounds (represented by benzene and vinyl chloride);
- Semi-volatile organic compounds (represented by benzo(a) pyrene);
- LNAPL contact; and
- PCBs.

The maximum concentration of the chemical hazards anticipated on site are listed in Exhibit 7-2. The primary routes of exposure for these contaminants are the inhalation of vapors, gases, or particulate; inhalation of contaminated soil particulate; direct skin contact with contaminated media; or the accidental ingestion of contaminated soil or water. Use of proper PPE, awareness, and air monitoring, when necessary, will reduce the potential for exposure. Periodic evaluation of the hazards associated with different work tasks and the determination for any changes will be made by the SSO, with concurrence from the PM.

Exhibit 7-2: Anticipated Maximum Concentration of Chemical Hazards

Identified Site Contaminants	Maximum Concentration in Groundwater (ppb)	Maximum Concentration in Soil (ppm)	DOSH PEL-TWA (STEL)
Arsenic	92	62.7	0.01 mg/m^3 (0.6 mg/m^3)
Chromium VI	unknown	unknown	0.005 mg/m^3
Mercury	0.9	0.694	0.05 mg/m^3
TPH (undifferentiated)	—	120,000	—
TPH-gasoline	1,200	9,400	300 ppm (500 ppm)
TPH-diesel	LNAPL	77,500	100 ppm (150 ppm)
TPH-oil	LNAPL	19,000	100 ppm (150 ppm)
Benzene	8.1	0.289	1 ppm (5 ppm)
Vinyl Chloride	100	0.01	1 ppm (5 ppm)
PCBs - 42% chlorine - 54% chlorine	0.41	274	1 mg/m^3(3 mg/m^3) 0.5 mg/m^3(1.5 mg/m^3)
cPAHs [benzo(a)pyrene]	0.12	0.73	0.2 mg/m^3(0.6 mg/m^3)

NOTES:

cPAHs = carcinogenic polynuclear aromatic hydrocarbons; DOSH = Washington State Department of Occupational Safety and Health; LNAPL = light non-aqueous-phase liquids; mg/m^3= milligrams per meter cubed; PCBs = polychlorinated biphenyls; PEL = permissible exposure levels; ppb = parts per billion; ppm = parts per million; STEL = short-term exposure limit; TPH = total petroleum hydrocarbons; TWA = 8-hour time-weighted average

An assessment of the chemical hazards as well as a discussion of symptoms are provided in Exhibit 7-3. Safety Data Sheets are provided in Attachment C. Air monitoring and respiratory protection are discussed within Section 9.1.

Exhibit 7-3: Chemical Hazards Assessment

Chemical Hazard	TLV/PEL	Route of Exposure	Signs and Symptoms
Petroleum Hydrocarbons (based on gasoline)	PEL-TWA = 300 ppm STEL = 500 ppm	Eye, Skin, Inhalation, Ingestion	Irritated eyes, skin, and mucous membranes; dermatitis; headache, fainting, blurred vision, dizziness, slurred speech, confusion, and convulsions; chemical pneumonia (aspiration); possible liver, kidney damage; carcinogen.
Polychlorinated Biphenyls	TLV = 0.5 mg/m^3 (skin) STEL = 5 mg/m^3	Inhalation, Skin, Ingestion, Eye	Skin and eye irritation on contact. Chloracne. Liver damage. Possible carcinogen. Headaches or numbness may occur if ingested.
Heavy Metals	TLV varies depending on the metal present	Skin, Ingestion, Eye	Skin and eye irritation, dermatitis, headache, and nausea. Ingestion can result in liver or kidney damage.
Volatile Organic Compounds (VOCs)	TLV varies depending on the VOC present	Inhalation, Skin, Ingestion, Eye	Irritated eyes, skin, nose, respiratory system; narcosis, headache, nausea, staggered gait, fatigue; anorexia; anesthesia, central nervous system depression, dermatitis; some may be carcinogens.
Polynuclear Aromatic Hydrocarbons (PAHs)	TLV varies depending on the PAH present	Skin, Ingestion, Eye	Irritated eyes, skin, upper respiratory, mucous membranes; dermatitis, headache, bronchitis, hyper pigmentation of skin; possible liver, kidney damage; some may be carcinogens.

NOTES:

mg/m^3= milligrams per meter cubed; PEL = permissible exposure limit; ppm = parts per million (milligrams per liter [mg/L]); STEL = 15-minute short-term exposure; TLV = threshold limit value; TWA = time-weighted average

7.2 Physical Hazards

Risk of exposure to physical hazards varies from task to task and often with the time of the year. Shannon & Wilson has developed a series of standard operating procedures for these physical hazards, which are provided within the Corporate HASP. Additional site hazard controls are discussed in Section 9.1.6. Field personnel shall follow these procedures while performing their specific work tasks. Exhibit 7-4 contains a summary of potential effects from physical hazards.

Exhibit 7-4: Physical Hazards and Effects

Physical Hazard	Effect
Noise	Hearing loss/disruption of communication
Rain/Humidity/Cold/Ice/Snow/ Lightning/Wind/Flood	Slips and falls/vehicle accident risk increase/instruments malfunction/electrocution/falling objects
Electrical	Electrical units used in wet environments
Ambient Heat	Heat rash/cramps/exhaustion/heatstroke
Cold	Hypothermia/frostbite
Heavy/Manual Lifting	Back strain/abdomen/arm/leg muscle/joint injury
Rough or Uneven Terrain	Vehicle accidents/slips/trips/falls
Unsafe Structures	Electrical buildings where polychlorinated biphenyl-containing equipment may have been located
Debris and Building Materials	Slips/trips/falls/punctures/cuts/fires/biological hazards
Biological Hazards	Insects, bears, cougars, poisonous plants
Traffic	Struck by vehicle/collision
Fire or Explosion Hazard	Burns
Materials Handling	Back injury/crushing from load shifts

The physical hazards identified at this site include the following:

7.2.1 Vehicular Traffic

All vehicular traffic routes that could impact worker safety must be identified and the locations communicated to field personnel. Whenever necessary, barriers or other methods must be established to prevent injury from moving vehicles. OSHA requirements for working in or around vehicular traffic must be communicated to and followed by all personnel. Safe practices for working within facilities with heavy vehicular traffic are discussed in more detail within Section 9.1.8.

7.2.2 Slips, Trips, and Falls

Slips, trips, and falls are of concern while working, especially in wet conditions. Personnel must be aware of their surroundings while moving about the site. Pathways and work areas must be kept free of debris and supplies to prevent unsafe walking and working conditions. Changes in elevation such as ruts, holes (including exposed vaults that once housed facility equipment), broken pavement, or berms should be pointed out to all field personnel. If possible, potential slip, trip, and fall areas should be marked with bright flagging or a similar type of marker.

When water is used during any of the work tasks, care must be taken to avoid creating muddy or slippery conditions. If slippery conditions are unavoidable, barriers and warning signs must be used to warn of these dangers. Additional strategies to minimize the occurrence of slips, trips, and falls are provided in Section 9.1.9.

7.2.3 Mechanical and Heavy Equipment Operations

Extreme caution must be taken by all personnel working around mechanical equipment, pumps, and heavy equipment such as an excavator or drill rig. Only authorized personnel should be allowed in the vicinity of such equipment. All personnel must avoid standing within the turning radius of the equipment or below any suspended load. Loose clothing, jewelry, long hair, or other items that have the potential to come in contact with rotating/operating equipment are prohibited. Job sites must be kept as clean and orderly as possible to prevent unsafe walking and working conditions.

When water is used, care must be taken to avoid creating muddy or slippery conditions. If slippery conditions are unavoidable, barriers and warning signs must be used to warn personnel of these dangers.

All equipment must be maintained in good working order and be operated in a safe manner. Heavy equipment must have audible back-up alarms, rollover protection, seatbelts, and be equipped with a fire extinguisher. Shannon & Wilson personnel shall not work near equipment they judge to be unsafe due to deterioration, missing parts, obvious defects, or improper operation.

7.2.4 Electrical Hazards

OSHA regulations require that employees who may be exposed to or required to work near electrical equipment be trained to recognize the associated hazards and use the appropriate control methods. Field personnel that will be required to perform such tasks will be properly trained in accordance with OSHA regulations prior to performing their tasks.

In addition, the following guidelines will be followed by all personnel while they are on site. All extension cords used for portable tools or other equipment must be designated for hard or extra usage and be three-wire pronged. All 120-volt, single-phase 15- and 20-ampere receptacle outlets located in areas of moisture or where water contact may occur must be equipped with a ground-fault circuit interrupter. Temporary lighting lamps for general illumination must be protected from accidental breakage and metal case sockets must be grounded.

7.2.5 Heat Stress

Heat stress at work can cause physical discomfort, loss of efficiency and attention to safety, and personal injury. Age, weight, degree of physical fitness, degree of acclimatization, metabolism, use of alcohol or drugs, and a variety of medical conditions such as hypertension all affect a person’s sensitivity to heat. The type of clothing worn must be considered. Prior heat injury predisposes an individual to additional injury.

The fluid loss and dehydration resulting from physical activity puts outdoor laborers at particular risk. Certain medications predispose individuals to heat stress, such as drugs that alter sweat production (antihistamines, anti-psychotics, antidepressants) or interfere with the body’s ability to regulate temperature. Persons with heart or circulatory diseases or those who are on low-salt diets should consult with their physicians prior to working in hot environments.

It is difficult to predict just who will be affected and when, because individual susceptibility varies. In addition, environmental factors include more than the ambient air temperature. Radiant heat, air movement, conduction, and relative humidity all affect an individual’s response to heat.

All personnel must be instructed on the symptoms of the primary heat-related disorders and how to minimize their chances of becoming affected by them. These disorders, their symptoms, and first-aid measures are briefly outlined below:

- Fainting (Heat Syncope): Victims usually recover quickly after a brief period of lying down. Moving around, rather than standing still, will usually reduce the possibility of fainting.
- Heat Rash: Decreased ability to tolerate heat, raised red vesicle on affected areas, and clothes that chafe. Maintain good personal hygiene and use drying powders or lotions.
- Heat Cramps: Muscle spasms and pain in the extremities and abdomen. Rest in cool area and drink plenty of fluids. If pain persists, seek medical attention.

- Heat Exhaustion: Shallow breathing; pale, cool, moist, clammy skin; profuse sweating; dizziness; lassitude; and fainting. Rest in a cool area and drink plenty of fluids. Get medical attention prior to returning to work.
- Heat Stroke: Red, hot, dry skin; no perspiration; nausea; dizziness; confusion; strong rapid pulse; coma. Cool victim immediately with cool or cold water. Seek immediate medical attention.

At a minimum, personnel wearing non-breathable clothing at temperatures greater than 70 degrees Fahrenheit (F) should take a break every one to two hours and drink plenty of fluids. The intake of an average of one quart of fluids per hour is recommended. A cool or shaded rest area should be provided. Detailed operating procedures and guidelines to prevent heat-related disorders are provided in Section 9.1.10 of this plan.

7.2.6 Cold Stress

Field personnel will be instructed on the signs and symptoms and the prevention of cold-related disorders prior to performing specific work tasks. The two major effects of cold stress are frostbite and hypothermia. These disorders, their symptoms, and first-aid measures are outlined briefly below:

- Frostnip: Occurs when the face or extremities are exposed to a cold wind, causing the skin to turn white. Frostnip is considered a minor condition with no permanent damage, as long as the human tissue is warmed up in time. If not, the condition can progress to frostbite.
- Frostbite: Sudden blanching of the skin progressing to skin with a waxy or white appearance that is firm to the touch, but the tissue beneath the skin is resilient to the touch.
- Hypothermia: The symptoms of systematic hypothermia are exhibited as follows: (a) shivering; (b) apathy, listlessness, and (sometimes) rapid cooling of the body to less than 90 degrees F; (c) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; (d) freezing of the extremities; and (e) death.
- Trench Foot: Swelling of the foot caused by long continuous exposure to cold without freezing, combined with persistent dampness or immersion in water. Edema (swelling), tingling, itching, and severe pain occurs, followed by blistering, necrotic tissue, and ulcerations.
- Chilblains: Similar symptoms as trench foot, except that other areas of the body are impacted. The cold exposure damages capillary beds in the skin, which in turn can cause redness, itching, blisters, and inflammation.
- Raynaud’s Phenomenon: The abnormal constriction of the blood vessels of the finger on exposure to cold temperatures, resulting in blanching of the fingertips. Numbness, itching, tingling, or a burning sensation may occur during related attacks. The disease is

also associated with the use of vibrating hand tools in a condition sometimes called White Finger Disease. Persistent cold sensitivity, ulceration, and amputations can occur in severe cases.

Personnel will monitor themselves and other team members for signs of cold stress. If temperatures fall below 20 degrees F, as measured by the wind chill index, thermal clothing may be required. Field activities will be curtailed if equivalent wind chill temperatures are less than zero degrees F unless operations are of an emergency nature. Section 9.1.11 of this plan provides detailed operating procedures and guidelines for working in cold temperature extremes.

7.2.7 Noise

Heavy equipment or operating machinery may produce noise levels that exceed 85 decibels (dBA) scale for personnel working in or around these areas. Thus, hearing protection must be worn by personnel exposed to noise levels of 85 dBA or greater. Noise measurements, if conducted, should be performed with sound level meters in slow response mode, or with noise dosimeters having a beginning collection point established at 80 dBA. A general guideline to follow is if a conversation cannot be held with a person 4 feet from you without raising your voice, the noise levels are too high and hearing protection should be worn. Anyone within a 20-foot radius of heavy equipment or machinery in operation will wear hearing protection.

7.2.8 Heavy Lifting

The use of some sampling equipment involves heavy lifting. To assure personnel safety, the following lifting guidelines will be employed at the site:

- If available, use mechanical equipment to move heavy objects.
- If possible, use two individuals to lift heavy objects, such as sample coolers that are filled with samples.
- Establish steady footing when lifting the load.
- Spread feet no wider than shoulder width when lifting.
- Use only one person to give commands when conducting team-lifting activities.

Back injury prevention is discussed in more detail within Section 9.1.12.

7.2.9 Unsafe Structures

As part of the fieldwork, personnel may enter site structures to collect samples. Because the condition of these structures is unknown, prior to entering any structure, field personnel will perform a cursory evaluation of the structure's exterior to determine if the building is safe to enter. Personnel will not enter any structure that is deemed to be unsafe.

7.2.10 Confined Spaces

OSHA defines a confined space as an area that is large enough for an employee to enter fully, not designed for continuous occupancy, and has a limited or restricted means of entry or exit. Confined spaces may exist at the worksite. Field personnel will inspect their work area prior to entering to determine the presence of confined spaces. Field personnel will not enter any confined spaces.

7.2.11 Drowning Hazard

Personnel may be required to work near or over deep bodies of water. Personnel must be aware of their surroundings at all times in order to avoid the hazards involved with drowning. Field personnel will perform a cursory inspection of the work site prior to commencing work in order to determine the need for additional controls associated with this hazard. Safe practices for working near or over water are discussed in more detail within Section 9.1.13.

7.3 Biological Hazards

The plant, animal, and/or microbial hazards most likely to be encountered by field personnel include animal bites, insect stings, or contact with irritant plants. Stinging insects, primarily bees and wasps, are prevalent during the warmer months. Stings are usually more of a nuisance than an immediate danger for most people, with the results of being stung including localized swelling, itching, and minor pain. The risk to these hazards will vary depending on the time of year and specific task performed.

8 SITE CONTROL

The purpose of site control is to minimize the health and safety risks to field personnel and the general public by means of establishing work zones and control procedures. A site map is included as Attachment A. Due to the nature and the anticipated chemicals of potential concern that may be encountered during the investigation, airborne exposures to contaminants are not anticipated. Therefore, the establishment of the three work zones as described by OSHA and U.S. Environmental Protection Agency hazardous waste regulations does not appear warranted, except as discussed within Section 12. Since field personnel will wear disposable PPE while they are performing the general reconnaissance and sampling activities, decontamination stations will not be required unless non-disposable equipment or tools will be used in support of these activities. Necessary first-aid equipment will be located within the support vehicle. This area (Support Zone) is considered to be uncontaminated; thus, personnel shall remove any PPE that has come into contact with hazardous waste or materials prior to entering this zone.

While conducting fieldwork, field personnel will identify an immediate work zone around their work area. Depending on the location and available room, this zone may be demarcated with tape or cones.

8.1 Communications

A critical element to ensure site control and safety to both on-site and field personnel will be open-line communications. The written and visual symbols may include:

- Written notification regarding schedules and activities to be conducted,
- Hand signals between work crews,
- Visual/physical barriers notifying personnel of areas of hazards, and
- Security fencing.

The audible communications for field personnel and between on-site and field personnel will include:

- Telephone,
- Radio, and
- Air horn.

8.2 Buddy System

When conditions present a risk to personnel (both physical and chemical), the buddy system will be implemented. A buddy system requires two people to work as a team, each looking out for the other. Buddies must maintain continuous line-of-sight contact with one another and can physically assist should rescue be necessary.

9 SAFETY PRACTICES AND HAZARD CONTROLS

General worker safety gear, such as steel-toed boots, hardhat, hearing protection, and safety glasses or goggles, will be worn at all times by personnel working around heavy equipment, and face shields and/or safety glasses and long-sleeved shirts will be worn by personnel clearing vegetation. Additional PPE (gloves, neoprene boots, etc.) shall be available for emergency use or for use on work tasks where this level of PPE has been selected for personnel safety.

Eating, drinking, smoking, and horseplay shall be strictly prohibited inside the Exclusion Zone (EZ). Inspections shall be made at the discretion of the SSO. Inspections will be conducted of all emergency response equipment, such as eyewash and first aid kits, and to ensure that fire extinguishers are available for use. Working upwind from wells helps to avoid exposure to vapors and contaminated dust. Intrinsically safe portable fans may be deployed if necessary.

Some activities require special safety considerations compared to routine tasks, such as vegetation clearing, handling of hazardous materials, and working over water. These tasks shall be performed in accordance with this HASP and the applicable regulatory requirements.

Washing facilities will be established on site or near the site. All personnel shall be informed of the location of these facilities. If necessary, mobile washing facilities will be established in the support vehicle and will consist of water, soap, means of drying, and receptacles for waste. An adequate supply of drinking water will be available near work areas. Water coolers or water bottles will be clearly marked as to their contents. Toilet facilities are available nearby.

Field operations shall be conducted in accordance with the minimum safety practices described below required for all Shannon & Wilson employees on all projects.

9.1 Chemical Hazards

9.1.1 General Practices for Hazardous Waste Sites

- Shannon & Wilson field personnel are to be thoroughly briefed on the anticipated hazards, equipment requirements, safety practices, emergency procedures, and communications methods, both initially and in daily briefings.
- At sites with known or suspected contamination, appropriate work areas for field personnel support, contaminant reduction, and exclusion will be designated and maintained.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increase the probability of hand-to-mouth transfer and ingestion of materials is prohibited in any area where the possibility of contamination exists.
- Hands must be thoroughly washed when leaving a contaminated or suspected contaminated area before eating, drinking, or any other activities.

- Contaminated protective equipment shall not be removed from the work area until it has been properly decontaminated or containerized on site.
- Avoid activities that may cause dust. Removal of materials from protective clothing or equipment by blowing, shaking, or any means that may disperse materials into the air is prohibited.
- All field personnel will, whenever possible, remain upwind of drilling rigs, open excavations, boreholes, etc.
- Field personnel are specifically prohibited from entering into excavations, trenches, or other confined spaces deeper than 4 feet. Unattended boreholes must be properly covered or otherwise protected.
- When collecting LNAPL samples, Tyvek overalls and boot covers will be used as a protective outer layer. If the LNAPL damages the Tyvek overall, a higher grade overall such as Saranex will be used.

9.1.2 Personnel Decontamination

Decontamination requirements will be established prior to site work on a case-by-case basis. The SSO will be responsible for determining these requirements.

Direct contact with pure contaminants is not anticipated. Instead, a more likely scenario is physical contact with materials such as decontamination water used for cleaning sampling supplies. Disposal PPE will be worn by field personnel performing general field investigation and decontamination activities. For protection, simple personnel decontamination will be performed near the work area using the following steps:

Step 1: Remove outer boot covers or wipe down boots.
Step 2: Remove hardhat and outer coveralls or Tyvek and wipe clean.
Step 3: Remove gloves.
Step 4: Depart the work area.
Step 5: Wash hands and face before drinking, eating, or smoking.

Because gross contamination is not anticipated, all disposable PPE shall be placed into heavy-duty plastic bags and disposed of with the general base refuse. If it is determined that a location has the potential to be or is suspected to be heavily contaminated such that the establishment of three zones is required based on the hazards present (Section 12), all personnel and portable equipment used in the work zone shall be subject to a thorough decontamination process. All reusable boots and gloves will be decontaminated using soap and water solution and scrub brushes, or simple removal and disposal, if the PPE is disposable. All wastewater generated during decontamination procedures will be stored on site in 55-gallon drums for subsequent disposal pending the associated analytical results. All disposable PPE will be disposed of in a trash bag. If necessary, disposal of decontamination wastes will be through certified disposal transporters/operators per the waste characteristics.

9.1.3 Sampling Equipment Decontamination

Before daily use, all portable monitoring equipment will be bagged or contained in such a way as to allow for simple decontamination procedures. Exposed parts shall be cleaned with wet cloths and/or alcohol wipes.

Sampling equipment will be decontaminated. The following procedures will be used to decontaminate equipment:

- Dislodge gross contamination from sampling utensils.
- Scrub with appropriate brush in a phosphate-free detergent.
- Rinse with tap water.
- Rinse with deionized water.
- Rinse a second time with deionized water.
- Air dry.

9.1.4 Air Monitoring

Air monitoring using a photoionization detector (PID) will be conducted when well monument lids are opened, an odor is detected, or LNAPL is present. The instrument will provide real-time measurements of airborne contaminant concentrations and provide the site workers with an additional level of protection against exposure to contaminants. The meter will be calibrated in accordance with the manufacturer's guidelines on a daily basis prior to the start of that day's field activities.

An action level of 5.0 parts per million (ppm) sustained for one minute in the worker's breathing zone has been established for this project. If PID readings exceed this established action level, the area may have to be evacuated for a period of time to allow levels to return to below action levels, alternative engineering controls may be implemented to lower the levels such as keeping all field personnel upwind of the borehole, or an upgrade to Modified Level C PPE will be required, which includes the use of respirators. If sustained elevated PID readings are obtained during the fieldwork, personnel will evaluate whether they are due to an external source such as a generator or vehicle or if the elevated readings are due to the presence of site contamination.

9.1.5 Respiratory Protection

- The Shannon & Wilson Respiratory Protection Program will be followed whenever a respirator is required.
- Field personnel must use the "buddy system" when wearing any respiratory protective devices. Communications between members must be maintained at all times. Emergency communications shall be prearranged in case unexpected situations arise. Visual contact must be maintained between pairs on site, and team members should stay close enough to assist each other in the event of an emergency.
- Personnel should be cautioned to inform each other of subjective symptoms of chemical exposure such as headache, dizziness, nausea, and irritation of the respiratory tract.
- No excessive facial hair that interferes with a satisfactory fit of the facepiece-to-face seal will be allowed on personnel required to wear respiratory protective equipment.
- The selection, use, and maintenance of respiratory protective equipment shall meet the requirements of established Shannon & Wilson procedures, recognized consensus standards (American Industrial Hygiene Association, American National Standards Institute, and National Institute for Occupational Safety and Health), and shall comply with the requirements set forth in 29 CFR 1910.134 and WAC 296-841.

9.1.6 Physical Hazards

9.1.7 Safe Driving

Operators of vehicles on company business must:

- Evaluate conditions of the vehicle and observe deficiencies of the vehicle before commencing operation.
- Driver must be in possession of a valid driver's license.
- Wear seat belts/available safety restraint systems in all vehicles.
- Drive defensively, be courteous, and obey all traffic rules and regulations.
- Do not exceed posted speed limits.
- Do not pick up hitchhikers.
- Do not use cell phones while driving.
- Under no circumstances should a Shannon & Wilson employee operate a vehicle while under the influence of intoxicating beverages, drugs, or other substances.
- Operate the vehicle at a SAFE speed in cases of inclement weather, heavy traffic, or other road hazards. Be especially aware of the hazards of black ice, particularly on bridges and overpasses.
- Remove keys and lock unattended vehicles.

All accidents involving a vehicle being operated on business, regardless of circumstances or severity, will be reported to the PM within 24 hours. It is important to note that this is done not to find fault, but to analyze specific incidents for future accident prevention.

9.1.8 Facility/Traffic

Cargo/transfer terminal sites and other work sites with high traffic flow and limited visibility present a significant hazard to Shannon & Wilson field staff. Since this is an area of extremely high risk, it is important that the following health and safety policies and procedures are followed. While visual devices are generally effective, the use of a structural barrier (such as a company vehicle) is a more effective method of protection should a vehicle driver fail to see an employee. Barriers shall be used on work sites when it is possible to do so without adversely affecting the project work or other client considerations. Employees are reminded to maintain a high degree of awareness of moving vehicles on the site. The following guidelines concerning traffic warning devices should be followed when working in traffic flow areas:

- Meet with the Facility Manager at the start of fieldwork to discuss equipment and personnel access to the work area;
- Obtain any facility-related emergency information, i.e., facility alarms, response phone numbers, evacuation areas, and special hazards;
- High-visibility vests shall be worn by employees when working around traffic flow areas. Ensure that there is a clear line of sight between approaching traffic and the work area;
- Orange cones are typically used to direct traffic flow on roadways but are not always appropriate as a flagging device on Shannon & Wilson project sites. Due to the low height, a cone can be easily overlooked, especially when a motorist is backing up. Tubular markers at least 4 feet high with flags attached at the top are more visible. Alternatively, a Type I barricade with flagging at the top may be used. One option often used with cones is to place an object on the cones that will make noise if struck by a car; and
- When two or more Shannon & Wilson employees are together on a site and a site-specific activity has a high risk of impact from vehicular traffic, one employee shall act as a look-out for the other employee performing the specific work activity.

9.1.9 Slip/Trip/Hit/Fall Hazards

Slip/trip/hit and fall injuries are the most frequent of all injuries to workers. They occur for a wide variety of reasons, but can be minimized by the following prudent practices:

- Spot check the work area to identify hazards;

- Establish and utilize a pathway that is most free of slip and trip hazards;
- Beware of trip hazards such as wet floors, slippery surfaces, and uneven surfaces or terrain;
- Carry loads that you can see over;
- Keep work area clean and free of clutter, especially in storage rooms and walkways;
- Communicate hazards to on-site personnel;
- Secure all loose clothing and ties, and remove jewelry while around machinery;
- Report and/or remove hazards; and
- Keep a safe buffer zone between workers using equipment and tools.

9.1.10 Heat Stress

The Washington State Department of Occupational Safety and Health (DOSH) regulates heat-related illness in WAC 296-62. DOSH defined Heat-Related Illness (HRI) triggers based on the type of clothes worn, ambient temperature, and whether the work is conducted in sun or shade. Exhibit 9-1 provides trigger conditions at which provisions of the HRI rule become mandatory.

Exhibit 9-1: DOSH Heat-Related Illness Trigger Conditions

Type of Clothes Worn	Work in Direct Sun	Work in Shade
Work clothes (standard construction clothes)	89°F	96°F
Double-layer woven clothes (coveralls over work clothes)	77°F	87°F
Vapor barrier (Tyvek, etc.)	52°F	62°F

NOTES:
DOSH = Washington State Department of Occupational Safety and Health; °F = degrees Fahrenheit

The HRI rule includes requirements for a written procedure, water on site, and training of staff and supervisors.

Written Procedures. The employer must establish, implement, and maintain written procedures to reduce to the extent feasible the risks of heat-related illness that include the following elements:

- Identification and evaluation of temperature, humidity, and other environmental factors associated with heat-related illness
- Provisions to reduce to the extent feasible the risks of heat-related illness that include the following elements:

  - The provision of rest breaks as needed to reduce to the extent feasible the risks of heat-related illness.
  - Encourage frequent consumption of water.
  - Procedures for responding to signs or symptoms of possible heat-related illness and accessing medical aid.
  - Employees are responsible for monitoring their own personal factors for heat-related illness, including ensuring they consume adequate water.

Drinking Water. Drinking water must be provided and made readily available in sufficient quantity to provide at least one quart per employee per hour. Employers may begin the shift with smaller quantities of drinking water if they have effective procedures for replenishment during the shift as needed to allow employees to drink one quart or more per hour.

Training. Training in the following topics must be provided to all employees who may be exposed to a heat-related illness hazard.

- The environmental factors that contribute to the risk of heat-related illness;
- General awareness of personal factors that may increase susceptibility to heat illness including, but not limited to, an individual's age, degree of acclimatization, medical conditions, water consumption, alcohol consumption, caffeine consumption, nicotine use, and use of prescription and nonprescription medications that affect hydration or other physiological responses to heat;
- The employer's procedures for identifying, evaluating, and controlling exposure;
- The importance of removing PPE that increases exposure to heat-related illness hazards during all breaks when feasible;
- The importance of frequent consumption of small quantities of water. One quart or more over the course of an hour may be necessary when the work environment is hot and employees may be sweating more than usual in the performance of their duties;
- The importance of acclimatization;
- The different types of heat-related illness and the common signs and symptoms of heat-related illness;
- The importance of immediately reporting to the employer, directly or through the employee's supervisor, symptoms or signs of heat illness in themselves, or in co-workers;
- The employer's procedures for responding to symptoms of possible heat-related illness, including how emergency medical services will be provided should they become necessary; and
- The purpose and requirements of this standard.

Prior to supervising employees who are working in conditions that may present heat-related illness hazards, supervisors must have training on the following topics:

- The procedures the supervisor is to follow to implement the HRI rule;
- The procedures the supervisor is to follow when an employee exhibits signs or symptoms consistent with possible heat-related illness, including emergency response procedures;
- Procedures for moving employees to a place where they can be reached by an emergency medical service provider, if necessary; and
- How to provide clear and precise directions to the emergency medical provider who needs to find the work site.

9.1.11 Cold Stress

To reduce adverse health effects from cold exposure, adopt the following work practices:

- Provide adequate dry insulating clothing to maintain core temperature above 98.6 degrees F to workers if work is performed in air temperature below 40 degrees F. Wind chill cooling rates and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.
- If the air temperature is 32 degrees F or less, hands should be protected by gloves or mittens.
- If available clothing does not give adequate protection to prevent cold injury, work should be modified or suspended until adequate clothing is made available, or until weather conditions improve.
- Use heated warming shelters available nearby (e.g., on-site trailer) at regular intervals, the frequency depending on the severity of the environmental exposure. When entering the heated shelter, remove the outer layer of clothing and loosen the remainder of clothing to permit heat evaporation or change to dry work clothing.
- Provide warm, sweet drinks (e.g., hot chocolate) and soups at the work site for calorie intake and fluid volume. Limit the intake of coffee because of the diuretic and circulatory effects of caffeine.
- Include the weight and bulk of clothing in estimating the required work performance and weights to be lifted by the worker.
- Implement a buddy system in which workers are responsible for observing fellow workers for early signs and symptoms of cold stress.
- Employees that are not acclimatized should not work full time in cold until they become accustomed to the working conditions and required protective clothing.

Exhibit 9-2 describes the cooling power of wind on exposed flesh. This information can be used as a guide for determining equivalent chill temperatures when the wind is present in cold environments.

Exhibit 9-2: Wind Chill Factors

Estimated Wind Speed (in mph)	Actual Temperature Reading (^{0}F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (^{0}F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-82	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-129	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect)	LITTLE DANGER In less than an hour with dry skin. Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute.			GREAT DANGER Flesh may freeze within 30 seconds.				
Trench foot may occur at any point on this chart.												

NOTES:
* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts.
°F = degrees Fahrenheit; mph = miles per hour

Field personnel will observe work and warming regimen as shown in Exhibit 9-3.

Exhibit 9-3: Cold Weather Work/Warm-Up Regimen

Air Temperature - Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
^{0}C (approx.)	^{0}F (approx.)	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks
-26 to -28	-15 to -19	(Norm Breaks) 1		(Norm Breaks) 1		75 min.	2	55 min.	3	40 min.	4
-29 to –31	-20 to -24	(Norm Breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32 to –34	-25 to -29	75 min.	2	55 min.	3	40 min.	4	30 min.	5	non-emergency work should cease	
-35 to –37	-30 to -34	55 min.	3	40 min.	4	30 min.	5	non-emergency work should cease		non-emergency work should cease	
-38 to –39	-35 to -39	40 min.	4	30 min.	5	non-emergency work should cease		non-emergency work should cease		non-emergency work should cease	
-40 to –42	-40 to -44	30 min.	5	non-emergency work should cease		non-emergency work should cease		non-emergency work should cease		non-emergency work should cease	
-43 and below	-45 and below	non-emergency work should cease		non-emergency work should cease		non-emergency work should cease		non-emergency work should cease		non-emergency work should cease	

NOTES:

* Developed by the American Conference of Governmental Industrial Hygienists.
°C = degrees Celsius; °F = degrees Fahrenheit; min. = minute; mph = miles per hour

9.1.12 Back Injury Prevention

Back injuries on the job are costing employers in the U.S.A. approximately $6.5 billion annually. Eight out of ten people will suffer a back injury during their life time, either on or off the job. Many of these injuries could be prevented by adhering to the following proper lifting concepts:

- **Keep the load close to the body.** Arrange tasks so that the load will be close to the body and at a proper and safe height that will not require bending or stooping. Tighten stomach muscles to offset the force of the load.
- **Keep the load within reach.** Try to arrange tasks to eliminate handling loads below 20 inches or above 50 inches. Try to keep the lifting zone between your shoulders and the knuckles.
- **Control the load size.** Loads that extend beyond 16 inches in front of the body put excessive lifting stress on the body and should be handled by two people or lifting aids should be employed.
- **Maintain proper alignment of body.** The task should be designed so that twisting of the body is minimized or eliminated. Twisting while carrying a load increases injury potential significantly.
- **Lift with your legs.** Your leg muscles are the strongest in your body. Always bend your knees and use your leg muscles when you go toward the floor whether you have a load or not. Do not bend at your waist if it can be avoided.
- **Balance your load if possible.** An evenly balanced load is much easier and much safer to handle than an off-balance load. Grasp the object at opposite corners if possible.
- **Avoid excessive weights if possible.** Mechanical aids should be used for loads that are greater than those which can be handled safely by one person.
- **Lift in a comfortable manner.** Workers should use a lifting position that feels comfortable for them; however, they should bend their knees and keep their back as straight as possible when performing a lift. Your feet should be shoulder-width apart in order to get the best footing possible.
- **Lift smoothly and gradually.** Quick jerking lifting motions increase sudden and abrupt stress to the back. This type of aggressive movement can affect the discs, muscles, and the ligaments. A well-controlled and smooth lifting motion will reduce the likelihood of injury.
- **Most importantly, think before lifting.**

In addition to these lifting techniques, it is also important to implement the proper carrying techniques as follows:

- **Eliminate carrying where possible.** If possible, conveyors, trucks, small loaders, and other mechanical equipment should be considered. Carts and dollies should be employed when surface conditions permit. Surface conditions can be altered with plywood or other materials.
- **Use two-handed carries where possible.** Using a two-handed carry method helps to balance the load and even out the body stress.
- **Keep the load close to the body.** Keeping the load in close and lifting in as erect a position as possible helps to reduce the stress to the lower spine.
- **Keep your arms straight.** Less stress is created on the muscles and ligaments when your arms are kept straight during a carry. Contraction of the muscles will quickly increase fatigue and the possibility of an accident.
- **Balance the load.** A balanced load is similar to the two-handed carry. The load is evenly distributed across the body and the stress is also evenly shared.
- **Avoid carrying any material on stairs.** Carrying on stairs will obstruct your vision and increase the likelihood of slip and fall. The bumping of the load on your leg as you climb or descend increases the chance of an injury.
- **Reduce the weight if possible.** When the weight of the lifts is high, look for ways to reduce the weight. Use smaller containers, put less in containers, indicate fill levels, and locate lighter containers.
- **Use handles.** Make the task easier by adding handles where possible. If numerous repetitions are required, it may be possible to design a handled device to accommodate a two-handed carrying task.

In addition to these lifting and carrying techniques, it is also important to consider pushing and pulling tasks:

- **Eliminate manual pushing and pulling where possible.** Look at those tasks that are repeated often to see if they can be modified or altered in a way that reduces pushing and pulling. Consider mechanical aids, powered conveyors, gravity slides, and chutes.
- **Reduce the necessary force.** Force required is a function of weight, gravity, and friction. Look for opportunities to reduce these factors. Improved bearings, larger wheels, reduced weight, improved rolling surfaces, lubrication, and improved regular maintenance are all opportunities for reducing work force and stress.
- **Push load instead of pulling.** Studies indicate that pushing loads rather than pulling them is the safest approach. There is less stress on muscles, joints, and ligaments. As in lifting, pushing pressure should be applied firmly, but gradually. Avoid aggressive impacts.

There are also a number of guidelines to follow when addressing tasks that involve shoveling operations:

- **Choose correct shovel type.** The shovel should be appropriate for the material and the project. Light, loose, and fluffy materials should be handled with a scoop-type shovel. A smaller shovel like a spade should be used for more dense material.
- **Use a long-handled shovel.** A long-handled shovel should be provided to avoid stooping during shoveling activities. Take the time to obtain the correct tool for the job.
- **Maintain load to 10 pounds per shovelful.** The general rule of thumb for the average work situation is 10 pounds per shovel load. Work performed is a function of repetition and load. Increasing shovel loads will increase fatigue as repetitions increase and it will also increase the potential for injury.

Drum handling operations can be made safer by considering the following techniques:

- **Use a drum cart where feasible.** A four-wheel cart is preferred for drum handling because it is more stable, better latched, and has a better handle positioning. In addition, it is more easily tipped back and held in place when the drums are loaded.
- **Do not rotate from horizontal to vertical unless nearly empty.** Only empty or nearly empty drums should be rotated from horizontal to vertical. A tipster or forklift with a proper drum handling attachment is the preferred method.
- **Use handling equipment for moving drums from one level to another.** Whenever possible, pallets, scales, and conveyors should be recessed in the floor to avoid raising drums to another level. If not, drums should be handled on a low platform or an incline adapter should be provided.
- **Limit drum weight to 450 to 500 pounds.** Regardless of the material involved, drums should only be filled to a maximum weight of 700 pounds. Drums over 300 pounds shall not be handled by hand. Use of mechanical equipment is required. *(Example: water = 8.6 lb per gallon x 52 gallons = 447.2 lbs)*
- **Limit travel distance to 30 feet.** The other general guideline regarding drum handling involves keeping drum transport to a maximum of 30 feet.

9.1.13 Drowning Prevention

To assure personnel safety, the following guidelines will be employed when the threat of drowning exists at the site:

- Do not work alone.
- Wear a U.S. Coast Guard-approved personal flotation device (PFD-Type III).
- Check weather reports to confirm safe working conditions (avoid storms).
- Take care when exiting and entering the boat from land or barge.
- Make sure the barge or boat is securely anchored at the work location.

- If possible, use two individuals to lift heavy objects, such as sample coolers that are filled with samples.
- Stop work if water conditions become hazardous (e.g., high swells, storms, etc.)

9.2 Biological Hazards

Animal bites, especially in remote areas, always pose a risk. This can be minimized by being observant and not approaching animals exhibiting unusual behavior. Avoiding contact with poison ivy, poison oak, or poison sumac, where present, will minimize the hazards from poisonous plants. Ways to reduce potential exposures to microbial hazards include using proper sanitation prior to eating or drinking liquids and limiting eating or drinking to areas outside the EZ. Treatment of stings can be handled by basic first-aid treatment. However, if personnel are allergic to bees or wasps, they should make this known to co-workers and have prescribed medication available while they are on site so that appropriate action can be taken. If a rodent nest or fecal pile is found, the area should be sprayed/soaked with bleach (again, a respirator and gloves should be worn). The materials used to perform the disinfecting of the area should also be disposed of in a dumpster. Personnel should be aware of their surroundings and wear the appropriate work clothing to minimize the amount of exposed skin.

10 PERSONAL PROTECTIVE AND SAFETY EQUIPMENT

The level of protection required to ensure the health and safety of field personnel will be determined by the SSO based on the specific site activities, available instrumentation readings, and professional experience and judgment. Based on the specific tasks associated with the work plan, field personnel shall wear Modified Level D PPE, depending on the task. Higher levels of PPE are not currently anticipated for this project. However, the Health and Safety Manager and SSO will adjust the level of PPE required for a specific work task, as necessary.

The Health and Safety Manager, in conjunction with the SSO, will establish action levels for minimum levels of protection for each area of the site where investigation activities will occur. The action levels will remain the same, but the level of protection may change due to changing site conditions.

10.1 Modified Level D Protection

Modified Level D PPE will be the initial requirement for all scoped tasks associated with the work plan. The Health and Safety Manager and SSO will upgrade and/or change the level of PPE as field conditions warrant. Modified Level D PPE includes the following:

- Coveralls or work clothes (dictated by weather).
- Tyvek coveralls (optional).
- Gloves (outer), chemical/liquid-resistant when there is a potential for wet work or contact with contaminated materials.
- Gloves (inner), chemical/liquid-resistant (surgical nitrile) when there is a potential to contact contaminated materials.
- Leather safety boots/shoes with chemical-resistant soles and steel-toed shanks when necessary.
- Safety glasses.
- Chemical-resistant boot covers when chemical hazards are present.
- Chemically protective safety boots as an alternative to leather boots with boot covers.
- Hardhat (with splash shield during high splash activities) and safety glasses.
- Hearing protection (where appropriate).

Use of Tyvek coveralls on site where work functions preclude splashes of chemicals or long-term contact with contaminated soil or water will be at the discretion of the SSO.

10.2 Unknown Environments

The requirement of field personnel entering unknown environments is not anticipated as part of the scope of work for this delivery order. If an unknown environment is encountered, personnel shall not enter the area until the chemical or physical hazards in the area can be identified and measures taken to reduce or eliminate those hazards.

10.3 Considerations for Selecting Levels of Protection

Factors to be considered in selecting the appropriate level of PPE include heat and cold stress; air-monitoring results; chemical, physical, and biological hazards associated with the task; routes of exposure; and weather conditions. The Health and Safety Manager will determine the level of PPE required for the specific work task following an evaluation of these factors. The SSO will be responsible for ensuring that all field personnel adhere to the PPE requirements. Based on existing information and data for the activities to be performed, modified Level D PPE will be the initial requirement for all scoped tasks. Exposure to elevated airborne concentrations of contaminants above the respective permissible exposure levels is considered to be low for the work plan; thus, the use of respiratory protection is anticipated only for collecting swipe samples inside on-site structures. However, if site conditions, field activities, or air-monitoring results indicate the need for respiratory protection during other field activities, the SSO and the Health and

Safety Manager will evaluate the initial activities to be performed by site personnel, and if necessary, modifications to the PPE requirements will be implemented.

10.4 Personnel Protective Equipment (PPE) for Visiting Personnel

Site visitors will be required to have the appropriate PPE prior to site entry. No personnel will be allowed to enter the site if they do not have the appropriate PPE.

10.5 Personnel Protective Equipment (PPE) Inspections

All PPE shall be inspected prior to, during, and after use. Inspectors will look for rips, tears, discolorations that may indicate bleed-through of chemicals, delamination, or any other signs of wear or degradation that would affect the effectiveness of protection. PPE will be stored in a manner that prevents degradation and is consistent with the manufacturer's instructions. Consideration should be given to ultra-violet damage, inability to dry/air-out, and unnecessary folds/creases. The SSO or the Health and Safety Manager will determine the need to repair or replace PPE.

10.6 Safety Equipment

Basic emergency and first aid equipment will be available in the support vehicle. All field personnel will be informed of the locations of the safety equipment and the proper use of the equipment. For the duration of the work plan, weekly inspections of the safety equipment will be performed by the SSO.

11 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURE

This section describes contingencies and emergency planning procedures to be implemented during the work plan. All incidents will be dealt with in a manner to minimize health risks to field personnel and the surrounding environment. In the event of an incident, the following procedures shall be completed at a minimum:

- First aid and other appropriate initial action will be administered by properly trained personnel closest to the incident. This assistance will be conducted in a manner to assure individuals rendering assistance are not placed in a situation of unacceptable risk.
- All incidents will be reported to and documented by the SSO, who is responsible for coordinating the emergency response in an efficient, rapid, and safe manner. The SSO will perform emergency equipment inspections to check that standard equipment is available on site to address likely emergencies.

- In the event of an accident or emergency, all workers on site are responsible to conduct themselves in a mature, calm manner to avoid spreading danger to themselves, the surrounding workers, or the community in general.

The initial response to any emergency will be to protect human health and safety. Secondary response to the emergency will be identification, containment, treatment, and disposal of contaminated materials. The local Fire Department will be called in all situations in which fires or explosions have occurred by dialing 911.

All field personnel will have access to the contact list provided in this HASP. If an emergency occurs that requires outside agency assistance or notification, site employees are instructed never to leave an emergency notification on an answering machine, but rather call the 24-hour emergency answering service number if no one answers the primary number.

Potential incidents fall under four general classifications: (a) worker injury or illness; (b) fire or explosion; (c) severe weather conditions such as tornado and lightning storms; and (d) chemical releases to the atmosphere, soil, or surface water.

11.1 Worker Injury or illness

If a non-life-threatening/serious injury occurs, the local hospital will be contacted for assistance prior to transporting the victim(s). The local hospital is Harborview Medical Center. Address and contact information are located prior to Section 1.0. A copy of a map showing the directions from the site to the Hospital is provided as Attachment D.

In the event of a medical emergency, personnel will take direction from the SSO (or alternate team leader if the SSO is injured), notify the appropriate emergency organization, and implement the following procedures:

- Call 911.
- Identify location, request medical assistance, and provide name and telephone number.
- Notify Shannon & Wilson's Health and Safety Manager and file an accident report.

11.2 Fire or Explosion

In the event of an emergency that necessitates the evacuation of the site, such as a fire or severe weather, field personnel will implement the following procedures:

- Field personnel will be alerted by sounding a portable horn, radio contact, or direct verbal means. (When air horns are used, two sustained blasts followed by one or two blasts will notify all personnel to exit.)

- Personnel in the work zone may or may not perform field decontamination prior to leaving the work zone, depending on the nature of the incident requiring the evacuation.
- Concurrent with the evacuation of field personnel, notification will be immediately made by dialing 911, indicating location of the incident, and providing information to local responders.

Immediately following an evacuation, a head count will be taken. Upon his/her arrival, the SSO, or his designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials on site.

11.3 Severe Weather

When a severe storm warning has been issued or when a lightning storm occurs, the information will be immediately relayed to all field personnel who shall be notified to stand by for emergency procedures. After the storm warning is cancelled and the storm passes, the SSO will inspect all on-site equipment to ensure its readiness for operation. If any equipment has been damaged, the work will not be restarted until the equipment has been repaired or replaced.

If the SSO's inspection indicates that a fire, explosion, or release has occurred as the result of a severe weather condition, he/she will follow the appropriate procedures outlined in this section.

In regard to lightning, personnel will follow the "30/30 rule," which states that personnel will seek appropriate shelter when working outdoors if thunder is heard less than 30 seconds after the strike is seen. Personnel who have sheltered may resume working 30 minutes after the last thunder is heard.

11.4 Chemical Release/Spill Containment Program

The objective of this part of the HASP is to meet the requirements of 29 CFR 1910.120(b)(4)(ii)(j).

11.4.1 Spill Prevention

All hazardous substances will be stored in secure locations in containers of suitable type, properly labeled, with tight-fitting lids. Any investigation-derived wastewater or free product will be stored in 55- or 16-gallon drums until properly disposed of. Spill containment drip pans and duck ponds will be utilized, when applicable, to contain small leaks during sampling activities and transfer.

11.4.2 Large Spill Response

The primary spill response kit is located in the support vehicle. The kit contains absorbent pads, shovels, and personal safety equipment. In the event of a spill of a hazardous substance, immediate action will be taken by all personnel present. The following actions will be taken in the event of a spill, when applicable:

- Attend to significantly injured personnel.
- Stop the source (e.g., shut off a pump, stand up fallen container).
- Control the spill by berming, ditching, or immediately absorbing the substance.
- Report spill to the SSO, PM, the Health and Safety Manager, and applicable regulating agencies.

If the PM determines that clean up can be performed safely with project personnel, the SSO may act as the spill team leader and designate required procedures. Before work begins, the SSO must conduct a hazard identification and assessment with response personnel. The following must be discussed and established:

- Levels of PPE and safety procedures.
- Safety and work zones.
- All steps of the response activities.
- Most effective procedures for cleanup.
- Means of containment.
- Decontamination procedures.
- Emergency decontamination.

11.5 Post-Incident Follow-Up

The PM or SSO must implement the necessary steps to ensure that the incident is properly documented and that the emergency response equipment is replenished. The PM must direct the necessary corrective actions to present recurrence and evaluate the response.

11.6 Security

During activation of the emergency procedures, the SSO or designated representative will control access to the site and maintain a security incident log that will include at a minimum:

- Time of entry
- Expected exit time
- Task being performed
- Location of task
- Rescue and response equipment used
- Protective equipment used

12 WORK COMPLETED WITHIN SUSPECTED POLYCHLORINATED BIPHENYLS (PCBs) AREAS

The work plan includes collection of soil samples within an area with PCB contamination. Activities completed within this area require the use of additional measures to ensure that worker safety is protected, and that the field activities do not result in the contamination of previously uncontaminated areas. The following sections summarize additional site control, site preparation, communication, PPE, and decontamination and disposal procedures for investigation activities to be completed within the area with PCB contamination.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work.

12.1 Site Control

Access to the work site will be restricted to designated personnel. To reduce the accidental spread of hazardous substances by workers or equipment from the contaminated area to the clean area, zones should be delineated on the site where different types of operations will occur, and the flow of personnel among the zones should be controlled. The establishment of work zones will help ensure that: personnel are properly protected against the hazards present where they are working, work activities and contamination are confined to the appropriate areas, and personnel can be located and evacuated in an emergency.

The area of PCB investigation will be separated into zones as needed to meet operational and safety objectives. It is intended that the area be separated by the use of cones and tape into zones as follows:

- Exclusion Zone (EZ), the contaminated area.
- Contamination Reduction Zone (CRZ), the area where decontamination takes place.
- Support Zone (SZ), the uncontaminated area where workers should not be exposed to hazardous conditions.

Movement of personnel and equipment among these zones should be minimized and restricted to specific Access Control Points to prevent cross-contamination from contaminated areas to clean areas.

An EZ/CRZ, and SZ will be set up for work being conducted within the limits of the work area. The full area designated for investigation of PCBs (where drilling and logging of borings will be undertaken) is the EZ. Only authorized personnel shall be permitted access to the EZ/CRZ. The drilling work in the EZ area will be completed before the drilling rig is moved outside of the EZ. In the EZ plastic will be placed on the ground around the boring area, and plastic will be placed on and below the boring logging table to prevent soil from the spilling to the ground. Tyvek overalls will be worn. Staff will decontaminate all equipment and gear as necessary prior to exiting the CRZ. Staff will take care to prevent the transport of contaminated soils during decontamination, and decontamination areas may be constructed with plastic sheeting on the ground to reduce transport of contaminated soils from the EZ to the SZ.

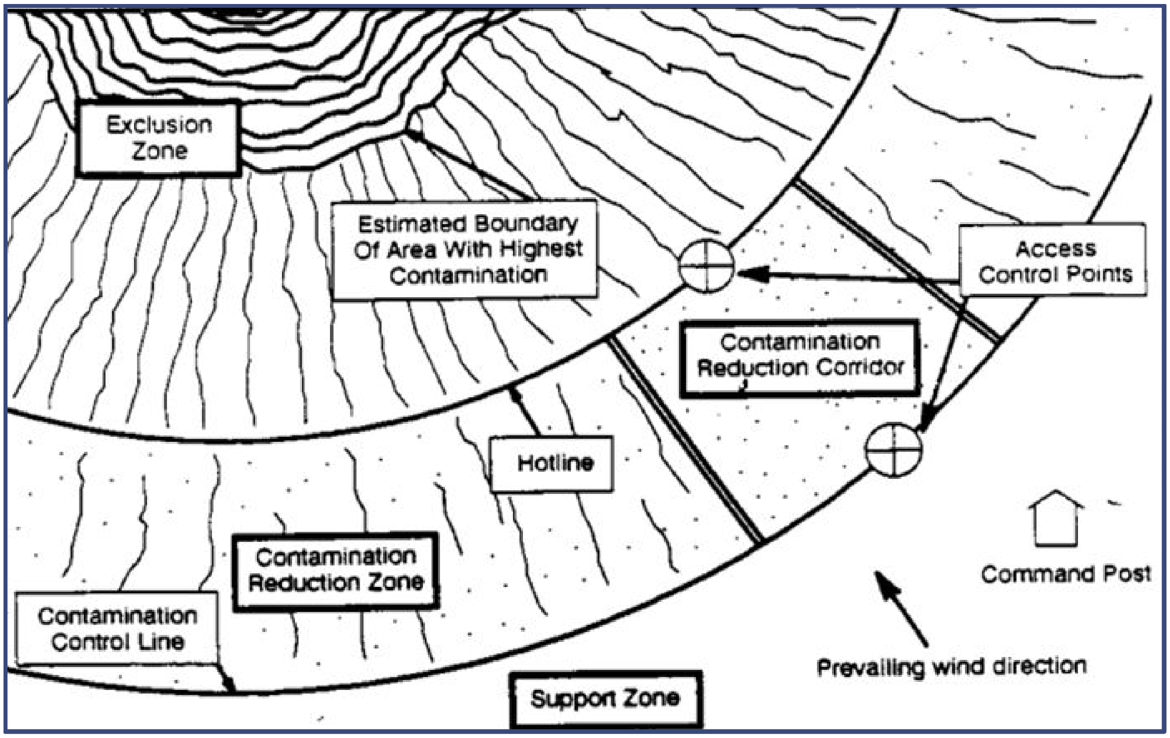


Exhibit 12-1: Illustration of Typical Work Zones

Provided by OSHA.gov

12.1.1 Exclusion Zone (EZ)

The EZ is the area where contamination does or could occur. The primary activities performed in the EZ are:

- Completion of borings and soil sampling.

The personnel working in the EZ may include the field team members, the SSO, the PM, and specialized personnel such as heavy equipment operators. All personnel within the EZ should wear appropriate PPE (Section 12.4).

Impermeable plastic must be placed across the surface within the EZ where contaminated soil is located to prevent spills from contacting unpaved surfaces (Section 12.2). Use of impermeable plastic can create a slip/trip/fall hazard; safety practices for this type of hazard were discussed in Section 9.1.9.

12.1.2 Contamination Reduction Zone (CRZ)

The CRZ is the transition area between the contaminated area and the clean area. This zone is designed to reduce the probability that the clean SZ will become contaminated or affected by other site hazards. The distance between the EZ and SZ provided by the CRZ, together with decontamination of workers and equipment, limits the physical transfer of hazardous substances into clean areas. The boundary between the CRZ and the EZ is called the Hotline. The degree of contamination in the CRZ decreases as one moves from the Hotline to the SZ, due both to the distance and the decontamination procedures.

Decontamination procedures take place in a designated area within the CRZ. Two lines of decontamination stations should be set up within the CRC: one for personnel and one for heavy equipment. Access into and out of the CRZ from the EZ is through the Access Control Point. The equipment will only enter and exit once at the beginning and end of the drilling.

Personnel entering the CRZ shall be required to wear the personal protective clothing and equipment prescribed for working in the CRZ. To reenter the SZ, workers should remove any protective clothing and equipment worn in the CRZ and leave through the personnel exit Access Control Point.

The CRZ must be well designed to facilitate:

- Decontamination of equipment, PDS operators, and personnel.
- Emergency response: first-aid equipment (such as bandages, blankets, eye wash, splints, and water); and containment equipment (absorbent and fire extinguisher).
- Equipment resupply: personal protective clothing and equipment (such as booties and gloves), sampling equipment (such as bottles and jars), and tools.
- Sample packaging and preparation for onsite or offsite laboratories.
- Worker temporary rest area: Water and other potable liquids should be clearly marked and stored properly to ensure that all glasses and cups are clean. Wash facilities should be located near drinking facilities to allow employees to wash before drinking. Drinking, and washing, should be located in a safe area where protective clothing can be removed.
- Drainage of water and other liquids that are used during decontamination.

Personnel within the CRZ should be required to maintain internal communications; line-of-sight contact with work parties; work party monitoring (e.g., fatigue, heat stress, and hypothermia); and site security.

12.1.3 Support Zone (SZ)

The SZ is the location of the administrative and other support functions needed to keep the operations in the EZ and CRZ running smoothly. Any function that need not or cannot be performed in a hazardous or potentially hazardous area is performed here. The Command Post Supervisor should be present in the SZ. Other personnel present will depend on the functions being performed, and may include the field team members who are preparing to enter or who have returned from the EZ.

Personnel may wear standard PPE (10.1) within this zone. Any potentially contaminated clothing, equipment, and samples must remain in the CRZ until decontaminated.

SZ personnel are responsible for alerting the proper agency in the event of an emergency. All emergency telephone numbers, evacuation route maps, and vehicle keys should be kept in the SZ.

When setting up support facilities, consider factors such as:

- Accessibility. Topography, open space available, locations of highways and railroad tracks, and ease of access for emergency vehicles.
- Resources. Adequate roads, power lines, telephones, shelter, and water.
- Visibility. Line-of-sight to all activities in the EZ.
- Wind direction. Upwind of the EZ, if possible. If upwind locations are not feasible due to fencing or structures, the best cross-wind location should be selected.
- Distance. As far from the EZ as practicable.

12.2 Site Preparation

Time and effort must be spent in preparing a site to ensure that worker safety is protection, field activities go smoothly, that the field activities do not result in the contamination of previously uncontaminated areas, and that contamination is not transported outside of the EZ. Safety measures should be afforded the same level of care at this stage as during other field activities. Proper site preparation includes:

- Arrange traffic control signage to ensure safe and efficient operations.
- Eliminate physical hazards from the work area as much as possible, including:
    - Ignition sources in flammable hazard areas.
    - Exposed or ungrounded electrical wiring, and low overhead wiring that may entangle equipment.
    - Sharp or protruding edges, such as glass, nails, and torn metal, which can puncture protective clothing and equipment and inflict puncture wounds.
    - Debris, holes, loose steps or flooring, protruding objects, slippery surfaces, or unsecured railings, which can cause falls, slips, and trips.

  - Unsecured objects, such as bricks and gas cylinders, near the edges of elevated surfaces, such as catwalks, roof tops, and scaffolding, which may dislodge and fall on workers.
  - Debris and weeds that obstruct visibility.
- Provide adequate illumination for work activities. Equip any temporary lights with guards to prevent accidental contact.
- The EZ must have impermeable plastic placed across the work area surfaces where feasible prior to work activity. Damage to the plastic can be repaired with the addition of impermeable plastic and duct tape.

The hotline should be clearly marked by lines, placards, hazard tape and/or signs; or enclosed by physical barriers, such as chains, fences, or ropes. Access Control Points should be established at the periphery of the EZ to regulate the flow of personnel and equipment into and out of the zone and to help verify that proper procedures for entering and exiting are followed. If feasible, separate entrances and exits should be established to separate personnel and equipment movement into and out of the EZ. The following steps describe how to establish the hotline:

- Visually survey the immediate site vicinity.
- Evaluate the results of previous soil and water sampling.
- Consider the physical area necessary for site operations.
- Consider meteorological conditions and the potential for contaminants to be blown from the area.
- Secure or mark the hotline.
- Modify its location, if necessary, as more information becomes available.

12.3 Communication

All site work will occur in teams and the primary means of communication on-site and with off-site contacts will be via cell phones. An agreed-upon system of alerting via air horns and/or vehicle horns may be used around heavy equipment to signal an emergency if shouting is ineffective. Any emergencies or significant incident situations will be immediately reported the PM.

12.4 Personnel Protective Equipment (PPE)

At a minimum, the work will be conducted in accordance with the HASP and workers will wear the appropriate personal protective equipment, which is expected to be Modified Level D outlined in Section 10.1.

The following hazard controls, based on the tasks identified in the field activities above, are required for field staff responsible for oversight, sample collection, inspection, and measuring tasks during active construction, performed from the SZ:

- Level D PPE, which includes hard hat, steel-toed boots, safety glasses, hearing protection, task-appropriate gloves, and a reflective safety vest.

The following hazard controls should be added when performing tasks within the EZ and/or CRZ:

- Chemical resistant coveralls or Tyvek.
- Chemical resistant boots or boot covers.

12.5 Decontamination and Disposal

All reusable equipment that comes into contact with soil should be decontaminated prior to moving to the next sampling location. Stainless steel bowls and spoons, and any tools used for sample processing will be decontaminated between each sample; alternatively, disposable bowls and spoons may be used.

Particulate matter and surface film will be removed using a brush followed by hot water pressure washing using potable water and Liquinox® detergent, or equivalent. Additionally, direct-push rods will be fitted with disposable plastic liners for sample collection to ensure that sample material does not come into contact with the interior of the direct-push rod. This process is the industry standard of care for decontamination of downhole drilling equipment.

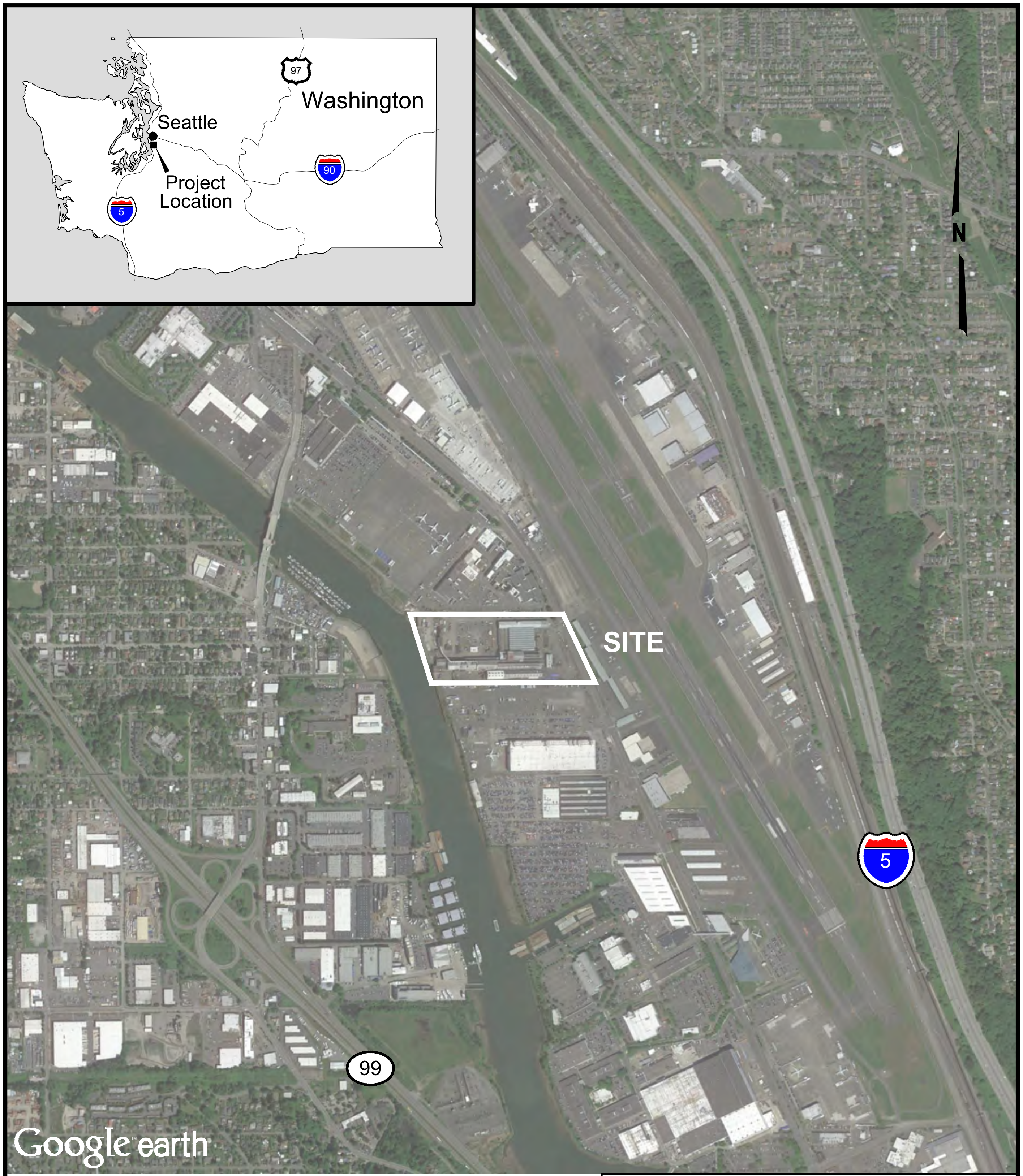
Decontamination wash water will be containerized separately from decontamination wash water from elsewhere on the Site and profiled for treatment or for off-site disposal. Excess soil will be placed in a drum, labeled as investigation-derived waste (IDW) pending characterization, and temporarily stored in a secure location for bulk disposal concurrent with excavation. If soil characterization data show that PCBs are present at concentrations greater than or equal to 50 ppm in any given sample associated with a particular drum (or drums) of IDW, then the entire drum(s) will be transported to a Subtitle C facility for disposal. All miscellaneous solid waste, such as PPE and disposable sampling equipment will be containerized or bagged in heavy-duty plastic bags and disposed of as municipal solid waste.

The drilling rig and equipment will be placed on plastic and brushed down with a hard brush before exiting the CRZ. Other drilling equipment will be decontaminated following the same procedure as sampling equipment.

ATTACHMENT A: SITE MAP

Attachment A

Site Map



Jorgensen Forge Facility
8531 East Marginal Way S
Tukwila, Washington

SITE LOCATION MAP

March 2020 21-1-12596-013

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1

Filename: J:\211\12596\013\21-1-12596-013 Site Location.dwg Date: 02-04-2020 Login: JRS

Attachment B

Daily Safety Meeting Log

ATTACHMENT B: DAILY SAFETY MEETING LOG

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

DAILY SAFETY MEETING LOG

JOB NAME: ____________________ JOB NO: ____________________ BORING NO: ____________________

LOCATION: ____________________ DATE: / / TIME: :

SUBCONTRACTOR: ____________________ S&W REP: __________ S&W PM: __________

WORK DESCRIPTION: ____________________

CHECK APPLICABLE HAZARDS: Heavy Equipment ☐, Vehicles ☐, Overhead ☐, Tools ☐, Temperature ☐, Lifting ☐ (Use Mechanical Means Instead), Site Housekeeping ☐ (Clear Walkways to Prevent Slips, Trips, Falls), Awkward Work Area ☐, Public ☐, Security ☐, Plants ☐, Animals ☐, Noise ☐, Vibration ☐, Dust ☐, Radiation ☐, UV exposure ☐, Repetitive Motion ☐, Suspected Contamination ☐, Chemical Exposure ☐, Flammable/Explosive ☐

OTHER HAZARDS: ____________________

EQUIPMENT ON SITE: ____________________

____

DOCUMENTATION:	Present	PPE:	Present
SSHSP On Site?	☐	Boots - Safety Toe / Other	☐
Hospital Map On Site?	☐	Safety Glasses	☐
Fall Protection Plan On Site?	☐	Vest - Class II / Class III	☐
Respiratory Protection Plan On Site?	☐	Hard Hat	☐
Confined Space Entry Plan On Site?	☐	Ear - Plugs / Muffs / Both	☐
Traffic Control Plan?	☐	Gloves - Type: __________	☐
Other Plan? __________	☐	Face Shield	☐
Current Fit Test?	☐	Respirator	☐

Cards/Certs Required? *List Below*

____

____

Other PPE? *List Below*

____

____

Hazards & Controls Discussed? ☐

Need to Update SSHSP? ☐

My signature below confirms that the above hazards, controls and plans have been discussed and that I understand them.

PRINT NAME	SIGNATURE	COMPANY	HAS ALL CARDS	PPE On?
			☐	☐
			☐	☐
			☐	☐
			☐	☐
			☐	☐
			☐	☐
			☐	☐

ATTACHMENT C: SAFETY DATA SHEETS

Attachment C

Safety Data Sheets

New Jersey Department of Health

Right to Know
Hazardous Substance Fact Sheet

Common Name: **ARSENIC**

Synonyms: Gray Arsenic; Arsen

Chemical Name: Arsenic

Date: June 1998 Revision: April 2008

CAS Number: 7440-38-2

RTK Substance Number: 0152

DOT Number: UN 1558

Description and Use

Arsenic is a silver-gray or white metallic, odorless, brittle solid. It is used as an alloying agent for heavy metals, and in solders, medicines and herbicides.

Reasons for Citation

- **Arsenic** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, NTP, DEP, IARC, IRIS and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while rinsing. Seek medical attention.

Skin Contact

- Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Inhalation

- Remove the person from exposure.
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE BACK PAGE

Hazard Summary

Hazard Rating	NJDOH	NFPA
HEALTH	4	-
FLAMMABILITY	0	-
REACTIVITY	0	-
CARCINOGEN POISONOUS GASES ARE PRODUCED IN FIRE		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Arsenic** can affect you when inhaled and may be absorbed through the skin.
- **Arsenic** is a CARCINOGEN and may cause reproductive damage. HANDLE WITH EXTREME CAUTION.
- Skin contact can cause irritation, burns, rash and loss of pigment
- Eye contact can cause irritation and burns.
- Inhaling **Arsenic** can irritate the nose and throat and can cause an ulcer or hole in the "bone" (septum) dividing the inner nose.
- Exposure to **Arsenic** can cause weakness, poor appetite, nausea, vomiting, headache, and even death.
- **Arsenic** may damage the nervous system and the liver.
- **Arsenic** is a noncombustible solid, but when in *dust* or *fine powder* form it can EXPLODE when exposed to heat, flame or hot surfaces.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **0.01 mg/m^3** averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit (REL) is **0.002 mg/m^3**, which should not be exceeded at any time.

ACGIH: The threshold limit value (TLV) is **0.01 mg/m^3** averaged over an 8-hour workshift.

- **Arsenic** is a CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.
- The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Arsenic**:

- Skin contact can cause irritation, burns, rash and loss of pigment.
- Eye contact can cause irritation, burns and red, watery eyes.
- Inhaling **Arsenic** can irritate the nose and throat causing coughing and wheezing.
- Exposure to **Arsenic** can cause weakness, poor appetite, nausea, vomiting, headache, muscle cramps and even death.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Arsenic** and can last for months or years:

Cancer Hazard

- **Arsenic** is a CARCINOGEN in humans. It has been shown to cause skin and lung cancer.
- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard

- Chronic **Arsenic** exposure has been associated with spontaneous abortions and still births.
- There is limited evidence that **Arsenic** is a teratogen in animals. Until further testing has been done, it should be treated as a possible teratogen in humans.

Other Effects

- Repeated skin contact can cause thickened skin and/or patchy areas of darkening and loss of pigment. Some persons may develop white lines on the nails.
- Long-term exposure can cause an ulcer or hole in the "bone" (septum) dividing the inner nose, hoarseness and sore eyes.
- **Arsenic** may damage the nervous system causing numbness, "pins and needles," and/or weakness in the hands and feet.
- **Arsenic** may damage the liver.

Medical

Medical Testing

Before first exposure and every 12 months thereafter, OSHA requires your employer to provide (for persons exposed to greater than **0.005 mg/m^3** of *Arsenic*) a work and medical history and exam which shall include:

- Chest x-ray
- Exam of the nose, skin and nails
- Test for urine **Arsenic**. This is most accurate at the end of the workday. Eating shellfish or fish may elevate **Arsenic** levels for up to two days. At NIOSH recommended exposure levels, urine **Arsenic** should not be greater than **100 micrograms per liter** of urine.

After suspected overexposure, repeat these tests and consider exam of the nervous system and liver function tests. Also examine your skin periodically for abnormal growth. Skin cancer from **Arsenic** can be easily cured when detected early.

OSHA requires your employer to provide you and your doctor with a copy of the OSHA *Inorganic Arsenic* Standard (29 CFR 1910.1018).

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures

- More than light alcohol consumption can cause liver damage. Drinking alcohol may increase the liver damage caused by **Arsenic**.

Conditions Made Worse By Exposure

- May scientists believe that skin changes such as thickening and pigment changes make those skin areas more likely to develop skin cancer.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Specific engineering controls are required for this chemical by OSHA. Refer to the OSHA *Inorganic Arsenic* Standard (29 CFR 1910.1018).
- Use a vacuum or a wet method to reduce dust during clean-up. DO NOT DRY SWEEP.
- Use a high efficiency particulate air (HEPA) filter when vacuuming. Do not use a standard shop vacuum.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Arsenic**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Safety equipment manufacturers recommend *Nitrile*, *Natural Rubber* or *Silver Shield®* for gloves and DuPont *Tyvek®*, or the equivalent, as protective materials for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear impact resistant eye protection with side shields.
- Wear a face shield with goggles when working with corrosive, high irritating or toxic substance.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure not higher than **0.1 mg/m^3**, use a half-mask air purifying respirator equipped with high efficiency filters.
- Where the potential exists for exposure not higher than **0.5 mg/m^3**, use a full facepiece, air purifying respirator with high efficiency filters.
- Where the potential exists for exposure not higher than **5 mg/m^3**, use any powered-air purifying respirator with high efficiency filters or a half-mask supplied-air respirator operated in a positive pressure mode.
- Leave the area immediately if (1) while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect **Arsenic**, (2) while wearing particulate filters abnormal resistance to breathing is experienced, or (3) eye irritation occurs while wearing a full facepiece respirator. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- Consider all potential sources of exposure in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
- Exposure to **5 mg/m^3** is immediately dangerous to life and health. If the possibility of exposure above **5 mg/m^3** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Arsenic** is noncombustible, however, **Arsenic** *dust* or *fine powder* can explode when exposed to heat, flame or hot surfaces.
- Use dry chemical, CO_2, water spray or foam as extinguishing agents.
- POISONOUS GASES ARE PRODUCED IN FIRE, including *Arsenic Oxides*.
- Use water spray to keep fire-exposed containers cool.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Arsenic** is spilled, take the following steps:

- ▸ Evacuate personnel and secure and control entrance to the area.
- ▸ Eliminate all ignition sources.
- ▸ Collect powdered material in the most convenient and safe manner, or use a HEPA-filter vacuum for clean-up, and deposit in sealed containers.
- ▸ Ventilate area of spill after clean-up is complete.
- ▸ DO NOT wash into sewer.
- ▸ It may be necessary to contain and dispose of **Arsenic** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Arsenic** you should be trained on its proper handling and storage.

- ▸ A regulated, marked area should be established where **Arsenic** is handled, used or stored as required by the OSHA *Inorganic Arsenic* Standard (29 CFR 1910.1018).
- ▸ **Arsenic** reacts with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) to cause fires and explosions.
- ▸ **Arsenic** reacts with ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC) and HYDROGEN GAS to produce toxic *Arsine gas*.
- ▸ **Arsenic** is not compatible with *powdered* METALS (such as ZINC, LITHIUM, RUBIDIUM and PLATINUM); BROMINE AZIDE; LEAD MONOXIDE; and MERCURY OXIDE.
- ▸ Store in tightly closed containers in a cool, well-ventilated area away from COMBUSTIBLES and HEAT.
- ▸ DO NOT store in metal tanks.

Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values are intended to provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database maintained by federal EPA. The database contains information on human health effects that may result from exposure to various chemicals in the environment.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

NJ Health
New Jersey Department of Health

Right to Know Hazardous Substance Fact Sheet

Emergency
Responders
Quick Reference

Common Name: **ARSENIC**

Synonyms: Gray Arsenic; Arsen
CAS No: 7440-38-2
Molecular Formula: As
RTK Substance No: 0152
Description: Silver-gray or white metallic, odorless, brittle solid

HAZARD DATA

Hazard Rating

4 - Health

0 - Fire

0 - Reactivity

DOT#: UN 1558

ERG Guide #: 152

Hazard Class: 6.1 (Poison)

Firefighting

Arsenic is noncombustible, however, *Arsenic dust* or *fine powder* can explode when exposed to heat, flame or hot surfaces.

Use dry chemical, CO_2, water spray or foam as extinguishing agents.

POISONOUS GASES ARE PRODUCED IN FIRE, including *Arsenic Oxides*.

Use water spray to keep fire-exposed containers cool.

Reactivity

Arsenic reacts with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) to cause fires and explosions.

Arsenic reacts with ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC) and HYDROGEN GAS to produce toxic *Arsine gas*.

Arsenic is not compatible with *powdered* METALS (such as ZINC, LITHIUM, RUBIDIUM and PLATINUM); BROMINE AZIDE; LEAD MONOXIDE; and MERCURY OXIDE.

SPILL/LEAKS

Isolation Distance:

Spills: 25 to 50 meters (75 to 150 feet)

Fire: 800 meters (1/2 mile)

Moisten spilled material first or use a HEPA-filter vacuum for clean-up.

DO NOT wash into sewer.

Toxic to aquatic organisms.

PHYSICAL PROPERTIES

Odor Threshold:	Odorless
Flash Point:	Noncombustible solid
Vapor Pressure:	1 mm Hg at 701°F (372°C)
Specific Gravity:	5.7 (water = 1)
Water Solubility:	Insoluble
Boiling Point:	1,350°F (613°C)
Ionization Potential:	9.87 eV
Molecular Weight:	74.9

EXPOSURE LIMITS

OSHA:	0.01 mg/m^3, 8-hr TWA
NIOSH:	0.002 mg/m^3, 15-min Ceiling
ACGIH:	0.01 mg/m^3, 8-hr TWA
IDLH:	5 mg/m^3

PROTECTIVE EQUIPMENT

Gloves:	Natural Rubber, Nitrile or Silver Shield®
Coveralls:	DuPont Tyvek®
Respirator:	<0.1 mg/m^3 - Full facepiece APR with High efficiency filter <0.5 mg/m^3 -Supplied air

HEALTH EFFECTS

Eyes:	Irritation, burns, red and watery eyes
Skin:	Irritation, burns, itching, rash and loss of pigment
Inhalation:	Nose and throat irritation with coughing, wheezing and hoarseness Weakness, headache, nausea, vomiting, and muscle cramps
Chronic:	Cancer (skin and lung) in humans

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn. Seek medical attention.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer to a medical facility.

April 2008

NJ Health
New Jersey Department of Health

Right to Know
Hazardous Substance Fact Sheet

Common Name: **BENZENE**

Synonyms: Benzin; Benzol; Phenyl Hydride

Chemical Name: Benzene

Date: January 2001 Revision: October 2008

CAS Number: 71-43-2

RTK Substance Number: 0197

DOT Number: UN 1114

Description and Use

Benzene is a clear, colorless liquid with a sweet *Petroleum*-like odor. It is used as a solvent and in making plastics, resins dyes and pesticides. It is also found in *Gasoline*.

- **ODOR THRESHOLD= 12 ppm**
- Odor thresholds vary greatly. Do not rely on odor alone to determine potentially hazardous exposures.

Reasons for Citation

- **Benzene** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, NTP, DEP, IARC, IRIS, NFPA and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while rinsing.

Skin Contact

- Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Inhalation

- Remove the person from exposure
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE BACK PAGE

Hazard Summary

Hazard Rating	NJDOH	NFPA
HEALTH	4	2
FLAMMABILITY	-	3
REACTIVITY	-	0

CARCINOGEN
FLAMMABLE
POISONOUS GASES ARE PRODUCED IN FIRE
CONTAINERS MAY EXPLODE IN FIRE

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Benzene** can affect you when inhaled and by passing through the skin.
- **Benzene** is a CARCINOGEN and MUTAGEN. HANDLE WITH EXTREME CAUTION.
- **Benzene** can irritate the skin and eyes with drying and scaling of the skin.
- Inhaling **Benzene** can irritate the nose and throat.
- **Benzene** can cause headache, dizziness, nausea and vomiting. Convulsions and coma, or sudden death from irregular heartbeat, may follow high exposure.
- Repeated exposure can cause damage to the blood cells (aplastic anemia).
- **Benzene** is a FLAMMABLE LIQUID and a DANGEROUS FIRE HAZARD.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **1 ppm** averaged over an 8-hour workshift and **5 ppm**, not to be exceeded during any 15-minute work period.

NIOSH: The recommended airborne exposure limit (REL) is **0.1 ppm** averaged over a 10-hour workshift and **1 ppm**, not to be exceeded during any 15-minute work period.

ACGIH: The threshold limit value (TLV) is **0.5 ppm** averaged over an 8-hour workshift and **2.5 ppm** as a STEL (short-term exposure limit).

- **Benzene** is a CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.
- The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Benzene**:

- Contact can irritate the skin and eyes.
- Inhaling **Benzene** can irritate the nose and throat causing coughing and wheezing.
- **Benzene** can cause headache, dizziness, lightheadedness, nausea and vomiting. Convulsions and coma, or sudden death from irregular heartbeat, may follow high exposure.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Benzene** and can last for months or years:

Cancer Hazard

- **Benzene** is a CARCINOGEN in humans. It has been shown to cause leukemia.
- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard

- There is limited evidence that **Benzene** is a teratogen in animals. Until further testing has been done, it should be treated as a possible teratogen in humans.

Other Effects

- **Benzene** can cause drying and scaling of the skin.
- Repeated exposure can cause damage to the blood cells (aplastic anemia).

Medical

Medical Testing

Before first exposure and every 12 months thereafter, OSHA requires your employer to provide (for persons exposed to greater than **0.5 ppm** of *Benzene*) a work and medical history and exam, which shall include:

- Thorough physical examination
- Complete blood count (CBC)
- Any other tests determined necessary by the examining physician

OSHA requires your employer to provide you and your doctor with a copy of the OSHA *Benzene* Standard (29 CFR 1910.1028).

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Specific engineering controls are required for this chemical by OSHA. Refer to the OSHA *Benzene* Standard (29 CFR 1910.1028).
- Before entering a confined space where **Benzene** may be present, check to make sure that an explosive concentration does not exist.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Benzene**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Safety equipment manufacturers recommend Polyvinyl Alcohol, Silver Shield®/4H®, Viton and Fluoroelastomer for gloves and Tychem® CPF 3, F, BR, LV, Responder®, and TK; Zytron® 300; and ONESuit® TEC, or the equivalent, as protective materials for *Hydrocarbons, Aromatic.*
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear indirect-vent, impact and splash resistant goggles when working with liquids.
- Wear non-vented, impact resistant goggles when working with fumes, gases, or vapors.
- Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.
- Do not wear contact lenses when working with this substance.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over **0.5 ppm**, use a NIOSH approved full facepiece respirator with an organic vapor cartridge. Increased protection is obtained from full facepiece powered-air purifying respirators.
- Leave the area immediately if (1) while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect **Benzene**, (2) while wearing particulate filters abnormal resistance to breathing is experienced, or (3) eye irritation occurs while wearing a full facepiece respirator. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- Consider all potential sources of exposure in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
- Where the potential exists for exposure over **5 ppm**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- Exposure to **500 ppm** is immediately dangerous to life and health. If the possibility of exposure above **500 ppm** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Benzene** is a FLAMMABLE LIQUID.
- Use dry chemical, CO_2, water spray or foam as extinguishing agents.
- Use water as fog, as spray may be ineffective and may scatter and spread fire.
- POISONOUS GASES ARE PRODUCED IN FIRE.
- CONTAINERS MAY EXPLODE IN FIRE.
- Use water spray to reduce vapors and keep containers cool.
- Vapors may travel to a source of ignition and flash back.
- Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Benzene** is spilled or leaked, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate all ignition sources.
- Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers.
- Ventilate area of spill or leak.
- Keep **Benzene** out of confined spaces, such as sewers, because of the possibility of an explosion.
- Use water spray to reduce vapors and keep containers cool.
- DO NOT wash into sewer.
- It may be necessary to contain and dispose of **Benzene** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Benzene** you should be trained on its proper handling and storage.

- A regulated, marked area should be established where **Benzene** is handled, used or stored as required by the OSHA *Benzene* Standard (29 CFR 1910.1028).
- **Benzene** reacts violently or explosively with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC).
- **Benzene** ignites on contact with CHROMIC ANHYDRIDE.
- **Benzene** is not compatible with LIQUID OXYGEN, HYDROGEN, and RANEY NICKEL.
- Store in tightly closed containers in a cool, well-ventilated area away from AIR and HEAT.
- **Benzene** attacks some RUBBER, COATINGS and PLASTICS.
- Sources of ignition, such as smoking and open flames, are prohibited where **Benzene** is used, handled, or stored.
- Metal containers involving the transfer of **Benzene** should be grounded and bonded.
- Use explosion-proof electrical equipment and fittings wherever **Benzene** is used, handled, manufactured, or stored.
- Use only non-sparking tools and equipment, especially when opening and closing containers of **Benzene**.

Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values are intended to provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database maintained by federal EPA. The database contains information on human health effects that may result from exposure to various chemicals in the environment.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

NJ Health New Jersey Department of Health

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **BENZENE**

Synonyms: Benzin; Benzol; Phenyl Hydride
CAS No: 71-43-2
Molecular Formula: C_6H_6
RTK Substance No: 0197
Description: Clear, colorless liquid with a sweet *Petroleum*-like odor

HAZARD DATA

Hazard Rating

4 - Health

3 - Fire

0 - Reactivity

DOT#: UN 1114

ERG Guide #: 130

Hazard Class: 3 (Flammable)

Firefighting

FLAMMABLE LIQUID

Use dry chemical, CO_2, water spray or foam as extinguishing agents.

Use water as fog, as spray may be ineffective and may scatter and spread fire.

POISONOUS GASES ARE PRODUCED IN FIRE.

CONTAINERS MAY EXPLODE IN FIRE.

Use water spray to reduce vapors and keep containers cool.

Vapors may travel to a source of ignition and flash back.

Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source.

Reactivity

Benzene reacts violently or explosively with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC).

Benzene ignites on contact with CHROMIC ANHYDRIDE.

Benzene is not compatible with LIQUID OXYGEN, HYDROGEN, and RANEY NICKEL.

SPILL/LEAKS

Isolation Distance:

Small Spill: 30 meters (100 feet)

Large Spill: 60 meters (200 feet)

Fire: 800 meters (1/2 mile)

Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers.

Keep **Benzene** out of confined spaces, such as sewers, because of the possibility of an explosion.

DO NOT wash into sewer.

Benzene is very toxic to aquatic organisms.

PHYSICAL PROPERTIES

Odor Threshold:	12 ppm
Flash Point:	12°F (-11°C)
LEL:	1%
UEL:	8%
Auto Ignition Temp:	928° to 1,076°F (498° to 580°C)
Vapor Density:	2.7 (air = 1)
Vapor Pressure:	75 mm Hg at 68°F (20°C)
Specific Gravity:	0.88 (water = 1)
Water Solubility:	Slightly soluble
Boiling Point:	176°F (80°C)
Freezing Point:	42°F (6°C)
Ionization Potential:	9.24 eV
Molecular Weight:	78.1

EXPOSURE LIMITS

OSHA:	1 ppm, 8-hr TWA; 5 ppm, 15-min STEL
NIOSH:	0.1 ppm, 10-hr TWA; 1 ppm, 15-min STEL
ACGIH:	0.5 ppm, 8-hr TWA; 2.5 ppm, 15-min STEL
IDLH:	500 ppm
	ERPG-1: 50 ppm; ERPG-2: 150 ppm
	EPRG-3: 1,000 ppm

PROTECTIVE EQUIPMENT

Gloves:	Polyvinyl Alcohol, Silver Shield®/4H®, Viton and Fluoroelastomer (>8-hr breakthrough)
Coveralls:	Tychem® CPF 3, F, BR, LV, Responder®, and TK; Zytron® 300; and ONESuit® TEC (>8-hr breakthrough for *Hydrocarbons, Aromatic*)
Respirator:	>0.5 ppm - Supplied air or SCBA

HEALTH EFFECTS

Eyes:	Irritation
Skin:	Irritation
Inhalation:	Nose and throat irritation with coughing and wheezing
	Headache, dizziness, convulsions and coma
Chronic:	Cancer (leukemia) in humans

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.

October 2008

Right to Know
Hazardous Substance Fact Sheet

Common Name: **BENZO(a)PYRENE**

Synonyms: 3,4-Benzopyrene; B[a]P

Chemical Name: Benzo[a]pyrene

Date: July 1998 Revision: October 2007

CAS Number: 50-32-8

RTK Substance Number: 0207

DOT Number: UN 3077

Description and Use

Benzo(a)pyrene is a pale yellow, crystalline solid or powder with a faint aromatic odor. In its pure form it is used as a laboratory reagent. It also forms as a gaseous by-product when certain carbon substances burn, such as coal tar chemicals, and is found in cigarette smoke.

Reasons for Citation

- **Benzo(a)pyrene** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, NTP, DEP, IARC, IRIS, and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while rinsing.

Skin Contact

- Remove contaminated clothing. Wash contaminated skin with soap and water.

Inhalation

- Remove the person from exposure.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE BACK PAGE

Hazard Summary

Hazard Rating	NJDOH	NFPA
HEALTH	3	-
FLAMMABILITY	1	-
REACTIVITY	0	-
CARCINOGEN POISONOUS GASES ARE PRODUCED IN FIRE		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Benzo(a)pyrene** can affect you when inhaled and by passing through the skin.
- **Benzo(a)pyrene** is a CARCINOGEN. HANDLE WITH EXTREME CAUTION.
- **Benzo(a)pyrene** may damage the developing fetus.
- Contact can irritate and burn the eyes.
- **Benzo(a)pyrene** can irritate the skin causing a rash or burning feeling on contact.
- Repeated exposure can cause thickening and darkening of the skin.
- Except in laboratories, **Benzo(a)pyrene** is usually found mixed with other "coal tar pitch" chemicals.
- *For more information, consult the Right to Know Hazardous Substance Fact Sheets on COAL TAR PITCH, CREOSOTE, CHRYSENE, and ANTHRACENE.*

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **0.2 mg/m^3** (as *Coal Tar Pitch Volatiles*) averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit (REL) is **0.1 mg/m^3** (as the *Cyclohexane-extractable fraction*) averaged over a 10-hour workshift.

ACGIH: Recommends that exposure by all routes be controlled to levels as low as possible.

- **Benzo(a)pyrene** is a PROBABLE CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.
- The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to **Benzo(a)pyrene**:

- Contact can irritate and burn the eyes.
- **Benzo(a)pyrene** can irritate the skin causing a rash or burning feeling on contact. Exposure to a combination of sunlight and this chemical can increase these effects.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to **Benzo(a)pyrene** and can last for months or years:

Cancer Hazard

- **Benzo(a)pyrene** is a PROBABLE CARCINOGEN in humans. There is some evidence that is causes stomach, skin, lung, blood, spleen, pancreas, and mammary cancer in animals.
- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard

- **Benzo(a)pyrene** may damage the developing fetus.
- There is limited evidence that **Benzo(a)pyrene** may damage the male and female reproductive systems.

Other Effects

- Repeated exposure can cause thickening and darkening of the skin and warts.

Medical

Medical Testing
There is no special test for this chemical. However, seek medical attention if illness occurs or overexposure is suspected.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are <u>not</u> a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures

- Sunlight may cause a rash to develop in people exposed to **Benzo(a)pyrene** and increases the risk of skin cancer.
- Tobacco smoke also contains **Benzo(a)pyrene.** Smoking may increase the risk of lung cancer with exposure to **Benzo(a)pyrene.**

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.

NJ Health
New Jersey Department of Health

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **GASOLINE**

Synonyms: Benzin; Motor Fuel; Petrol
CAS No: 8006-61-9
Molecular Formula: C_5H_{12} to C_9H_{20} (Mixture of hydrocarbons which vary by grade)
RTK Substance No: 0957
Description: Clear, colorless to amber-colored liquid with a petroleum odor

HAZARD DATA

Hazard Rating

2 - Health

3 - Fire

0 - Reactivity

DOT#: UN 1203

ERG Guide #: 128

Hazard Class: 3 (Flammable)

Firefighting

FLAMMABLE LIQUID

Use dry chemical, CO_2, alcohol-resistant foam or other foam extinguishing agents, as water may not be effective in fighting fires.

POISONOUS GASES ARE PRODUCED IN FIRE.

CONTAINERS MAY EXPLODE IN FIRE.

Use water spray to keep fire-exposed containers cool.

Vapors may travel to a source of ignition and flash back.

Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source.

Flow or agitation may generate electrostatic charges.

Reactivity

Gasoline may react violently with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and NITRIC ACID.

SPILL/LEAKS

Isolation Distance:

Spill: 50 meters (150 feet)

Fire: 800 meters (1/2 mile)

Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers for disposal.

Keep **Gasoline** out of confined spaces, such as sewers, because of the possibility of an explosion.

Use only non-sparking tools and equipment, especially when opening and closing containers of **Gasoline**.

DO NOT wash into sewer.

Gasoline is harmful to aquatic organisms and is a marine pollutant.

PHYSICAL PROPERTIES

Odor Threshold:	0.25 ppm
Flash Point:	-36°F (-38°C)
LEL:	1.2%
UEL:	7.6%
Auto Ignition Temp:	536° to 853°F (280° to 456°C)
Vapor Density:	3 to 4 (air = 1)
Vapor Pressure:	38 to 300 mm Hg at 68°F (20°C)
Specific Gravity:	0.73 (water = 1)
Water Solubility:	Insoluble
Boiling Point:	140° to 390°F (60° to 199°C)
Molecular Weight:	72 to 100

EXPOSURE LIMITS

ACGIH: 300 ppm, 8-hr TWA; 500 ppm, STEL

The Protective Action Criteria values are:

PAC-1 = 500 ppm,
PAC-2 = 500 ppm
PAC-3 = 1,500 ppm

PROTECTIVE EQUIPMENT

Gloves:	Nitrile and Viton (>8-hr breakthrough)
Coveralls:	Tychem® BR, LV, Responder® and TK (>8-hr breakthrough)
Respirator:	>300 ppm - Supplied air or SCBA

HEALTH EFFECTS

Eyes:	Irritation and burns
Skin:	Irritation and burns
Inhalation:	Nose, throat and lung irritation with coughing, wheezing and shortness of breath Headache, nausea, weakness, dizziness, blurred vision, irregular heartbeat, and passing out
Chronic:	Cancer (liver) in animals

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn. Seek medical attention.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility

December 2008

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

Protective Action Criteria (PAC) are values established by the Department of Energy and are based on AEGLs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Gasoline** is spilled or leaked, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate all ignition sources.
- Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers for disposal.
- Keep **Gasoline** out of confined spaces, such as sewers, because of the possibility of an explosion.
- Use water spray to keep containers cool.
- Ventilate and wash area after clean-up is complete.
- DO NOT wash into sewer.
- It may be necessary to contain and dispose of **Gasoline** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Gasoline** you should be trained on its proper handling and storage.

- **Gasoline** may react violently with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and NITRIC ACID.
- Store in tightly closed containers in a cool, well-ventilated area.
- Sources of ignition, such as smoking and open flames, are prohibited where **Gasoline** is used, handled, or stored.
- Metal containers involving the transfer of **Gasoline** should be grounded and bonded.
- Use explosion-proof electrical equipment and fittings wherever **Gasoline** is used, handled, manufactured, or stored.
- Use only non-sparking tools and equipment, especially when opening and closing containers of **Gasoline**.
- Flow or agitation may generate electrostatic charges.

Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Before entering a confined space where **Gasoline** may be present, check to make sure that an explosive concentration does not exist.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Gasoline**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Safety equipment manufacturers recommend Nitrile and Viton for gloves, and Tychem® BR, LV, Responder® and TK, or the equivalent, as protective materials for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear indirect-vent, impact and splash resistant goggles when working with liquids.
- If additional protection is needed for the entire face, use in combination with a face shield. A face shield should not be used without another type of eye protection.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over **300 ppm**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Gasoline** is a FLAMMABLE LIQUID.
- Use dry chemical, CO_2, alcohol-resistant foam or other foam extinguishing agents, as water may not be effective in fighting fires.
- POISONOUS GASES ARE PRODUCED IN FIRE.
- CONTAINERS MAY EXPLODE IN FIRE.
- Use water spray to keep fire-exposed containers cool.
- Vapors may travel to a source of ignition and flash back.
- Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Gasoline**:

- Contact can irritate and burn the skin and eyes with possible eye damage.
- Inhaling **Gasoline** can irritate the nose, throat and lungs causing coughing, wheezing and/or shortness of breath.
- High exposure can cause headache, nausea, weakness, dizziness, blurred vision, irregular heartbeat, poor coordination, lightheadedness, and passing out.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Gasoline** and can last for months or years:

Cancer Hazard

- **Gasoline** may be a CARCINOGEN in humans since it has been shown to cause liver cancer in animals.
- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard

- There is limited evidence that **Gasoline** may damage the developing fetus and may affect female fertility.

Other Effects

- Prolonged or repeated exposure can cause drying and cracking of the skin with redness.
- Repeated high exposure may affect the lungs and brain.
- **Gasoline** may damage the liver.

Medical

Medical Testing

If symptoms develop or overexposure is suspected, the following are recommended:

- Chest x-ray and lung function tests
- Liver function tests
- Exam of the nervous system
- EEG

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures

- Smoking can cause heart disease, lung cancer, emphysema, and other respiratory problems. It may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.
- More than light alcohol consumption can cause liver damage. Drinking alcohol can increase the liver damage caused by **Gasoline**.

Right to Know
Hazardous Substance Fact Sheet

Common Name: **GASOLINE**

Synonyms: Benzin; Motor Fuel; Petrol

Chemical Name: Gasoline, Natural

Date: April 2003 Revision: December 2008

CAS Number: 8006-61-9

RTK Substance Number: 0957

DOT Number: UN 1203

Description and Use

Gasoline is a clear, colorless to amber-colored liquid with a petroleum odor. It is a blend of hydrocarbons used as an automotive fuel and as a solvent.

- **ODOR THRESHOLD= 0.25 ppm**
- Odor thresholds vary greatly. Do not rely on odor alone to determine potentially hazardous exposures.

Reasons for Citation

- **Gasoline** is on the Right to Know Hazardous Substance List because it is cited by ACGIH, DOT, NIOSH, DEP, IARC and NFPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while flushing. Seek medical attention.

Skin Contact

- Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Inhalation

- Remove the person from exposure.
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE BACK PAGE

Hazard Summary

Hazard Rating	NJDOH	NFPA
HEALTH	2	1
FLAMMABILITY	-	3
REACTIVITY	-	0

CARCINOGEN
FLAMMABLE
POISONOUS GASES ARE PRODUCED IN FIRE
CONTAINERS MAY EXPLODE IN FIRE

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Gasoline** can affect you when inhaled and by passing through the skin.
- **Gasoline** should be handled as a CARCINOGEN--WITH EXTREME CAUTION.
- Contact can irritate and burn the skin and eyes with possible eye damage.
- Inhaling **Gasoline** can irritate the nose, throat and lungs.
- High exposure can cause headache, dizziness, lightheadedness, and passing out.
- Prolonged or repeated exposure can cause drying and cracking of the skin with redness.
- Repeated high exposure may affect the lungs and brain.
- **Gasoline** may damage the liver.
- **Gasoline** may contain *Lead* and *Benzene*. *For more information, consult the Right to Know Hazardous Substance Fact Sheets on BENZENE and TETRAETHYL LEAD.*
- **Gasoline** is a FLAMMABLE LIQUID and a DANGEROUS FIRE HAZARD.

Workplace Exposure Limits

NIOSH: Recommends that exposure to occupational carcinogens be limited to the lowest feasible concentration.

ACGIH: The threshold limit value (TLV) is **300 ppm** averaged over an 8-hour workshift and **500 ppm** as a STEL (short-term exposure limit).

- **Gasoline** may be a CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.
- The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

NJ Health
New Jersey Department of Health

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **CHROMIUM**

Synonyms: Chrome; Metallic Chromium
CAS No: 7440-47-3
Molecular Formula: Cr
RTK Substance No: 0432
Description: Hard, gray, odorless solid with a metallic luster

HAZARD DATA

Hazard Rating

2 - Health

3 - Fire

0 - Reactivity

DOT#: UN 3089

ERG Guide #: 170

Hazard Class: 4.1 (Flammable Solid)

Firefighting

Extinguish fire using an agent suitable for type of surrounding fire. **Chromium** itself does not burn.

Chromium in *powder* form is FLAMMABLE and a DANGEROUS FIRE HAZARD. It may also spontaneously explode in air.

Use dry sand or dry chemical extinguishing agents to fight **Chromium** *powder* fires.

POISONOUS GASES ARE PRODUCED IN FIRE.

CONTAINERS MAY EXPLODE IN FIRE.

DO NOT get water inside container.

Reactivity

Chromium may react violently or explosively with AMMONIUM NITRATE; CARBON DIOXIDE ATMOSPHERES; BROMINE PENTAFLUORIDE; LITHIUM; NITROGEN OXIDES; and SULFUR DIOXIDE.

Chromium is not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); STRONG ACIDS (such as HYDROCHLORIC and SULFURIC); and ALKALI METALS (such as SODIUM and POTASSIUM).

SPILL/LEAKS

Isolation Distance:

Spill: 25 meters (75 feet)

Fire: 800 meters (1/2 mile)

Moisten spilled material first or use a HEPA-filter vacuum for clean-up and place into sealed containers for disposal.

Keep **Chromium** *powder* out of confined spaces, such as sewers, because of the possibility of an explosion.

DO NOT wash into sewer.

PHYSICAL PROPERTIES

Odor Threshold:	Odorless
Flash Point:	Noncombustible solid, Flammable *powder*
Vapor Pressure:	<0 mm Hg at 68°F (20°C) (approximate)
Specific Gravity:	7.2 (water = 1)
Water Solubility:	Insoluble
Boiling Point:	4,788°F (2,642°C)
Melting Point:	3,452°F (1,900°C)
Molecular Weight:	52

EXPOSURE LIMITS

OSHA:	1 mg/m^3, 8-hr TWA
NIOSH:	0.5 mg/m^3, 8-hr TWA
ACGIH:	0.5 mg/m^3, 8-hr TWA
IDLH:	250 mg/m^3

The Protective Action Criteria values are:

PAC-1 = 1.5 mg/m^3 PAC-3 = 250 mg/m^3
PAC-2 = 2.5 mg/m^3

PROTECTIVE EQUIPMENT

Gloves:	Nitrile or Natural Rubber
Coveralls:	Tyvek®
Respirator:	>0.5 mg/m^3 - full facepiece APR with High efficiency filters >1.5 mg/m^3 - SCBA

HEALTH EFFECTS

Eyes:	Irritation, burns and possible eye damage
Skin:	Irritation, burns, itching, rash and skin ulcers
Inhalation:	Nose and throat irritation with coughing and wheezing
	Headache, fever and chills

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 30 minutes. Remove contact lenses if worn. Seek medical attention.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.

March 2009

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

Protective Action Criteria (PAC) are values established by the Department of Energy and are based on AEGLs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Chromium** *powder* is spilled, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate all ignition sources.
- Moisten spilled material first or use a HEPA-filter vacuum for clean-up and place into sealed containers for disposal.
- Keep **Chromium** *powder* out of confined spaces, such as sewers, because of the possibility of an explosion.
- Ventilate and wash area after clean-up is complete.
- DO NOT wash into sewer.
- It may be necessary to contain and dispose of **Chromium** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Chromium** you should be trained on its proper handling and storage.

- **Chromium** may react violently or explosively with AMMONIUM NITRATE; CARBON DIOXIDE ATMOSPHERES; BROMINE PENTAFLUORIDE; LITHIUM; NITROGEN OXIDES; and SULFUR DIOXIDE.
- **Chromium** is not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); STRONG ACIDS (such as HYDROCHLORIC and SULFURIC); and ALKALI METALS (such as SODIUM and POTASSIUM).
- Store in tightly closed containers in a cool, well-ventilated area.
- Sources of ignition, such as smoking and open flames, are prohibited where **Chromium** *powder* is used, handled, or stored.

Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Before entering a confined space where **Chromium** *powder* may be present, check to make sure that an explosive concentration does not exist.
- Use a vacuum or a wet method to reduce dust during clean-up. DO NOT DRY SWEEP.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Chromium**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Safety equipment manufacturers recommend Nitrile and Natural Rubber for gloves, and Tyvek®, or the equivalent, as a protective material for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear eye protection with side shields or goggles.
- If additional protection is needed for the entire face, use in combination with a face shield. A face shield should not be used without another type of eye protection.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over **0.5 mg/m^3**, use a NIOSH approved negative pressure, air-purifying, particulate filter respirator with an N, R or P95 filter. More protection is provided by a full facepiece respirator than by a half-mask respirator, and even greater protection is provided by a powered-air purifying respirator.
- Leave the area immediately if (1) while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect **Chromium**, (2) while wearing particulate filters abnormal resistance to breathing is experienced, or (3) eye irritation occurs while wearing a full facepiece respirator. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- Consider all potential sources of exposure in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
- Where the potential exists for exposure over **5 mg/m^3**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- Exposure to **250 mg/m^3** is immediately dangerous to life and health. If the possibility of exposure above **250 mg/m^3** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- Extinguish fire using an agent suitable for type of surrounding fire. **Chromium** itself does not burn.
- **Chromium** in *powder* form is FLAMMABLE and a DANGEROUS FIRE HAZARD. It may also spontaneously explode in air.
- Use dry sand or dry chemical extinguishing agents to fight **Chromium** *powder* fires.
- POISONOUS GASES ARE PRODUCED IN FIRE.
- CONTAINERS MAY EXPLODE IN FIRE.
- DO NOT get water inside container.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Chromium**:

- Contact can irritate and burn the skin and eyes with possible eye damage.
- Inhaling **Chromium** can irritate the nose and throat causing coughing and wheezing.
- Exposure to **Chromium** *fumes* can cause *"metal fume fever."* This is a flu-like illness with symptoms of metallic taste in the mouth, headache, fever and chills, aches, chest tightness and cough. The symptoms may be delayed for several hours after exposure and usually last for a day or two.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Chromium** and can last for months or years:

Cancer Hazard

- While **Chromium** has been tested, it is not classifiable as to its potential to cause cancer.

Reproductive Hazard

- There is no evidence that **Chromium** affects reproduction. This is based on test results presently available to the NJDHSS from published studies.

Other Effects

- Inhaling **Chromium** can cause a sore and/or a hole in the "bone" (septum) dividing the inner nose, sometimes with bleeding, discharge, and/or formation of a crust.
- **Chromium** may cause a skin allergy. If allergy develops, very low future exposure can cause itching and a skin rash.
- **Chromium** may cause an asthma-like allergy. Future exposure can cause asthma attacks with shortness of breath, wheezing, coughing, and/or chest tightness.
- Prolonged skin contact can cause burns, blisters and deep ulcers
- **Chromium** may affect the liver and kidneys.

Medical

Medical Testing

For frequent or potentially high exposure (half the TLV or greater), the following are recommended before beginning work and at regular times after that:

- Lung function tests. The results may be normal if the person is not having an attack at the time of the test.

If symptoms develop or overexposure is suspected, the following are recommended:

- Examine your skin periodically for little bumps or blisters, the first sign of "chrome ulcers." If not treated early, these can last for years after exposure.
- Evaluation by a qualified allergist can help diagnose skin allergy.
- Liver and kidney function tests

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are <u>not</u> a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures

- Smoking can cause heart disease, lung cancer, emphysema, and other respiratory problems. It may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.
- More than light alcohol consumption can cause liver damage. Drinking alcohol can increase the liver damage caused by **Chromium**.

NJ Health
New Jersey Department of Health

Right to Know
Hazardous Substance Fact Sheet

Common Name: **CHROMIUM**

Synonyms: Chrome; Metallic Chromium

Chemical Name: Chromium

Date: January 2000 Revision: March 2009

CAS Number: 7440-47-3

RTK Substance Number: 0432

DOT Number: UN 3089

Description and Use

Chromium is a hard, gray, odorless solid with a metallic luster. It is used in stainless and alloy steels, in making alloys, and as an isotope in medicine and research.

Reasons for Citation

- **Chromium** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, DEP, IARC and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 30 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while flushing. Seek medical attention.

Skin Contact

- Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Inhalation

- Remove the person from exposure
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE LAST PAGE

Hazard Summary

Hazard Rating	NJDOH	NFPA
HEALTH	2	-
FLAMMABILITY	3	-
REACTIVITY	0	-

FLAMMABLE POWDER
POISONOUS GASES ARE PRODUCED IN FIRE
CONTAINERS MAY EXPLODE IN FIRE

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Chromium** can affect you when inhaled.
- Contact can irritate and burn the skin and eyes with possible eye damage.
- Inhaling **Chromium** can irritate the nose and throat.
- Exposure to **Chromium** *fumes* can cause a flu-like illness called *metal fume fever*.
- **Chromium** may cause a skin allergy and an asthma-like allergy
- Inhaling **Chromium** can cause a sore and/or a hole in the "bone" (septum) dividing the inner nose.
- **Chromium** may affect the liver and kidneys.
- **Chromium** in *powder* form is FLAMMABLE and a DANGEROUS FIRE HAZARD. It may also spontaneously explode in air.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **1 mg/m^3** averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit (REL) is **0.5 mg/m^3** averaged over a 8-hour workshift.

ACGIH: The threshold limit value (TLV) is **0.5 mg/m^3** averaged over an 8-hour workshift.

NJ Health
New Jersey Department of Health

Right to Know Hazardous Substance Fact Sheet

Emergency Responders
Quick Reference

Common Name: **BENZO(a)PYRENE**

Synonyms: 3,4-Benzopyrene; B[a]P
CAS No: 50-32-8
Molecular Formula: $C_{20} H_{12}$
RTK Substance No: 0207
Description: Pale yellow, crystalline solid or powder

HAZARD DATA

Hazard Rating

3 - Health
1 - Fire
0 - Reactivity

DOT#: UN 3077

ERG Guide #: 171

Hazard Class: 9

(Miscellaneous Hazardous Materials)

Firefighting

Benzo(a)pyrene may burn, but does not readily ignite.

Use dry chemical, CO_2, water spray or foam as extinguishing agents.

POISONOUS GASES ARE PRODUCED IN FIRE.

Reactivity

Benzo(a)pyrene reacts with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) to cause fires and explosions.

SPILL/LEAKS

Isolation Distance: 50 meters (150 feet)

Moisten spilled material first or use a HEPA-filter vacuum for clean-up.

Toxic to aquatic organisms.

PHYSICAL PROPERTIES

Odor Threshold:	Faint aromatic odor
Flash Point:	No information
Specific Gravity:	1.35
Vapor Density:	8.7 (air = 1)
Vapor Pressure:	5.49 X 10^9 mm Hg at 77°F (25°C)
Water Solubility:	Insoluble
Boiling Point:	590° - 594°F (310° - 312°C)
Melting Point:	347° - 354 F (175 ° - 179°C)

EXPOSURE LIMITS

OSHA:	0.2 mg/m^3, 8-hr TWA
NIOSH:	0.1 mg/m^3, 10-hr TWA
ACGIH:	lowest level possible
IDLH LEVEL:	80 mg/m^3 (as *Coal Tar Pitch Volatiles*)

PROTECTIVE EQUIPMENT

Gloves:	No information
Coveralls:	DuPont Tychem®, CPF-2, SL, CPF-4, Responder® (all >8-hr permeation time)
Boots:	No information
Respirator:	>0.1 mg/m^3 - Supplied air

HEALTH EFFECTS

Eyes:	Irritation and burns
Skin:	Irritation, rash and burning feeling
Chronic:	Cancer (stomach, skin, lung, blood, spleen, pancreas, and mammary) in animals. May affect the developing fetus Thickening and darkening of the skin and warts

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn.

Remove contaminated clothing and wash contaminated skin with soap and water.

Transfer to a medical facility.

October 2007

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values are intended to provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database maintained by federal EPA. The database contains information on human health effects that may result from exposure to various chemicals in the environment.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

PIH is a DOT designation for chemicals which are Poison Inhalation Hazards.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Use a Class I, Type B, biological safety hood when working with **Benzo(a)pyrene** in a laboratory.
- Use a vacuum or a wet method to reduce dust during clean-up. DO NOT DRY SWEEP.
- Use a high efficiency particulate air (HEPA) filter when vacuuming. Do not use a standard shop vacuum.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Benzo(a)pyrene**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Safety equipment manufacturers recommend DuPont *Tychem® CPF-2, SL, CPF-4* and *Responder®* as protective materials for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear eye protection with side shields or goggles.
- Do not wear contact lenses when working with this substance.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over **0.1 mg/m^3**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- Exposure to **80 mg/m^3** (as *Coal Tar Pitch Volatiles*) is immediately dangerous to life and health. If the possibility of exposure above **80 mg/m^3** (as *Coal Tar Pitch Volatiles*) exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Benzo(a)pyrene** may burn, but does not readily ignite.
- Use dry chemical, CO_2, water spray or foam as extinguishing agents.
- POISONOUS GASES ARE PRODUCED IN FIRE.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Benzo(a)pyrene** is spilled, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate all ignition sources.
- Moisten spilled material first to reduce dust or use a HEPA-filter vacuum for clean-up.
- Ventilate and wash area after clean-up is complete.
- It may be necessary to contain and dispose of **Benzo(a)pyrene** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP), Nuclear Regulatory Commission (NRC) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Benzo(a)pyrene** you should be trained on its proper handling and storage.

- A regulated, marked area should be established where **Benzo(a)pyrene** is handled, used, or stored.
- **Benzo(a)pyrene** reacts with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE).
- Store in tightly closed containers in a cool, well-ventilated area.
- Sources of ignition, such as smoking and open flames, are prohibited where **Benzo(a)pyrene** is used, handled, or stored in a manner that could create a potential fire or explosion hazard.

NJ Health
New Jersey Department of Health

Right to Know

Hazardous Substance Fact Sheet

Common Name: **MERCURY, ELEMENTAL AND INORGANIC COMPOUNDS**

Synonyms: Colloidal Mercury; Quicksilver
Chemical Name: Mercury
Date: May 2009 Revision: November 2009

CAS Number: 7439-97-6
RTK Substance Number: 1183
DOT Number: UN 2809

Description and Use

Mercury is a heavy, silvery, liquid metal. It is used for gold recovery and in dental amalgams, thermometers, barometers and other gauges, and in dry cell batteries.

Reasons for Citation

- **Mercury** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, DEP, IARC, IRIS and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while flushing. Seek medical attention immediately.

Skin Contact

- Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water. Seek medical attention immediately.

Inhalation

- Remove the person from exposure.
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222
CHEMTREC: 1-800-424-9300
NJDEP Hotline: 1-877-927-6337
National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE LAST PAGE

Hazard Summary

Hazard Rating	NJDOH	NFPA
HEALTH	3	-
FLAMMABILITY	0	-
REACTIVITY	0	-
CORROSIVE POISONOUS GASES ARE PRODUCED IN FIRE		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Mercury** can affect you when inhaled and may be absorbed through the skin.
- Contact can irritate the skin and eyes.
- Inhaling **Mercury** can irritate the nose, throat and lungs.
- Exposure can cause metallic taste in the mouth, nausea and vomiting, and abdominal pain.
- **Mercury** may cause a skin allergy and make the skin turn gray.
- Repeated exposure can cause *Mercury poisoning* with tremors, personality changes, trouble remembering and concentrating, and gum problems.
- **Mercury** may damage the kidneys.
- **Mercury** is a DOT CORROSIVE material.

Workplace Exposure Limits

OSHA:	The legal airborne permissible exposure limit (PEL) is **0.1 mg/m^3** averaged over an 8-hour workshift.
NIOSH:	The recommended airborne exposure limit (REL) is **0.05 mg/m^3** (as **Mercury** *vapor*) averaged over a 10-hour workshift <u>and</u> **0.1 mg/m^3** (as **Mercury**), not to be exceeded at any time.
ACGIH:	The threshold limit value (TLV) is **0.025 mg/m^3** averaged over an 8-hour workshift.

- The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to **Mercury**:

- Contact can irritate the skin and eyes.
- Inhaling **Mercury** can irritate the nose, throat and lungs causing coughing, wheezing and/or shortness of breath.
- Exposure can cause metallic taste in the mouth, nausea and vomiting, and abdominal pain.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to **Mercury** and can last for months or years:

Cancer Hazard
- While **Mercury** has been tested, it is not classifiable as to its potential to cause cancer.

Reproductive Hazard
- There is limited evidence that **Mercury** may cause an increase in spontaneous abortions and menstrual disorders in exposed women.
- There is limited evidence that **Mercury** may affect male fertility.
- **Mercury** may also damage the developing fetus in animals.

Other Effects
- **Mercury** can irritate the lungs. Repeated exposure may cause bronchitis to develop with coughing, phlegm, and/or shortness of breath.
- **Mercury** may cause a skin allergy. If allergy develops, very low future exposure can cause itching and a skin rash.
- Long-term contact can cause the skin to turn gray, brown staining in the eyes, and may affect peripheral vision (ability to see to the sides).
- Repeated exposure or a very high single exposure can cause *Mercury poisoning*. Symptoms include tremors (shaking), trouble remembering and concentrating, gum problems, increased salivation, loss of appetite and weight, and changes in mood and personality. These can be severe and cause hallucinating and psychosis.
- **Mercury** may damage the kidneys.

Medical

Medical Testing
For frequent or potentially high exposure (half the TLV or greater), the following are recommended before beginning work and at regular times after that:

- Exam of the nervous system (including handwriting test to detect early hand tremor)
- Urine *Mercury* level (usually less than **0.02 mg/liter)**
- Kidney function tests

If symptoms develop or overexposure is suspected, the following is recommended:

- Lung function tests
- Exam of the eyes and vision
- Evaluation by a qualified allergist can help diagnose skin allergy.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures
- Smoking can cause heart disease, lung cancer, emphysema, and other respiratory problems. It may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.
- Creams to whiten or bleach skin may contain *Mercury*. If you use them, you may be at increased risk of *Mercury* poisoning. A high fish diet, especially of marine predatory fish (fish-eating fish), also may increase your blood *Mercury* levels.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- For clean-up, use a specialized charcoal-filtered vacuum or suction pump to avoid generating *Mercury vapor*. Do not disturb spilled material.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Mercury**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Safety equipment manufacturers recommend Butyl, Nitrile, Neoprene, Polyvinyl Chloride, Silver Shield®/4H® and Viton for gloves, and Tychem® fabrics, or the equivalent, as protective materials for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear non-vented, impact resistant goggles when working with fumes, gases, or vapors.
- If additional protection is needed for the entire face, use in combination with a face shield. A face shield should not be used without another type of eye protection.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over **0.05 mg/m^3** (as **Mercury** *vapor*), or over **0.1 mg/m^3** but less than **1 mg/m^3** (as **Mercury**), use a NIOSH approved half-mask respirator with cartridges specific for **Mercury** *vapor*. These cartridges have end of service life indicators (ESLI) which visually indicate when filters must be changed.
- If while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect **Mercury**, or if while wearing particulate filters abnormal resistance to breathing is experienced, or eye irritation occurs while wearing a full facepiece respirator, leave the area immediately. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- Be sure to consider all potential exposures in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
- Where the potential exists for exposure over **0.5 mg/m^3** (as **Mercury** *vapor*) or over **1 mg/m^3** (as **Mercury**), use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- Exposure to **10 mg/m^3** (as **Mercury**) is immediately dangerous to life and health. If the possibility of exposure above **10 mg/m^3** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- Extinguish fire using an agent suitable for type of surrounding fire. **Mercury** itself does not burn.
- POISONOUS GASES ARE PRODUCED IN FIRE.
- Use water spray to keep fire-exposed containers cool.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Mercury** is spilled or leaked, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate all ignition sources.
- Cover with a *Sulfur compound* to keep from vaporizing and collect with a charcoal filter vacuum. Kits specific for the clean-up of *Mercury* spills are available. DO NOT USE a regular or shop vacuum.
- Use *Zinc* or *Copper flakes* and a flashlight to check for remaining **Mercury** after clean-up.
- Ventilate and wash area of spill or leak.
- DO NOT wash into sewer.
- It may be necessary to contain and dispose of **Mercury** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Mercury** you should be trained on its proper handling and storage.

- **Mercury** reacts with ACETYLENE to form explosive *Acetylide*.
- **Mercury** can form explosive compounds with AMMONIA and will explode when mixed with CHLORINE DIOXIDE; OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC); and METHYL AZIDE.
- **Mercury** is not compatible with COMBUSTIBLE MATERIALS; METALS (such as ALUMINUM and COPPER); CALCIUM; SODIUM CARBIDE; AMINES; LITHIUM; and RUBIDIUM.
- Store in tightly closed containers in a cool, well-ventilated area.

Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

LEL or Lower Explosive Limit, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

Protective Action Criteria (PAC) are values established by the Department of Energy and are based on AEGLs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.

NJ Health New Jersey Department of Health

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **MERCURY, ELEMENTAL AND INORGANIC COMPOUNDS**

Synonyms: Colloidal Mercury; Quicksilver
CAS No: 7439-97-6
Molecular Formula: Hg
RTK Substance No: 1183
Description: Heavy, silvery, liquid metal

HAZARD DATA

Hazard Rating

3 - Health

0 - Fire

0 - Reactivity

DOT#: UN 2809

ERG Guide #: 172

Hazard Class: 8 (Corrosive)

Firefighting

Extinguish fire using an agent suitable for type of surrounding fire. **Mercury** itself does not burn.

POISONOUS GASES ARE PRODUCED IN FIRE.

Use water spray to keep fire-exposed containers cool.

Reactivity

Mercury reacts with ACETYLENE to form explosive *Acetylide*.

Mercury can form explosive compounds with AMMONIA and will explode when mixed with CHLORINE DIOXIDE; OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC); and METHYL AZIDE.

Mercury is not compatible with COMBUSTIBLE MATERIALS; METALS (such as ALUMINUM and COPPER); CALCIUM; SODIUM CARBIDE; AMINES; LITHIUM; and RUBIDIUM.

SPILL/LEAKS

Isolation Distance:

Spill: 50 meters (150 feet)

Fire: 500 meters (1/3 mile)

Cover spill with a *Sulfur compound* to prevent vaporization and collect with a charcoal filter vacuum.

Use *Zinc* or *Copper flakes* and a flashlight to check for remaining **Mercury** after clean-up.

Mercury is very toxic to aquatic life and bioaccumulates.

PHYSICAL PROPERTIES

Odor Threshold:	Odorless
Flash Point:	Nonflammable
Vapor Density:	6.9 (air = 1)
Vapor Pressure:	0.002 mm Hg at 77°F (25°C)
Specific Gravity:	13.6 (water = 1)
Water Solubility:	Insoluble
Boiling Point:	674°F (357°C)
Melting Point:	-38°F (-39°C)
Ionization Potential:	10.4 eV
Molecular Weight:	200.6

EXPOSURE LIMITS

NIOSH: 0.05 mg/m^3, 10-hr TWA (as **Mercury** *vapor*)
0.1 mg/m^3, Ceiling (as **Mercury**)
ACGIH: 0.025 mg/m^3, 8-hr TWA (as **Mercury**)
IDLH: 10 mg/m^3 (as **Mercury**)

The Protective Action Criteria values are:
PAC-1 = 0.3 mg/m^3
PAC-2 = 2.05 mg/m^3
PAC-3 = 4.1 mg/m^3

PROTECTIVE EQUIPMENT

Gloves:	Butyl, Nitrile, Neoprene, Polyvinyl Chloride, Silver Shield®/4H® and Viton (>8-hr breakthrough)
Coveralls:	Tychem® fabrics (>8-hr breakthrough)
Respirator:	>0.025 mg/m^3 - full facepiece APR with cartridges specific for **Mercury** >0.3 mg/m^3 - SCBA

HEALTH EFFECTS

Eyes:	Irritation
Skin:	Irritation
Inhalation:	Nose, throat and lung irritation with coughing, wheezing and/or shortness of breath Nausea, vomiting and abdominal pain

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn. Seek medical attention immediately.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water. Seek medical attention immediately.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.

November 2009

Right to Know
Hazardous Substance Fact Sheet

Common Name: **POLYCHLORINATED BIPHENYLS**

Synonyms: Aroclor; Chlorodiphenyls; PCBs
Chemical Name: 1,1'-Biphenyl, Chloro Derivs.
Date: April 2002 Revision: November 2008

CAS Number: 1336-36-3
RTK Substance Number: 1554
DOT Number: UN 2315

Description and Use

Polychlorinated Biphenyls are light yellow or colorless, thick, oily liquids. They are used in hydraulic and heat transfer liquids. They were formally used in electrical capacitators and transformers.

Reasons for Citation

- **Polychlorinated Biphenyls** are on the Right to Know Hazardous Substance List because they are cited by OSHA, ACGIH, DOT, NIOSH, NTP, DEP, IARC, IRIS, NFPA and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact
- Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while rinsing.

Skin Contact
- Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Inhalation
- Remove the person from exposure
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222
CHEMTREC: 1-800-424-9300
NJDEP Hotline: 1-877-927-6337
National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE BACK PAGE

Hazard Summary

Hazard Rating	NJDOH	NFPA
HEALTH	3	2
FLAMMABILITY	-	1
REACTIVITY	-	0
CARCINOGEN TERATOGEN POISONOUS GASES ARE PRODUCED IN FIRE		

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Polychlorinated Biphenyls** can affect you when inhaled and by passing through the skin.
- **Polychlorinated Biphenyls** should be handled as CARCINOGENS and may be TERATOGENS. HANDLE WITH EXTREME CAUTION.
- Contact can irritate the skin and eyes.
- **Polychlorinated Biphenyls** may cause brownish pigmentation of the skin, eyes and fingernails.
- Skin contact may cause an acne-like rash (chloracne).
- Inhaling the vapors can irritate the nose, throat and lungs.
- Exposure to **Polychlorinated Biphenyls** can cause headache, nausea, vomiting, loss of weight and abdominal pain.
- High exposure can damage the nervous system causing headache, numbness, weakness, and tingling ("pins and needles) in the arms and legs.
- **Polychlorinated Biphenyls** may damage the liver.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **1 mg/m^3** (42% *Chlorine*) and **0.5 mg/m^3** (54% *Chlorine*) averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit (REL) is **0.001 mg/m^3** averaged over a 10-hour workshift.

ACGIH: The threshold limit value (TLV) is **1 mg/m^3** (42% *Chlorine*) and **0.5 mg/m^3** (54% *Chlorine*) averaged over an 8-hour workshift.

- **Polychlorinated Biphenyls** are PROBABLE CARCINOGENS and TERATOGENS in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.
- The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to **Polychlorinated Biphenyls**:

- Contact can irritate the skin and eyes.
- Inhaling the vapors can irritate the nose, throat and lungs causing coughing, wheezing and/or shortness of breath.
- Exposure to **Polychlorinated Biphenyls** can cause headache, nausea, vomiting, loss of weight and abdominal pain.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to **Polychlorinated Biphenyls** and can last for months or years:

Cancer Hazard
- **Polychlorinated Biphenyls** are PROBABLE CARCINOGENS in humans. There is evidence that they cause cancer of the skin, brain, and pancreas in humans and have been shown to cause liver and pituitary cancer, and leukemia, in animals.
- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard
- **Polychlorinated Biphenyls** may be TERATOGENS in humans since they are teratogens in animals.
- There is limited evidence that **Polychlorinated Biphenyls** may affect male and female fertility.

Other Effects
- **Polychlorinated Biphenyls** may cause brownish pigmentation of the skin, eyes and fingernails.
- Skin contact may cause an acne-like rash (chloracne).
- High exposure can damage the nervous system causing headache, numbness, weakness, and tingling ("pins and needles) in the arms and legs.
- **Polychlorinated Biphenyls** may damage the liver.

Medical

Medical Testing
Before beginning employment and at regular times after that, for frequent or potentially high exposures, the following are recommended:

- Liver function tests
- Exam of the skin and fingernails

If symptoms develop or overexposure is suspected, the following are recommended:

- Blood PCB levels
- Exam of the nervous system

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures
- More than light alcohol consumption can cause liver damage. Drinking alcohol can increase the liver damage caused by **Polychlorinated Biphenyls**.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Where possible, transfer **Polychlorinated Biphenyls** from drums or other containers to process containers in an enclosed system.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Polychlorinated Biphenyls**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Safety equipment manufacturers recommend Butyl, Neoprene, Polyvinyl Chloride, Silver Shield®/4H® and Viton for gloves, and Tychem® CPF 2, SL, CPF 4 and Responder®, or the equivalent, as protective materials for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear indirect-vent, impact and splash resistant goggles when working with liquids.
- Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over **0.001 mg/m^3**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- Exposure to **5 mg/m^3** is immediately dangerous to life and health. If the possibility of exposure above **5 mg/m^3** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Polychlorinated Biphenyls** may burn, but do not readily ignite.
- Use dry chemical, CO_2, water spray or alcohol-resistant foam as extinguishing agents.
- POISONOUS GASES ARE PRODUCED IN FIRE, including *Polychlorinated Dibenzofurans* and *Chlorinated Dibenzo-p-dioxins*.
- Use water spray to keep fire-exposed containers cool.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Polychlorinated Biphenyls** are spilled or leaked, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate all ignition sources.
- Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers for disposal.
- Ventilate and wash area after clean-up is complete.
- DO NOT wash into sewer.
- It may be necessary to contain and dispose of **Polychlorinated Biphenyls** as HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Polychlorinated Biphenyls** you should be trained on its proper handling and storage.

- **Polychlorinated Biphenyls** are not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC).
- Store in tightly closed containers in a cool, well-ventilated area away from STRONG ULTRAVIOLET LIGHT and SUNLIGHT.

Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

Protective Action Criteria (PAC) are values established by the Department of Energy and are based on AEGLs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.

NJ Health
New Jersey Department of Health

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **POLYCHLORINATED BIPHENYLS**

Synonyms: Aroclor; Chlorodiphenyls; PCBs
CAS No: 1336-36-3
Molecular Formula: $C_{12}H_{10-n}Cl_n$
RTK Substance No: 1554
Description: Light yellow or colorless, thick, oily liquids

HAZARD DATA

Hazard Rating

3 - Health

1 - Fire

0 - Reactivity

DOT#: UN 2315

ERG Guide #: 171

Hazard Class: 9 (Miscellaneous Hazardous Materials)

Firefighting

Polychlorinated Biphenyls may burn, but do not readily ignite.

Use dry chemical, CO_2, water spray or alcohol-resistant foam as extinguishing agents.

POISONOUS GASES ARE PRODUCED IN FIRE, including *Polychlorinated Dibenzofurans* and *Chlorinated Dibenzo-p-dioxins.*

Use water spray to keep fire-exposed containers cool.

Reactivity

Polychlorinated Biphenyls are not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC).

SPILL/LEAKS

Isolation Distance:

Spills: 50 meters (150 feet)

Fire: 800 meters (1/2 mile)

Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers for disposal.

DO NOT wash into sewer.

Polychlorinated Biphenyls bioaccumulate and are hazardous to the environment.

PHYSICAL PROPERTIES

Flash Point:	286° to 385°F (141° to 196°C)
Auto Ignition Temp:	464°F (240°C)
Vapor Pressure:	0.001 mm Hg at 68°F (20°C)
Specific Gravity:	1.3 (water = 1)
Water Solubility:	Insoluble
Boiling Point:	617° to 734°F (325° to 390°C)
Melting Point:	-2° to 50°F (-19° to 10°C)
Molecular Weight:	258 to 326

EXPOSURE LIMITS

OSHA:	1 mg/m^3, 8-hr TWA (42% *Chlorine*) and 0.5 mg/m^3, 8-hr TWA (54% *Chlorine*)
NIOSH:	0.001 mg/m^3, 10-hr TWA
ACGIH:	1 mg/m^3, 8-hr TWA (42% *Chlorine*) and 0.5 mg/m^3, 8-hr TWA (54% *Chlorine*)
IDLH:	5 mg/m^3

PROTECTIVE EQUIPMENT

Gloves:	Butyl, Neoprene, Polyvinyl Chloride, Silver Shield®/4H® and Viton (>4-hr breakthrough)
Coveralls:	Tychem® CPF 2, SL, CPF 4 and Responder® (>8-hr breakthrough)
Respirator:	>0.001 mg/m^3 - Supplied air or SCBA

HEALTH EFFECTS

Eyes:	Irritation
Skin:	Irritation
Inhalation:	Nose, throat and lung irritation with coughing, wheezing and shortness of breath Headache, nausea, vomiting, and abdominal pain
Chronic:	Cancer (skin, brain, pancreas) in humans

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility

November 2008

NJ Health
New Jersey Department of Health

Right to Know
Hazardous Substance Fact Sheet

Common Name: **PETROLEUM DISTILLATES**

Synonyms: Crude Oil; Petroleum Oil

Chemical Name: Petroleum

Date: August 2011

CAS Number: 8002-05-9

RTK Substance Number: 2648

DOT Number: UN 1268

Description and Use

Petroleum Distillates are dark yellow to brown or green-black liquids with a mild *gasoline* or *kerosene*-like odor. They are a complex blend of *Hydrocarbons* used in making petroleum products.

Reasons for Citation

- **Petroleum Distillates** are on the Right to Know Hazardous Substance List because they are cited by OSHA, DOT, NIOSH and IARC.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while rinsing.

Skin Contact

- Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Inhalation

- Remove the person from exposure.
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE LAST PAGE

Hazard Summary

Hazard Rating	NJDOH	NFPA
HEALTH	2	-
FLAMMABILITY	3	-
REACTIVITY	0	-

FLAMMABLE
POISONOUS GASES ARE PRODUCED IN FIRE
CONTAINERS MAY EXPLODE IN FIRE

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Petroleum Distillates** can affect you when inhaled and may be absorbed through the skin.
- Contact can irritate and burn the skin and eyes.
- Inhaling **Petroleum Distillates** can irritate the nose, throat and lungs.
- **Petroleum Distillates** can affect the nervous system causing headache, dizziness, nausea, and loss of balance and coordination.
- **Petroleum Distillates** may affect the liver and kidneys.
- **Petroleum Distillates** are FLAMMABLE LIQUIDS and DANGEROUS FIRE HAZARDS.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **3,500 ppm** averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit (REL) is **88 ppm** averaged over a 10-hour workshift and **450 ppm**, not to be exceeded during any 15-minute work period.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act and the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to **Petroleum Distillates**:

- Contact can irritate and burn the skin and eyes.
- Inhaling **Petroleum Distillates** can irritate the nose, throat and lungs causing coughing, wheezing and/or shortness of breath.
- **Petroleum Distillates** can affect the nervous system causing headache, dizziness, nausea, vomiting, blurred vision, confusion, and loss of balance and coordination. Higher levels may cause coma and death.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to **Petroleum Distillates** and can last for months or years:

Cancer Hazard
- While **Petroleum Distillates** have been tested, they are not classifiable as to their potential to cause cancer.

Reproductive Hazard
- There is limited evidence that **Petroleum Distillates** may affect female fertility.

Other Effects
- Prolonged or repeated exposure can cause drying and cracking of the skin with redness.
- **Petroleum Distillates** can irritate the lungs. Repeated exposure may cause bronchitis to develop with coughing, phlegm, and/or shortness of breath.
- **Petroleum Distillates** may affect the liver and kidneys.

Medical

Medical Testing
For frequent or potentially high exposure (half the REL or greater), the following are recommended before beginning work and at regular times after that:

- Liver and kidney function tests

If symptoms develop or overexposure is suspected, the following are recommended:

- Chest x-ray and lung function tests
- Exam of the nervous system

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are <u>not</u> a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures
- Smoking can cause heart disease, lung cancer, emphysema, and other respiratory problems. It may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.
- More than light alcohol consumption can cause liver damage. Drinking alcohol may increase the liver damage caused by **Petroleum Distillates**.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- ▸ Label process containers.
- ▸ Provide employees with hazard information and training.
- ▸ Monitor airborne chemical concentrations.
- ▸ Use engineering controls if concentrations exceed recommended exposure levels.
- ▸ Provide eye wash fountains and emergency showers.
- ▸ Wash or shower if skin comes in contact with a hazardous material.
- ▸ Always wash at the end of the workshift.
- ▸ Change into clean clothing if clothing becomes contaminated.
- ▸ Do not take contaminated clothing home.
- ▸ Get special training to wash contaminated clothing.
- ▸ Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- ▸ Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- ▸ Before entering a confined space where **Petroleum Distillates** may be present, check to make sure that an explosive concentration does not exist.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- ▸ Avoid skin contact with **Petroleum Distillates**. Wear personal protective equipment made from material that can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- ▸ The recommended glove materials for *Hydrocarbons* are Silver Shield®/4H®, Viton, Viton/Butyl and Barrier®.
- ▸ The recommended protective clothing materials for *Hydrocarbons* are Tychem® BR, CSM and TK; and Trellchem® HPS and VPS, or the equivalent.
- ▸ All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- ▸ Wear indirect vent goggles when working with liquids that may splash, spray or mist. A face shield is also required if the liquid is severely irritating or corrosive to the skin and eyes.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- ▸ Where the potential exists for exposure over **88 ppm**, use a NIOSH approved supplied-air respirator with a full faceplece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus or an emergency escape air cylinder.
- ▸ Exposure to **1,100 ppm** is immediately dangerous to life and health. If the possibility of exposure above **1,100 ppm** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- ▸ **Petroleum Distillates** are FLAMMABLE LIQUIDS.
- ▸ Use dry chemical, CO_2, alcohol-resistant foam or other foam extinguishing agents, as water may not be effective in fighting fires.
- ▸ POISONOUS GASES ARE PRODUCED IN FIRE.
- ▸ CONTAINERS MAY EXPLODE IN FIRE.
- ▸ Use water spray to keep fire-exposed containers cool.
- ▸ Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source and flash back.
- ▸ Flow or agitation may generate electrostatic charges.
- ▸ **Petroleum Distillates** may form an ignitable vapor/air mixture in closed tanks or containers.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Petroleum Distillates** are spilled or leaked, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate all ignition sources.
- Absorb liquids in dry sand, earth, or a noncombustible material and place into sealed containers for disposal.
- Ventilate area of spill or leak.
- Keep **Petroleum Distillates** out of confined spaces, such as sewers, because of the possibility of an explosion.
- DO NOT wash into sewer.
- It may be necessary to contain and dispose of **Petroleum Distillates** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Petroleum Distillates** you should be trained on its proper handling and storage.

- **Petroleum Distillates** may react violently with OXIDIZING AGENTS (such as NITROGEN TETROXIDE, PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and NITRIC ACID.
- Store in tightly closed containers in a cool, well-ventilated area.
- Sources of ignition, such as smoking and open flames, are prohibited where **Petroleum Distillates** are used, handled, or stored.
- Metal containers involving the transfer of **Petroleum Distillates** should be grounded and bonded.
- Use explosion-proof electrical equipment and fittings wherever **Petroleum Distillates** are used, handled, manufactured, or stored.
- Use only non-sparking tools and equipment, especially when opening and closing containers of **Petroleum Distillates.**
- **Petroleum Distillates** may accumulate static electricity when being filled into properly grounded containers.

Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

The **critical temperature** is the temperature above which a gas cannot be liquefied, regardless of the pressure applied.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

Protective Action Criteria (PAC) are values established by the Department of Energy and are based on AEGLs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Air*), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **PETROLEUM DISTILLATES**

Synonyms: Crude Oil; Petroleum; Petroleum Oil
CAS No: 8002-05-9
Molecular Formula: Varies
RTK Substance No: 2648
Description: Dark yellow to brown or green-black liquids with a mild *gasoline* or *kerosene* odor

HAZARD DATA

Hazard Rating

2 - Health

3 - Fire

0 - Reactivity

DOT#: UN 1268

ERG Guide #: 128

Hazard Class: 3 (Flammable)

Firefighting

FLAMMABLE LIQUIDS

Use dry chemical, CO_2, alcohol-resistant foam or other foam extinguishing agents, as water may not be effective in fighting fires.

POISONOUS GASES ARE PRODUCED IN FIRE.

CONTAINERS MAY EXPLODE IN FIRE.

Use water spray to keep fire-exposed containers cool.

Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source and flash back.

Flow or agitation may generate electrostatic charges.

Petroleum Distillates may form an ignitable vapor/air mixture in closed tanks or containers.

Reactivity

Petroleum Distillates may react violently with OXIDIZING AGENTS (such as NITROGEN TETROXIDE, PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and NITRIC ACID.

SPILL/LEAKS

Isolation Distance:

Spill: 50 meters (150 feet)

Fire: 800 meters (1/2 mile)

Absorb liquids in dry sand, earth, or a noncombustible material and place into sealed containers for disposal.

Bond and ground containers when transferring **Petroleum Distillates.**

Use only non-sparking tools and equipment.

Keep **Petroleum Distillates** out of confined spaces, such as sewers, because of the possibility of an explosion.

DO NOT wash into sewer.

PHYSICAL PROPERTIES

Odor Threshold:	Mild *gasoline* or *kerosene*-like
Flash Point:	-40° to -86°F (-40° to -66°C)
LEL:	1.1%
UEL:	5.9%
Vapor Pressure:	40 mm Hg at 68°F (20°C) (approximately)
Specific Gravity:	0.78 to 0.97 (water = 1)
Water Solubility:	Insoluble
Boiling Point:	86 ° to 460°F (30° to 238°C)
Freezing Point:	-99°F (-73°C)
Molecular Weight:	98 (approximately)

EXPOSURE LIMITS

OSHA:	500 ppm, 8-hr TWA
NIOSH:	88 ppm, 10-hr TWA; 450 ppm, Ceiling (15-minute)
IDLH:	1,100 ppm

The Protective Action Criteria values are:

PAC-1 = 87.5 ppm PAC-2 = 450 ppm
PAC-3 = 1,100 ppm

PROTECTIVE EQUIPMENT

Gloves:	Silver Shield®/4H®, Viton, Viton/Butyl and Barrier® (>8-hr breakthrough for *Hydrocarbons*)
Coveralls:	Tychem® BR, CSM and TK; and Trellchem® HPS and VPS (>8-hr breakthrough for *Hydrocarbons*) **Use turn out gear or flash protection if ignition/fire is the greatest hazard.**
Respirator:	>88 ppm - SCBA

HEALTH EFFECTS

Eyes:	Irritation and burns
Skin:	Irritation and burns
Inhalation:	Nose, throat and lung irritation, with coughing, wheezing and shortness of breath Headache, dizziness, confusion and loss of balance

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.

August 2011

Right to Know
Hazardous Substance Fact Sheet

Common Name: **VINYL CHLORIDE**

Synonyms: Chloroethylene; Monochloroethylene; VCM
Chemical Name: Ethene, Chloro-
Date: June 2001 Revision: November 2010

CAS Number: 75-01-4
RTK Substance Number: 2001
DOT Number: UN 1086

Description and Use

Vinyl Chloride is a colorless gas, with a sweet odor at high concentrations, that is usually handled as a liquid under pressure. It is used to make *Polyvinyl Chloride* for pipes, wire, and cable coatings, and in furniture, automobiles, and adhesives.

- **ODOR THRESHOLD = >3,000 ppm**
- Odor thresholds vary greatly. Do not rely on odor alone to determine potentially hazardous exposures.

Reasons for Citation

- **Vinyl Chloride** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, NTP, DEP, IARC, IRIS, NFPA and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact
- Immediately flush with large amounts of water for at least 30 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while flushing. Seek medical attention.

Skin Contact
- Immerse affected part in warm water. Seek medical attention.

Inhalation
- Remove the person from exposure.
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222
CHEMTREC: 1-800-424-9300
NJDEP Hotline: 1-877-927-6337
National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE LAST PAGE

Hazard Summary

Hazard Rating	NJDOH	NFPA
HEALTH	4	2
FLAMMABILITY	4	4
REACTIVITY	2	2

CARCINOGEN
FLAMMABLE AND REACTIVE
POISONOUS GASES ARE PRODUCED IN FIRE
CONTAINERS MAY EXPLODE IN FIRE

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Vinyl Chloride** can affect you when inhaled.
- **Vinyl Chloride** is a CARCINOGEN and MUTAGEN. HANDLE WITH EXTREME CAUTION.
- **Vinyl Chloride** can cause reproductive damage.
- Exposure to **Vinyl Chloride** can severely irritate and burn the skin and eyes with possible eye damage. Contact with the *liquid or gas* can cause frostbite.
- Inhaling **Vinyl Chloride** can irritate the nose, throat and lungs.
- **Vinyl Chloride** can cause headache, nausea, vomiting, dizziness, fatigue, weakness and confusion. Higher levels can cause lightheadedness and passing out.
- Prolonged or repeated exposure can damage the liver, nervous system and lungs.
- Repeated exposure can damage the skin (scleroderma), bones (acro-osteolysis) and blood vessels in the hands (Raynaud's Syndrome).
- **Vinyl Chloride** is FLAMMABLE and REACTIVE and a DANGEROUS FIRE and EXPLOSION HAZARD.
- EXPLOSIVE POLYMERIZATION may occur at elevated temperatures if **Vinyl Chloride** is not inhibited.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **1 ppm** averaged over an 8-hour workshift and **5 ppm**, not to be exceeded during any 15-minute work period.

NIOSH: Recommends that exposure to occupational carcinogens be limited to the lowest feasible concentration.

ACGIH: The threshold limit value (TLV) is **1 ppm** averaged over an 8-hour workshift.

- **Vinyl Chloride** is a CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act and the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to **Vinyl Chloride**:

- Exposure to **Vinyl Chloride** can severely irritate and burn the skin and eyes with possible eye damage. Contact with the *liquid or gas* can cause frostbite.
- Inhaling **Vinyl Chloride** can irritate the nose, throat and lungs causing coughing, wheezing and/or shortness of breath.
- **Vinyl Chloride** can cause headache, nausea, vomiting, dizziness, fatigue, weakness and confusion. Higher levels can cause lightheadedness and passing out.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to **Vinyl Chloride** and can last for months or years:

Cancer Hazard

- **Vinyl Chloride** is a CARCINOGEN in humans. It has been shown to cause liver, brain, lung, and other types of cancer.
- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard

- **Vinyl Chloride** may damage the developing fetus.
- There is limited evidence that **Vinyl Chloride** is a teratogen in animals. Until further testing has been done, it should be treated as a possible teratogen in humans.
- There is limited evidence that **Vinyl Chloride** may damage the male reproductive system (including decreasing the sperm count) and may affect male fertility.
- An excess of spontaneous abortions has been reported among spouses of workers who had been exposed to **Vinyl Chloride**.

Other Effects

- Prolonged or repeated exposure can damage the liver, nervous system and lungs.
- Repeated exposure can cause a disease called "scleroderma." This causes the skin to become very smooth, tight and shiny. It causes the bones of the fingers to erode (acro-osteolysis), and damages the blood vessels in the hands or feet (Raynaud's syndrome). This causes the fingers or toes to turn numb, pale or blue, with even mild cold exposure.

Medical

Medical Testing
Before first exposure and every 12 months thereafter, OSHA requires your employer to provide (for persons exposed to **0.5 ppm of Vinyl Chloride**) a work and medical history and exam which shall include:

- Liver function tests
- Chest x-ray and lung function tests

If symptoms develop or overexposure is suspected, the following are recommended:

- Exam of the nervous system
- Exam of the skin

OSHA requires your employer to provide you and your doctor with a copy of the OSHA **Vinyl Chloride** Standard (29 CFR 1910.1017).

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are <u>not</u> a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures

- More than light alcohol consumption can cause liver damage. Drinking alcohol may increase the liver damage caused by **Vinyl Chloride**.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Specific actions are required for this chemical by OSHA. Refer to the OSHA **Vinyl Chloride** Standard (29 CFR 1910.1017).
- Before entering a confined space where **Vinyl Chloride** may be present, check to make sure that an explosive concentration does not exist.
- Transfer **Vinyl Chloride** from cylinders or other containers to process containers in an enclosed system.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Vinyl Chloride**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- The recommended glove materials for **Vinyl Chloride** are Viton, Viton/Butyl, Silver Shield®/4H® and Barrier®.
- The recommended protective clothing materials for **Vinyl Chloride** are Tychem® BR, CSM and TK; and Trellchem® HPS and VPS or the equivalent.
- Where exposure to cold equipment, vapors, or liquid may occur, employees should be provided with *insulated* gloves and special clothing designed to prevent the freezing of body tissues.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear non-vented, impact resistant goggles when working with fumes, gases, or vapors.
- Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.
- Do not wear contact lenses when working with this substance.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over **1 ppm**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus or an emergency escape air cylinder.
- DO NOT USE CHEMICAL CARTRIDGE OR CANISTER RESPIRATORS.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Vinyl Chloride** is a FLAMMABLE AND REACTIVE GAS that can EXPLOSIVELY POLYMERIZE if not inhibited.
- DO NOT attempt to extinguish fire unless flow can be stopped. Shut off supply or let burn.
- Use dry chemical or CO_2 for small fires.
- POISONOUS GASES ARE PRODUCED IN FIRE, including *Hydrogen Chloride* and *Phosgene*.
- CONTAINERS MAY EXPLODE IN FIRE.
- Use water spray to reduce vapors and to keep containers cool.
- Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source or flash back.
- Flow or agitation may generate electrostatic charges.
- **Vinyl Chloride** may form an ignitable vapor/air mixture in closed tanks or containers.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Vinyl Chloride** is leaked, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate ignition sources.
- Ventilate area of leak to disperse the gas.
- Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.
- Absorb liquids in dry sand, earth, or a similar material and place into sealed containers for disposal.
- Turn leaking cylinder with leak up to prevent escape of gas in liquid state.
- Ventilate area of spill or leak.
- Keep **Vinyl Chloride** out of confined spaces, such as sewers, because of the possibility of an explosion.
- DO NOT wash into sewer.
- It may be necessary to contain and dispose of **Vinyl Chloride** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Vinyl Chloride** you should be trained on its proper handling and storage.

- A regulated, marked area should be established where **Vinyl Chloride** is handled, used or stored as required by the OSHA **Vinyl Chloride** Standard (29 CFR 1910.1017).
- **Vinyl Chloride** can polymerize rapidly or explosively when exposed to elevated temperatures (over 125°F (52°C)), or when exposed to AIR or LIGHT in the presence of a CATALYST.
- **Vinyl Chloride** reacts violently with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE).
- **Vinyl Chloride** is not compatible with WATER; METALS (such as COPPER, ALUMINUM, IRON and STEEL); METAL CARBIDES; and METAL ALLOYS as fires and/or explosions may occur.
- *Phenol* should be used as an inhibitor to prevent violent polymerization of **Vinyl Chloride**.
- Store in tightly closed containers in a cool, well-ventilated area away from MOISTURE, HEAT SOURCES and METALS.
- Sources of ignition, such as smoking and open flames, are prohibited where **Vinyl Chloride** is used, handled, or stored.
- Metal containers involving the transfer of **Vinyl Chloride** should be grounded and bonded.
- Use explosion-proof electrical equipment and fittings wherever **Vinyl Chloride** is used, handled, manufactured, or stored.
- Use only non-sparking tools and equipment, especially when opening and closing containers of **Vinyl Chloride**.
- **Vinyl Chloride** may accumulate static electricity.

Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health
Right to Know
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: http://www.nj.gov/health/eoh/rtkweb

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

The **critical temperature** is the temperature above which a gas cannot be liquefied, regardless of the pressure applied.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

Protective Action Criteria (PAC) are values established by the Department of Energy and are based on AEGLs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Air*), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.

NJ Health
New Jersey Department of Health

Right to Know Hazardous Substance Fact Sheet

Emergency
Responders
Quick Reference

Common Name: VINYL CHLORIDE

Synonyms: Chloroethylene; Monochloroethylene, VCM
CAS No: 75-01-4
Molecular Formula: $CH_2 = CHCl$
RTK Substance No: 2001

Description: Colorless gas, with a sweet odor at high concentrations, that is usually handled as a liquid under pressure

HAZARD DATA

Hazard Rating

4 - Health

4 - Fire

2 - Reactivity

DOT#: UN 1086

ERG Guide #: 116P

Hazard Class: 2.1

(Flammable Gas)

Firefighting

FLAMMABLE AND REACTIVE GAS that can EXPLOSIVELY POLYMERIZE if not inhibited.

DO NOT attempt to extinguish fire unless flow can be stopped. Shut off supply or let burn.

Use dry chemical or CO_2 for small fires.

POISONOUS GASES ARE PRODUCED IN FIRE, including *Hydrogen Chloride* and *Phosgene*.

CONTAINERS MAY EXPLODE IN FIRE.

Use water spray to reduce vapors and to keep containers cool.

Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source or flash back.

Flow or agitation may generate electrostatic charges.

Vinyl Chloride may form an ignitable vapor/air mixture in closed tanks or containers.

Reactivity

Vinyl Chloride can polymerize rapidly or explosively when exposed to elevated temperatures (over 125°F (52°C)), or when exposed to AIR or LIGHT in the presence of a CATALYST.

Vinyl Chloride reacts violently with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE).

Vinyl Chloride is not compatible with WATER; METALS (such as COPPER, ALUMINUM, IRON and STEEL); METAL CARBIDES; and METAL ALLOYS as fires and/or explosions may occur.

Phenol should be used as an inhibitor to prevent violent polymerization of **Vinyl Chloride**.

Vinyl Chloride may accumulate static electricity.

SPILL/LEAKS

Isolation Distance:

Spill: 100 meters (330 feet)

Fire: 800 meters (1/2 mile)

Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.

Absorb liquids in dry sand, earth, or a similar material and place into sealed containers for disposal.

Keep **Vinyl Chloride** out of confined spaces, such as sewers, because of the possibility of an explosion.

Turn leaking cylinder with leak up to prevent escape of gas in liquid state.

Use nonsparking tools and ground and bond containers when transferring **Vinyl Chloride**.

Vinyl Chloride is hazardous to the environment.

EXPOSURE LIMITS

OSHA: 1 ppm, 8-hr TWA; 5 ppm, Ceiling

NIOSH: Lowest feasible concentration

ACGIH: 1 ppm, 8-hr TWA

The Protective Action Criteria values are:

PAC-1 = 250 ppm PAC-2 = 1,200 ppm
PAC-3 = 4,800 ppm

HEALTH EFFECTS

Eyes:	Irritation and burns, contact with *liquid* or *gas* may cause frostbite
Skin:	Irritation and burns, contact with *liquid* or *gas* may cause frostbite
Inhalation:	Nose, throat and lung irritation with coughing, wheezing and shortness of breath Headache, dizziness, lightheadedness and passing out
Chronic:	Cancer (liver, brain, and lung) in humans

PHYSICAL PROPERTIES

Odor Threshold:	>3,000 ppm
Flash Point:	-108°F (-78°C)
LEL:	3.6%
UEL:	33%
Auto Ignition Temp:	882°F (472°C)
Vapor Density:	2.2 (air = 1)
Vapor Pressure:	2,524 mm Hg at 68°F (20°C)
Specific Gravity:	0.9 (water = 1)
Water Solubility:	Very slightly soluble
Boiling Point:	17°F (-8.3°C)
Freezing Point:	-245° to -256°F (-154° to -160°C)
Ionization Potential:	9.99 eV
Critical Temperature:	306° to 317.3°F (152° to 158.5°C)
Molecular Weight:	62.5

PROTECTIVE EQUIPMENT

Gloves:	Insulated Viton, Viton/Butyl, Silver Shield®/4H® and Barrier® (>8-hr breakthrough)
Coveralls:	Tychem® BR, CSM and TK; Trellchem HPS and VPS (8-hr breakthrough) >10% of the LEL wear flash protection or turnout gear
Respirator:	SCBA

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 30 minutes. Remove contact lenses if worn. Seek medical attention.

Immerse affected part in warm water. Seek medical attention.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.

November 2010

MATERIAL SAFETY DATA SHEET

ANSULITE 3% AFFF (AFC-3-A)

Product Code: 1010-2-016 ANa Issue Date: 08-30-2010

1. Product and Company Identification

Material name	**ANSULITE 3% AFFF (AFC-3-A)**
Version #	01
Revision date	08-30-2010
CAS #	Mixture
Product Code	1010-2-016 ANa
Product use	Fire extinguishing agent
Manufacturer / Importer / Supplier	
Name	Tyco Fire Suppression and Building Products
Address	One Stanton Street Marinette, WI 54143-2542
Phone	715-735-7411
Internet	http://www.ansul.com
Emergency Phone Number	CHEMTREC 800-424-9300 or 703-527-3887

2. Hazards Identification

Emergency overview	WARNING! Causes skin and eye irritation.
OSHA regulatory status	This product is considered hazardous under 29 CFR 1910.1200 (Hazard Communication).
Potential health effects	
Routes of exposure	Eye contact. Skin contact. Inhalation. Ingestion.
Eyes	Do not get this material in contact with eyes.
Skin	Avoid contact with the skin. Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis.
Inhalation	Do not breathe vapor. May be irritating.
Ingestion	Not a likely route of entry. Do not ingest.
Target organs	Eyes. RESPIRATORY SYSTEM. Skin. Central nervous system.
Chronic effects	Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis.
Signs and symptoms	Irritation of nose and throat. Irritation of eyes and mucous membranes. Defatting of the skin. Rash. Skin irritation.

3. Composition / Information on Ingredients

Components	CAS #	Percent
Butyl Carbitol	112-34-5	2.5 - 10
Other components below reportable levels		> 90

4. First Aid Measures

First aid procedures	
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation persists after washing.
Skin contact	Wash off with warm water and soap. Get medical attention if irritation develops and persists.
Inhalation	Move to fresh air. For breathing difficulties, oxygen may be necessary. Get medical attention, if needed.
Ingestion	Rinse mouth. Do not induce vomiting without advice from poison control center. IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.
Notes to physician	Symptoms may be delayed.

General advice	If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance.

5. Fire Fighting Measures

Flammable properties	No unusual fire or explosion hazards noted.
Extinguishing media	
Suitable extinguishing media	This product is not flammable. Use extinguishing agent suitable for type of surrounding fire.
Protection of firefighters	
Specific hazards arising from the chemical	None known.
Specific methods	None known.
Hazardous combustion products	May include oxides of nitrogen.

6. Accidental Release Measures

Personal precautions	Local authorities should be advised if significant spillages cannot be contained. Surfaces may become slippery after spillage.
Environmental precautions	Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground.
Methods for containment	Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Prevent entry into waterways, sewer, basements or confined areas.
Methods for cleaning up	Should not be released into the environment. Large Spills: Dike far ahead of spill for later disposal. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Never return spills in original containers for re-use. Following product recovery, flush area with water. Clean surface thoroughly to remove residual contamination.

7. Handling and Storage

Handling	Do not get this material in contact with eyes. Avoid contact with skin. Avoid prolonged exposure. Handle and open container with care.
Storage	Store in cool place. Store in a well-ventilated place. Keep container tightly closed. Keep out of the reach of children. Use care in handling/storage.

8. Exposure Controls / Personal Protection

Personal protective equipment	
Eye / face protection	Do not get in eyes. Wear approved chemical safety glasses or goggles where eye exposure is reasonably probable.
Skin protection	Wear appropriate chemical resistant clothing. Chemical resistant gloves.
Respiratory protection	When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
General hygiene considerations	Handle in accordance with good industrial hygiene and safety practice. When using, do not eat, drink or smoke. Avoid contact with skin.

9. Physical & Chemical Properties

Appearance	
Form	Liquid.
Color	Light yellow. Clear.
Odor	Mild. Sweet.
Physical state	Liquid.
pH	6.5 - 8.5
Melting point	Not available.
Freezing point	Not available.
Boiling point	206.6 °F (97 °C)

Flash point	> 212 °F (> 100 °C)
Evaporation rate	Not available.
Flammability limits in air, upper, % by volume	Not available.
Flammability limits in air, lower, % by volume	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Specific gravity	1.02
Relative density	Not available.
Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	Not available
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
VOC	Not available.

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	None known.
Incompatible materials	Alkaline metals. Strong acids, alkalies and oxidizing agents.
Hazardous decomposition products	Nitrogen oxides (NOx). Sulfur oxides. Carbon oxides.

11. Toxicological Information

Toxicological information The toxicity of this product has not been tested.

Toxicological data

Components	Test Results
Butyl Carbitol (112-34-5)	Acute Dermal LD50 Rabbit: 2700 mg/kg Acute Oral LD50 Guinea pig: 2000 mg/kg Acute Oral LD50 Rabbit: 2200 mg/kg Acute Oral LD50 Rat: 6560 mg/kg Acute Other LD50 Mouse: 850 mg/kg Acute Other LD50 Rat: 500 mg/kg

Local effects	Components of the product may be absorbed into the body through the skin. Contact may irritate or burn eyes.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

12. Ecological Information

Ecotoxicological data

Components	Test Results
Butyl Carbitol (112-34-5)	EC50 Algae: > 100 mg/l 96.00 Hours EC50 Water flea (Daphnia magna): 3184 mg/l 24.00 hours LC50 Bluegill (Lepomis macrochirus): 1300 mg/l 96.00 hours

Ecotoxicity	Not expected to be harmful to aquatic organisms.
Environmental effects	An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Persistence and degradability	Not available.

13. Disposal Considerations

Disposal instructions	This product, in its present state, when discarded or disposed of, is not a hazardous waste according to Federal regulations (40 CFR 261.4 (b)(4)). Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for hazardous waste. Dispose of waste material according to Local, State, Federal, and Provincial Environmental Regulations.
Waste from residues / unused products	Dispose of in accordance with local regulations.

14. Transport Information

DOT

Not regulated as dangerous goods.

15. Regulatory Information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

US EPCRA (SARA Title III) Section 313 - Toxic Chemical: De minimis concentration

Butyl Carbitol (CAS 112-34-5)	1.0 % N230

US EPCRA (SARA Title III) Section 313 - Toxic Chemical: Listed substance

Butyl Carbitol (CAS 112-34-5)	Listed. N230

CERCLA (Superfund) reportable quantity

None

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Acute Health - Yes Chronic Health - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No
Section 302 extremely hazardous substance	No
Section 311 hazardous chemical	No

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

State regulations This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US - New Jersey Community RTK (EHS Survey): Reportable threshold

Butyl Carbitol (CAS 112-34-5)	500 LBS

US - Pennsylvania RTK - Hazardous Substances: Listed substance

Butyl Carbitol (CAS 112-34-5)	Listed.

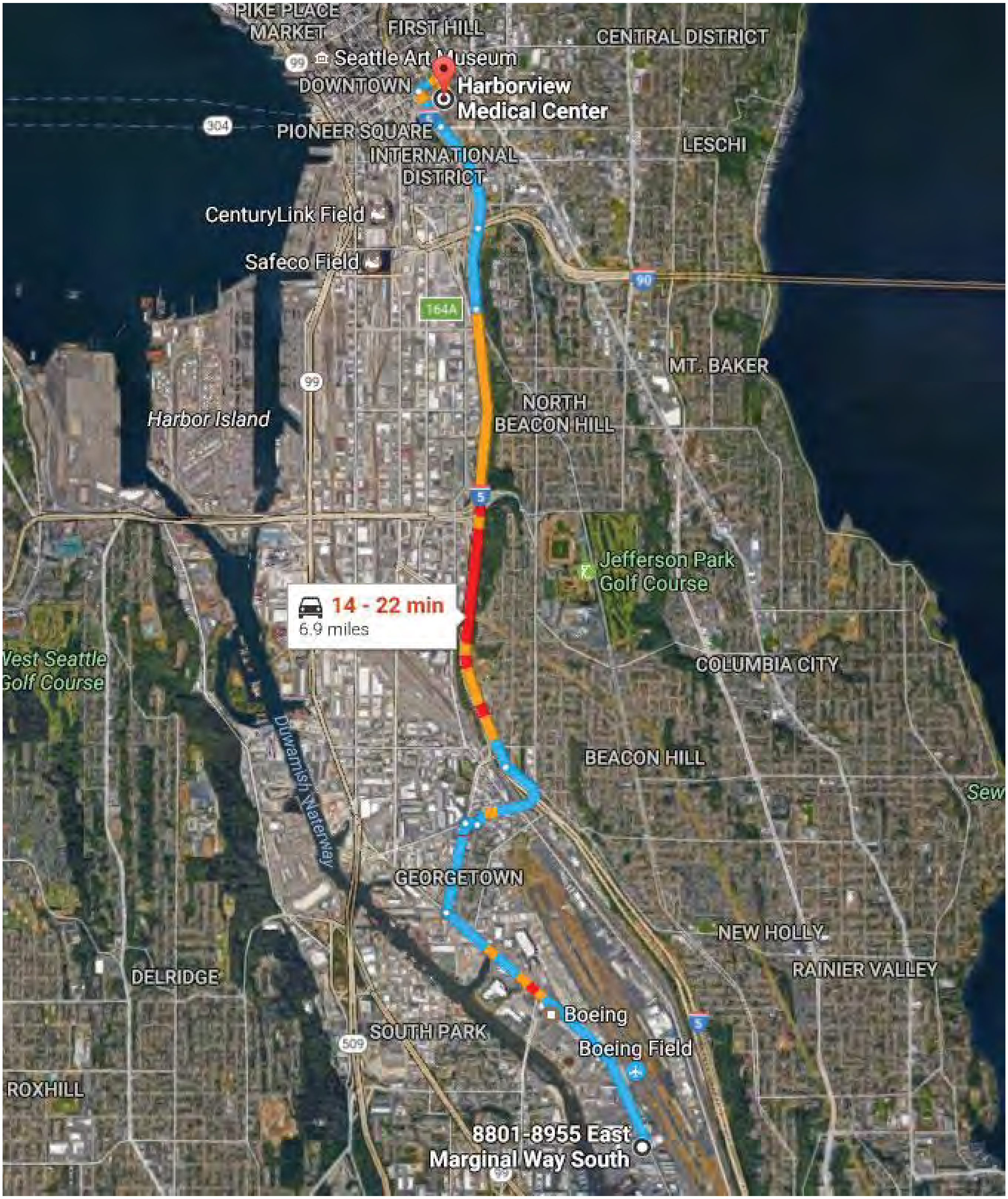
16. Other Information

Further information	HMIS® is a registered trade and service mark of the NPCA.
HMIS® ratings	Health: 1 Flammability: 0 Physical hazard: 0
NFPA ratings	Health: 1 Flammability: 0 Instability: 0
Disclaimer	The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.
Issue date	08-30-2010

ATTACHMENT D: SITE MAPS TO NEAREST WALK-IN CLINIC AND HOSPITAL

Attachment D

Site Maps to Nearest Walk-In Clinic and Hospital


PIKE PLACE MARKET
FIRST HILL
CENTRAL DISTRICT
Seattle Art Museum
99
DOWNTOWN
Harborview Medical Center
304
PIONEER SQUARE
LESCHI
INTERNATIONAL DISTRICT
CenturyLink Field
Safeco Field
90
164A
MT. BAKER
99
Harbor Island
NORTH BEACON HILL
5
Jefferson Park Golf Course
14 - 22 min
6.9 miles
West Seattle Golf Course
COLUMBIA CITY
BEACON HILL
Sew
Duwamish Waterway
GEORGETOWN
NEW HOLLY
RAINIER VALLEY
DELRIDGE
Boeing
5
SOUTH PARK
509
Boeing Field
ROXHILL
8801-8955 East Marginal Way South
99


Harbor Island
US HealthWorks Medical Group
NORTH BEACON HILL
Jefferson Park Golf Course
INDUSTRIAL DISTRICT
Puget Park
COLUMBIA CITY
S Genesee
S Lucile St
10 - 16 min
7.8 miles
S Orcas St
S Graham St
10 - 18 min
4.3 miles
NEW HOLLY
DELRIDGE
Boeing
Boeing Field
SOUTH PARK
12 - 20 min
5.6 miles
Duwamish Waterway
1st Avenue South
E Marginal Way
Airport Way S
SW Roxbury St

Appendix H

Cross-Reference of Feature Identifications

Jorgensen Forge Corporation Property, Tukwila, Washington

CONTENTS

Table H-1 - Cross-Reference of Vault Names with SoundEarth's Identification

Name of Vault	SoundEarth's Vault Name	SoundEarth's Number
Area 1 - Hollowbore Area		
Hollowbore 59/60 Lathes Cutting Oil Holding Tank Vault	Outside Hollowbore Cutting Fluid Tank Vault	2A
Hollowbore 59/60 Lathes Cutting Oil Holding Tank	Outside Hollowbore Cutting Fluid Tank	2
Office Building Heating Oil UST	Front Office Fuel Oil Tank	1
Hollowbore 59 Lathe Vault	Hollowbore 59	3
Frenchman 63 Lathe Vault	Frenchman	4
Ingersoll	Ingersoll	6
Carlton	Carlton	7
Tacchi	Tacchi #1	8
MAE	MAE	10
Small Freight Scale Pit in Shipping	Small Freight Scale Pit in Shipping	65
Large Freight Scale in Shipping / Inspection	Large Freight Scale in Shipping / Inspection	66
Hollowbore 60 Lathe Vault	Hollowbore 60	3A
Hollowbore 58 Oil-Return Trench	Hollowbore 58	3B
Tacchi #2	Tacchi #2	3C
Hollowbore 58 Lathe Vault	Inside Hollowbore Cutting Fluid Vault	5A
Area 2 - Oil-Water Separator and Decommissioned Diesel Storage Area		
660-Ton Press	660 Press	22
660-Ton Press Pump Room	660 Press Pump Room	22A
1,250-Ton Press	1250 Press	19
1,250-Ton Press Pump Room	1250 Press Pump Room	19A
5,000-Ton Press Vault	5K Press	24
Billet Storage Scale	Billet Storage Scale	80
Decommissioned Diesel Storage Area Vault	Large Vault at 8 Tank Lcoation	17I
F-21 Gear Box Pit	F-21 Gear Box Pit	47
F-23 Gear Box Pit	F-23 Gear Box Pit	48
F-25 Gear Box Pit	F-25 Gear Box Pit	49
F-35 Gear Box Pit	F-35 Gear Box Pit	53
Former Truck Scale	Aluminum Heat Treat Scale	77
H-2 Gear Box Pit	H-2 Gear Box Pit	59
L and F Press Vault and Hydraulic Plant	LMF Press	23
Oil-Water Separator (West of Aluminum Heat Treat Building)	API (Oil Water Separator)	15
Outdoor Railroad Scale Vault	Outside Rail Road Freight Scale	27
Portable Quench Tank 4 (Q4)	Quench Tank #Q4	72
Portable Quench Tank 9 (Q9)		-
Quench Tank 5 (Q5)	Quench Tank #Q5	73
Quench Tank 6 (Q6)	Quench Tank #Q6	74
Quench Tank 7 (Q7)	Quench Tank #Q7	71
Quench Tank 8 (Q8) Vault	Tank in Aluminum Heat Treat	18A
Ring Expander Vault	Ring Expander	21
Ring Mill Vault and Coolant Storage Vault	Ring Mill	20
Small Ring Mill	Small Ring Mill	25
Steam Tunnel	Press Tunnel East to West Forge Shop	63

Table H-1 - Cross-Reference of Vault Names with SoundEarth's Identification

Name of Vault	SoundEarth's Vault Name	SoundEarth's Number
Area 4- Decommissioned Oil Storage Area		
Decommissioned Oil Storage Area Vault	Large Vault at 10 Tank Location	16K
H-18 Gear Box Pit	H-18 Gear Box Pit	61
Oil-Water Separator (Decommissioned Oil Storage Area)	Oil Recycling Center Tanks	14
Waste Oil Tank	Oil Recycling Center Tanks	14
Waste Oil Tank Vault	Oil Recycling Center Pit	14A
Area 5 - Remaining Building Interior Area		
2,500-Ton Press Pump Room	2500 Press Pump Room	26A
2,500-Ton Press Vault	2500 Press	26
Billet Grinder Rotator Vault	West Grinder Pits (#2)	67A
Bueltmann Bar Peeler Oil-Return Vault	Bultmann	9
East Craven Lathe Vault	East Craven	12
Electrical Trench	Electrical Trench East to West Machine Shop	62
F-11 Gear Box Pit	F-11 Gear Box Pit	43
F-13 Gear Box Pit	F-13 Gear Box Pit	44
F-15 Gear Box Pit	F-15 Gear Box Pit	45
F-19 Gear Box Pit	F-19 Gear Box Pit	46
F-3 Gear Box Pit	F-3 Gear Box Pit	41
F-5 Gear Box Pit	F-5 Gear Box Pit	42
Former Underground Quench Tank	Former Underground Quench Tank	79
H-10 Gear Box Pit	H-10 Gear Box Pit	57
H-4 Gear Box Pit	H-4 Gear Box Pit	54
Large Bullard	Large Bullard	37
Large Hypro	Large Hypro	39
Quench Tanks 1, 2, and 3 (Q1, Q2, and Q3)	Vertical Quench Tanks	13
Quench Tanks 1, 2, and 3 (Q1, Q2, and Q3) Vault	Vertical Quench Tanks Vault	13A
Small Bullard	Small Bullard	36
The Planner (Kysor)	The Planner (Kysor)	35
West Craven Lathe Vault	West Craven	11
West Grinder Pit #1	West Grinder Pit #1	67
West Grinder Pit #3	West Grinder Pit #3	67B
Area 7 - Former Metals Storage Area		
Arc Furnace Vault	Melt Furnace #1, Melt Furnace #2	32, 32A
AOD Scale Vault	AOD Causeway Scale	76B
AOD Tapping Vault	AOD Pit	31
Cooling Tower Pit South Side Melt Shop	Cooling Tower Pit South Side Melt Shop	75
Electrical Trench North to South Melt Shop	Electrical Trench North to South Melt Shop	64
F-1 Gear Box Pit	F-1 Gear Box Pit	40
Ingot Mold Vaults	North Side Teeming Pit, South Side Teeming Pit	29, 29A
Outdoor Scrap Metal Scale Vault	Outside Melt Scale	33
Soaking Furnace Vault	Soaking Pit	28
Vacuum-Degassing Vaults	Vacuum Degasser Pit	30

Table H-1 - Cross-Reference of Vault Names with SoundEarth's Identification

Name of Vault	SoundEarth's Vault Name	SoundEarth's Number
Area 8 - Shoreline and Embayment		
Melt Shop Baghouse Cooling Tower Vaults	Cooling Tower Pits	34

NOTES:

- indicates that no identifier was assigned.

AOD = argon-oxygen decarbonization; UST = underground storage tank

Table H-2 - Cross-Reference of AST/UST Names with SoundEarth Identification

AST/UST Identification	AST/UST Name	SoundEarth's AST/UST Identification[1]
UST-1	Hollowbore 59/60 Lathes Cutting Oil Holding Tank	UST-2
UST-2	Hollowbore 59/60 Horizontal Lathes Intermediate Cutting Oil Tank	AST-17
UST-3	Hollowbore 58 Horizontal Lathe Clean Cutting Oil Tank	AST-15
UST-4	Hollowbore 58 Horizontal Lathe Cutting Cutting Oil Tank	AST-16
UST-5	Tacchi Cutting Oil Tank	AST-18
UST-6	Office Building Heating Oil UST	UST-1
UST-7	5,000-Ton Press Hydraulic Oil Tank	-
UST-8	Ring Expander Hydraulic Oil Tank	AST-4
UST-9	Ring Mill Coolant Tank	AST-9
UST-10	Ring Mill Coolant Tank	AST-10
UST-11	Quench Tank 5 (Q5)	-
UST-12	Quench Tank 6 (Q6)	-
UST-13	Quench Tank 7 (Q7)	-
UST-14	Quench Tank 8 (Q8)	Q-8
UST-15 through UST-22	Decommissioned Diesel Storage Area Tanks (8 tanks)	AST-33 through AST-40
UST-23	Former Regulated Gasoline UST	-
UST-24	Former Unregulated Gasoline UST	-
UST-25	Former Unregulated Gasoline UST	-
UST-26 through UST-33	Decommissioned Oil Storage Area Tanks (10 Tanks)	AST-23 through AST-32
UST-36	Waste Oil Tank	AST-21
UST-37	West Craven Lathe	AST-14
UST-38	East Craven Lathe	-
UST-39	Quench Tank 1 (Q1)	-
UST-40	Quench Tank 2 (Q2)	-
UST-41	Quench Tank 3 (Q3)	-
UST-42	Arc Furnace Hydraulic Oil Tank	AST-1
UST-43	Arc Furnace Hydraulic Oil Tank	AST-2
AST-1	Former Cutting Oil Suuply Tank	-
AST-2	660-Ton Press Hydraulic Oil Tank	AST-5
AST-3	1,250-Ton Press Hydraulic Oil Tank	AST-8
AST-4	L and F Press Hydraulic Oil Tank	AST-7
AST-5	Used Oil Centrifuge	AST-19
AST-6	Clean Hydraulic Oil Tank	AST-20
AST-7	2,500-Ton Press Hydraulic Oil Tank	AST-3
AST-8	Quench Tank 4 (Q4)	AST-11
AST-9	Quench Tank 9 (Q9)	AST-12
AST-10	Former Gasoline AST	-
AST-11	Diesel Fuel Tank	AST-22

NOTES:

[1] SoundEarth AST/UST IDs obtained from *SoundEarth Strategies, LLC, 2019, Star Forge, LLC - October 2019 UST Site Visit, Former Jorgensen Forge Facility, 8531 East Marginal Way, Tukwila, Washington, Project Number 0995-002, November 21.*

- indicates that no identifier was assigned.

AST = aboveground storage tank; UST = underground storage tank

IMPORTANT INFORMATION

Important Information

About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland