WSDOT

SR 520 BRIDGE REPLACEMENT AND HOV PROGRAM

Data Gaps Investigation Work Plan/Sampling and Analysis Plan for Montlake Gas Station, SR 520 Bridge Replacement and HOV Program, Seattle, Washington

Prepared for

Washington State Department of Transportation
SR520 Bridge Replacement and HOV Program
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Acronyms and Abbreviations

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
°C	degrees Celsius
COC	chain of custody
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
EDB	ethylene dibromide
EDC	ethylene dichloride
EIM	Environmental Information Management
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
ESA	environmental site assessment
HOV	high-occupancy vehicle
IDW	investigation-derived waste
L/min	liters per minute
mL/min	milliliters per minute
MTCA	(Washington State) Model Toxics Control Act
NAPL	non-aqueous phase liquid
NTU	nephelometric turbidity units
NWTPH-Dx	Northwest Total Petroleum Hydrocarbon – Diesel Extended
NWTPH-Gx	Northwest Total Petroleum Hydrocarbon – Gasoline Extended
ORP	oxidation-reduction potential
PID	photoionization detector
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
Site	Montlake Gas Station

SPT	standard penetration testing
SR	State Route
TDS	total dissolved solids
UST	underground storage tank
VOA	volatile organic analyte
VOCs	volatile organic compounds
VPH	volatile petroleum hydrocarbons
Work Plan	Data Gaps Investigation Work Plan
WSDOT	Washington State Department of Transportation

Introduction

Authorization

Shannon & Wilson has prepared this Data Gaps Investigation Work Plan (Work Plan) and Sampling and Analysis Plan of the Montlake Gas Station (Site) located at 2625 East Montlake Place East, Seattle, Washington (Exhibit 1) for the Washington State Department of Transportation (WSDOT) State Route (SR) 520 Bridge Replacement and High Occupancy Vehicle (HOV) Program. This service was conducted under Master Subconsultant Agreement Y-11848, Task Order DA.00.

Site Description

The Site is three parcels of land located at 2625 East Montlake Place East in Seattle, Washington. The Site is currently used as a gasoline service station and marketplace.

Previous environmental explorations at the Site have discovered soil and groundwater containing concentrations of regulated contaminants exceeding environmental action cleanup levels set forth in the Washington State Model Toxics Control Act (MTCA) regulation. The source of the releases is likely the underground storage tanks (USTs) on the Site used to store petroleum hydrocarbons. The location of the USTs can be found on the Site Map, included as Exhibit 2.

The chemicals of concern at the Site known to exceed MTCA regulation include gasoline-, diesel-, and heavy-oil range petroleum hydrocarbons; benzene, toluene, ethylbenzene, and xylene (BTEX); naphthalene; ethylene dibromide (EDB) and/or ethylene dichloride (EDC); and arsenic. Other potential chemicals of concern have been detected below MTCA regulation and include carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and the metals chromium, selenium, silver, barium, cadmium, lead, and mercury. The investigation of these additional potential chemicals of concern will be limited.

Previous Environmental Investigations

Previous environmental investigations have been performed for the Site, including:

- Limited Phase I Environmental Site Assessment (ESA) (WSDOT, 2016)
- Phase II ESA (Innovex, 2016)
- Supplemental Limited Phase II ESA (Innovex, 2018a)
- Second Supplemental Limited Phase II ESA (Innovex, 2018b)
- Third Supplemental Limited Phase II ESA (Innovex, 2019)
- Phase II ESA, Montlake Market and Gas Station Properties (Hart Crowser, 2019)
- DRAFT Indoor Air Testing (Shannon & Wilson, 2019)

Exhibit 3 has been included to summarize analytical soil sample results collected from the Site that exceed applicable MTCA cleanup levels. Exhibit 4 has been included to summarize analytical groundwater sample results collected from the Site that exceed applicable MTCA cleanup levels.

The results of the investigations indicate that:

- Gasoline-range hydrocarbons were detected above MTCA cleanup levels in soil sample(s) collected from borings H-4-16, H-16-18, H-17-18, and H-19-18.
- Heavy oil-range hydrocarbons were detected above MTCA cleanup levels in one soil sample collected from boring H-19-18.
- Volatile organic compounds (VOCs), including BTEX and/or naphthalene, were detected above applicable MTCA cleanup levels in soil sample(s) collected from borings H-3-16, H-4-16, H-16-18, H-17-18, H-19-18, and H-20-18.
- Gasoline-range hydrocarbons were detected above MTCA cleanup levels in reconnaissance groundwater sample(s) collected from borings H-17-18, H-18-18, H-19-18, and H-21-18.
- Diesel-range hydrocarbons were detected above MTCA cleanup levels in one reconnaissance groundwater sample collected from H-20-18.
- VOCs including BTEX and/or naphthalene were detected above applicable MTCA cleanup levels in reconnaissance groundwater samples collected from borings H-3-16, H-16-18, H-17-18, H-18-18, H-19-18, H-20-18, and H-21-18.

Objectives

This Work Plan was prepared to further define the nature and extent of contamination previously identified at the Site. Information obtained from the performance of this Work Plan will inform cleanup efforts at the Site. Specifically, this Work Plan is designed to resolve currently identified data gaps for the Site, as discussed in the following sections. Exhibit 5 describes the purpose for each proposed exploration location, and detailed descriptions of sampling approaches are provided later in the text.

Further Delineation of Contaminant Extents

Previous investigations indicate that contaminated soil exists underneath the area adjacent to the fueling canopies. Additional soil borings proposed in this Work Plan will better define the lateral extent of the soil contamination by collecting soil samples around the periphery of the suspected plume area. The vertical extent of contamination will be better defined by collecting and analyzing soil from just above or at the groundwater table (possible smear zone) and from below contamination to delineate the maximum depth of contamination (this may include sampling within the underlying glacial till).

Groundwater collected from temporary wells installed in previous Site soil borings contained contamination. However, contaminant concentrations in temporary wells may be artificially increased due to turbidity from the drilling action. Monitoring wells will be installed to collect groundwater samples that are more representative of subsurface groundwater conditions to evaluate for the presence of contaminants.

Evaluate for Vapor Intrusion

Soil and groundwater contamination, including gasoline and BTEX, have been identified on the Site near adjacent buildings. Since gasoline and BTEX readily partition from soil and groundwater into a vapor or gaseous phase, this creates the potential for migration of gasoline and BTEX as vapor through the subsurface vadose (e.g., unsaturated) zone. Chemical vapors can potentially migrate from nearby soil and groundwater contamination into the indoor air of nearby buildings. For this reason, two soil vapor monitoring points will be installed adjacent to the nearby structure (Montlake Market Building) to evaluate for the potential of vapor intrusion into adjacent structures. The Montlake Gas Station building, which potentially overlays the contaminant plume, will be demolished during later construction phases of the SR 520 project, and therefore will not be evaluated for vapor intrusion potential. Indoor air at the Montlake Market may be assessed based on the data collected from soil gas samples via the vapor monitoring points.

Assess for Contaminant Migration in Nearby Utility

This Work Plan will conduct a preliminary assessment on the potential for contaminants to discharge to the gravel pack of the nearby sewer utility (Exhibit 2). The gravel pack will be assessed for contaminants to evaluate if further investigation along the sewer utility is required for delineation. Gravel pack surrounding utility lines can act as a preferential contaminant transport conduit and can distribute contamination to distances beyond typical subsurface transport processes.

Obtain Groundwater Flow Data

Groundwater flow direction informs the potential direction of migration and extent of suspected groundwater contamination. Groundwater flow direction has not been investigated for this Site. This Work Plan will evaluate the groundwater flow direction by installing up to four monitoring wells near the suspected groundwater plume and collecting groundwater level data. Falling head or rising head slug testing will be performed at up to two wells to evaluate hydraulic conductivity at the Site.

Characterize Investigation-Derived Waste (IDW)

This Work Plan will generate chemical testing results that will aid in IDW characterization and disposal. Additionally, the results will inform removal methods and disposal options for the planned excavation of contaminated media.

Scope

This Work Plan describes the field activities, including explorations, field testing, soil and groundwater sampling, data analysis, and the handling of IDW. The scope of this Work Plan includes the following tasks:

- Advancement of up to 15 borings in and around the Site, including:
  - Nine soil borings with no installations
  - Four borings completed as groundwater monitoring wells
  - Two borings completed as vapor monitoring points
- Collection of soil, groundwater, and soil vapor samples for chemical analysis to further delineate and define Site contamination.
- Analysis of groundwater levels to try to obtain an estimated groundwater gradient direction for the Site and hydraulic conductivity.

Preparation

Prior to the field phase, a public and private utility location will be undertaken in the areas of proposed invasive subsurface exploration (Exhibit 2). Exploration locations will be marked with white paint. Shannon & Wilson will obtain a public utility locating ticket number by coordinating with the Washington State Utility Notification Center. A private utility location will be undertaken utilizing surface detection, drain-line delineating, and/or ground penetrating radar methods. If exploration locations are adjusted significantly due to utility locations, Shannon & Wilson will notify WSDOT and provide pictures for approval of final exploration locations.

A Site-specific health and safety plan for the environmental explorations and sampling has been prepared (Appendix A) and will be implemented during field activities. The plan addresses worker safety and safety related to protecting the public from hazards associated with explorations and sampling. An exclusion zone will be established around each exploration with safety cones to protect field personnel from parking lot hazards and to isolate the public from the work zone. Prior to the start of fieldwork each day, a tailgate safety meeting will be held to identify potential job hazards and to remind personnel to be aware of their surroundings. A daily health and safety tailgate meeting sign-in sheet will be completed to document field personnel were briefed on safety hazards expected for that day.

Traffic control will be required during drilling and subsequent well development and groundwater sampling activities. Traffic control plans and a street use permit will be acquired prior to field mobilization.

Exploration Summary

Soil Borings

The location of proposed soil borings is shown in Exhibit 2 as "SB-#-19."

Up to nine soil borings will be advanced using sonic drilling to approximately 25 feet below ground surface (bgs) and will not extend more than 5 feet below the groundwater table or 5 feet below the underlying glacial till. Past explorations have shown that contamination concentrations decrease rapidly once the glacial till is encountered. One soil boring located in the center of the gas station will extend to approximately 60 feet bgs to delineate the vertical extent (bottom) of contaminants underneath the zone of greatest soil and groundwater contamination. Reconnaissance groundwater samples will be collected from each soil boring using 1-inch-diameter temporary wells. Soil borings will be backfilled with hydrated bentonite, and the surface will be patched to match existing grade using either concrete, asphalt, or other on-site surrounding material (e.g., grass, soil, mulch, etc.).

Up to two soil samples per boring will be selected for chemical analyses. The soil samples selected for chemical analyses will be located (1) just above or at the groundwater table and (2) if contamination is expected, from below the contamination to delineate the maximum depth of contamination at the location. The number and depth interval of soil samples selected for chemical analyses may be altered depending on conditions encountered.

Groundwater Monitoring Wells

The location of proposed groundwater monitoring wells is shown in Exhibit 2 as "MW-#-19."

Up to four groundwater monitoring wells will be installed to approximately 25 feet bgs using a sonic rig. Groundwater monitoring wells will be installed such that the screens fully penetrate the saturated thickness of the Site's shallow groundwater table aquifer. Based on previous explorations, the groundwater table aquifer appears to be perched on glacial till and is typically encountered around 20 to 25 feet bgs. Groundwater monitoring wells will be constructed with 1 to 2 feet of screen above the groundwater table to evaluate if free petroleum hydrocarbon product/non-aqueous phase liquid (NAPL) has accumulated or pooled on the water table. Previously tested soil and groundwater contained concentrations of gasoline-range petroleum hydrocarbons indicative of potential NAPL presence. Evaluating for the existence of NAPL on Site will be important in developing the Site conceptual model along with potentially influencing remedial design and disposal concerns.

One of the monitoring wells (MW-3-19) is located adjacent to the sewer line. This monitoring well may be relocated to enable easier access to the sewer line (for example, it may be moved farther north where the sewer line is nearer the surface). A vactor truck will be used or a pit will be dug to identify the position of the monitoring well adjacent to the utility line before the sonic rig is used to finish the boring. This monitoring well will be installed into the sewer line bedding material at approximately 17 to 24 feet bgs (or shallower if the boring location is moved) to assess if the material is acting as a preferential pathway for the identified contamination.

Except for the monitoring well adjacent to the sewer line, up to two soil samples per boring will be selected for chemical analyses unless obvious signs of contamination indicate that additional samples should be analyzed. The soil samples selected for chemical analyses will be located (1) just above or at the groundwater table and (2) if contamination is expected, from below the contamination to

delineate the maximum depth of contamination at the location. The number and depth interval of soil samples selected for chemical analyses may be altered depending on conditions encountered.

Following monitoring well installation, the monitoring wells will be developed using a pump-and-surge block prior to sampling the wells using low-flow technology. The well development will be performed to (1) remove fine-grained materials that may have accumulated in the well during installation and (2) hydraulically connect the monitoring well to the shallow aquifer.

Soil Vapor Monitoring Points

The locations of proposed soil vapor monitoring points are shown in Exhibit 2 as SG-1-19 and SG-2-19. SG-1-19 will be advanced to just above the groundwater table, at 15 feet bgs. SG-2-19 will be advanced to just under the paved slab, at 5 feet bgs.

Two soil samples from SG-1-19 will be selected for chemical analyses unless obvious signs of contamination indicate that additional samples should be analyzed. SG-1-19 will be sampled at 0 to 5 feet bgs and the bottom of the boring.

One soil sample will be collected from SG-2-19 at bottom of boring, unless obvious signs of contamination indicate that additional samples should be analyzed.

Following installation, soil vapor samples will be collected from each vapor monitoring point using standard methodology. One vapor sample will be collected from each of the vapor monitoring points.

Geotechnical Soil Samples

The primary objective of this Work Plan is to environmentally characterize the Site; however, some geotechnical information will be collected to support remedial design options.

Selected soil samples will be submitted for limited geotechnical laboratory tests, which may include natural moisture content, grain size analysis, and Atterberg Limits.

Sample Collection

Up to 15 explorations as borings in and around the Site will be advanced, including nine borings with no installations, four borings completed as groundwater monitoring wells, and two borings completed as vapor monitoring points. The location and identification of the borings are shown in Exhibit 2. Explorations may be conducted in two mobilizations due to permitting and schedule constraints.

The depths and other specifications mentioned above are based on previous explorations completed near or at the Site. The proposed locations, depths, sampling depths, and screen depths may be altered based on conditions encountered during fieldwork. WSDOT will be notified if the boring locations or depths become significantly altered from those outlined in this Work Plan.

Prior to the initiation of sampling activities, necessary field equipment and documentation materials will be prepared. Laboratory-supplied sample containers will be checked for the proper preservative and inventoried to count that adequate containers are available.

The calibration of meters will be checked at the start of each work period or prior to arrival on the Site and will be recalibrated as necessary. Calibration will be valid for field conditions and will be completed in accordance with manufacturer recommendations. Calibration measurements will be documented in the project field activity log. Calibrations will be checked at approximately four-hour intervals thereafter, and will be recalibrated, as necessary, during the work period.

Contamination is expected to be encountered during drilling. For worker safety, a photoionization detector (PID) will be used to monitor for contaminants in ambient air during drilling. As outlined in the Health and Safety Plan (Appendix A), should PID readings indicate contaminants in ambient air at sustained and elevated concentrations, respirators may be required to continue drilling.

An exploration summary is provided as Exhibit 5.

Drilling

Prior to advancing the explorations, each location will be potholed to approximately 5 feet bgs using air and vacuum methods. The explorations will be advanced using sonic drilling methods with standard penetration testing (SPT) equipment and a split-spoon sampler for environmental soil sample collection. Shannon & Wilson will collect soil samples, field screen for contamination, and log the borings.

Soil Samples

Soil samples will be collected at 5-foot intervals with the SPT split-spoon sampler; however, the frequency of SPT sampling may be increased if field observations warrant.

Soil will be visually described using Shannon & Wilson's soil classification procedure, which is a modified version of the Unified Soil Classification System (see Appendix B). The soil descriptions will be recorded on field logs. When a soil sample is selected for chemical analysis, the soil sample will be placed into laboratory-supplied glassware using disposable, stainless steel spoons or disposable plastic syringes.

Reconnaissance Groundwater Samples

Groundwater samples will be collected from temporary 1-inch-diameter polyvinyl chloride (PVC) wells installed at up to nine soil boring locations. A peristaltic pump and disposable tubing will be used to pump water into laboratory-supplied glassware. The temporary wells will be removed following sampling and each hole will be backfilled in accordance with state regulations.

Groundwater Monitoring Well Installation and Development

Permanent groundwater monitoring wells will be installed at select locations to collect groundwater samples and to allow for future groundwater sampling. The well depths and screen intervals were chosen based on the depth of observed groundwater during previous investigations at the Site.

The wells will be constructed of 2-inch-diameter, Schedule 40 PVC, thread-coupled, flush-joint riser pipe, and a 0.010-inch Schedule 40 slotted screen (10-slot). The wells will be constructed with 1 to 2 feet of screen above the groundwater table to evaluate if free petroleum hydrocarbon product/NAPL has accumulated or pooled on the water table. The annulus between the boring wall and the well screen will be backfilled with clean filter sand (U.S. No. 10-20) to 2 feet above the top of the screen. The remaining annular space will be filled with bentonite chips (hydrated in place) to 2 feet bgs. Each well will be completed with a concrete plug and a flush-mount traffic-rated monument.

To collect representative groundwater samples, the groundwater monitoring wells will be developed by field personnel using a pump-and-surge method using a surge block and submersible pump. Development will be completed no sooner than 24 hours after the new wells have been installed. Before development, each well will be evaluated for the presence of floating free product using an oil-water interface probe.

Development includes surging the screen in 0.5-foot intervals followed by pumping fines from the casing. Development will be considered complete when sediments have been removed from the casing and the groundwater removed from the well becomes clear or has stabilized. Groundwater quality parameters, including conductivity, pH, turbidity, and temperature, will be measured periodically during development.

Groundwater Samples

An initial monitoring and sampling event will include using an electronic oil-water interface probe to evaluate if there is free product in each well. During the initial event, each well that does not have measurable free product will be used for groundwater sampling. The groundwater sampling event will include (1) collecting depth to groundwater measurements at each sampled location, (2) measuring field water quality parameters during purging, (3) and collecting groundwater samples for laboratory analysis.

Product and Groundwater Level Measurements

Prior to collecting initial groundwater samples, an oil-water interface probe will be used to evaluate for the presence of free product. If product is present, we will measure the depth to product, depth to groundwater, and product thickness. If product is not present, we will measure depth to groundwater.

Groundwater Sampling

During the groundwater sampling event, each well that does not have measurable free product present will be sampled for groundwater. If free product is present, it may be sampled for density and/or specific gravity analyses. Groundwater sampling will include purging the well while collecting field groundwater parameter readings followed by the collection of samples into laboratory-supplied and appropriately preserved containers.

Either a peristaltic or bladder sampling pump will be fitted with disposable polyethylene, and silicon (at the pump head and water quality instrument connections) tubing will be used to purge and sample each monitoring well. At each location:

- If free product is not present, new disposable tubing will be lowered into the well until the intake is placed below the groundwater table. The time will be recorded on a Water Sampling Log (Appendix C) and the pump will be started.
- 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.
- Field groundwater quality parameters, including pH, specific conductivity, temperature, dissolved oxygen (DO), Oxidation-Reduction Potential (ORP), turbidity as nephelometric turbidity units (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 ±0.01 pH units,
  - Specific conductivity to ±0.01 siemens per centimeter,
  - Temperature to ±0.1 degree Celsius (°C),
  - DO to ±0.01 milligrams per liter,
  - ORP to ±0.1 millivolt,
  - Turbidity to ±0.01 NTU, and
  - TDS to ±0.001 gram per liter.
- 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 evaluated for stabilization:
  - pH to ±0.1 pH units,
  - Specific conductivity to ±10% (readings within 10% of each other),
  - Temperature to ±10%,
  - DO to ±10%, and
  - Turbidity to ±10%.

- If field parameters do not stabilize after one hour of pumping, the sample will be collected. Well purging data will be recorded on a Water Sampling Log (Appendix C).
- 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. Measured water levels and pumping rate changes will be recorded on a Water Sampling Log.

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. Sample handling and field quality assurance (QA) sample collection procedures are outlined in the Field Quality Assurance/Quality Control (QA/QC) section.

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.

After sample collection is complete, the peristaltic pump will be disconnected from the tubing, the well cap will be replaced, and the monument lid will be secured.

Soil Vapor Samples

Two vapor monitoring points will be installed such that one vapor intake will be placed just above the groundwater table, at approximately 15 feet bgs, and the other just below the paved surface at approximately 5 feet bgs. Soil vapor monitoring points will be completed with:

- Vapor monitoring point of ¼-inch-diameter, 6-inch-long, stainless steel point with inlet perforations resting at the bottom of the boring
- Filter pack of 10/20 Colorado silica sand to 1 to 2 feet above the vapor point
- Blank tubing of ¼-inch-diameter silicone from the vapor point up to the monument
- Sealed with hydrated-in-place bentonite chips to 2 to 3 feet bgs
- Concrete plug to ground surface with flush-mount, traffic-rated monuments

Before sampling, at least two days will elapse following installation of the soil vapor monitoring point to allow for construction materials to cure and the subsurface to equilibrate.

The upper end of the tubing will be connected to the purging and sampling system. A flow controller may be attached to the sample setup to regulate the flow of soil vapor into the sample container. The line will be checked for leaks. The line will be purged for one minute or a period of time sufficient to achieve a purge volume that equals at least three volumes of the sampling train, and then the sample will be collected using a laboratory-supplied stainless-steel canister (e.g., Summa canister) or other appropriate container. Helium will be used as a tracer gas to check for leakage in the system. A diagram of the soil vapor purging and sampling system is provided as Appendix D along with details on the sampling procedures.

Investigation-Derived Waste (IDW)

IDW may include soil cuttings, water used for decontamination of equipment, development and sampling purge water from monitoring wells, and disposable personal protective equipment and sampling equipment. IDW will be stored in 55-gallon drums. The IDW drums will be staged on the Site until characterized and disposed of offsite.

Chemical Testing

The soil and groundwater samples will be submitted to OnSite Laboratories of Redmond, Washington. Soil vapor samples will be submitted to Freidman & Bruya, Inc. of Seattle, Washington. Laboratory quantitative limits are provided in Appendix E. A summary of samples and proposed analyses are provided as Exhibit 6.

Soil Samples

Soil samples will be analyzed for:

- Gasoline-range petroleum hydrocarbons using Washington State Department of Ecology's (Ecology's) Northwest Total Petroleum Hydrocarbon - Gasoline Extended (NWTPH-Gx) method
- BTEX and naphthalene by U.S. Environmental Protection Agency (EPA) 8260 Method

In addition, up to one soil sample from each boring will be analyzed for the following:

- Diesel and oil-range petroleum hydrocarbons using Ecology's Northwest Total Petroleum Hydrocarbon – Diesel Extended (NWTPH-Dx) Method
- EDB and EDC by EPA 8260 Method
- Resource Conservation Recovery Act (RCRA) Metals by EPA Method 6010
- cPAHs by EPA Method 8270 SIM

Soil from just above or at the water table at locations SB-1-19, SB-5-19, SB-6-19, and SB-7-19 will be analyzed for total organic carbon by EPA 9060A (or equivalent) method.

Soil at location SB-1-19 is expected to have a high level of contamination. Additional sample analyses will be performed on the samples taken from just above or at the groundwater table; they will be analyzed for the following parameters important for the Voluntary Cleanup Program, the Site conceptual model, and remedial design, including:

- Hexane by EPA 8260 Method
- Extractable petroleum hydrocarbons (EPHs) by Ecology's NWTPH-EPH Method
- Volatile petroleum hydrocarbons (VPHs) by Ecology's NWTPH-VPH Method

Reconnaissance Groundwater Samples

The reconnaissance groundwater samples will be submitted to the laboratory for analyses of the primary chemicals of concern:

- Gasoline-range petroleum hydrocarbons using Ecology's NWTPH-Gx Method
- BTEX and naphthalene by EPA 8260 Method

In addition, every other soil and reconnaissance soil and reconnaissance groundwater sample (SB-1-19, SB-2-19, SB-3-19, SB-5-19, SB-6-19, and SB-7-19) will be submitted to the laboratory for analyses of potential chemicals of concern:

- Diesel and oil-range petroleum hydrocarbons using Ecology's NWTPH-Dx Method

- EDB and EDC by EPA 8260 Method
- Total and dissolved RCRA Metals by EPA Method 6010/7470
- cPAHs by EPA Method 8270 SIM

Groundwater Samples After Well Development

Following development, groundwater samples will be collected from each monitoring well that does not have free product and analyzed for:

- Gasoline-range petroleum hydrocarbons using Ecology's NWTPH-Gx Method
- BTEX and naphthalene by EPA 8260 Method
- Diesel and oil-range petroleum hydrocarbons using Ecology's NWTPH-Dx Method
- EDB and EDC by EPA 8260 Method
- Total and dissolved RCRA Metals by EPA Method 6010/7470
- cPAHs by EPA Method 8270 SIM

Soil Vapor Samples

Soil vapor samples will be submitted to the laboratory for analyses of the following chemicals using EPA TO-15 Method:

- Air-phase hydrocarbons
- BTEX
- Naphthalene

Field and Laboratory Quality Assurance/Quality Control (QA/QC)

Field and laboratory QA/QC protocols have been established so that samples can be tracked from collection through analysis to evaluate the efficiency and reproducibility of sampling procedures.

Sampling Handling, Chain-Of-Custody (COC), and Transportation Procedures

Environmental samples collected during the project will be labeled, stored, and transported using standard protocols. These protocols are summarized below:

Sample Labeling

Sample container labels will be completed immediately before or immediately following sample collection. Container labels will include the following information:

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

Trip blanks will be used to test for the potential of volatile cross-contamination during transport. Trip blanks are purified water samples stored in glass vials within the sampling cooler. One trip blank will be analyzed for volatile contaminants per sample cooler.

Equipment blanks will be used to test for the potential of cross-contamination as a result of sampling equipment. Equipment blanks are known to be non-contaminated samples (either soil or water) collected through the sampling system. Detections in equipment blanks indicate that samples may be cross-contaminated as a result of the sampling equipment used.

The nomenclature for sample labeling is as follows:

• Soil Samples	Sample Location: Depth	SB-1-19:5.0 (For location SB-1-19 at 5 feet bgs)
• Groundwater Reconnaissance Samples	Well Number–GW-RECON–Date	MW-1-19-GW-RECON-07202019 (For MW-1-19 sampled July 20, 2019)
• Groundwater samples collected after a well has been developed	Well Number–Date	MW-1-19-GW-07202019 (For MW-1-19 sampled July 20, 2019)

• Soil Vapor Samples	Sample Location–Date of Collection	SG-1-19-07202019 (For SG-1-19 sampled July 20, 2019)
• Duplicate Samples	Use same format as appropriate for given matrix, except use a location identification commencing at numeral 100	MW-100-19-07202019 (For a groundwater sample duplicate that was sampled July 20, 2019)
• Trip Blank	TB–Numeral starting at 1–Date	TB-1-07202019 (For the first trip blank of the Work Plan. Labeled July 20, 2019)
• Equipment Blank	EB-Numeral starting at 1-Date	EB-1-07202019 (For the first equipment blank of the Work Plan. Labeled July 20, 2019)

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.

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 chain-of-custody record detailing requested analyses, the Laboratory Coordinator(s) or his/her delegate will:

- Verify paperwork, COC records, and similar documentation;
- Log in samples, assign unique laboratory sample numbers, and attach the numbers to the sample container(s);
- 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.

Sample Transportation

Samples will be transported to the analytical laboratory within a cooler containing blue ice so that samples are maintained within the appropriate temperature range (less than or equal to 6°C). Samples will be delivered to the laboratory by field personnel, picked up by the laboratory (or courier) at Shannon & Wilson's office, picked up by the laboratory (or courier) at the Site, or shipped directly to the laboratory. 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.

Quality Assurance/Quality Control (QA/QC) Samples

QA/QC samples will be collected during the fieldwork to evaluate the reproducibility of the sampling technique and the subsequent laboratory analysis. These will include field duplicate samples, trip blank samples, and equipment blank samples to be collected in the field. The laboratory will test the reproducibility of their results by using matrix spike/matrix spike duplicate samples.

Field Duplicate Samples

Field duplicate samples are a second sample collected from a location. This sample is submitted to the laboratory with a different, yet distinguishable sample number 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. The field team will note in the field log where duplicate samples were collected. Duplicates will be collected as follows and are assigned to selected locations as shown in Exhibit 5:

- Duplicates of soil samples from three locations. Each duplicate collected from a single depth interval (total of three duplicate samples).
- Two duplicates of reconnaissance groundwater samples.
- One duplicate of a groundwater sample.
- One duplicate of a soil vapor sample.

Trip Blank Samples

One trip blank will be submitted with each cooler containing samples for volatile analytes (e.g., gasoline and BTEX). The trip blanks are provided by the laboratory as vials filled with deionized water. 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 volatile constituents only.

Temperature Blank Samples

Temperature blank samples are used to evaluate 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. Often, the lab will double the use of the trip blank sample as the temperature blank sample as well.

Groundwater Flow Study

WSDOT will survey the coordinates and elevation of each well. With the survey information and water level data, a potentiometric surface map will be created for the Site to estimate groundwater flow direction(s). This will be completed following the groundwater sampling event.

Hydraulic Conductivity Testing

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

Falling head slug tests involve rapidly raising the water level within the well and recording the water level as the well returns to equilibrium. Rising head slug tests involve rapidly dropping the water level within the well and recording the water level 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 or sand-filled PVC 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 the 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.

Data Review and Reporting

QA/QC analysis of the laboratory analytical data will be conducted to evaluate if data quality objectives are met. Shannon & Wilson will review the analytical laboratory reports for precision, accuracy, and representativeness according to the QA objectives established by the EPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review (2017).

The data will be uploaded into Ecology's Environmental Information Management (EIM) database using laboratory-provided electronic data deliverables formatted for the EIM database upload.

Following completion of environmental explorations, a draft Remedial Investigation (RI) Report, which will incorporate data from the current and previous environmental explorations, will be completed. The RI Report will follow the requirements set forth by Ecology in the MTCA regulation. After incorporating comments from WSDOT, the RI Report will be submitted to Ecology.

References

Hart Crowser, Inc., 2019, Phase II Environmental Site Assessment, Montlake Market and Gas Station Properties, January 30.

Innovex Environmental Management, Inc., 2016, Phase II environmental site assessment, SR 520 Eastbound Off-Ramp to Montlake Vicinity, Seattle, Washington. December 8.

Innovex Environmental Management, Inc., 2018a, Supplemental Limited Phase II environmental site assessment, SR 520 Eastbound Off-Ramp to Montlake Vicinity, Seattle, Washington. February 21.

Innovex Environmental Management, Inc., 2018b, Second Supplemental Limited Phase II environmental site assessment, SR 520 Eastbound Off-Ramp to Montlake Vicinity, Seattle, Washington. June 15

Innovex Environmental Management, Inc., 2019, Third Supplemental Limited Phase II environmental site assessment, SR 520 Eastbound Off-Ramp to Montlake Vicinity, Seattle, Washington. January 16.

Shannon & Wilson, Inc., 2019, 2209 East Lake Washington Boulevard – Indoor Air Testing, March 8.

WSDOT Environmental Services Office, 2016, Limited Phase I environmental site assessment, SR520 Montlake ’76 Gasoline and Service Station, Seattle, Washington. February 16.

0 1,000 2,000

Approximate Scale in Feet

NOTE

Bing Map Image adapted from aerial imagery provided by Autodesk Live Maps and Microsoft Bing Maps reprinted with permission from Microsoft Corporation.

Montlake Gas Station VCP
2625 Montlake Place East
Seattle, Washington

VICINITY MAP

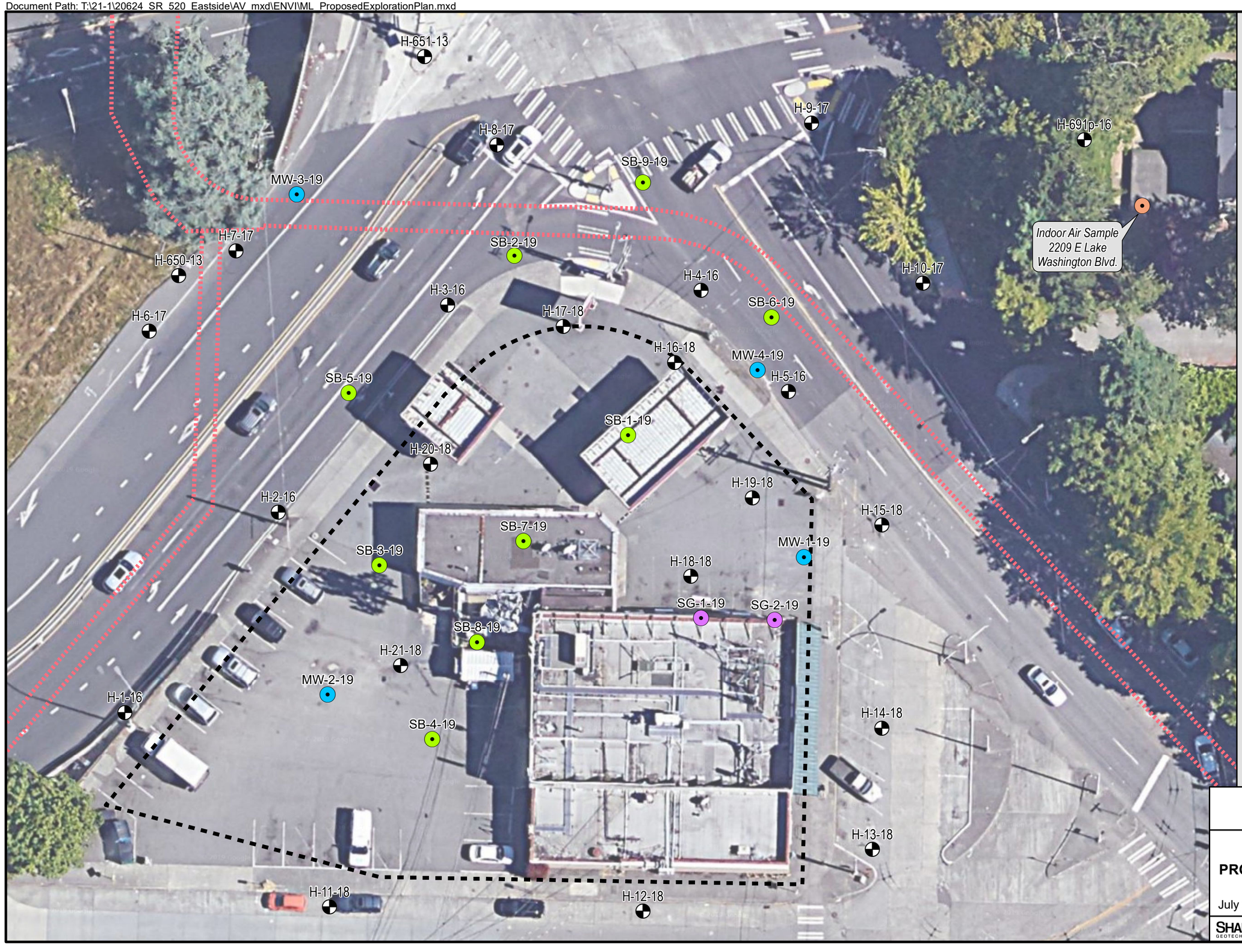
July 2019 21-1-22242-101

SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Exhibit 1

Filename: J:\211\22242\101\21-1-22242-101 Vicinity Map.dwg Date: 06-25-2019 Login: JRS

Document Path: T:\21-1\20624_SR_520_Eastside\AV_mxd\ENVI\ML_ProposedExplorationPlan.mxd



LEGEND

RECENT EXPLORATIONS

PROPOSED EXPLORATIONS

Proposed Soil Borings

Proposed Groundwater Monitoring Well

Proposed Soil Gas Probes

Existing Utility - Sewer Line

King County Parcel Boundary
Public Right of Way Limit

NOTE
SB-1-19 to 60 FT to define vertical extent of impact. SB-2-19 may be completed as a monitoring well, dependent on conditions encountered in the field.

N
W E
S

0 30
Feet

Montlake Gas Station VCP
2625 East Montlake Place East
Seattle, WA

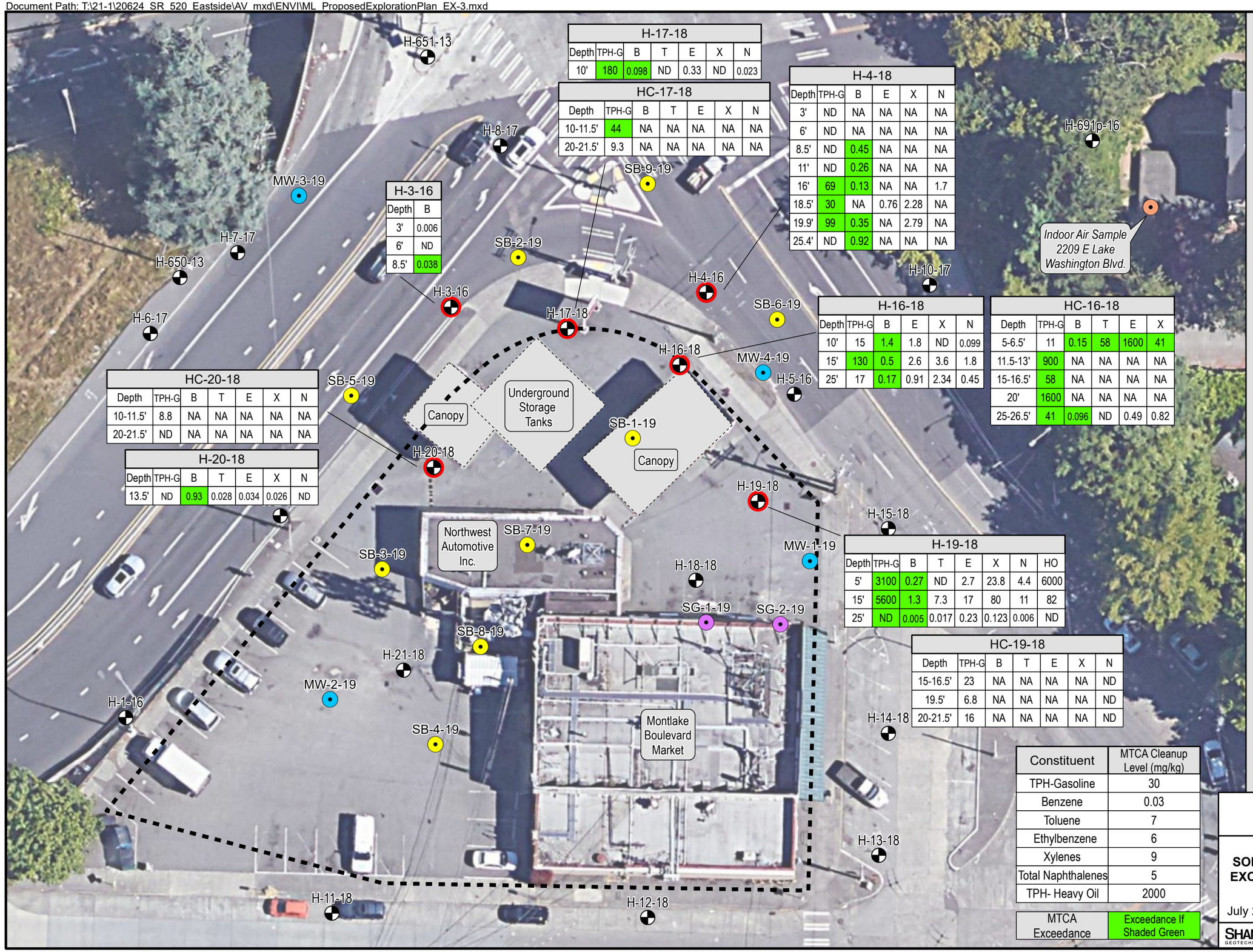
SITE MAP AND PROPOSED INVESTIGATION PLAN

July 2019 21-1-22242-101

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

EXHIBIT 2

Document Path: T:\21-1\20624_SR_520_Eastside\AV_mxd\ENVI\ML_ProposedExplorationPlan_EX-3.mxd



H-17-18						
Depth	TPH-G	B	T	E	X	N
10'	180	0.098	ND	0.33	ND	0.023

HC-17-18						
Depth	TPH-G	B	T	E	X	N
10-11.5'	44	NA	NA	NA	NA	NA
20-21.5'	9.3	NA	NA	NA	NA	NA

H-3-16	
Depth	B
3'	0.006
6'	ND
8.5'	0.038

H-4-18					
Depth	TPH-G	B	E	X	N
3'	ND	NA	NA	NA	NA
6'	ND	NA	NA	NA	NA
8.5'	ND	0.45	NA	NA	NA
11'	ND	0.26	NA	NA	NA
16'	69	0.13	NA	NA	1.7
18.5'	30	NA	0.76	2.28	NA
19.9'	99	0.35	NA	2.79	NA
25.4'	ND	0.92	NA	NA	NA

H-16-18					
Depth	TPH-G	B	E	X	N
10'	15	1.4	1.8	ND	0.099
15'	130	0.5	2.6	3.6	1.8
25'	17	0.17	0.91	2.34	0.45

HC-16-18					
Depth	TPH-G	B	T	E	X
5-6.5'	11	0.15	58	1600	41
11.5-13'	900	NA	NA	NA	NA
15-16.5'	58	NA	NA	NA	NA
20'	1600	NA	NA	NA	NA
25-26.5'	41	0.096	ND	0.49	0.82

HC-20-18						
Depth	TPH-G	B	T	E	X	N
10-11.5'	8.8	NA	NA	NA	NA	NA
20-21.5'	ND	NA	NA	NA	NA	NA

H-20-18						
Depth	TPH-G	B	T	E	X	N
13.5'	ND	0.93	0.028	0.034	0.026	ND

H-19-18							
Depth	TPH-G	B	T	E	X	N	HO
5'	3100	0.27	ND	2.7	23.8	4.4	6000
15'	5600	1.3	7.3	17	80	11	82
25'	ND	0.005	0.017	0.23	0.123	0.006	ND

HC-19-18							
Depth	TPH-G	B	T	E	X	N	
15-16.5'	23	NA	NA	NA	NA	NA	ND
19.5'	6.8	NA	NA	NA	NA	NA	ND
20-21.5'	16	NA	NA	NA	NA	NA	ND

Constituent	MTCA Cleanup Level (mg/kg)
TPH-Gasoline	30
Benzene	0.03
Toluene	7
Ethylbenzene	6
Xylenes	9
Total Naphthalenes	5
TPH- Heavy Oil	2000
MTCA Exceedance	Exceedance If Shaded Green

LEGEND

MTCA Level Exceedance

RECENT EXPLORATIONS

PROPOSED EXPLORATIONS

Proposed Soil Borings

Proposed Groundwater Monitoring Well

Proposed Soil Gas Probes

King County Parcel Boundary
Public Right of Way Limit

NOTES

1. SB-1-19 to 60 FT to define vertical extent of impact. SB-2-19 may be completed as a monitoring well, dependent on conditions encountered in the field.
2. HC-#-# = Sample collected by Hart Crowser during December 2018 Investigation by WSDOT.
3. H-#-# = Sample collected by WSDOT during previous investigations.
4. NA = Not Analyzed
5. ND = Not Detected

N W E S

0 30

Feet

Montlake Gas Station VCP
2625 East Montlake Place East
Seattle, WA

SOIL SAMPLE ANALYTICAL RESULTS EXCEEDING MTCA CLEAN UP LEVELS

July 2019 21-1-22242-101

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

EXHIBIT 3

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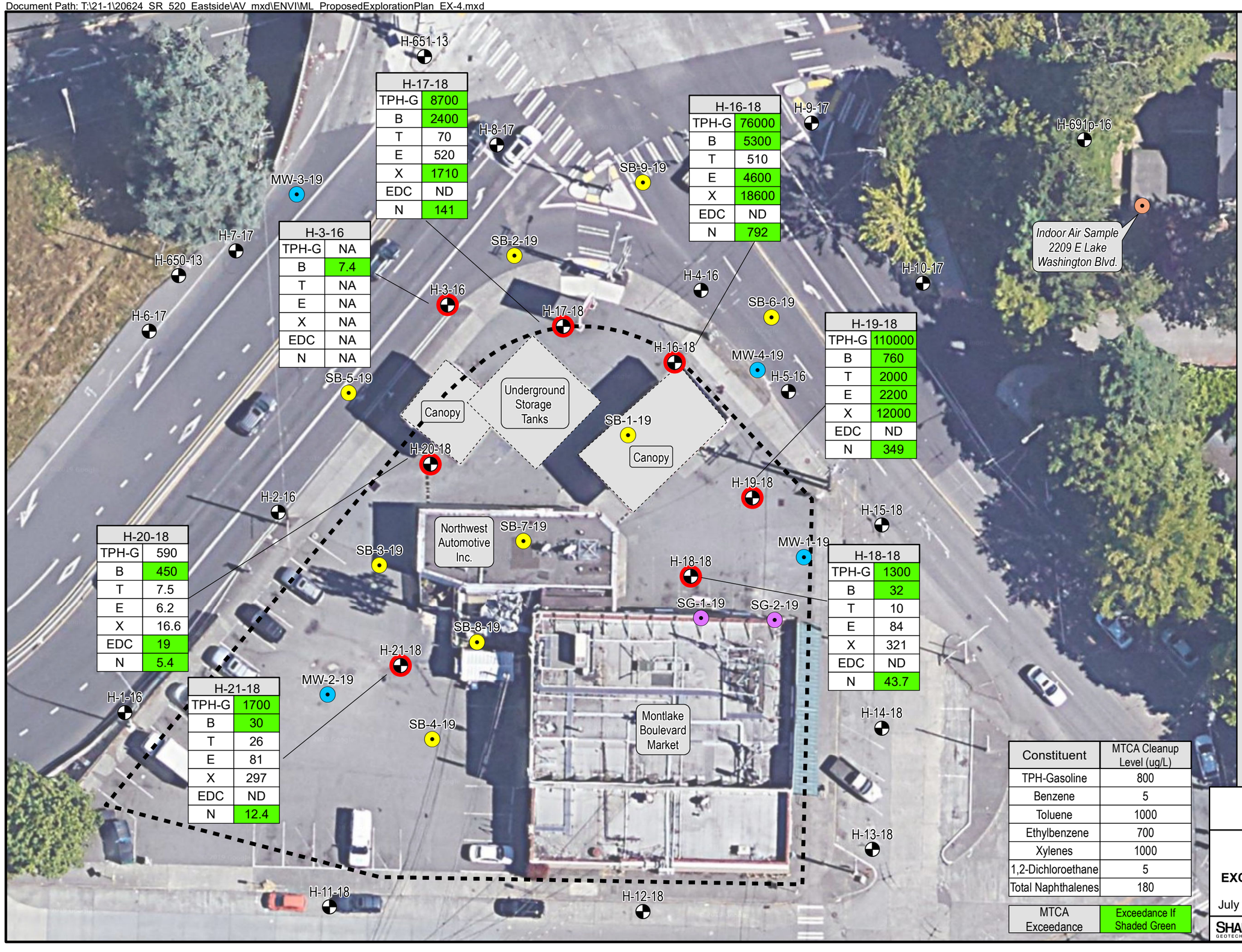

LEGEND

MTCA Level Exceedance

RECENT EXPLORATIONS

PROPOSED EXPLORATIONS

Proposed Soil Borings

Proposed Groundwater Monitoring Well

Proposed Soil Gas Probes

King County Parcel Boundary
Public Right of Way Limit

NOTES

1. SB-1-19 to 60 FT to define vertical extent of impact. SB-2-19 may be completed as a monitoring well, dependent on conditions encountered in the field.
2. H-#-# = Sample collected by WSDOT during previous investigations.
3. NA = Not Analyzed
4. ND = Not Detected

N W E S

0 30

Feet

Constituent	MTCA Cleanup Level (ug/L)
TPH-Gasoline	800
Benzene	5
Toluene	1000
Ethylbenzene	700
Xylenes	1000
1,2-Dichloroethane	5
Total Naphthalenes	180

MTCA Exceedance	Exceedance If Shaded Green

Montlake Gas Station VCP
2625 East Montlake Place East
Seattle, WA

GROUNDWATER SAMPLE ANALYTICAL RESULTS EXCEEDING MTCA CLEAN UP LEVELS

July 2019 21-1-22242-101

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

EXHIBIT 4

Boring ID	Purpose	Depth of Boring (feet bgs)	Instrumentation Installation	Soil Sample Collection and Analysis	Reconnaissance Groundwater Sample Collection and Analysis	QA/QC Sample Collection (environmental)
SB-1-19	Delineate vertical extent of contamination in center of plume.	60 feet	None	Collect soil samples using SPT (each 5 foot interval). The frequency of SPT sampling may be increased if field observations warrant.	Collect reconnaissance GW sample and analyze.	
SB-2-19	Soil and groundwater contaminant footprint delineation; northwest of plume. Evaluate potential for contaminant into utility gravel fill.	25 feet but not more than 5 feet below GW table and no more than 5 feet into underlying glacial till.	None	Same as above	Same as above	
SB-3-19	Evaluate for continuity between groundwater contamination in H-20-18 and H-21-18 (e.g. are two plumes present?)	25 feet but not more than 5 feet below GW table and no more than 5 feet into underlying glacial till.	None	Same as above	Same as above	Duplicate of a soil sample from a single depth interval.
SB-4-19	Groundwater contaminant footprint delineation south of H-21-18.	25 feet but not more than 5 feet below GW table and no more than 5 feet into underlying glacial till.	None	Same as above	Same as above	GW reconnaissance sample duplicate
SB-5-19	Soil and groundwater contaminant foot print delineation; west of borings H-3-16 and H-20-18.	25 feet but not more than 5 feet below GW table and no more than 5 feet into underlying glacial till.	None	Same as above	Same as above	
SB-6-19	Soil and groundwater contaminant delineation; southeast of H-4-16. Evaluate potential for contaminant into utility gravel fill.	25 feet but not more than 5 feet below GW table and no more than 5 feet into underlying glacial till.	None	Same as above	Same as above	Duplicate of a soil sample from a single depth interval
SB-7-19	Soil and groundwater contaminant footprint delineation; south of and under the current gas station.	25 feet but not more than 5 feet below GW table and no more than 5 feet into underlying glacial till.	None	Same as above	Same as above	
SB-8-19	Soil and groundwater contaminant footprint delineation; fenced-in area northwest corner of Montlake Market. Visible dark staining at surface.	25 feet but not more than 5 feet below GW table and no more than 5 feet into underlying glacial till.	None	Same as above	Same as above	
SB-9-19	Evaluate potential for contaminant on opposite side of utility corridor.	25 feet but not more than 5 feet below GW table and no more than 5 feet into underlying glacial till.	None	Same as above	Same as above	
MW-1-19	Groundwater potentiometric surface interpolation point. Delineate soil and groundwater contamination to the southeast of H-19-18.	25 feet	GW monitoring well	Same as above	None	Duplicate of a soil sample from a single depth interval
MW-2-19	Groundwater potentiometric surface interpolation point. Delineate groundwater contamination to the southwest of H-21-18.	25 feet	GW monitoring well	Same as above	None	
MW-3-19	Groundwater elevation measurement downgradient of utility corridor. Benzene detected below cleanup level in soil in H-7-17.	25 feet	GW monitoring well	Same as above	None	
MW-4-19	Groundwater potentiometric surface interpolation point. Delineate groundwater contamination east of plume.	25 feet	GW monitoring well	Same as above	None	GW sample duplicate

Boring ID	Purpose	Depth of Boring (feet bgs)	Instrumentation Installation	Soil Sample Collection and Analysis	Reconnaissance Groundwater Sample Collection and Analysis	QA/QC Sample Collection (environmental)
SG-1-19	Evaluate for hazardous vapors near the contaminant plume.	15 feet	Soil vapor monitoring point	Same as above	None	Soil vapor sample duplicate
SG-2-19	Evaluate for hazardous vapors near the contaminant plume.	5 feet	Soil vapor monitoring point	Same as above	None	

Notes:

bgs = below ground surface

GW = groundwater

ID = identification

QA/QC = Quality Assurance / Quality Control

Boring ID	Sample Location*	NWTPH-Gx	NWTPH-Dx	BTEX by EPA 8260	EDB and EDC by EPA 8260	Total and Dissolved RCRA metals by EPA 6010 / 7470	cPAHs by EPA 8270 SIM	TOC by EPA 9060	Hexane by EPA 8260	EPH by NWTPH-EPH	VPH by NWTPH-VPH	APH by EPA TO-15	BTEX by EPA TO-15	Naphthalene by EPA TO-15
SB-1-19	Soil just above groundwater table	X	X	X	X	X	X	X	X	X	X			
	Soil one foot into glacial till or at bottom of boring.	X		X										
	Reconnaissance GW sample	X	X	X	X	X	X							
SB-2-19	Soil just above groundwater table	X	X	X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	Reconnaissance GW sample	X	X	X	X	X	X							
SB-3-19	Soil just above groundwater table	X		X	X	X	X							
	Soil duplicate of sample from just above groundwater table	X		X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	Reconnaissance GW sample	X	X	X	X	X	X							
SB-4-19	Soil just above groundwater table	X		X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	Reconnaissance GW sample	X		X										
	Reconnaissance GW sample duplicate	X		X										
SB-5-19	Soil just above groundwater table	X		X	X	X	X	X						
	Soil one foot into glacial till or at bottom of boring.	X		X										
	Reconnaissance GW sample	X	X	X	X	X	X							
SB-6-19	Soil just above groundwater table	X		X	X	X	X	X						
	Soil duplicate of sample from just above groundwater table	X		X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	Reconnaissance GW sample	X	X	X	X	X	X							
SB-7-19	Soil just above groundwater table	X		X	X	X	X	X						
	Soil one foot into glacial till or at bottom of boring.	X		X										
	Reconnaissance GW sample	X	X	X	X	X	X							
SB-8-19	Soil just above groundwater table	X		X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	Reconnaissance GW sample	X		X										
SB-9-19	Soil just above groundwater table	X		X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	Reconnaissance GW sample	X		X										

Boring ID	Sample Location*	NWTPH-Gx	NWTPH-Dx	BTEX by EPA 8260	EDB and EDC by EPA 8260	Total and Dissolved RCRA metals by EPA 6010 / 7470	cPAHs by EPA 8270 SIM	TOC by EPA 9060	Hexane by EPA 8260	EPH by NWTPH-EPH	VPH by NWTPH-VPH	APH by EPA TO-15	BTEX by EPA TO-15	Naphthalene by EPA TO-15
MW-1-19	Soil just above groundwater table	X		X	X	X	X							
	Soil duplicate of sample from just above groundwater table	X		X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	GW sample after well development	X	X	X	X	X	X							
MW-2-19	Soil just above groundwater table	X		X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	GW sample after well development	X	X	X	X	X	X							
MW-3-19	Soil just above groundwater table	X		X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	GW sample after well development	X	X	X	X	X	X							
MW-4-19	Soil just above groundwater table	X		X	X	X	X							
	Soil one foot into glacial till or at bottom of boring.	X		X										
	GW sample after well development	X	X	X	X	X	X							
	GW duplicate	X	X	X	X	X	X							
SG-1-19	Soil at 0-5 feet bgs	X		X	X	X	X							
	Soil at bottom of boring	X		X										
	Soil vapor											X	X	X
	Soil vapor duplicate											X	X	X
SG-2-19	Soil at 0-5 feet bgs	X		X	X	X	X							
	Soil vapor											X	X	X

Notes:

*Analyze two soil samples at each boring: one from just above the groundwater table, the other from at least one foot into glacial till or at bottom of the boring. Collect and analyze additional soil samples if warranted by indications of contamination.

bgs = below ground surface; ID = identification; NWTPH = Northwest total petroleum hydrocarbon; Gx = gasoline extended

Dx = diesel extended; BTEX = benzene, toluene, ethylbenzene, and xylene; EPA = Environmental Protection Agency

EDB = ethylene dibromide; EDC = ethylene dichloride; RCRA = Resource Conservation Recovery Act;

cPAHs = carcinogenic polycyclic aromatic hydrocarbons, TOC = total organic carbon; EPH = extractable petroleum hydrocarbon

VPH = volatile petroleum hydrocarbon; APH = air-phase petroleum hydrocarbon

Appendix A: Site-Specific Health and Safety Plan

PREPARED FOR:
Washington State Department of Transportation
SR520 Bridge Replacement and HOV Program
999 3rd Avenue, Suite 2200
Seattle, WA 98104

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

(206) 632-8020
www.shannonwilson.com

HEALTH AND SAFETY PLAN

Montlake Gas Station

SEATTLE, WASHINGTON

SHANNON & WILSON

July 23, 2019

Shannon & Wilson No: 21-1-22242-101

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Attachments

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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
_____	_____
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Signature	Date
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Signature	Date

ACRONYMS

CFR	Code of Federal Regulations
CRZ	Contamination Reduction Zone
dBA	decibels
DOSH	Washington State Department of Occupational Safety and Health
EZ	Exclusion Zone
F	Fahrenheit
HASP	health and safety plan
HRI	heat-related illness
IDW	investigation-derived waste
LNAPL	light nonaqueous phase liquid
OSHA	Occupational Safety and Health Administration
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
SSO	Site Safety Officer
SZ	Support Zone
the Site	Montlake Gas Station
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

HEALTH AND SAFETY CONTACT INFORMATION

SITE LOCATION:	Montlake Gas Station 2625 East Montlake Place East Seattle, Washington
PROJECT COORDINATOR:	Meg Strong, Shannon & Wilson, Inc. (206) 695-6787 (office) (425) 864-2096 (mobile)
PROJECT MANAGER:	Joseph Sawdey, Shannon & Wilson, Inc. (206) 695-6907 (office) (206) 702-6984 (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:	Robyn Boyd, WSDOT (206) 770-3594 (direct) (425) 471-3386 (mobile)
NEAREST WALK-IN CLINIC:	Country Doctor Community Clinic 500 19th Ave E, Seattle, WA (206) 299-1600
NEAREST HOSPITAL:	Virginia Mason Hospital 129 Terry Avenue N, Seattle, WA (206) 223-6600

1 INTRODUCTION

This health and safety plan (HASP) has been prepared to address health and safety considerations for the proposed activities outlined within the Data Gaps Investigation Work Plan/Sampling and Analysis Plan (the Work Plan). This HASP is included as Attachment A.

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 Washington State Department of Transportation (WSDOT) for entry onto the property.

The proposed activities are to be conducted at the Montlake Gas Station located at 2625 East Montlake Place East, Seattle, Washington (the Site). The site is owned by WSDOT. The activities are being completed on behalf of WSDOT.

2 SCOPE OF WORK

The scope of work, as outlined in 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 sonic drilling methods, installation of groundwater monitoring wells, installation of permanent vapor monitoring points, groundwater and soil vapor monitoring and sampling, soil sampling, and LNAPL sampling if present. Investigative activities may be completed within an area suspected to be contaminated with predominantly gasoline. Procedures for work within this area are discussed in Section 8.

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 three parcels of land. The Site was used as a gasoline service station. The facility will be shut down prior to implementing the Work Plan. Currently, the structures on the Site remain. Asphalt, concrete paving, and buildings cover most the property. A Site map is provided in the Work Plan.

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), 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.
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.	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.
4.	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.

	Activity	Potential Hazards	Recommended Controls
5.	Decontaminate equipment	Contact with potentially contaminated decontamination solutions	Wear appropriate PPE, including nitrile gloves, work clothes, and safety glasses.
6.	Field screening of samples	Contact with potentially contaminated soil or sediment	Wear appropriate PPE, including nitrile gloves, work clothes, and safety glasses.
7.	Sample packaging	Back strain	When possible, two people will handle heavy sample coolers, or multiple coolers containing fewer sample containers will be used.
8.	Handle investigation-derived waste drums	Back strain	Use proper drum handling procedures and equipment.
9.	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
10. 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 shutoff 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

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 in air include the following:

- Petroleum hydrocarbons,
- Volatile organic compounds, and
- LNAPL contact.

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)
TPH-gasoline	110,000	5,600	300 ppm (500 ppm)
TPH-diesel	690		100 ppm (150 ppm)
TPH-oil		6,000	100 ppm (150 ppm)
Benzene	5,300	1.4	1 ppm (5 ppm)
Toluene	2,000	7.3	100 ppm (150 ppm)
Ethylbenzene	4,600	17	100 ppm (125 ppm)
Total Xylenes	18,600	80	100 ppm (150 ppm)
1,3,5-trimethylbenzene	2,100		25 ppm (38 ppm)
Naphthalene	970	11	10 ppm (15 ppm)
Arsenic	580		0.01 mg/m^3
Barium	14,000	200	0.5 mg/m^3 (1.5 mg/m^3)
Cadmium	12		0.005 mg/m^3
Chromium	4,800		0.5 mg/m^3
Lead	800		0.05 mg/m^3

NOTES:

DOSH = Washington State Department of Occupational Safety and Health; mg/m^3= milligrams per meter cubed; 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.
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.

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. 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 Terrain	Vehicle accidents/slips/trips/falls

Physical Hazard	Effect
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, 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 9.1.7.

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, 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 9.1.8.

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 9.1.9 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 9.1.10 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 9.1.11.

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.

7.3 Biological Hazards

The plant, animal, and/or microbial hazards most likely to be encountered by field personnel include 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 WORK COMPLETED WITHIN SUSPECTED CONTAMINATED AREAS

The Work Plan includes collection of soil samples within an area with soil and groundwater 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 contaminated area.

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 PM and identify any deviations from these guidelines prior to fieldwork.

8.1 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 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 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 spilling to the ground. 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.

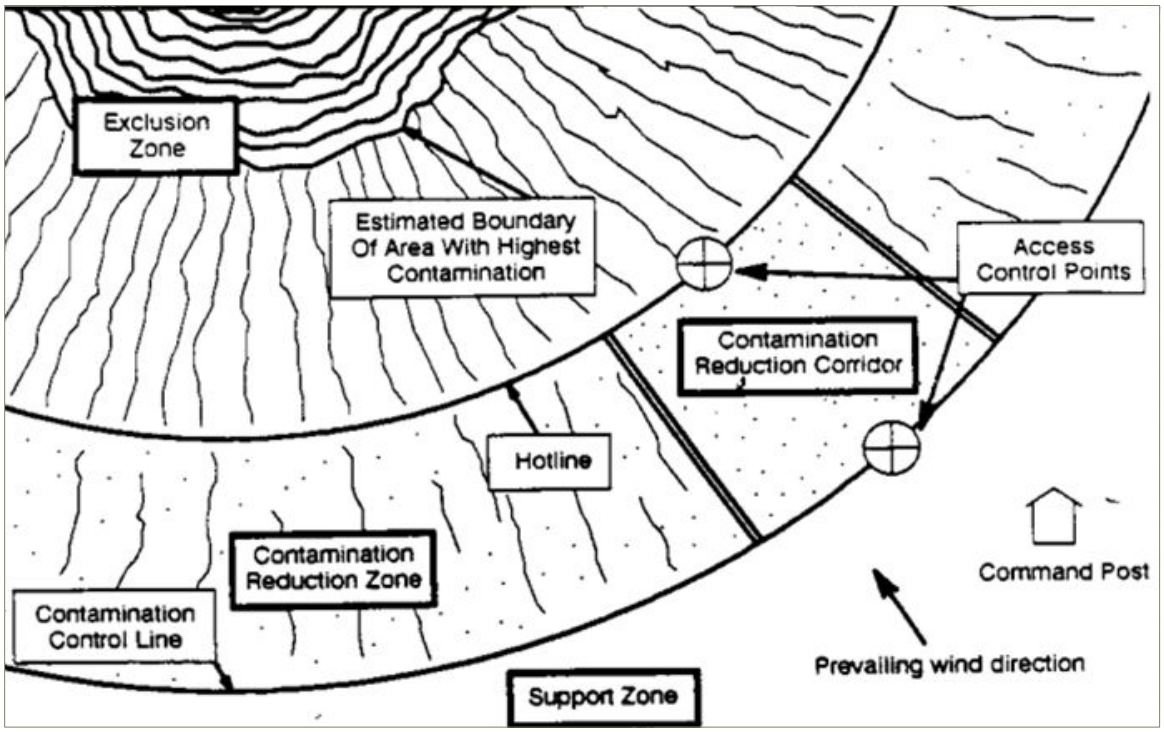


Exhibit 8-1: Illustration of Typical Work Zones

Reference: Provided by OSHA.gov

8.1.1 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 8.4).

Impermeable plastic must be placed across the surface within the EZ where contaminated soil is located to prevent spills from contacting unpaved surfaces (Section 8.2). Use of impermeable plastic can create a slip/trip/fall hazard; safety practices for this type of hazard were discussed in Section 9.1.8.

8.1.2 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 Contamination Reduction Corridor: 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, Personnel Decontamination Station operators, and personnel.
- Emergency response: first-aid equipment (such as bandages, blankets, eyewash, 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.

8.1.3 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.

8.2 Site Preparation

Time and effort must be spent in preparing a site to ensure that worker safety is protected, 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, rooftops, 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.

8.3 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 to the PM.

8.4 Personal 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, as 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 hardhat, 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 overalls.
- Chemical-resistant boots or boot covers.

8.5 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. 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.

8.6 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 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 increases 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, overalls and boot covers will be used as a protective outer layer. If the LNAPL damages the 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 overalls 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 with methyl alcohol (only if required based on contaminants present).
- 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 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 Safe Driving

Operators of vehicles on company business must:

- Evaluate conditions of the vehicle and observe deficiencies of the vehicle before commencing operation.
- 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.
- Not exceed posted speed limits.
- Not pick up hitchhikers.
- 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.

9.1.7 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.

9.1.8 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.

9.1.9 Heat Stress

The Washington State Department of Occupational Safety and Health (DOSH) regulates heat-related illness (HRI) in WAC 296-62. DOSH defined 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:

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 HRI that include the following elements:

- Identification and evaluation of temperature, humidity, and other environmental factors associated with HRI
- Provisions to reduce to the extent feasible the risks of HRI that include the following elements:
  - The provision of rest breaks as needed to reduce to the extent feasible the risks of HRI.
  - Encourage frequent consumption of water.
  - Procedures for responding to signs or symptoms of possible HRI and accessing medical aid.
  - Employees are responsible for monitoring their own personal factors for HRI, 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 HRI hazard.

- The environmental factors that contribute to the risk of HRI;

- General awareness of personal factors that may increase susceptibility to HRI, 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 HRI 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 HRI and the common signs and symptoms of HRI;
- The importance of immediately reporting to the employer, directly or through the employee's supervisor, symptoms or signs of HRI in themselves or in coworkers;
- The employer's procedures for responding to symptoms of possible HRI, 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 HRI 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 HRI, 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.

9.1.10 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 (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°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:

°F = degrees Fahrenheit; mph = miles per hour

Reference: Developed by U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts.

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:

°C = degrees Celsius; °F = degrees Fahrenheit; min. = minute; mph = miles per hour

Reference: Developed by the American Conference of Governmental Industrial Hygienists.

9.1.11 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 lifetime, 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 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.

9.2 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 coworkers 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 Personal 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 Personal Protective Equipment (PPE) Inspections

All PPE shall be inspected prior to, during, and after use. Inspectors will look for rips, tears, and 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 is 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:

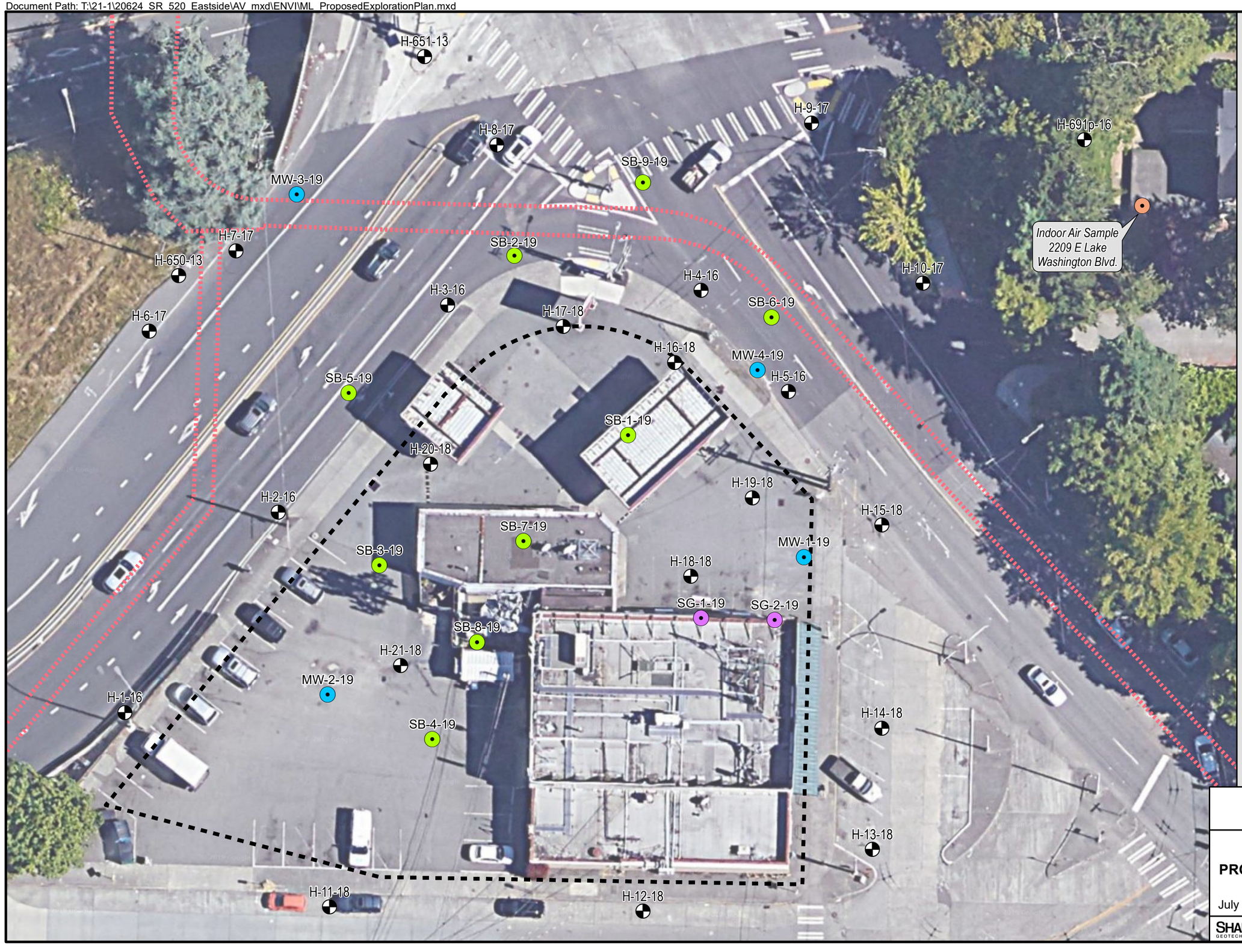
- Time of entry
- Expected exit time
- Task being performed
- Location of task
- Rescue and response equipment used
- Protective equipment used

ATTACHMENT A: SITE MAP

Attachment A

Site Map

Document Path: T:\21-1\20624_SR_520_Eastside\AV_mxd\ENVI\ML_ProposedExplorationPlan.mxd



LEGEND

RECENT EXPLORATIONS

PROPOSED EXPLORATIONS

Proposed Soil Borings

Proposed Groundwater Monitoring Well

Proposed Soil Gas Probes

Existing Utility - Sewer Line

King County Parcel Boundary
Public Right of Way Limit

NOTE
SB-1-19 to 60 FT to define vertical extent of impact. SB-2-19 may be completed as a monitoring well, dependent on conditions encountered in the field.

N
W E
S

0 30
Feet

Montlake Gas Station VCP
2625 East Montlake Place East
Seattle, WA

SITE MAP AND PROPOSED INVESTIGATION PLAN

July 2019 21-1-22242-101

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Attachment A

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

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	Firefighting	Reactivity
2 - Health **3 - Fire** **0 - Reactivity** **DOT#:** UN 1203 **ERG Guide #:** 128 **Hazard Class:** 3 (Flammable)	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.	**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

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

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

EMERGENCY RESPONDERS >>>> SEE BACK PAGE

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

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.

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

EMERGENCY RESPONDERS >>>> SEE BACK PAGE

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

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

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.

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	Firefighting	Reactivity
4 - Health **3 - Fire** **0 - Reactivity** **DOT#:** UN 1114 **ERG Guide #:** 130 **Hazard Class:** 3 (Flammable)	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.	**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: **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 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 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 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.
- 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

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: **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	Firefighting	Reactivity
2 - Health **3 - Fire** **0 - Reactivity** **DOT#:** UN 1268 **ERG Guide #:** 128 **Hazard Class:** 3 (Flammable)	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.	**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

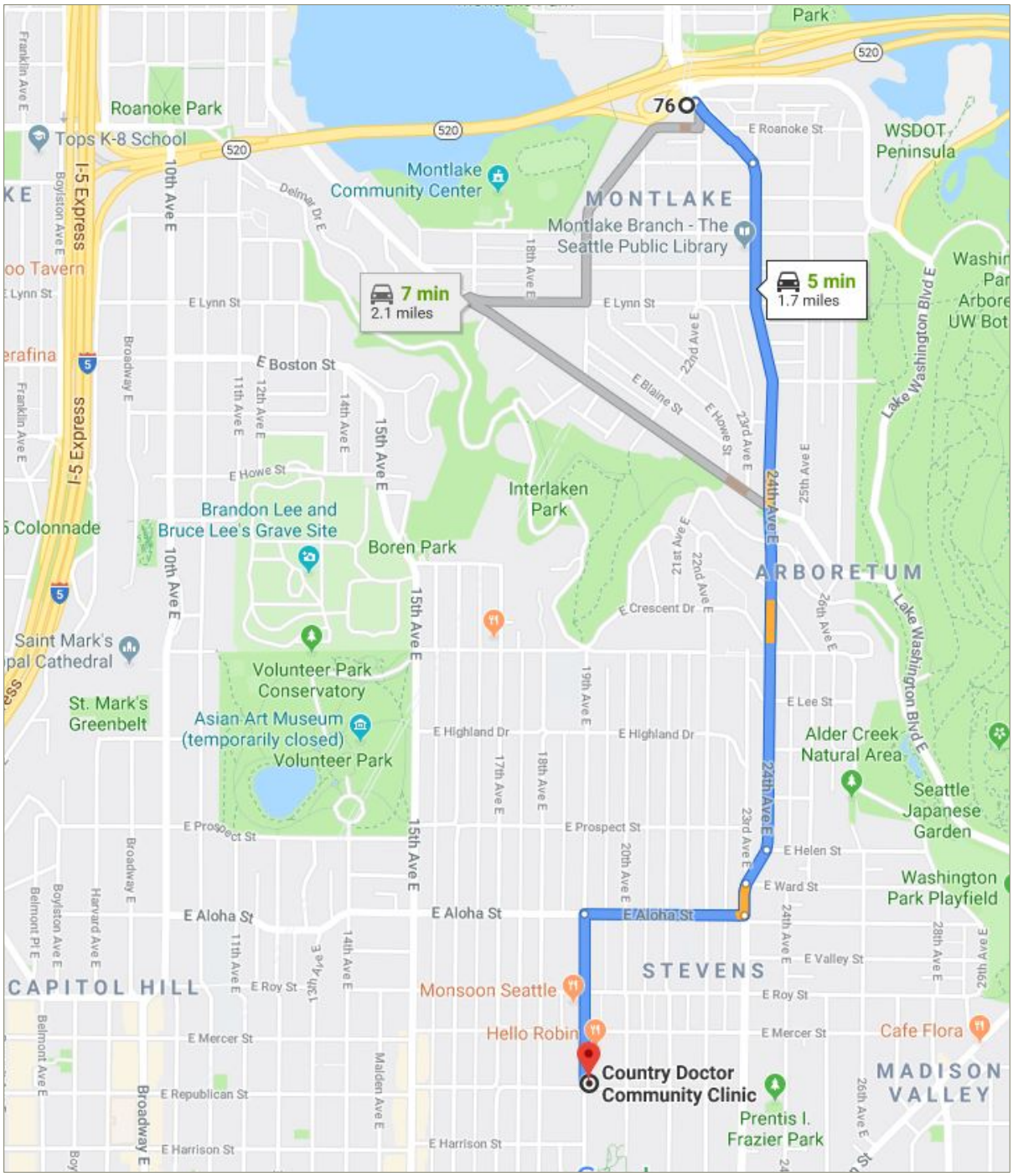
Remove the person from exposure.
Flush eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn.
Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.
Begin artificial respiration if breathing has stopped and CPR if necessary.
Transfer promptly to a medical facility.

ATTACHMENT D: SITE MAPS TO NEAREST WALK-IN CLINIC AND HOSPITAL

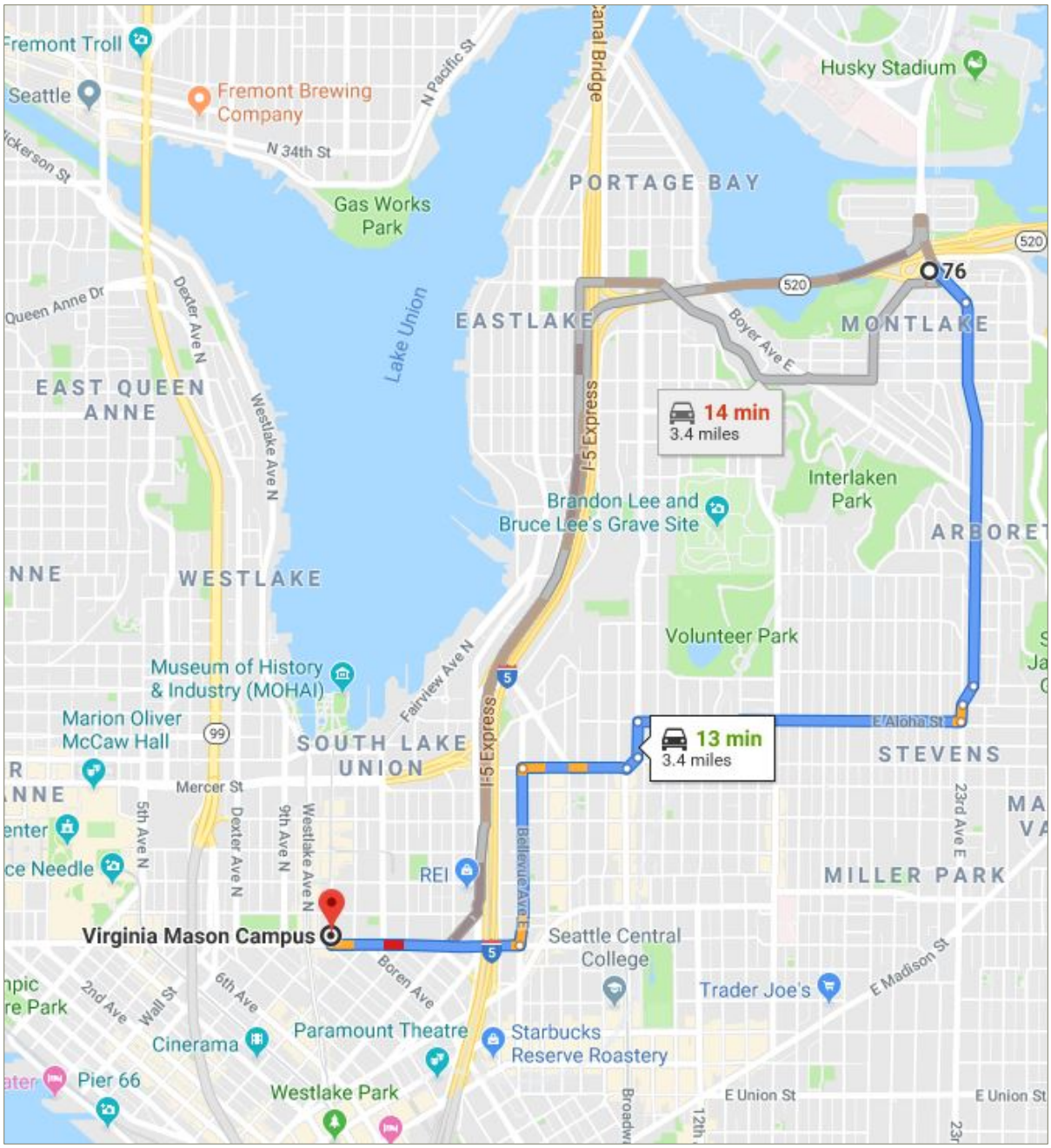
Attachment D

Site Maps to Nearest Walk-In Clinic and Hospital

ATTACHMENT D: SITE MAPS TO NEAREST WALK-IN CLINIC AND HOSPITAL



ATTACHMENT D: SITE MAPS TO NEAREST WALK-IN CLINIC AND HOSPITAL



Appendix B: Soil Description and Log Key

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT[2]	FINE-GRAINED SOILS (50% or more fines)[1]	COARSE-GRAINED SOILS (less than 50% fines)[1]
Major	***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3]	***Sand*** or ***Gravel***[4]
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4]	More than 12% fine-grained: ***Silty*** or ***Clayey***[3]
Minor Follows major constituent	15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4]	5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3]
	30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5]	15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5]

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor*.
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.

NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

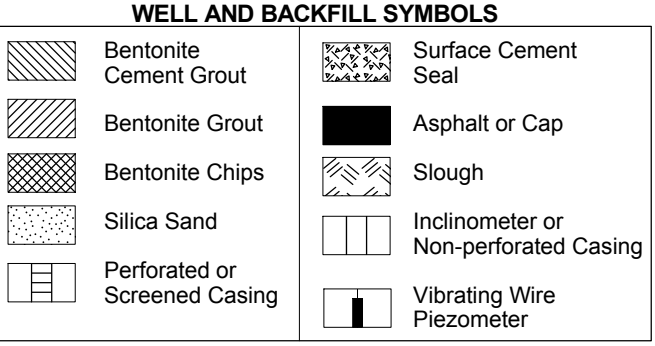
PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND	
Fine	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.)
Medium	#40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.)
Coarse	#10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL	
Fine	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.)
Coarse	3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS		COHESIVE SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS



PERCENTAGES TERMS [1, 2]

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

[2]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

Data Gaps Investigation Work Plan/Sampling and Analysis Plan for Montlake Gas Station
SR 520 Bridge Replacement and HOV Program

SOIL DESCRIPTION AND LOG KEY

June 2019 | 21-1-22242-101

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B-1
Sheet 1 of 3

SOIL_CLASS_KEY_PG1 102067.GPJ SHAN_WIL.GDT 6/26/19

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL		TYPICAL IDENTIFICATIONS
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Gravel *(less than 5% fines)*	GW		Well-Graded Gravel; Well-Graded Gravel with Sand
			GP		Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(more than 12% fines)*	GM		Silty Gravel; Silty Gravel with Sand
			GC		Clayey Gravel; Clayey Gravel with Sand
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Sand *(less than 5% fines)*	SW		Well-Graded Sand; Well-Graded Sand with Gravel
			SP		Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(more than 12% fines)*	SM		Silty Sand; Silty Sand with Gravel
			SC		Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML		Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL		Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH		Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH		Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT		Peat or other highly organic soils (see ASTM D4427)

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

Data Gaps Investigation Work Plan/Sampling and Analysis Plan for Montlake Gas Station
SR 520 Bridge Replacement and HOV Program

SOIL DESCRIPTION AND LOG KEY

June 2019 | 21-1-22242-101

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B-1
Sheet 2 of 3

SOIL_CLASS_KEY_PG2 102067.GPJ SHAN_WIL.GDT 6/26/19

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS[1]

Weak	Crumbles or breaks with handling or slight finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

PLASTICITY[2]

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASITICITY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20
High	It takes considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS[1]

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

[1]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

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ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q_u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS[1]

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

Data Gaps Investigation Work Plan/Sampling and Analysis Plan for Montlake Gas Station
SR 520 Bridge Replacement and HOV Program

SOIL DESCRIPTION AND LOG KEY

June 2019 | 21-1-22242-101

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B-1
Sheet 3 of 3

SOIL_CLASS_KEY_PG3 102067.GPJ SHAN_WIL.GDT 6/26/19

Appendix C: Water Sampling Log Sheet

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°)	Eh (mV)	pH	COND. (µmhos / cm)	D.O. (mg / L)	TURBIDITY (NTU)	SALINITY (%)	TDS (g / L)	COLOR	TIME
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

Appendix D: Soil Gas Sampling System

Introduction

Investigation methods for soil gas, including sample collection, sample handling and documentation procedures, and selected analyses are discussed briefly in the following sections. Sample collection and documentation will be completed in accordance with Shannon & Wilson's standard operating procedures.

Soil Gas Sample Collection

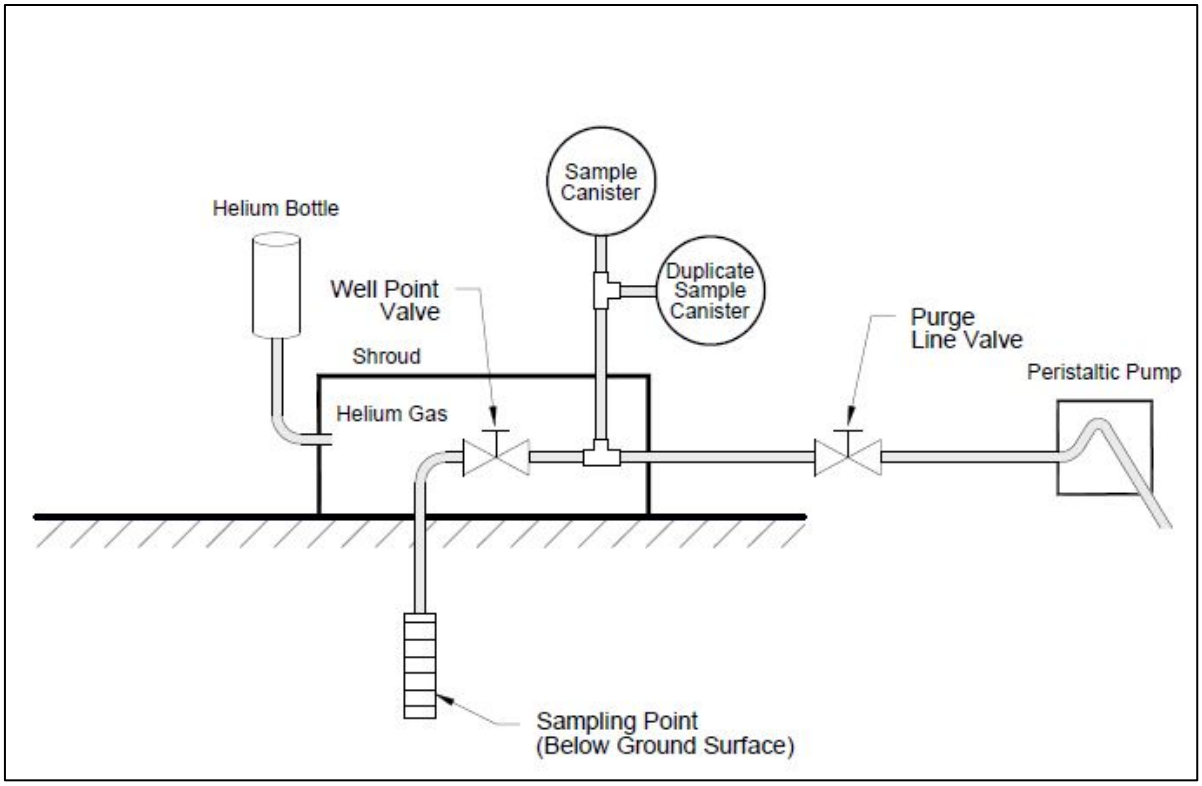
Before sampling, at least two days will elapse following installation of the soil vapor monitoring point to allow for construction materials to cure and the subsurface to equilibrate.

Each soil gas probe is accessed through a flush-mounted steel monitoring well cover. At each location, activities include setting up the sampling manifold, performing a leak test, and collecting the soil gas sample.

Sampling Manifold Setup

Each sampling manifold will be constructed as follows:

- Attach Teflon® tubing to the well point.
- Attach ¼-inch turn valve (well point valve) to the Teflon® tubing.
- Connect Teflon® tubing to the well point valve and, using silicon tubing, connect to a vinyl tee.
- Cover the well point, well point valve, and above-described tubing and vinyl tee with the "shroud." The shroud is comprised of an acrylic bowl with three pre-drilled holes to allow for purge line tubing and sample tubing to enter/exit the shroud and to allow for tracer gas (helium) to enter the shroud.
- From one end of the vinyl tee, use silicone and Teflon® tubing to exit the shroud and connect to a ¼-inch turn valve (purge line valve). Use silicone and Teflon® tubing to connect a peristaltic pump to the purge line valve.
- From the other end of the vinyl tee, use silicone and Teflon® tubing to exit the shroud and connect to the sample cannister flow controller using a ¼-inch nut and Teflon® ferrule. If a duplicate sample is to be collected, an additional vinyl tee with silicone tubing is used to split the tubing exiting the shroud heading toward the sample cannisters.
- Use silicone and Teflon® tubing to connect the tracer gas (helium) canister to the shroud.



Leak Testing

Prior to sampling at each location, a leak test will be performed to demonstrate that the tubing is properly connected and the valves are not leaking. The leak tests will be performed as follows:

- Close the well point valve.
- Open the purge line valve.
- Turn on the peristaltic pump until the vacuum gauge on the sample canister reads 10 inches of mercury or greater.
- Close the purge line valve.
- Observe the sample canister vacuum gauge over a period of five minutes. If the vacuum gauge reading is unchanged after five minutes, the manifold is determined to have passed the leak test.

If the leak test is failed, the connections will be tightened. If necessary, the manifold or portions of the manifold will be replaced, and the leak test will be repeated. The process will be repeated until the leak test is passed. The leak test results will be documented on the monitoring log.

Sample Collection

Soil gas samples will be collected within laboratory-provided evacuated cylinders from each soil gas monitoring point. A field-duplicate sample will also be collected. Initial pressure and time will be recorded on the monitoring log prior to opening the canister.

The following procedures will be used to collect each soil gas sample:

- Confirm that the purge line valve is closed.

- Open the well point valve.
- Fill the shroud with tracer gas (helium). Use a helium gas detector to ensure the shroud is full.
- Open the sample canister. Document the time the canister was opened and the initial vacuum on the monitoring log.
- Close the sample canister when the vacuum gauge reads approximately 5 inches of mercury. Record the time the canister was closed and final vacuum on the monitoring log.

When a duplicate sample is being collected, both sample cannisters will be opened and closed simultaneously.

Sample Handling and Documentation

Environmental samples will be collected using disposable sampling equipment. New nitrile gloves were worn by the sample handler during collection of each sample. Non-disposable sampling equipment will be decontaminated between sample locations to reduce potential for cross-contamination. Field notes will document site conditions, barometric pressure, wind speed/ direction, and sample collection actions.

Samples for laboratory analysis will be collected within pre-cleaned laboratory-provided evacuated cylinders. The sample cylinders will be labeled using luggage tags, which include sample name, date, time, and location. The samples will be transported under chain-of-custody procedures with standard turn-around analysis time (ten days).

Appendix E: Laboratory Quantitation Limits

EXHIBIT E-1
ONSITE ENVIRONMENTAL, INC. QUANTITATION LIMITS
SOIL SAMPLES

Analyte	Units	MDL	PQL	LCS Recovery Limits		MS/MSD Limits		
				Low	High	Low	High	RPD
Diesel and Heavy Oil by NWTPH-Dx/Dx-Ext								
Diesel Fuel #2	mg/kg	8.31	25	68	137	-	-	-
Heavy oil range hydrocarbons	mg/kg	17.2	50	-	-	-	-	-
Gasoline by NWTPH-Gx								
Gasoline range hydrocarbons	mg/kg	1.68	5	-	-	-	-	-
VOCs by EPA Method 8260								
Benzene	mg/kg	0.000156379	0.001	71	129	67	131	28
toluene	mg/kg	0.000211507	0.005	74	125	66	128	26
ethylbenzene	mg/kg	0.000172013	0.001	-	-	-	-	-
m,p-xylene	mg/kg	0.000669301	0.002	-	-	-	-	-
o-xylene	mg/kg	0.000171578	0.001	-	-	-	-	-
ethylene dibromide (EDB)	mg/kg	0.000283691	0.001	-	-	-	-	-
ethylene dichloride (EDC)	mg/kg	0.000219324	0.001	-	-	-	-	-
naphthalene	mg/kg	0.000209271	0.001	-	-	-	-	-
Volatiles by EPA Method 8021B								
Hexane	mg/kg	-	0.05	-	-	-	-	-
Metals by EPA Method 6010								
Arsenic	mg/kg	2.07	10	80	120	75	125	20
Barium	mg/kg	0.0475	2.5	80	120	75	125	20
Cadmium	mg/kg	0.102	0.5	80	120	75	125	20
Chromium	mg/kg	0.076	0.5	80	120	75	125	20
Lead	mg/kg	1.42	5	80	120	75	125	20
Selenium	mg/kg	1.86	10	80	120	75	125	20
Silver	mg/kg	0.135	0.5	80	120	75	125	20
Mercury by Method 7470A/7471B								
Mercury	mg/kg	0.0002	0.25	80	120	75	125	20

EXHIBIT E-1
ONSITE ENVIRONMENTAL, INC. QUANTITATION LIMITS
SOIL SAMPLES

Analyte	Units	MDL	PQL	LCS Recovery Limits		MS/MSD Limits		
				Low	High	Low	High	RPD
cPAHs by EPA Method 8270 SIM								
Benzo[a]anthracene	mg/kg	0.000102	0.0067	64	127	53	131	23
Chrysene	mg/kg	0.000122	0.0067	63	121	46	126	24
Benzo[b]fluoranthene	mg/kg	0.000194	0.0067	61	122	45	127	25
Benzo[j,k]fluoranthene	mg/kg	0.000203	0.0067	64	123	52	122	21
Benzo[a]pyrene	mg/kg	0.000123	0.0067	62	122	51	126	24
Indeno(1,2,3-c,d)pyrene	mg/kg	0.000227	0.0067	59	124	48	127	23
Dibenz[a,h]anthracene	mg/kg	0.000262	0.0067	61	123	51	124	22
Benzo[g,h,i]perylene	mg/kg	0.000208	0.0067	61	119	50	120	22
Extractable Petroleum Hydrocarbons by NWTPH-EPH								
aliphatic ranges	mg/kg	-	5	-	-	70	130	20
aromatic ranges	mg/kg	-	5	-	-	70	130	20
Volatile Petroleum Hydrocarbons by NWTPH-VPH								
All ranges	mg/kg	-	5	-	-	-	-	-
Total Organic Carbon by SM 5310C								
Total Organic Carbon	Percent	0.0148	0.042	90	121	-	-	-

Notes:

EPA = U.S. Environmental Protection Agency

LCS = laboratory control sample

µg/L = micrograms per liter

MDL = method detection limit

MS/MSD = matrix spike / matrix spike duplicate

NWTPH-Dx/Dx-Ext = Northwest Total Petroleum Hydrocarbon -Diesel/Diesel Extended

NWTPH-Gx = Northwest Total Petroleum Hydrocarbon-Gasoline Extended

PQL = project quantitation level

RPD = relative percent difference

VOCs = volatile organic compounds

- = value not defined by the lab

EXHIBIT E-2
ONSITE ENVIRONMENTAL, INC. QUANTITATION LIMITS
WATER SAMPLES

Analyte	Units	MDL	PQL	LCS Recovery Limits		MS/MSD Limits		
				Low	High	Low	High	RPD
Diesel and Heavy Oil by NWTPH-Dx/Dx-Ext								
Diesel Fuel #2	ppb	0.0677	0.25	64	123	-	-	-
Heavy oil range hydrocarbons	ppb	0.205	0.4	-	-	-	-	-
Gasoline by NWTPH-Gx								
Gasoline range hydrocarbons	ppb	5.68	100	-	-	-	-	-
VOCs by EPA Method 8260								
Benzene	ppb	0.042673348	0.2	76	125	73	131	16
toluene	ppb	0.047210125	1	80	124	84	123	19
ethylbenzene	ppb	0.039311613	0.2	-	-	-	-	-
m,p-xylene	ppb	0.087992197	0.4	-	-	-	-	-
o-xylene	ppb	0.046989308	0.2	-	-	-	-	-
ethylene dibromide (EDB)	ppb	0.052216201	0.2	-	-	-	-	-
ethylene dichloride (EDC)	ppb	0.039570905	0.2	-	-	-	-	-
naphthalene	ppb	0.073500364	1	-	-	-	-	-
Metals by EPA Method 200.8								
Arsenic (Total)	ppb	0.342	3.3	80	120	75	125	20
Arsenic (Dissolved)	ppb	0.307	3	80	120	75	125	20
Barium (Total)	ppb	0.176	28	80	120	75	125	20
Barium (Dissolved)	ppb	0.41	25	80	120	75	125	20
Cadmium (Total)	ppb	0.173	4.4	80	120	75	125	20
Cadmium (Dissolved)	ppb	0.229	4	80	120	75	125	20
Chromium (Total)	ppb	1.75	11	80	120	75	125	20
Chromium (Dissolved)	ppb	1.82	10	80	120	75	125	20
Lead (Total)	ppb	0.339	1.1	80	120	75	125	20
Lead (Dissolved)	ppb	0.462	1	80	120	75	125	20
Selenium (Total)	ppb	1.28	5.6	80	120	75	125	20
Selenium (Dissolved)	ppb	1.64	5	80	120	75	125	20
Silver (Total)	ppb	0.243	11	80	120	75	125	20
Silver (Dissolved)	ppb	0.189	10	80	120	75	125	20

EXHIBIT E-2
ONSITE ENVIRONMENTAL, INC. QUANTITATION LIMITS
WATER SAMPLES

Analyte	Units	MDL	PQL	LCS Recovery Limits		MS/MSD Limits		
				Low	High	Low	High	RPD
Mercury by Method 7470A/7471B								
Mercury (Total)	ppb	0.0278	0.5	80	120	75	125	20
cPAHs by EPA Method 8270 SIM								
Benzo[a]anthracene	ppb	0.00481	0.01	59	127	59	127	24
Chrysene	ppb	0.00425	0.01	57	122	57	122	24
Benzo[b]fluoranthene	ppb	0.00706	0.01	58	123	58	123	26
Benzo[j,k]fluoranthene	ppb	0.00512	0.01	60	123	60	123	22
Benzo[a]pyrene	ppb	0.00416	0.01	54	121	54	121	24
Indeno(1,2,3-c,d)pyrene	ppb	0.00555	0.01	55	125	55	125	26
Dibenz[a,h]anthracene	ppb	0.00514	0.01	57	127	57	127	25
Benzo[g,h,i]perylene	ppb	0.0054	0.01	54	122	54	122	25

Notes:

EPA = U.S. Environmental Protection Agency

LCS = laboratory control sample

µg/L = micrograms per liter

MDL = method detection limit

MS/MSD = matrix spike / matrix spike duplicate

NWTPH-Dx/Dx-Ext = Northwest Total Petroleum Hydrocarbon -Diesel/Diesel Extended

NWTPH-Gx = Northwest Total Petroleum Hydrocarbon-Gasoline Extended

PQL = project quantitation level

RPD = relative percent difference

VOCs = volatile organic compounds

- = value not defined by the lab

EXHIBIT E-3
FREIDMAN & BRUYA, INC. QUANTITATION LIMITS
SOIL VAPOR SAMPLES

Analyte	Units	MTCA Cleanup Levels	MDL	RL	LCS Recovery Limits		MS/MSD Limits		
					Low	High	Low	High	RPD
APH by Method MA-APH									
APH EC5-8 aliphatics	µg/m^3	90000	-	46	70	130	-	-	-
APH EC9-12 aliphatics	µg/m^3	4700	-	70	70	130	-	-	-
APH EC9-10 aromatics	µg/m^3	6000	-	50	70	130	-	-	-
VOCs by EPA Method TO-15									
Benzene	µg/m^3	10.7	0.018	0.32	70	130	-	-	-
toluene	µg/m^3	76200	0.034	0.38	70	130	-	-	-
ethylbenzene	µg/m^3	15200	0.055	0.43	70	130	-	-	-
m,p-xylene	µg/m^3	1520	0.082	0.87	70	130	-	-	-
o-xylene	µg/m^3	1520	0.048	0.43	70	130	-	-	-
Naphthalene	µg/m^3	2.45	0.022	0.52	70	130	-	-	-

Notes:

MTCA cleanup levels are stated as MTCA Method B cleanup levels for sub slab soil gas. When cancer and noncancer levels are available, the lower of the two is stated.

APH = air phase hydrocarbons

EPA = U.S. Environmental Protection Agency

LCS = laboratory control sample

µg/m^3 = micrograms per cubic meter

MDL = method detection limit

MS/MSD = matrix spike / matrix spike duplicate

MTCA = Model Toxics Control Act

RL = reporting limit

RPD = relative percent difference

VOCs = volatile organic compounds

- = value not defined by the lab