FINAL REMEDIAL INVESTIGATION WORK PLAN
FORMER CHEVRON SERVICE STATION NO. 90129
4700 Brooklyn Avenue Northeast
Seattle, Washington

May 26, 2017

Prepared for:
Washington State Department of Ecology
3190 160th Ave SE
Bellevue, Washington 98008

Prepared by:
Leidos Inc.
18912 North Creek Parkway, Suite 101
Bothell, Washington 98011

On Behalf of:
Chevron Environmental Management Company
6001 Bollinger Canyon Road
San Ramon, California 94583

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FINAL REMEDIAL INVESTIGATION WORK PLAN
FORMER CHEVRON SERVICE STATION NO. 90129

1 INTRODUCTION AND OBJECTIVES

Leidos Inc. (Leidos), prepared this work plan, on behalf of Chevron Environmental Management Company (CEMC), to perform a Remedial Investigation (RI) at the Former Chevron Service Station No. 90129, located at 4700 Brooklyn Avenue NE in Seattle, Washington. In accordance with Section 200 of Chapter 173-340 of the Washington Administrative Code (WAC 173-340-200), the Site will be defined as the area where concentrations of constituents of concern (COCs), released from the former service station property, exceed regulatory cleanup levels (the Site). The results of this investigation will be used to determine the full extent of the Site, as defined by WAC 173-340-200.

The objectives of this investigation are to address data gaps regarding the nature and extent of petroleum contamination in soil, ground water, and soil vapor at the Site, and to comply with the requirements of Agreed Order No. DE 13815, which was recently entered into by CEMC, FH Brooklyn, LLC (FH Brooklyn), and the Washington State Department of Ecology (Ecology), with the effective date of January 11, 2017. The Agreed Order requires FH Brooklyn and CEMC to complete a remedial investigation (RI) and Feasibility Study (FS), and to complete a draft cleanup action plan (DCAP) for the Site. The purpose of the RI is to collect sufficient information to evaluate the impact on human health and the environment to enable development and evaluation of technically feasible cleanup alternatives in accordance with WAC 173-340-360 through 173-340-390. The RI will provide sufficient data to refine the conceptual site model for use in evaluating technically feasible cleanup alternatives for selection of a final cleanup action applicable to the Site.

The first phase of the RI was completed in November 2016 by Aspect Consulting, LLC (Aspect) and documented in the *On-Property Remedial Investigation Data Report* dated January 17, 2017 (Aspect, 2017a). The first phase was done in accordance with the *Preliminary Draft Remedial Investigation Work Plan* (Aspect, 2016). Data collected on-property will be used to design an Interim Action excavation as well as be incorporated into the Remedial Investigation Report. The Interim Action is planned in conjunction with property redevelopment, which Leidos understands is currently scheduled to begin in the spring of 2018.

Data collected from the second phase of the RI, will also be incorporated in the Remedial Investigation Report. The second phase of the RI includes the following investigative components:

- Installation and sampling of off-property ground water monitoring wells to delineate the extent of contamination in soil and ground water; and
- A Tier 1 vapor intrusion assessment to evaluate vapor risk for existing and future buildings.

Collectively, these data will be used to:

- Identify data gaps regarding the nature and extent of petroleum contamination at the Site;
- Develop a preliminary list of cleanup action alternatives to be evaluated in a Feasibility Study (FS); and

- Determine whether additional Site data are necessary to facilitate evaluation of the preliminary cleanup action alternatives identified for the Site.

2 SITE DESCRIPTION AND BACKGROUND

2.1 SITE DESCRIPTION

The Site is located at 4700 Brooklyn Avenue NE at the northeast corner of the intersection of Brooklyn Avenue NE and NE 47th Street in Seattle, Washington, as shown on Figure 1. The Site currently consists of King County Tax Parcel 8816400985, which is a relatively flat lot approximately 0.38 acres in size. The Site is currently occupied by a closed gasoline service station and convenience store. The service station has been closed since November 2016.

2.2 SITE HISTORY

Service station operations reportedly started as early as 1919 and ended in November 2016. Two double-walled 12,000 gallon gasoline underground storage tanks (USTs) and one double-walled 12,000 gallon diesel UST were removed by FH Brooklyn in February 2017 (Aspect, 2017b). The existing building, four dispenser islands, and associated piping will be removed at a later date, in conjunction with the interim removal action.

The current service station building was constructed in 1969. Chevron U.S.A. Inc. (CUSA) sold the Site to Bedrock Northwest Inc. in 2003. H&S Oil LLC purchased the site from Bedrock Northwest Inc. in August of 2004. In April 2007, H&S Oil sold the property to WASU Inc., when it was subsequently sold to FH Brooklyn in June 2016. The property has experienced four station reconfigurations between 1919 and 2017 as detailed in the *Baseline Environmental Assessment Report* (Riley Group, 2015) and *Preliminary Draft Remedial Investigation Work Plan* (Aspect, 2016). Refer to those reports for a more detailed site history.

2.3 ADJACENT PROPERTIES

The Site is bounded by a paved alleyway and a bank to the east, a parking lot and shopping complex to the north, Northeast 47th Street to the south, and Brooklyn Avenue Northeast to the west.

A 76 Station is located to the southwest diagonally across the intersection of Brooklyn Avenue NE and NE 47th Street from the former Chevron service station. In addition, a recently closed dry cleaning business (Carson Cleaners) was located across Brooklyn Ave NE to the west.

In addition, the following historical businesses have been documented adjacent to the former Chevron service station:

- Max S Shell Service Station, located at 4556 Brooklyn Ave NE was located approximately 250 feet south of the Site.
- Sanders M.H., located at 4532 Brooklyn Ave NE was an auto repair shop from 1925 to 1944. It is located approximately 625 feet south of the Site.
- Husky Laundry, located at 4703 University Way NE was a “cleaners” in 1955 and located at the current Bank of America property to the east.
- Ravenna Cleaners, located at 4709 University Way NE, was a “cleaner and dryer” from 1955 to 1960 and was located at the current Bank of America property to the east.

- Home Style Laundry (aka College Cleaners), located at 4733 University Way NE, was a "cleaner and dryer" site from 1940 to 1990. It was located approximately 125 feet northeast of the site.
- Nifty Cleaners, located at 4736 University Way NE, was a "cleaner and dryer" site in 1970, which was located approximately 175 feet north of the Site.
- Clean N Shop, located at 4822 Brooklyn Ave NE, was a "cleaner and dryer" in 1970, which was located approximately 150 north of the site.

2.4 LAND USE AND ENVIRONMENTAL SETTING

The Site is located in the Seattle city limits within King County, Washington. The area has been recently rezoned to SM-U 75-240 which allows for mixed residential and commercial businesses with typical street front businesses and residential units above. The property owner (FH Brooklyn, LLC) plans to redevelop the subject property to a 24 story apartment building with commercial space and two levels of below-grade parking.

2.4.1 Topography

The Site is a flat, paved, rectangular lot located near the University of Washington campus and the future Sound Transit Link light rail U District Station (to be located on Brooklyn Ave NE between NE 45th and NE 43rd Streets). The physiography of Seattle is characterized by a series of north/south-trending ridges and troughs. The Site is situated between two large troughs, Puget Sound and Lake Washington, at an approximate elevation of 215 feet. The north/south-trending ridges and troughs are characteristic of glacially overridden terrain in the Puget Lowland.

2.4.2 Surface Water

Surface water within the vicinity of the Site drains to the south toward Portage Bay and the Ship Canal. The property is located approximately 3,600 feet north of Portage Bay. Lake Union is approximately 8,700 feet to the southwest and Lake Washington is approximately 6,300 feet to the southeast of the property.

2.4.3 Climate

The Seattle climate is characterized by mild temperatures and an extended rainy season, with an average annual rainfall of 37 inches. Average temperatures vary between 36 and 47 degrees Fahrenheit in the winter and 55 to 73 degrees Fahrenheit in the summer. The driest month of the year is typically July, with the rainy season extending from October to March.

2.4.4 Hydrogeology

The regional geology in the Seattle area consists of a thick series of glacial and interglacial soils overlying bedrock. These sediments were deposited as glaciers that advanced and retreated during the Pleistocene Epoch. Soils at the Site are mapped as Vashon ice-contact deposits (Qvi) from the Vashon stade of the Fraser Glaciation Age (Troost et al, 2005).

Site geology consists of a thin layer of glacial till overlying a silty sand layer to approximately 27 feet below ground surface (bgs). Underlying the sand unit, a stiff to hard gray silt layer has been logged at a depth of 25 to 35 feet bgs, the maximum depth explored. A fill unit above the glacial till deposit has been found in several areas across the Site up to a maximum depth of 15 feet bgs.

Ground water gauging and sampling events indicate ground water is typically encountered at approximately 15 to 19 feet bgs with a 5-foot seasonal fluctuation in elevation. Ground water flow varies toward the southeast and northeast depending on seasonal variation. The hydraulic gradient on the site typically ranges from 0.01 to 0.03 feet/foot. There are no domestic or commercial wells within a one mile radius of the site (Ecology, 2017). The City of Seattle Water Department provides domestic water service within the city limits.

2.5 PREVIOUS INVESTIGATIONS

Petroleum-hydrocarbon contamination was first encountered at the Site in December 1989 during the removal of three gasoline USTs (two 12,000-gallon steel tanks and one 5,000-gallon steel tank), two pump islands, and associated fuel lines from the northern portion of the Site. In addition, an undocumented, abandoned-in-place 1,000-gallon UST was discovered and removed from the southern portion of the site and along the eastern wall of the most recent UST pit. The fuel type for the abandoned-in-place UST was not able to be determined. Gasoline-range hydrocarbons (GRO), benzene, toluene, ethylbenzene, and total xylenes (BTEX) were detected at concentrations exceeding Ecology's Model Toxics Control Act (MTCA) Method A cleanup levels in soil samples collected from the UST excavations. GeoEngineers, Inc. documented approximately 450 cubic yards of affected soil and 450 cubic yards of unaffected soil that was transported off site for disposal (GeoEngineers, 1990a).

Following UST removal and replacement, GeoEngineers, oversaw the installation of 15 soil borings (MW-1 through MW-14 and RW-1). Fourteen of the borings were completed as monitoring wells and one was completed as a recovery well (RW-1). Residual hydrocarbons were present in samples from eight of the 15 soil borings with benzene concentrations above the MTCA Method A cleanup level in four of the soil borings.

GeoEngineers, Inc. performed ground water measurements and sampling from all monitoring wells in January and February 1990. Separate-phase hydrocarbons (SPH) were present in MW-4 and MW-12 with thicknesses of 2.27 and 1.22 feet, respectively. Ground water samples collected from MW-1, MW-2, MW-3, MW-7, MW-9, MW-10, MW-11, and MW-12 contained benzene concentrations that exceeded the MTCA Method A cleanup level. Ground water samples from MW-7, MW-11, and MW-12 contained concentrations of GRO above the MTCA Method A cleanup level.

In February 1990, under the direction of GeoEngineers, Inc., H2Oil Recovery Equipment installed a vapor extraction system (VES). The VES was connected to eleven of the newly installed monitoring wells (MW-1, MW-3, NW-4, MW-6, MW-7, MW-8, MW-9, MW-11, MW-12, MW-14, and RW-1) and was activated on May 16, 1990, with a portable incineration combustion unit (ICU) to oxidize the extracted hydrocarbon vapors. The ICU was removed in 1991, and the VES emissions were discharged directly to the atmosphere (GeoEngineers, 1990b).

In March 1991, air-sparging units were installed in wells MW-4 and MW-12 to reduce the thickness of SPH. In addition, on November 22, 1994, EMCON removed SPH from monitoring well MW-12 and installed a ground water aeration line to induce aeration of the product and to recover the volatile organics within the VES. In January 1996, EMCON estimated that 20,853 pounds of volatile organic vapors had been removed from soil beneath the site. There is no record of the system deactivation date.

In 1992, an environmental investigation was conducted by Pacific Environmental Group, Inc. (Pacific) coinciding with a Stage II vapor recovery retrofit. Two soil samples were collected during the investigation: one sample was taken from an excavation trench (T-1) and the other sample was collected from stockpiled soil associated with the excavation area. Concentrations of GRO in both samples were above MTCA Method A cleanup levels. Analytical results for BTEX compounds and total lead were below MTCA Method A cleanup levels. Approximately 17 cubic yards of soil was removed and disposed of offsite.

In March 2001, Delta Environmental Consultants, Inc. (Delta) performed a site investigation and reported the results in the *Supplemental Environmental Investigation* letter dated July 24, 2001 (Delta, 2001). Two soil borings were installed and completed as monitoring wells (MW-15 and MW-16) in the northeastern and southeastern corners of the property, respectively, in order to delineate lateral soil and ground water impacts. Soil analytical data for MW-15 and MW-16 indicate that all analytes were at concentrations either below laboratory detection limits or below their respective MTCA Method A cleanup levels. Ground water analytical data indicated that GRO, benzene, and methyl tertiary butyl ether (MTBE) were detected at concentrations that exceed their respective MTCA Method A cleanup levels in monitoring well MW-16. All other analytes from monitoring wells MW-15 and MW-16 were detected in ground water at concentrations below laboratory detection limits or below their respective MTCA Method A cleanup levels.

In October 2010, SAIC advanced one soil boring, SB-1, to a depth of 25 feet below ground surface (bgs) in the northwest corner of the property in order to delineate the lateral extent of soil impacts to the north (Figure 2). Three attempts were made to install a monitoring well near the center of the northern property boundary adjacent to the northwest corner or the station building. However, all three attempts encountered a thick concrete slab approximately 2.5 to 3.5 feet bgs. None of the target analytes selected were detected in the soil samples collected.

Nine test probes (P1 through P9) were advanced to depths ranging from 5 to 22 feet bgs by Riley Group, Inc. in 2015. Details of the investigation were described in the *Baseline Environmental Assessment Report* dated March 31, 2015 (Riley Group, 2015). A total of 9 soil samples and two ground water grab samples were submitted to the laboratory for analysis. Soil samples collected from borings P4 and P6 were above MTCA Method A cleanup levels for benzene. Ground water samples collected from soil boring location P1 and P8 were all below MTCA Method A cleanup levels.

Aspect advanced nine soil borings in November 2016, collected 56 soil samples, and 14 ground water samples from existing monitoring wells (Aspect, 2017a). Eight of the soil samples exceeded the proposed cleanup level for one or more analyte. Soil samples that exceeded the proposed cleanup levels ranged in depth of 14 to 33 feet bgs.

In February 2017, Aspect provided oversight during removal of three 12,000 gallon USTs on the property by Wyser Construction Company, Inc., and collected seven confirmation soil samples from the UST excavation and three samples from stockpiled pea gravel (Aspect, 2017b). All soil analytical results were less than the MTCA Method A soil cleanup levels, with the exception of sample Tank-B1-12, where benzene was detected at a concentration 0.073 mg/kg.

Prior to UST decommissioning, existing Site monitoring wells (MW-1, MW-5, MW-4, MW-8, MW-9, and RW-1) were abandoned in accordance with WAC 173-160 to allow for UST

Decommissioning. The remainder of existing Site monitoring wells will be abandoned prior to beginning the planned Interim Action excavation activities.

3 TECHNICAL ISSUES FOR THE REMEDIAL INVESTIGATION

This section summarizes the technical issues to be considered for the RI that were identified from previous investigations and the operational history of the Site. These technical issues may be modified as appropriate, based on the results of the RI.

3.1 CONTAMINANTS OF POTENTIAL CONCERN

The proposed cleanup levels used to identify the concentrations of chemicals of potential concern (COPCs) that present a risk to human health and the environment at the Site for this RI are consistent with the *Preliminary Draft RI Work Plan* and the *On-Property Remedial Investigation Data Report* (Aspect, 2016 and Aspect, 2017a). The proposed cleanup levels were derived from MTCA Method A cleanup levels for unrestricted land use and Method B cleanup levels for cis-DCE for which there was no Method A value available (Table 1).

Previous investigations detected concentrations of one or more of the COPCs over the proposed cleanup levels in ground water and soil at the Site, as summarized in Section 2.5, *Previous Investigations*, and those defined in the Agreed Order. The COPCs detected above the proposed cleanup levels in previous investigations conducted at the Site include:

- Gasoline-, diesel-, and oil-range hydrocarbons in soil and ground water;
- Naphthalene in soil;
- BTEX in soil and ground water; and
- Dissolved lead, cis-DCE, vinyl chloride, and MTBE in ground water.

3.2 MEDIA OF CONCERN AND PATHWAYS

Ground water and soil are the media of concern for the Site. Potential media of concern that will be further evaluated as part of the RI include vapor intrusion to nearby buildings.

Potential pathways for the migration of COCs include:

- Leaching from soil to ground water;
- Lateral and vertical transport in ground water; and
- Volatilization from soil and/or ground water to indoor ambient air.

Due to the continued presence of petroleum-related contamination in subsurface soil and ground water at the Site, Leidos performed a Preliminary Vapor Intrusion (VI) Assessment for the Site per Ecology VI guidance (Ecology, 2016a). Per the Ecology VI guidance, the goal of a Preliminary VI Assessment is to determine whether any potential exists for toxic vapors to be present in the subsurface that could migrate and enter nearby buildings.

In simplified form, the following two questions, provided in an abbreviated form, provide the framework for performing a Preliminary VI Assessment:

- Are chemicals of sufficient volatility and toxicity known or reasonably suspected to be present at the Site?
- Are occupied buildings present (or could they be constructed in the future) above or near contamination at the Site?

Petroleum contamination, including the presence of SPH, is known to be present beneath the Site. Therefore, the results of the Preliminary VI Assessment for the Site indicate that current site conditions may result in the potential for a VI pathway to exist and that further evaluation in the form of a Tier I VI Assessment, should be performed.

4 PRELIMINARY CONCEPTUAL SITE MODEL

The Preliminary Conceptual Site Model has been developed to summarize the current understanding of the Site to assist with identification of the applicable COPCs, the confirmed or potential sources of COPCs, the media of concern with concentrations of COPCs above the proposed cleanup levels, and potential migration and exposure pathways. The sources of data used in developing the Preliminary Conceptual Site Model developed for this RI Work Plan include previous site investigations, site plans; aerial photographs; and information for the City of Seattle Department of Planning and Development, and Sanborn Fire Insurance Maps. The Preliminary Conceptual Site Model has been used to develop the scope of work presented in this RI Work Plan to meet the data requirements for the completion of the RI in accordance with WAC 173-340-350.

4.1 KNOWN OR SUSPECTED HUMAN AND ENVIRONMENTAL RECEPTORS

The Preliminary Conceptual Site Model developed for this Site indicates the following potential receptors to be considered in the evaluation of impacts on human health and the environment. Identified potential receptors include:

- Workers who contact contaminated soil in the future during construction, if no worker protection controls are in place;
- Humans who contact contaminated soil in the future if pavement is removed;
- Humans who inhale contaminated soil particles in the future during remedial action activities, if no protection controls are in place;
- Accidental contact or consumption of ground water during investigation, remediation, and/or construction work by humans. Drinking water is supplied by the City of Seattle, and no drinking water wells are within one mile of the Site but ground water will still be considered a potential source of drinking water;
- Humans who inhale indoor air contaminated via vapor intrusion by volatilization of contaminated shallow ground water or shallow soil.

These potential human receptors have been considered in the scope of work. Potential ecological receptors will be evaluated with a terrestrial ecological evaluation (TEE) as part of the RI as well.

4.2 DATA GAPS

The following data gaps have been identified in the Preliminary Conceptual Site Model as necessary information needed to accomplish the goals of the RI and enable the evaluation and selection of a technically feasible cleanup alternative. These data gaps are:

- The vertical and lateral extent of soil contamination off-property to the west, south, and east. Additional soil investigation data is needed to better define the boundary of the Site.
- The concentrations of COPCs in soil and ground water migrating from potential up-gradient sources.

- The lateral extent of concentrations of COPCs above proposed cleanup levels in ground water down-gradient of the service station property.
- A Tier 1 vapor intrusion assessment to determine whether volatile organic compounds (VOCs) are present in soil vapor.

5 REMEDIAL INVESTIGATION SCOPE OF WORK

This section provides the approach and scope of work for the RI. The scope of work is designed to address the data gaps presented in Section 4.2, Data Gaps, and to provide sufficient information to evaluate and select a technically feasible cleanup alternative.

A phased approach is being used to conduct the RI, in order to meet construction timelines at the former service station property and to meet the Schedule of Deliverables timeline in the Agreed Order. The first phase of the RI was completed on the former station property in November 2016. The second phase of the RI includes installing and monitoring ground water monitoring wells to define the nature and extent of COPCs in soil and ground water off the former service station property and further define the Site, per MTCA. The second phase of the RI will include a vapor intrusion assessment to address the continued presence of petroleum-related contamination in subsurface soil and ground water along the border of the property.

To accomplish these objectives, Leidos proposes to install 12 ground water monitoring wells and two soil vapor sampling probes as depicted in Figure 2. Additional monitoring wells may be added or removed from the scope of work, based on results of the Interim Action excavation, as well as location of utilities in the right-of-way, or the interference with shoring/construction designs. If additional monitoring wells are needed to fully delineate the extent of groundwater contamination at the Site, a *Remedial Investigation Work Plan Addendum* will be written to address any data gaps remaining, pending results of this investigation.

This section of the Work Plan provides an overview of the proposed off-property remedial investigation. Proposed RI field data collection activities and quality assurance/quality control procedures are described in detail in the *Preliminary Draft RI Work Plan* (Aspect, 2016) and included in this Work Plan for reference as Appendix B. An Addendum to the Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) is included in Appendix A of this work plan and describes field collection procedures that are specific to the off-property remedial investigation.

5.1 PROPOSED LOCATIONS

The proposed location for each of the ground water monitoring wells and soil-vapor sampling probes are shown on Figure 2. The locations proposed are adjacent to monitoring wells that have historically contained measurable SPH. The proposed locations and selection rationale are as follows:

- Proposed monitoring wells MW-17, MW-18, MW-19, and MW-20 are located in a parking strip along Brooklyn Avenue. They serve to bound the lateral extent of soil impacts to the west but also serve as upgradient monitoring wells.
- Monitoring wells MW-21 through MW-24 and soil vapor probe SVP-1 are located along the alley between the former service station property and the Bank of America property. Soil and ground water samples collected from these proposed locations will delineate impacts to the east.

- MW-25, MW-26, and SVP-2 are located in a parking strip along NE 47th Street and are located downgradient of the former service station property.
- To the south of the former station, proposed monitoring wells MW-27 and MW-28 will be installed. MW-27 and MW-28 will be located south and downgradient of monitoring wells MW-13 and MW-11, which have both historically contained measurable SPH. Pending results of the Interim Action and this remedial investigation, an additional monitoring well may be needed in the southwest corner or the property but due to safety concerns it was not addressed in this Work Plan.

The ground water monitoring well locations and the soil-vapor sampling probe locations shown on Figure 2 are proposed; therefore, actual locations may differ based on permit conditions, construction plans, utilities, or other conditions encountered in the field.

5.2 SITE ACCESS

Leidos will obtain street use or public right-of-way access permits from the City of Seattle, as appropriate. The RI field activities will be dependent on obtaining necessary permitting and approval in a timely fashion.

If the location of utilities in the alley prevents installation of the monitoring wells and the soil vapor point, they may be moved further to the east to private property. An access agreement will then be requested by Leidos and Chevron prior to conducting any work on private property.

5.3 UTILITY LOCATE

Prior to beginning ground water monitoring or soil-vapor probe installation, Leidos will contact the Utilities Underground Location Center to request location of all public utilities in the vicinity of the proposed locations. In addition, Leidos will subcontract a private utility locating contractor to locate other potential infrastructure or other buried objects that would not typically be identified through the public utility locating process.

5.4 INVESTIGATION-DERIVED WASTE

Soil cuttings from hand auger, air knifing, or drilling of soil borings will be contained in 55-gallon Department of Transportation (DOT) approved drums, which will be left on the subject property for temporary storage. Following receipt of laboratory analytical data, the soil will be removed for disposal.

All decontamination and purge water from monitoring well development will be stored in 55-gallon DOT approved waste drums. This waste water will be transported for disposal at a permitted facility by an approved disposal subcontractor.

5.5 ECOLOGICAL IMPACT MONITORING

As part of the RI, the Site will be assessed for risk to terrestrial organisms using criteria described in WAC 173-340-7491. According to MTCA, a Terrestrial Ecological Evaluation (TEE) is conducted for the following reasons:

- To determine if the existence of hazardous substances at a site could harm plants or animals.
- To identify and characterize the existing or potential threats to the plants or animals that may be exposed to hazardous substances in the soil.

- To establish cleanup levels to protect the plants and animals, as well as the ecologically important functions of the soil biota.

Certain circumstances provide a primary exclusion from any further ecological evaluation either because the contaminants have no pathway to harm the plants or animals (e.g., they are under buildings or deep in the ground), or because there is no habitat where plants or animals live near the contamination, or because the contamination does not occur at concentrations higher than occurs naturally in the area. If a site meets any one of these primary exclusions, the ecological evaluation is complete.

If the site does not meet the exclusion criteria described in this section of MTCA, then a Terrestrial Ecological Evaluation (TEE) or simplified TEE will be conducted. These evaluations involve examination of the nature of potential receptors, the toxicity of on-site contaminants to terrestrial organisms, and the presence of exposure pathways.

The type of evaluation required, TEE or simplified TEE, is dependent upon four primary concerns about a site in relation to terrestrial ecological receptors, as described in MTCA. If none of the listed situations of concern are applicable to the site, then the site qualifies for a simplified TEE. The purpose of the simplified terrestrial ecological evaluation process is to identify those sites that do not have a substantial potential for posing a threat of significant adverse effects to terrestrial ecological receptors, and thus remove them from further ecological consideration during the remedial investigation and cleanup process. For the remaining sites, the process provides several options, including chemical concentrations that may be used as cleanup levels, and the choice of developing site-specific concentrations using bioassays or conducting a site-specific evaluation. Under MTCA, it is always an option to conduct a site-specific terrestrial ecological evaluation and to develop site-specific cleanup levels.

6 SCHEDULE

The schedule for conducting the RI is presented in Exhibit C, Table 1 of the Agreed Order. The anticipated schedule for implementation of this investigation is as follows:

1. Completion of RI Field Investigations – 180 days after Final RI Work Plan. This timeline is heavily dependent on permitting and access to the proposed boring locations.
2. Agency Review Draft RI Report – Within 90 days of receiving all validated analytical data.
3. Public Review Draft RI Report- 30 days after receipt of Ecology comments.
4. Final RI Report- Within 30 days after receipt of Ecology comments, subsequent to public comment.

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LIMITATIONS

This technical document was prepared on behalf of CEMC and is intended for its sole use and for use by the local, state, or federal regulatory agency that the technical document was sent to by Leidos. Any other person or entity obtaining, using, or relying on this technical document hereby acknowledges that they do so at their own risk, and Leidos shall have no responsibility or liability for the consequences thereof.

Site history and background information provided in this technical document are based on sources that may include interviews with environmental regulatory agencies and property management personnel and a review of acquired environmental regulatory agency documents and property information obtained from CEMC and others. Leidos has not made, nor has it been asked to make, any independent investigation concerning the accuracy, reliability, or completeness of such information beyond that described in this technical document.

Recognizing reasonable limits of time and cost, this technical document cannot wholly eliminate uncertainty regarding the vertical and lateral extent of impacted environmental media.

Opinions and recommendations presented in this technical document apply only to site conditions and features as they existed at the time of Leidos site visits or site work and cannot be applied to conditions and features of which Leidos is unaware and has not had the opportunity to evaluate.

All sources of information on which Leidos has relied in making its conclusions (including direct field observations) are identified by reference in this technical document or in appendices attached to this technical document. Any information not listed by reference or in appendices has not been evaluated or relied on by Leidos in the context of this technical document. The conclusions, therefore, represent our professional opinion based on the identified sources of information.

Table

TABLE 1
Proposed Cleanup Levels and Laboratory Reporting Limits
CHEVRON SERVICE STATION NO. 90129
4700 Brooklyn Avenue
Seattle, Washington

Analyte	MTCA Method A Unrestricted Land Uses Soil in mg/kg	MTCA Method A Unrestricted Land Uses Groundwater in µg/L
Total Petroleum Hydrocarbons		
Gasoline-Range Organics	30/100 [a]	800/1,000 [a]
Diesel-Range Organics	2,000	500
Heavy Oil-Range Organics	2,000	500
Volatile Organic Compounds		
Benzene	0.03	5
Cis-1,2-Dichloroethene[b]	160	16
Ethylbenzene	6	700
Ethylene Dibromide	0.005	0.01
Ethylene Dichloride	480 [c]	5
MTBE	0.1	20
Toluene	7	1,000
Vinyl Chloride	0.67 [c]	0.2
Xylenes	9	1,000
Carcinogenic Polycyclic Aromatic Hydrocarbons		
benzo[a]pyrene	0.1 [d]	0.1 [d]
benzo[a]anthracene	d	d
benzo[b]fluoranthene	d	d
benzo[k]fluoranthene	d	d
chrysene	d	d
dibenz[a,h]anthracene	d	d
indeno[1,2,3-cd]pyrene	d	d
Metals		
Cadmium	2	5
Chromium	19/2000 [e]	50
Lead	250	15
Nickel	1,600 [c]	320 [c]
Zinc	24,000 [c]	4,800 [c]
Polychlorinated Biphenyls		
PCB Mixtures	1	0.1

Notes:

Soil cleanup levels are primarily based on the protection of groundwater for drinking water with these exceptions: diesel and oil are based on preventing accumulation of free product; cis-1,2 DCE, vinyl chloride and lead are based on protection of human direct contact.

Groundwater cleanup levels are based on protection of groudnwater for drinking water.

a Benzene present/no detectable benzene

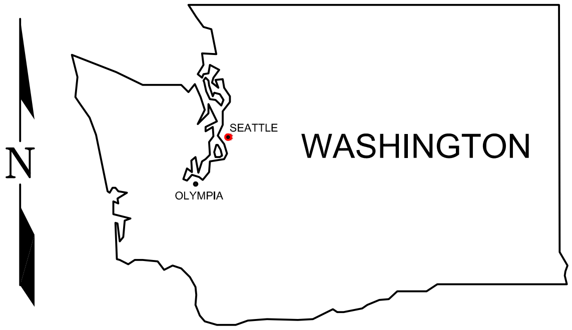
b No Method A soil or groundwater cleanup level. The value listed is Method B - noncancer.

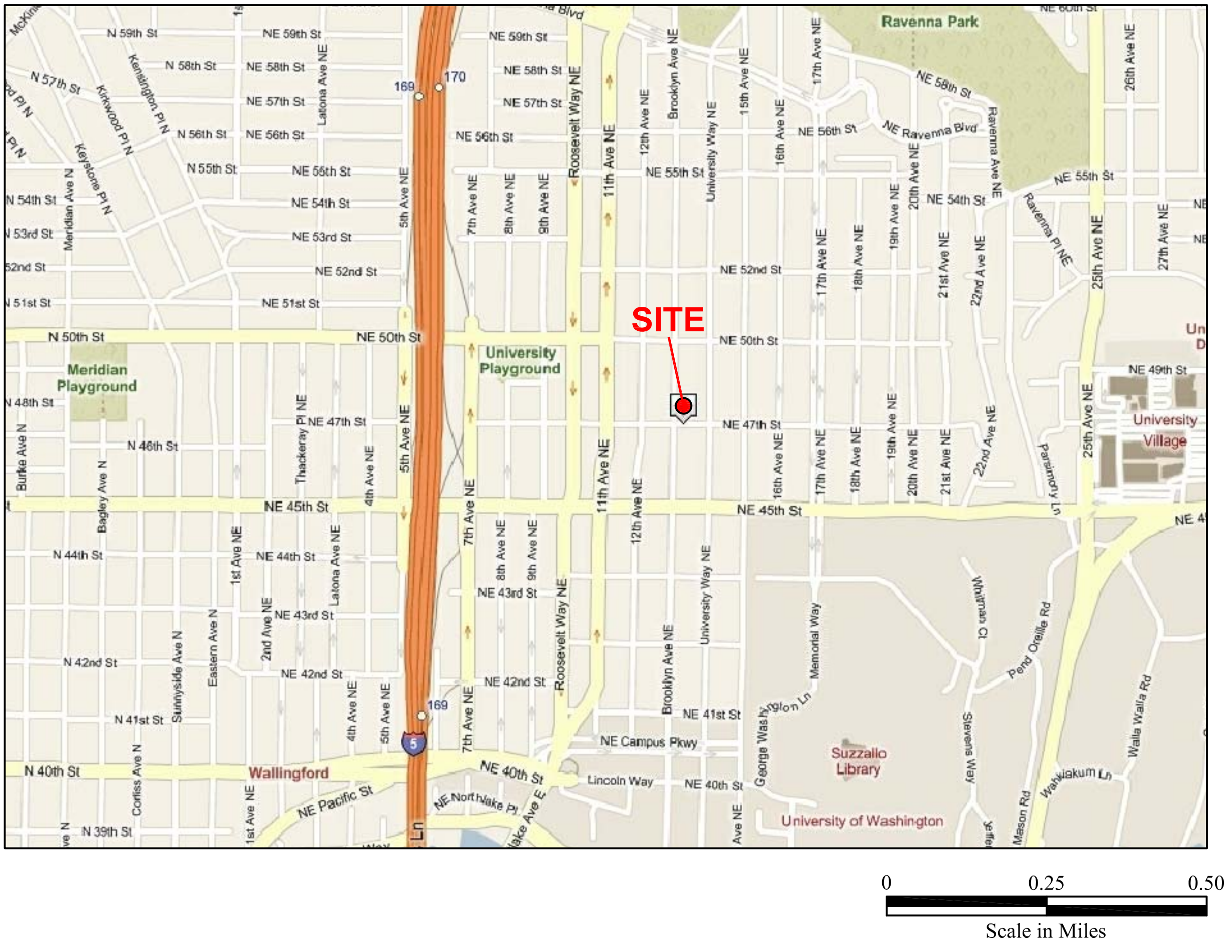
c Method A does not have a soil cleanup level for this analyte. The value listed is Method B - Soil Direct Contact.

d As per MTCA Method A, if other carcinogenic PAHs are detected, we will use this value as the total concentration that all carcinogenic PAHs must meet using the toxicity equivalency methodology in WAC 173-340-708(8).

e Method A soil cleanup levels for Chromium IV/Chromium III

Figures

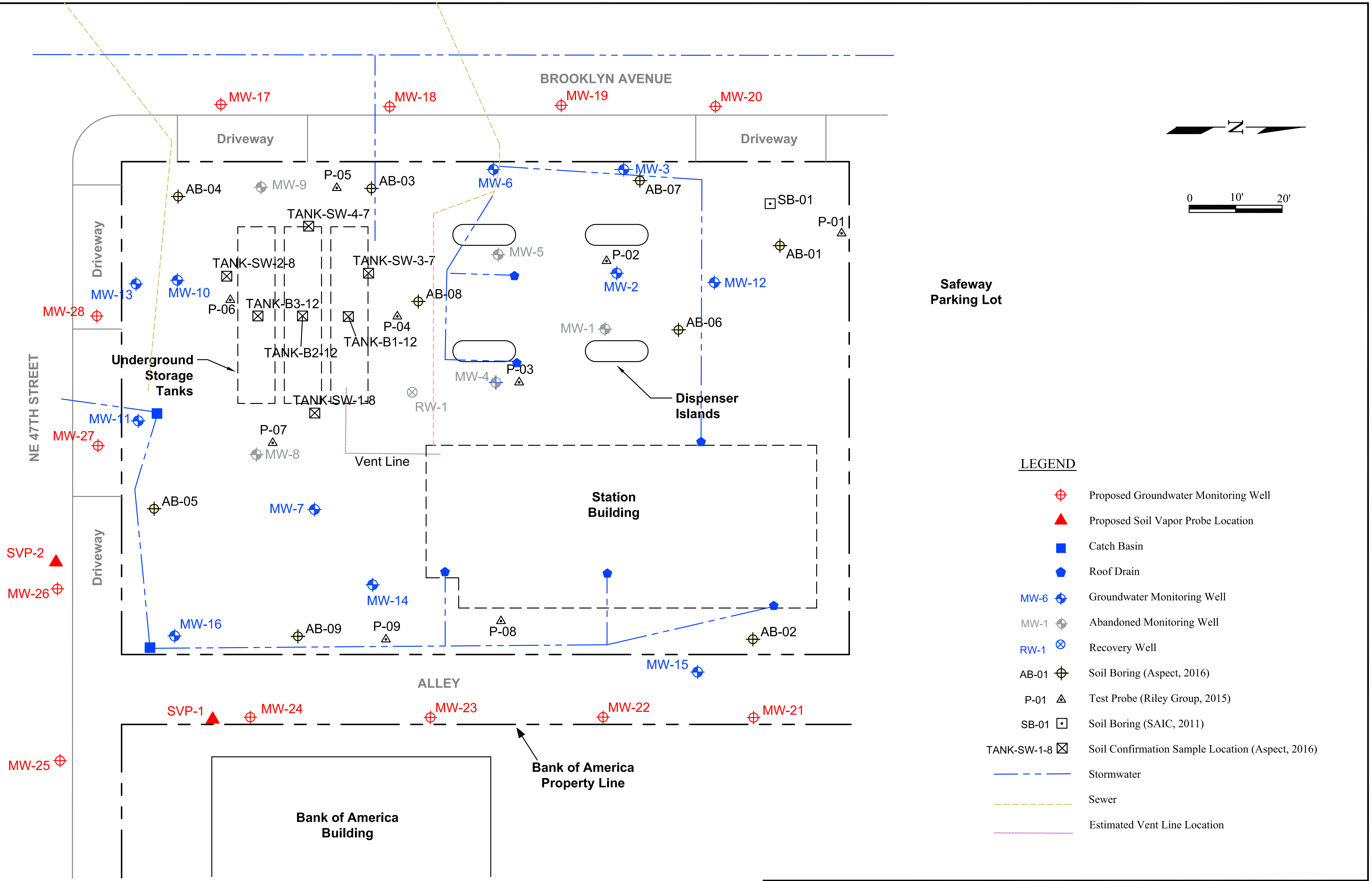




Chevron Service Station No. 90129
4700 Brooklyn Avenue
Seattle, Washington

FIGURE 1
Vicinity Map

DATE: 4/14/2014
DRAWING: 90129_VM.dwg



leidos

Chevron Service Station No. 90129
4700 Brooklyn Avenue
Seattle, Washington

FIGURE 2
Proposed Groundwater Monitoring Well
and Soil Vapor Probe Locations

DATE: 5/2/2017
DRAWING: 90129 Site Map 2013.dwg

Appendix A:
Addendum to Sampling and Analysis Plan/Quality Assurance Project Plan

ADDENDUM TO SAMPLING AND ANALYSIS PLAN/ QUALITY ASSURANCE PROJECT PLAN
FORMER CHEVRON SERVICE STATION NO. 90129

INTRODUCTION AND OBJECTIVES

This document is an addendum to the Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) in the *Preliminary Draft Remedial Investigation Work Plan* (Aspect, 2016). This addendum outlines additional sampling and testing activities proposed for the Site, activities supplementary to work conducted by Aspect. This addendum includes revisions to specific sections of the original SAP/QAPP as detailed below. All other sections in the original SAP/QAPP have remained unchanged because either the content or purpose is still applicable to these additional site assessment activities.

This addendum provides specific guidance for field methodology and quality assurance procedures that will be followed by Leidos and subcontractors. The addendum to the SAP/QAPP was prepared in accordance with the Agreed Order and was developed to meet the requirements of an RI as defined by WAC 173-340.

FIELD SAMPLING PLAN

SOIL BORINGS AND SOIL SAMPLING

Soil samples collected during the remedial investigation will be obtained using a hand auger, hollow-stem auger, or sonic drilling methods. The specific soil sample locations and chemical analyses are provided in Table A-1.

Sample Collection for Laboratory Analysis

Selected soil samples collected in both the ground water monitoring well boring as well as the soil vapor sampling probes will be submitted to Eurofins Lancaster Laboratories for the following analyses:

- Gasoline-range organics (GRO) by ECY 97-602 NWTPH-Gx;
- Diesel-range organics (DRO) and heavy oil-range organics (HRO) by ECY 97-602 NWTPH-Dx, without silica gel cleanup;
- Benzene, toluene, ethylbenzene, and total xylenes (BTEX), by USEPA 8260B; and
- Total lead by USEPA 6010B.

Select soil samples will be also analyzed for the following analyses:

- Methyl tertiary butyl ether (MTBE) and naphthalene by USEPA 8260B;
- Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) by USEPA 8270 SIM; and
- Chlorinated volatile organic compounds (CVOCs) by USEPA 8260B.

Select soil samples from the saturated zone from borings MW-17, MW-18, and MW-28 will be submitted for analyses of CVOCs. Samples from other borings may be submitted for analysis if necessary to delineate extent of CVOCs in soil.

Duplicate soil samples will be collected at a rate of one per each 20 soil samples and submitted for the above-referenced analyses to ensure quality assurance and quality control (QA/QC). Additional QA/QC samples will include one trip blank to accompany each sample cooler, and equipment rinse samples to verify equipment decontamination procedures. Equipment rinse sampling will be performed by collecting laboratory-supplied distilled water that has been used as the final rinse following equipment decontamination procedures. Equipment rinse samples will be collected at a rate of one per sample collection method (e.g., hand-auger or sonic core barrel). Trip blank and equipment rinse QA/QC samples will be submitted for the following analyses:

- GRO by ECY 97-602 NWTPH-Gx; and
- BTEX by USEPA 8260B.

Laboratory analytical reporting limits for soil sample analyses are presented in Table 1.

GROUND WATER MONITORING WELLS

Monitoring Well Installation and Sampling

In order to comply with current CEMC requirements for subsurface asset avoidance, each boring will initially be cleared to a depth of at least 8 feet bgs using an air-vacuum excavation system or similar “soft-dig” method to avoid damage to buried utilities or other subsurface infrastructure. Within this interval, the diameter of the boring is required to be at least 3 inches larger than the largest diameter of tooling to be advanced into the boring. Air-vacuum excavation services will be provided by Cascade Drilling, L.P. (Cascade) of Woodinville, Washington.

A Leidos representative will oversee the borehole clearance process and will collect soil samples from the boring at approximate 2-foot intervals using a stainless steel hand-auger. Samples will be classified and logged in accordance with the Unified Soil Classification System and will be field-screened for the presence of petroleum hydrocarbons by visual and olfactory observations, headspace vapor measurements using a PID, and sheen testing.

Following completion of the borehole clearance procedure, a limited access drilling rig will be used to advance each boring to the depth necessary to meet the monitoring well objectives at each location. Within this interval, the drill rig will collect a continuous core sample. The cores will be logged in the field by a Leidos representative and field-screened for the presence of petroleum hydrocarbons.

At a minimum, two soil samples will be collected and submitted for laboratory analysis: one from the capillary fringe, and the second from the bottom-most sample interval attained in the boring. The bottom-most sample will be used to demonstrate that the sampling effort has advanced to sufficient depth to define the vertical extent of petroleum-hydrocarbon impacts, if present. Additional soil samples may also be submitted based on field-screening observations. For example, the sample producing the highest PID readings, strongest sheen, or otherwise having the greatest visual or olfactory indication of petroleum-hydrocarbon impact may also be submitted for laboratory analysis.

Monitoring Well Construction and Development

Following the completion of drilling and sampling activities at each location, each boring will be completed as a 2-inch diameter monitoring well in accordance with the Washington Administrative Code (WAC) Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC).

Wells will be constructed using a 2-inch-diameter PVC casing with 0.020-inch, factory-slotted screen. The screen-interval for the wells are anticipated to be from approximately 10 to 25 feet bgs, but exact depths will depend on the water table at that location. Each well screen will be positioned to straddle the water table during anticipated seasonal fluctuations. The screen interval filter pack will consist of 2/12 sand to a depth of two feet above the top-of-screen elevation. Above the filter pack, the remaining borehole annulus will be filled with bentonite chips to approximately 1.5 feet bgs. The remaining annular space will be filled with cement and completed with a flush-mount, traffic-rated well box.

Well development will consist of surging for 10 minutes and pumping at least 10 well-casing volumes of ground water from the well using an electric submersible pump until water produced from the well is clear and free of sediment.

Monitoring Well Location and Elevation Survey

Following installation of the new wells, Leidos will subcontract a Washington State licensed land-surveying firm to perform a location and elevation survey of the new monitoring wells. Monitoring well elevation measurements will be made to the nearest 0.01 foot at the ground surface (i.e., top of well-box lid) and at the top of the well casing, relative to the North American Vertical Datum of 1988. Monitoring well location measurements will be made relative to the North American Datum 1983 High Accuracy Reference Network [NAD83(HARN)].

Ground Water Monitoring

Following completion of the monitoring well installation activities, each of the 12 new monitoring wells will be added to a quarterly ground water monitoring program for the Site.

Ground water monitoring will consist of SPH thickness and water level measurements, and ground water samples will be collected for laboratory analysis if no SPH is present. When conditions permit, ground water samples will be collected using low-flow purging and sampling techniques per the SAP/QAPP and will be submitted to Eurofins Lancaster Laboratories for the following analyses:

- GRO by ECY 97-602 NWTPH-Gx; and
- DRO and HRO by ECY 97-602 NWTPH-Dx, without silica gel cleanup;
- BTEX, MTBE, and EDC by USEPA 8260B;
- EDB by USEPA 8011;
- CVOCs by USEPA 8260B; and
- Dissolved lead by USEPA 6010B.

Laboratory analytical reporting limits for ground water sample analyses are presented in Table 1.

SOIL VAPOR SAMPLING PROBES

Soil Vapor Sampling Probe Locations

The proposed locations for the two soil-vapor sampling probes are shown on Figure 2. One soil-vapor sampling probe will be located south of the former service station property, downgradient of monitoring wells MW-13 and MW-11, both of which has historically contained measurable SPH. Another soil vapor probe will be the located east of monitoring well MW-16, which is the closest monitoring well to the Bank of America property with COPCs above proposed cleanup levels.

The soil vapor sampling probe locations shown on Figure 2 are proposed; therefore, actual probe locations may differ based on permit conditions or conditions encountered in the field.

Soil Vapor Sampling Probe Construction and Installation

Soil vapor probe installation and sampling will meet requirements outlined in Ecology’s Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action (Ecology, 2016a).

Soil borings will be advanced to a depth of 5.5 feet bgs using a hand auger. Each soil vapor sampling probe will consist of a shallow probe that will be installed at a depth of approximately 5.25 feet bgs.

Once each soil vapor probe has been advanced to its maximum depth, a soil vapor sampling probe consisting of a 6-inch long, 0.75-inch diameter stainless steel screen with a 0.0057-inch (0.15-millimeter) screen pore size. Each screen will be connected to a length of ¼-inch outside diameter (O.D.) Teflon® tubing via a Swagelok® fitting with a rubber compression ferule. The above-grade end of the soil vapor sampling probe tubing will be fitted with a Swagelok® stainless steel on/off control valve.

Each 6-inch long screen tip will be vertically centered in a 1-foot long interval containing standard sand pack, resulting in 3 inches of sand being above and below the screen. Each sand pack will be covered with a 1-foot interval of dry granular bentonite, which is then covered with at least 2 feet of hydrated granular bentonite. The dry granular bentonite is emplaced immediately above the sand pack to ensure that hydrated granular bentonite slurry does not flow down to the probe screen and seal it off from the adjacent soil. The remainder of the borehole will be filled with hydrated granular bentonite slurry (mixed at the surface and poured in) to approximately 12 inches bgs. The top portion will be completed with a 1-foot thick cement cap. An 8-inch flush-mounted well box will be installed to protect the tubing line that is set in the cement cap.

Soil Vapor Sample Collection and Analysis

Once the soil probes are installed and the concrete at each vapor point has fully cured, vapor sampling activities will commence (minimum of 48 hours). Sampling will not be conducted during or immediately after a significant rain event due to the reduced effective diffusion coefficient and decrease in relative vapor saturation in the unsaturated zone. If rain is encountered prior to sampling, the event will be postponed at least 24 hours. Written documentation will be kept of field conditions including temperature, barometric pressure, wind direction and speed, humidity, and surface soil conditions. Records will also be kept of names of field personnel, dates and times of sampling, purge volumes and purge rate, sampling volume, and leak testing description.

Soil vapor samples will be collected in 6-liter Summa air-sampling canisters (Summa canisters), which will be provided by the Eurofins Air Toxics Ltd. (Air Toxics) laboratory of Folsom, California. Each Summa canister used for sample collection will be individually certified (100-percent certified) to contain less than the reporting limit for each of the target compounds.

Prior to sample collection, the initial vacuum of each Summa canister will be measured to verify that the canister has not leaked or been inadvertently opened prior to the sampling event. The initial vacuum, which should be approximately 29 inches of mercury vacuum, will be recorded on the canister’s identification tag and in the project log book.

Following the initial canister vacuum check, the sampling canister will be fitted with a sampling manifold, which will allow the sampling canister to be connected to another Summa canister that will be used for purging the sample collection train. The manifold is also equipped with a filter and a flow restrictor that is calibrated to provide a sampling flow rate of approximately 167 milliliters per minute (mL/min). This flow rate equates to a sampling interval of approximately 30 minutes for a 6-liter Summa canister.

After connecting the sampling manifold and purge canister, a preliminary leak check of the system will be performed. With the inlet to the manifold tightly capped, the purge canister will be opened momentarily and then shut, thereby applying a vacuum to the sampling manifold. Initial vacuum readings will then be recorded from both of the two vacuum gauges on the sampling manifold. After a period of approximately 5 minutes, the vacuum readings of each gauge will be checked again to verify that the initial vacuum levels have been maintained. If the vacuum readings between the initial and final reading differ, the manifold will be reconnected to the canisters and checked again until the system is leak free. If, after a third attempt, a leak-free connection cannot be maintained, the sampling manifold will be removed from service and not used for sample collection.

Following completion of the preliminary leak check, the sampling manifold will be connected to the soil vapor sampling probe. Teflon® tubing (¼–inch outside diameter) will be used to connect the soil-vapor sampling probe control valve to the inlet of the sampling manifold. Swagelok® fittings with rubber compression ferrules will be used to make connections from the Teflon® tubing to the control valve and sampling manifold inlet.

As a secondary check for leaks or short circuiting, helium will be used as a tracer gas to test for ambient air leakage into the sampling system. To accomplish this, the entire soil-vapor sampling train (soil-vapor sampling probe, sampling manifold, sampling canister, and purge canister) will be contained in a shroud in which a helium-rich environment will be maintained throughout the duration of the sample collection. Laboratory-grade helium will be used as the tracer gas. During the duration of the sampling, the concentration of helium inside the shroud will be monitored using a Mark 9822, or equivalent, helium detector. During sample collection, the sampling technicians will attempt to maintain a concentration of helium of approximately 10 percent by volume in the sampling shroud.

Prior to collecting a soil-vapor sample, each soil-vapor sampling probe will be purged to remove stagnant air from the sample collection train. Purge volume will be based on the volume of air contained within the inner diameter of the soil-vapor sampling probe and all tubing connected to the inlet of the sampling canister. The sand pack volume of the soil-vapor sampling probe will not be included in the purge volume calculation, as it is assumed that the soil-vapor concentration in the sand pack will be in equilibrium with the surrounding soil. Three volumes will be purged from each soil-vapor sampling probe prior to sample collection. Assuming use of ¼-inch O.D. tubing and an approximate combined sampling probe and tubing length of 10 feet, it is estimated that the total purge volume would be equal to approximately 300 milliliters, which would equate to a purge time of approximately 2 minutes at a purge rate of 167 mL/min.

Following completion of the purge cycle, the valve on the sampling canister will be opened to begin sample collection. The start time and initial canister vacuum will be recorded in the project log book. Collection of the sample should require approximately 30 minutes. During this time, the sampling technician will periodically check the canister vacuum to verify that the canister is filling at the expected rate. The sampling technician will also monitor and maintain the concentration of helium leak-detection gas within the sampling shroud. Sample collection will be stopped when the vacuum gauge on the sampling canister indicates that between 3 to 5 inches of mercury vacuum is remaining in the sampling canister. Once sample collection is done, the final canister vacuum will be recorded on the canister ID tag and also in the project log book.

In order to verify sample collection, and laboratory quality assurance and quality control (QA/QC), one equipment blank and one duplicate soil-vapor sample will be collected. The QA/QC equipment blank will be collected by passing laboratory-certified nitrogen through a section of Teflon® tubing, and the sampling manifold, into a 6-liter Summa canister. The QA/QC duplicate sample will be collected using a duplicate-sampling manifold, which will allow two sample collection canisters to be filled simultaneously in a parallel configuration. Due to the doubling of the sample volume to be collected for a duplicate sample, the sample collection time for this sample will be approximately 60 minutes.

Soil Vapor Sampling Analytical Methods

Soil vapor samples will be submitted to Air Toxics for the following analyses:

- BTEX, MTBE; and naphthalene by EPA Method TO-15 (Low Level); and
- Oxygen, carbon dioxide, methane, nitrogen, and helium by American Society for Testing and Materials (ASTM) D1946.

Standard laboratory turn-around time will be requested for each of the above-referenced analytical methods. The canisters will be packaged for shipping and sent to the laboratory under chain of custody protocol. Chain of custody will be maintained and documented at all times, including sealing the shipping container with chain of custody seals.

Soil gas samples will be collected from two soil vapor probes, along with a duplicate. In addition, an equipment blank will be collected by collecting a sample of nitrogen through the probe materials prior to installation activities

QUALITY ASSURANCE PROJECT PLAN

This document is to be used in conjunction with the Quality Assurance Project Plan prepared for this Site by Aspect in the *Preliminary Draft Remedial Investigation Work Plan* (Aspect, 2016). .

PROJECT ORGANIZATION AND RESPONSIBILITIES

Laboratory Project Manager- Eurofins Air Toxics, Inc. Eurofins Air Toxics, Inc. will be utilized for soil vapor analyses. The laboratory project manager is responsible for ensuring that all laboratory analytical work for soil, water, or soil vapor media complies with project requirements, and acting as a liaison with the project manager, field manager, and data quality manager to fulfill project needs on the analytical laboratory work. This responsibility also applies to analysis the laboratory project manager subcontracts to another laboratory.

ANALYTICAL METHODS AND REPORTING LIMITS

Laboratory analytical methods for soil vapor analyses to be performed during this environmental characterization are listed in Table A-2.

Method Detection Limit and Method Reporting Limit

The expected method detection limits (MDLs) and limit of quantitation (LOQs) for soil vapor sampling are summarized in Table A-2.

DATA QUALITY OBJECTIVES

Specific QC parameters associated with each of the MQIs for soil vapor samples are summarized in Table A-2.

Appendix Table A-1
Soil Exploration Plan

Sample Location	Gas-Range TPH (NWTPH-G)	Diesel-Range TPH (NWTPH-Dx)	BTEX (8260B)	Total Lead (6010)	Chlorinated VOCs (EPA 8260)	MTBE, naphthalene (8260)	cPAHs (8270)
MW-17	X	X	X	X	X	(1)	(1)
MW-18	X	X	X	X	X		
MW-19	X	X	X	X			
MW-20	X	X	X	X			
MW-21	X	X	X	X			
MW-22	X	X	X	X			
MW-23	X	X	X	X			
MW-24	X	X	X	X			
MW-25	X	X	X	X			
MW-26	X	X	X	X			
MW-27	X	X	X	X			
MW-28	X	X	X	X	X		
SVP-1	X	X	X	X			
SVP-2	X	X	X	X			

Notes:

TPH = total petroleum hydrocarbons

VOCs = volatile organic compounds

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

MTBE = methyl tertiary-butyl ether

[1] Soil samples will be selected for analysis based on field observations including sheen, odor, and PID readings.

Appendix Table A-2
Vapor Sample Analysis
Target Analytes, Laboratory Methods, and Analytical Limits

Analyte	Soil Vapor					
	Analytical Method	MDL	LOD	LOQ*	LCS	RPD
		(ug/m^3)			(%)	
Volatile Organic Compounds						
Benzene	EPA TO-15 (Low)	0.27	0.42	0.83	70 - 130	≤ 25
Ethylbenzene	EPA TO-15 (Low)	0.26	0.56	1.1	70 - 130	≤ 25
Methyl tert-butyl ether (MTBE)	EPA TO-15 (Low)	0.40	0.47	0.94	70 - 130	≤ 25
Toluene	EPA TO-15 (Low)	0.21	0.49	0.99	70 - 130	≤ 25
m,p-Xylene	EPA TO-15 (Low)	0.28	0.56	1.1	70 - 130	≤ 25
o-Xylene	EPA TO-15 (Low)	0.27	0.56	1.1	70 - 130	≤ 25
Naphthalene	EPA TO-15 (Low)	2.3	5.5	6.8	60 - 140	≤ 25

Analyte	Soil Vapor					
	Analytical Method	MDL	LOD	LOQ*	LCS	RPD
		(%)			(%)	
Atmospheric Gases (%)						
Carbon dioxide	ASTM D-1946 modified	--	--	0.01	--	--
Helium	ASTM D-1946 modified	--	--	0.05	--	--
Methane	ASTM D-1946 modified	--	--	0.0001	--	--
Nitrogen	ASTM D-1946 modified	--	--	0.01	--	--
Oxygen	ASTM D-1946 modified	--	--	0.01	--	--

LCS = laboratory control sample (supplied by Air Toxics)
LOD = limit of detection (supplied by Air Toxics)
LOQ = limit of quantitation (supplied by Air Toxics; equivalent to PQLs or RLs)
MDL = method detection limit (supplied by Air Toxics)
RPD = relative percent difference (supplied by Air Toxics)
Low refers to low-level or medium-level quantitation limits.
* LOQs for soil vapor are considered approximate; LOQs for atmospheric gases are in percent.
ug/m^3 = micrograms per cubic meter
-- Not applicable or not available

Appendix B:
Project SAP/QAPP
from *Preliminary Draft Remedial Investigation Work Plan* (Aspect, 2016)

APPENDIX B

Preliminary Draft

Sampling and Analysis Plan/ Quality Assurance Project Plan

Appendix B Contents

List of Tables

B1 Introduction

This Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) has been prepared for the 4700 Brooklyn Ave NE Site (Site) as Appendix B to the Remedial Investigation Work Plan (RIWP). The purpose of this SAP is to ensure that field sample collection, handling, and laboratory analysis will generate data to meet project-specific data quality objectives (DQOs) in accordance with the Model Toxics Control Act (MTCA) requirements (WAC 173-340-350). This SAP/QAPP is comprised of two major components: a Field Sampling Plan (FSP) defining field protocols and a Quality Assurance Project Plan (QAPP) defining analytical protocols.

Environmental investigation activities to be performed under this SAP/QAPP are on behalf of two parties, FH Brooklyn LLC (FH Brooklyn) and Chevron Environmental Management (Chevron) according to the Agreed Order 13815. The parties have an agreement of responsibility for the different environmental investigations to be performed and therefore each investigation will have a lead party. FH Brooklyn is the lead party for on-property activities and Aspect Consulting LLC (Aspect) will perform activities on behalf of FH Brooklyn. Chevron is the lead party for off-property activities and Leidos will perform activities on behalf of Chevron. Given this joint party agreement, this SAP/QAPP contains counterpart elements that apply to the on-property work performed by Aspect, and the off-property work performed by Leidos. It is the responsibility of the Aspect and Leidos personnel and subcontracted analytical laboratory personnel performing the sampling and analysis activities to adhere to the requirements of this SAP/QAPP.

The Field Sampling Plan (Section B2) and Quality Assurance Project Plan (Section B3) are presented below.

B2 Field Sampling Plan

B2.1 Soil Borings and Soil Sampling

Soil samples collected during the on-property investigation will be obtained using sonic drilling methods, which allow dual-casing to prevent drag-down of shallow contamination. The specific soil sample locations, depths, and chemical analyses are provided in Section 8 of the RIWP, with Table 2 tabulating the specific chemical analyses to be collected. The following subsections detail the procedures for soil sample collection, handling, identification, and sample quality assurance/quality control (QA/QC).

The responsible lead party will subcontract with a Washington-licensed resource protection well driller to complete soil borings in accordance with requirements of Chapter 173-160 WAC.

Each boring will be advanced to collect samples at depth intervals specified in the RIWP or as determined by field screening. The sonic drilling method provides continuous cores of soil.

B2.1.1 Soil Sample Collection and Handling Procedures

A geologist from Aspect and/or Leidos will oversee the drilling activities and prepare a geologic log for each of the explorations completed, including an examination of the full length of each soil core recovered by the sonic drilling rig. The field representative will visually classify the soils in accordance with American Society of Testing and Materials (ASTM) Method D2488 and record soil descriptions, field screening results, and other relevant details (e.g., staining, debris, odors, etc.) on the boring log form. If samples are collected for chemical analysis, the sample ID and depth will also be recorded on the log. We anticipate encountering a silt unit at the base of the borings. The geologist will use hydrogen peroxide to determine if disseminated organics are present in the silt layer to distinguish between the Lawton Clay (no organics-no reaction with peroxide) or Pre-Fraser lacustrine deposits (organics present – reaction with peroxide).

Headspace Vapor

Each sample will be field screened to obtain a relative estimate of its volatile organic carbon (VOC) concentration. This field screening will be performed by measuring the concentration of VOCs in the headspace above the sample in a closed container using a field flame-ionization detector (FID) or photoionization detector (PID). The field screening will be performed by placing the soil into a sealed plastic bag (e.g., Ziploc), disaggregating the soil by hand, allowing the sample to equilibrate for at least five minutes, and then opening the bag slightly, inserting the instrument probe, and measuring the VOC concentration in the headspace. If the ambient temperature is below 65ºF, the sample will be warmed (e.g., in a heated vehicle) before the headspace measurement is made.

The PID will be calibrated daily in the field using the manufacturer’s calibration standard (100 ppm isobutylene gas). A calibration test, referred to as a “bump test,” will be performed as necessary in the field using the calibration gas to check that the PID remains properly calibrated throughout the day.

Sheen Testing

Sheen testing will be conducted by placing soil in a pan of water and observing the water surface for signs of sheen. Sheens are classified as follows:

- **Slight Sheen:** Light, colorless, dull sheen. The spread is irregular and dissipates rapidly.
- **Moderate Sheen:** Light to heavy sheen, may show color/iridescence. The spread is irregular to flowing. Few remaining areas of no sheen are evident on the water surface.
- **Heavy Sheen:** Heavy sheen with color/iridescence. The spread is rapid and the entire water surface may be covered with sheen.

Sample Collection for Laboratory Analysis

All soil samples to be submitted for gasoline-range total petroleum hydrocarbons (TPH-Gx) and VOC analyses will be collected in accordance with U.S. Environmental Protection Agency (EPA) Method 5035A. Since sonic drilling can produce high soil temperatures resulting in loss of volatiles, soil samples will be collected from the center of the soil core. The soil aliquot for these analyses will be collected from the undisturbed soil sample core using a laboratory-supplied modified disposable plastic syringe as required by the EPA Method 5035A, and placed in preweighed laboratory-supplied vials.

For all other analyses, the soil samples will be removed from the sampler using a stainless-steel spoon and placed in a stainless-steel bowl for homogenization with the stainless-steel spoon. Gravel-sized material greater than approximately 0.5 inch will be removed from the sample during mixing. A representative aliquot of the homogenized soil will be placed into certified-clean jars supplied by the analytical laboratory.

The initial laboratory submittal will have samples selected for TPH-Gx, TPH-Dx, and BTEX. Samples will be selected based on field screening and to provide proper horizontal and vertical characterization. Select soil samples from the saturated zone from borings AB-3 and AB-4 will be submitted for analysis of chlorinated volatile compounds (CVOCs). Samples from other borings may be submitted for analysis if necessary to delineate extent of CVOCs in soil.

Based on TPH results, select samples may be submitted for follow-on analysis. Up to five soil samples will be analyzed for MTBE, EDB, EDC, naphthalene and total lead. Samples will be selected from borings AB-5, AB-6, and AB-8, where gasoline-range TPH is detected in laboratory analysis and to provide proper horizontal and vertical characterization. Up to five soil samples will be analyzed for PCBs, cPAHs, cadmium, chromium, nickel, and zinc as a follow-on analysis if oil-range TPH is detected in laboratory analysis. If oil-range TPH is detected in more than five samples, sample selection will be made to provide proper horizontal and vertical characterization.

QC soil samples (e.g., field duplicates and trip blanks) will be collected at the respective frequencies prescribed in Section B3.5 of the QAPP.

Each soil boring will be decommissioned with hydrated granular bentonite in accordance with requirements of Chapter 173-160 WAC.

B.2.1.2 Soil Sample Identification

Each soil sample collected for chemical analysis will be assigned a unique sample identification number including the boring number and the depth from which the sample was collected. For example, the soil sample collected from boring B-10 at a depth of 4 to 5 feet below ground surface (bgs) would be identified as B-10-4-5.

B2.2 Ground Water Sampling

Ground water samples will be collected and handled in accordance with the procedures described below:

- The locking well cap will be removed and the depth-to-ground water will be measured from the surveyed location to the nearest 0.01 foot using an electronic water level measuring device. The depth to the bottom of the monitoring well will also be measured to evaluate siltation of the monitoring well. The water level indicator will be decontaminated between wells.

- The presence of light non-aqueous phase liquid (LNAPL) will be evaluated in all wells screened in the 15-foot zone within the area of LNAPL indicators depicted in Figure 6 of the RIWP. LNAPL presence and thickness will be evaluated using an electronic oil/water interface probe. The oil/water interface probe will be decontaminated between wells.
- Each monitoring well will be purged at a low-flow rate less than 0.5 liter per minute (Puls and Barcelona, 1996; Ecology, 2012) using a peristaltic pump and dedicated tubing (polyethylene tubing with a short length of silicon tubing through the pump head). The tubing intake will be placed just below the center of the saturated section of well screen. During purging, field parameters (temperature, pH, specific electrical conductance, dissolved oxygen, and oxidation-reduction potential [ORP]) will be monitored using a YSI meter and flow-through cell, or equivalent. These field parameters will be recorded at 2- to 4-minute intervals throughout well purging until they stabilize. Stabilization is defined as three successive readings where the parameter values vary by less than 10 percent (or 0.5 milligrams per liter [mg/L] dissolved oxygen if the readings are below 1 mg/L). However, no more than three well casing volumes will be purged prior to ground water sample collection. Three turbidity measurements will also be made before collecting the sample (Hach 2100Q turbidimeter).
- Samples with a field-measured specific electrical conductance greater than 1,000 microSiemans per centimeter (µS/cm) or turbidity greater than 25 nephelometric turbidity units (NTU) will be denoted as such on the chain-of-custody (COC) form, so that the laboratory can employ appropriate sample preparation techniques to avoid analytical interferences for specific analyses.
- If the monitoring well is completely dewatered during purging, samples will be collected when sufficient recharge has occurred to allow filling of all sample containers.
- Once purging is complete, the ground water samples will be collected using the same low-flow rate directly into laboratory-supplied sample containers. Samples for dissolved metals analyses will be filtered using an in-line 0.45 micrometer (µm) filter; at least 0.5 liter of water will be purged through the filter prior to sample collection.
- In wells that have measurable LNAPL, but that require sample collection for CVOC analysis, an additional sampling procedure will be implemented to advance the 1/4-inch peristaltic tubing past the LNAPL. One end of a length of 3/8-inch tubing will be covered with Teflon plumbers tape and the tubing will be placed into the well to a level below the measured LNAPL layer. The 1/4-inch peristaltic tubing will be inserted into the 3/8-inch tubing and pushed through the Teflon tape at the end of the 3/8-inch tubing. Purging and sample collection will then proceed as described above.
- QC ground water samples (e.g., field duplicates and trip blanks) will be collected at the respective frequencies prescribed in Section B3.5.

- Following sampling, the wells cap and monument cap will be secured. Each well's dedicated tubing will be retained in a labeled Ziploc bag for subsequent sampling events. Any damaged or defective well caps or monuments will be noted and scheduled for replacement, if necessary.

B2.2.1 Ground water Sample Identification

Each ground water sample will be assigned a unique sample identification number that includes the well number and the 8-digit date on which the sample was collected. For example, a ground water sample collected from monitoring well MW-10 on December 10, 2016, would be identified as MW-10-121016.B2.6

B.2.3 Sample Custody and Field Documentation

B2.3.1 Sample Custody

Upon collection, samples will be placed upright in a cooler. Ice or blue ice will be placed in each cooler to meet sample preservation requirements. Inert cushioning material will be placed in the remaining space of the cooler as needed to limit movement of the sample containers. If the sample coolers are being shipped, not hand carried, to the laboratory, the COC form will be placed in a waterproof bag taped to the inside lid of the cooler for shipment.

After collection, samples will be maintained in the consultant's custody until formally transferred to the analytical laboratory. For purposes of this work, custody of the samples will be defined as follows:

- In plain view of the field representatives;
- Inside a cooler that is in plain view of the field representative; or
- Inside any locked space such as a cooler, locker, car, or truck to which the field representative has the only immediately available key(s).

A COC record provided by the laboratory will be initiated at the time of sampling for all samples collected. The record will be signed by the field representative and others who subsequently take custody of the sample. Couriers or other professional shipping representatives are not required to sign the COC form; however, shipping receipts will be collected and maintained as a part of custody documentation in project files. A copy of the COC form with appropriate signatures will be kept by consultants's project manager.

Upon sample receipt, the laboratory will fill out a cooler receipt form to document sample delivery conditions. A designated sample custodian will accept custody of the shipped samples and will verify that the COC form matches the samples received. The laboratory will notify the project manager, as soon as possible, of any issues noted with the sample shipment or custody.

B2.3.2 Field Documentation

While conducting field work, the field representative will document pertinent observations and events, specific to each activity, on field forms (e.g., boring log form, as-built well completion form, well development form, ground water sampling form, etc.)

and/or in a field notebook, and, when warranted, provide photographic documentation of specific sampling efforts. Field notes will include a description of the field activity, sample descriptions, and associated details such as the date, time, and field conditions.

B2.4 Ground Water Level Monitoring

Depth-to-ground water measurements will be conducted in monitoring wells using an electric well sounder, graduated to 0.01 foot. Where there is potential for light or dense non-aqueous phase liquid (NAPL), an oil-water interface probe will be used to measure water levels and evaluate the presence of separate-phase product—either floating or at the bottom of the well.

B2.5 Exploration Surveying

Horizontal coordinates for each soil sampling location will be recorded using a hand-held global positioning system (GPS) instrument with real-time differential correction. The horizontal coordinates and elevations of monitoring wells included in the assessment will be surveyed by a licensed surveyor relative to a common horizontal and vertical datum (1988 North American Vertical Datum (NAVD 88)). Monitoring well top-of-casing elevations will be surveyed to the nearest 0.01 foot, and horizontal coordinates to the nearest 0.1 foot, or better. Each well will be surveyed at the marked spot on the top of the PVC well casing from which depth-to-water measurements are collected.

B2.6 Decontamination and Investigative-Derived Waste Management

All non-disposable sampling equipment (stainless steel spoons and bowls) will be decontaminated before collection of each sample. The decontamination sequence consists of a scrub with a non-phosphate (Alconox or Liquinox) solution, followed by tap water (potable) rinse, and finished with thorough spraying with deionized or distilled water. A solvent rinse – methanol or hexane – may be used to remove petroleum product from sampling equipment prior to the decontamination procedure described above.

Investigation-derived waste (IDW) water generated during equipment decontamination and sampling will be containerized in labeled drums. The containerized IDW water will be disposed of appropriately at a permitted off-site disposal facility.

Soil cuttings from borings and disposable personal protective equipment (PPE) will be placed in labeled Department of Transportation (DOT)-approved drums pending the analytical results to determine appropriate disposal. Each drum will be labeled with the following information:

- Non Classified IDW
- Content of the drum (soil, water, PPE) and its source (i.e., the exploration[s] from which the contents came);
- Date IDW was generated; and
- Name and telephone number of the contact person.

The drums of IDW will be temporarily consolidated on-site, profiled (in accordance with applicable waste regulations) based on available analytical data, and disposed of appropriately at a permitted off-site disposal facility. Containers of IDW will be on site less than 90 days from date of generation.

Documentation for off-site disposal of IDW will be maintained in the project file.

B3 Quality Assurance Project Plan

This QAPP identifies QC procedures and criteria required to ensure that data collected are of known quality and acceptable to achieve project objectives. Specific protocols and criteria are also set forth in this QAPP for data quality evaluation, upon the completion of data collection, to determine the level of completeness and usability of the data. It is the responsibility of the project personnel performing or overseeing the sampling and analysis activities to adhere to the requirements of the FSP and this QAPP.

B3.1 Purpose of the QAPP

As stated in the Washington State Department of Ecology's (Ecology) Guidelines for Preparation of Quality Assurance Project Plans for Environmental Studies (Ecology Publication No. 04-03-030, July 2004), specific goals of this QAPP are as follows:

- Focus project manager and project team to factors affecting data quality during the planning stage of the project;
- Facilitate communication among field, laboratory, and management staff as the project progresses;
- Document the planning, implementation, and assessment procedures for QA/QC activities for the investigation;
- Ensure that the DQOs are achieved; and
- Provide a record of the project to facilitate final report preparation.

The DQOs for the project include both qualitative and quantitative objectives, which define the appropriate type of data, and specify the tolerable levels of potential decision errors that will be used as a basis for establishing the quality and quantity of data needed to support the environmental assessment. To ensure that the DQOs are achieved, this QAPP details aspects of data collection including analytical methods, QA/QC procedures, and data quality reviews. This QAPP describes both quantitative and qualitative measures of data to ensure that the DQOs are achieved. DQOs dictate data collection rationale, sampling and analysis designs that are presented in the main body of the RIWP, and sample collection procedures that are presented in the FSP (Section B2 of this Appendix).

B3.2 Project Organization and Responsibilities

The project consultant team involved with data generation includes representatives from the lead party, either Aspect or Leidos, depending on party responsible for the investigation component. Key individuals and their roles on this project are as follows:

Project Manager—Aspect; Leidos. The project manager is responsible for the successful completion of all aspects of this project, including day-to-day management, production of reports, liaison with party and regulatory agencies, and coordination with the project team members. The project manager is also responsible for resolution of non-conformance issues, is the lead author on project plans and reports, and will provide regular, up-to-date progress reports and other requested information to project team and Ecology.

Field Manager—Aspect; Leidos. The field manager is responsible for overseeing the field sampling program outlined in this plan, including collecting representative samples and ensuring that they are handled properly prior to transfer of custody to the project laboratory. The field manager will manage procurement of necessary field supplies, assure that monitoring equipment is operational and calibrated in accordance with the specifications provided herein, and act as the Site Health and Safety Officer.

Data Quality Manager—Aspect; Leidos. The data quality manager is responsible for developing data quality objectives, selecting analytical methods, coordinating with the analytical laboratory, overseeing laboratory performance, and approving QA/QC procedures. The data quality manager is also responsible for overseeing QA validation of the analytical data reports received from the project laboratory. Data will be validated in-house by the lead party for the data collection, either Aspect or Leidos. The validator works independently, with no interference from those who collect and use the Site data.

Laboratory Project Manager – Friedman and Bruya, Inc. (FBI); Eurofins Lancaster Laboratories. Aspect will contract FBI laboratory for the on-property investigation described in this work plan. Chevron will contract Eurofins Lancaster Laboratories for investigation activities for which their responsible. The laboratory project manager is responsible for ensuring that all laboratory analytical work for soil and water media complies with project requirements, and acting as a liaison with the project manager, field manager, and data quality manager to fulfill project needs on the analytical laboratory work. This responsibility also applies to analysis the laboratory project manager subcontracts to another laboratory.

B3.3 Analytical Methods and Reporting Limits

Laboratory analytical methods for soil and ground water analyses to be performed during this environmental characterization are as follow:

Chemical Group and Analyte	Analytical Method
Gasoline Range Organics	NWTPH-Gx
Diesel & Residual Range Organics	NWTPH-Dx
Benzene, Toluene, Ethylbenzene, Xylenes	EPA 8260C or 8021B
Chlorinated Volatile Organic Compounds	EPA 8260C
Petroleum Fractionation (EPH/VPH)	NWEPH and NWVPH
Total/Dissolved Lead, cadmium, chromium, nickel, and zinc	EPA 6000 series
Methyl tert-butyl ether (MTBE) Ethylene dibromide (EDB) and Ethylene Dichloride (EDC), Naphthalene	EPA 8260C
Carcinogenic polycyclic aromatic hydrocarbons (cPAHs)	EPA 8270
Polychlorinated biphenyls (PCBs)	EPA 8082

Tables 2 and 3 of the RIWP, respectively, list the laboratory analytical methods for soil and ground water analyses to be performed. Table B-1 lists samples containers, preservation, and analytical holding times for each analysis.

B3.3.1 Method Detection Limit and Method Reporting Limit

The method detection limit (MDL) is the minimum concentration of a compound that can be measured and reported with a 99-percent confidence that the analyte concentration is greater than zero. MDLs are established by the laboratory using prepared samples, not samples of environmental media.

The method reporting limit (RL) is defined as the lowest concentration at which a chemical can be accurately and reproducibly quantified, within specified limits of precision and accuracy, for a given environmental sample. The RL can vary from sample to sample depending on sample size, sample dilution, matrix interferences, moisture content, and other sample-specific conditions. As a minimum requirement for organic analyses, the RL should be equivalent to or greater than the concentration of the lowest calibration standard in the initial calibration curve. The expected MDLs and RLs from FBI laboratory are summarized in Tables B-3 and B-4 for water and soil samples collected by Aspect, respectively The expected MDLs and RLs from Eurofins Lancaster Laboratory are summarized in Tables B-5 and B-6 for water and soil samples collected by Leidos, respectively.

B3.4 Data Quality Objectives

DQOs, including the Measurement Quality Indicators (MQIs)—precision, accuracy, representativeness, comparability, completeness, and sensitivity (namely PARCCS parameters) —and sample-specific RLs are dictated by the data quality objectives, project requirements, and intended uses of the data. For this project, the analytical data must be of sufficient technical quality to determine whether contaminants are present and, if present, whether their concentrations are greater than or less than applicable screening criteria based on protection of human health and the environment.

The quality of data generated will be assessed against the MQIs set forth in this QAPP. Specific QC parameters associated with each of the MQIs are summarized in Table B-2.

Specific MQI goals and evaluation criteria (i.e., MDLs, RLs, percent recovery (%R) for accuracy measurements, relative percent difference (RPD) for precision measurements, are defined in Tables B-3 through B-6. Definitions of these parameters and the applicable QC procedures are presented below.

B3.4.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared with their average values. Analytical precision is measured through matrix spike/matrix spike duplicate (MS/MSD) samples and laboratory control samples/laboratory control sample duplicate (LCS/LCSD) when there is sufficient sample volume. A laboratory duplicate sample or just an LCS/LCSD may be used in place of an MS/MSD if there is insufficient volume.

Analytical precision is quantitatively expressed as the relative percent difference (RPD) between the LCS/LCSD, MS/MSD, or laboratory duplicate pairs and is calculated with the following formula:

$$RPD\ (\%) = 100 \times \frac{|S - D|}{(S + D)/2}$$

where:
S = analyte concentration in sample
D = analyte concentration in duplicate sample

Analytical precision measurements will be carried out at a minimum frequency of 1 per 20 samples for each matrix sampled, or one per laboratory analysis group. Laboratory precision will be evaluated against laboratory quantitative RPD performance criteria as defined in Tables B-3 through B-6 for specific analytical methods and sample matrices. If the control criteria are not met, the laboratory will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. The RPD will be evaluated during data review and validation. The data reviewer will note deviations from the specified limits and will comment on the effect of the deviations on reported data.

B3.4.2 Accuracy

Accuracy measures the closeness of the measured value to the true value. The accuracy of chemical test results is assessed by “spiking” samples with known standards (surrogates, blank spikes, or matrix spikes) and establishing the average recovery. Accuracy is quantified as the %R. The closer the %R is to 100 percent, the more accurate the data.

Surrogate recovery will be calculated as follows:

$$\text{Recovery (\%)} = \frac{MC}{SC} \times 100$$

where:

SC = spiked concentration
MC = measured concentration

MS percent recovery will be calculated as follows:

$$\text{Recovery (\%)} = \frac{MC - USC}{SC} \times 100$$

where:

SC = spiked concentration
MC = measured concentration
USC = unspiked sample concentration

Accuracy measurements on MS samples will be carried out at a minimum frequency of 1 in 20 samples per matrix analyzed. Blank spikes will also be analyzed at a minimum frequency of 1 in 20 samples (not including QC samples) per matrix analyzed. Surrogate recoveries for organic compounds will be determined for each sample analyzed for respective compounds. Laboratory accuracy will be evaluated against the performance criteria defined in Tables B-3 through B-6. If the control criteria are not met, the laboratory will supply a justification of why the limits were exceeded and implement the appropriate corrective actions. Percent recoveries will be evaluated during data review and validation, and the data reviewer will comment on the effect of the deviations on the reported data.

B3.4.3 Representativeness

Representativeness measures how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the matrix sampled. The FSP sampling techniques and sample handling protocols (e.g., homogenizing, storage, preservation, and use of duplicates and blanks) have been developed to ensure representative samples. Only representative data will be deemed usable. Sampling locations are described in Section 7 of the RIWP. The field sampling procedures are described in the FSP (Section B2) of this SAP.

The representativeness of a data point is determined by assessing the integrity of the sample upon receipt at the laboratory (e.g., consistency of sample ID and collection date/time between container labels versus COC forms, breakage/leakage, cooler temperature, preservation, headspace for VOA containers, etc.); compliance of method required sample preparation and analysis holding times; the conditions of blanks (trip blank, rinsate blank, field blank, method/preparation blank, and calibration blank) associated with the sample; and the overall consistency of the results within a field duplicate pair.

B3.4.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. This goal will be achieved through the use of standard techniques to collect samples, USEPA-approved standard methods to analyze samples, and consistent units to report analytical results. Data comparability also depends on data quality. Data of unknown quality cannot be compared.

B3.4.5 Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid. Results will be considered valid if the precision, accuracy, and representativeness objectives are met and if RLs are sufficient for the intended uses of the data. Completeness is calculated as follows:

$$Completeness\ (\%) = \frac{V}{P} \times 100$$

where:

V = number of valid measurements
P = number of measurements taken

Valid and invalid data (i.e., data qualified with the R flag [rejected]) will be identified during data validation. The target completeness goal for this project is 95 percent.

B3.4.6 Sensitivity

Sensitivity depicts the level of ability an analytical system (i.e., sample preparation and instrumental analysis) of detecting a target component in a given sample matrix with a defined level of confidence. Factors affecting the sensitivity of an analytical system include: analytical system background (e.g., laboratory artifact or method blank contamination), sample matrix (e.g., mass spectrometry ion ratio change, co-elution of peaks, or baseline elevation), and instrument instability.

B3.5 Quality Control Procedures

Field and laboratory QC procedures are outlined below.

B3.5.1 Field Quality Control

Beyond use of standard sampling protocols defined in the FSP, field QC procedures include maintaining the field instrumentation used. Field instruments (e.g., PID for evaluating presence of VOCs in soil samples, and the YSI meter for measuring field parameters during ground water sampling) are maintained and calibrated regularly prior to use, in accordance with manufacturer recommendations.

In addition, field QC samples will be collected and submitted for analyses to monitor the precision and accuracy associated with field procedures. Field QC samples to be collected and analyzed for this RI include field duplicates, trip blanks, and equipment rinsate blanks. The definition and sampling requirements for field QC samples are presented below.

Blind Field Duplicates

Blind field duplicate samples are used to check for sampling and analysis reproducibility; however, the field duplicate sample results include variability introduced during both field sampling and laboratory preparation and analysis, and EPA data validation guidance provides no specific evaluation criteria for field duplicate samples. Advisory evaluation criteria are set forth at 35 percent for RPD (if both results are greater than five times the RL) and two times the RLs for concentration difference (if either of the result is less than five times the RL) between the original and field duplicate results.

Field Duplicates will be submitted “blind” to the laboratory as discrete samples (i.e., given unique sample identifiers to keep the duplicate identity unknown to the laboratory), but will be clearly identified in the field log. **Field duplicate samples will be collected at a frequency of 5 percent (1 per 20) of the field samples for each matrix and analytical method, but not less than one duplicate per sampling event per matrix.**

If a given soil sample depth interval lacks sufficient volume (recovery) to supply material for a planned analysis and its field duplicate analysis, the field duplicate aliquot will be collected for that analysis from another depth interval in that same location if practical.

Trip Blank

Trip blank samples will be used to monitor possible VOC cross-contamination occurring during sample transport. Trip blank samples are prepared and supplied by the laboratory using organic-free, reagent-grade water into a VOC vial prior to the collection of field samples. The trip blank sample vials are placed with and accompany the VOC and TPH-Gx samples through the entire transporting process. **One trip blank will be collected for each soil sampling round and each ground water sampling round where VOC or TPH-Gx analyses are conducted.**

In case a target compound is present in a trip blank, results for all samples shipped with this trip blank will be evaluated and data qualified accordingly if determined that the results are affected.

Equipment Rinsate Blank

Equipment rinsate blanks are collected to determine the potential of cross-contamination introduced by nondedicated equipment (e.g., bladder pump and YSI meter) that is used at multiple sample locations. Deionized water (obtained from the laboratory) is rinsed through the decontaminated sampling equipment and collected into adequate sample containers for analysis. The equipment rinsate blank is then handled in a manner identical to the primary samples collected with that piece of equipment. The blank is then processed, analyzed, and reported as a regular field sample. **The rinsate blank collection frequency will be 1 per 20 samples for each matrix and analytical method,**

but not less than one equipment rinsate per sampling event per matrix. When dedicated equipment is used, equipment rinsate blanks will not be collected.

B3.5.2 Laboratory Quality Control

The laboratories' analytical procedures must meet requirements specified in the respective analytical methods or approved laboratory standard operating procedures (SOPs), e.g., instrument performance check, initial calibration, calibration check, blanks, surrogate spikes, internal standards, and/or labeled compound spikes. Specific laboratory QC analyses required for this project will consist of the following at a minimum:

- Instrument tuning, instrument initial calibration, and calibration verification analyses as required in the analytical methods and the laboratory standard operating procedures (SOPs);
- Laboratory and/or instrument method blank measurements at a minimum frequency of 5percent (1 per 20 samples) or in accordance with method requirements, whichever is more frequent; and
- Accuracy and precision measurements as defined in Table B-2, at a minimum frequency of 5 percent (1 per 20 samples) or in accordance with method requirements, whichever is more frequent. In cases where a pair of MS/MSD or MS/laboratory duplicate analyses are not performed on a project sample, a set of LCS/LCSD analyses will be performed to provide sufficient measures for analytical precision and accuracy evaluation.

The laboratory's QA officers are responsible for ensuring that the laboratory implements the internal QC and QA procedures detailed in the laboratory's Quality Assurance Manual.

B3.6 Corrective Actions

If routine QC audits by the laboratory result in detection of unacceptable conditions or data, actions specified in the laboratory SOPs will be taken. Specific corrective actions are outlined in each SOP used and can include the following:

- Identifying the source of the violation;
- Reanalyzing samples if holding time criteria permit;
- Resampling and analyzing;
- Evaluating and amending sampling and analytical procedures; and/or
- Accepting but qualifying data to indicate the level of uncertainty.

If unacceptable conditions occur, the laboratory will contact the project manager to discuss the issues and determine the appropriate corrective action. Corrective actions taken by the laboratory during analysis of samples for this project will be documented by the laboratory in the case narrative associated with the affected samples.

In addition, the project data quality manager will review the laboratory data generated for this investigation to ensure that project DQOs are met. If the review indicates that non-conformances in the data have resulted from field sampling or documentation procedures or laboratory analytical or documentation procedures, the impact of those non-conformances on the overall project data usability will be assessed. Appropriate actions, including re-sampling and/or re-analysis of samples may be recommended to the project manager to achieve project objectives.

B3.7 Data Reduction, Quality Review, and Reporting

All data will undergo a QA/QC evaluation at the laboratory which will then be reviewed by the responsible data quality manager. Initial data reduction, evaluation, and reporting at the laboratory will be carried out in full compliance with the method requirement and laboratory SOPs. The laboratory internal review will include verification (for correctness and completeness) of electronic data deliverable (EDD) accompanied with each laboratory report. The responsible database manager will verify the completeness and correctness of all laboratory deliverables (i.e., laboratory report and EDDs) before releasing the deliverables for data validation.

B3.7.1 Minimum Data Reporting Requirements

The following sections specify general and specific requirements for analytical data reporting to provide sufficient deliverables for project documentation and data quality assessment.

General Requirements

The following requirements apply to laboratory reports for all types of analyses:

- A laboratory report will include a cover page signed by the laboratory director, the laboratory QA officer, or his/her designee to certify the eligibility of the reported contents and the conformance with applicable analytical methodology.
- Definitions of abbreviations, data flags and data qualifiers used in the report.
- Cross reference of field sample names and laboratory sample identity for all samples in the SDG.
- Completed COC document signed and dated by parties of acquiring and receiving.
- Completed sample receipt document with record of cooler temperature and sample conditions upon receipt at the laboratory. Anomalies such as inadequate sample preservation, inconsistent bottle counts, and sample container breakage, and communication record and corrective actions in response to the anomalies will be documented and incorporated in the sample receipt document. The document will be initialed and dated by personnel that complete the document.
- Case narrative that addresses any anomalies or QC outliers in relation to sample receiving, sample preparation, and sample analysis on samples in the sample delivery group (SDG). The narrative will be presented separately for each analytical method and each sample matrix.
- All pages in the report are to be paginated. Any insertion of pages after the laboratory report is issued will be paginated with starting page number suffixed

with letters (e.g., pages inserted between pages 134 and 135 should be paginated as 134A, 134B, etc.)

- Any resubmitted or revised report pages will be submitted to project manager with a cover page stating the reason(s) and scope of resubmission or revision, and signed by laboratory director, QA officer, or the designee.

Specific Requirements

The following presents specific requirements for laboratory reports:

- Sample results: All soil sample results will be reported on a dry-weight basis. The report pages for sample results (namely Form 1s) will, at minimum, include sample results, RLs, unit, proper data flags, preparation, and analysis, dilution factor, and percent moisture (for solid samples).
- Method blank results.
- LCS and LCSD (if matrix spike duplicate analysis is not performed) results with laboratory acceptance criteria for %R and RPD.
- Surrogate spike results with laboratory acceptance criteria for %R.
- MS and MSD results with laboratory acceptance criteria for %R and RPD. In cases where MS/MSD analyses were not performed on a project sample, LCS/LCSD analyses should be performed and reported instead.

B3.8 Data Quality Verification and Validation

Reported analytical results will be qualified by the laboratory to identify QC concerns in accordance with the specifications of the analytical methods. Additional laboratory data qualifiers may be defined and reported by the laboratory to more completely explain QC concerns regarding a particular sample result. All data qualifiers will be defined in the laboratory’s narrative reports associated with each case.

Data validation will be performed on all data consistent with United States Environmental Protection Agency Stage 2B requirements. In cases where a systematic QC problem is suspected, such as unusual detections of an analyte or consistent outlying results of a QC parameter, a more detailed review will be performed on laboratory records pertinent to the concerned analysis to further evaluate the extend of the QC issue and the final data quality and usability. The actual level of validation for each data point will be entered in the electrical database submitted to the Ecology Environmental Information Management system (EIMs). Data validation will be conducted following the guidance below:

- EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, Office of Superfund Remediation and Technical Innovation, U.S. Environmental Protection Agency, January 2010, USEPA 540/R-10/011
- EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, Office of Superfund Remediation and Technical

Innovation, U.S. Environmental Protection Agency, June 2008, USEPA-540-R-08-01.

The data validation will examine and verify the following parameters against the method requirements and laboratory control limits specified in Tables B-3 through B-6:

- Sample management and holding times;
- Instrument performance check, calibration, and calibration verification;
- Laboratory and field blank results;
- Detection and reporting limits;
- Laboratory replicate results;
- MS/MSD results;
- LCS and/or standard reference material results;
- Field duplicate results;
- Surrogate spike recovery (organic analyses only);
- Internal standard recovery (internal calibration methods only);
- Inter-element interference check (ICP analyses only);
- Serial dilution (metals only);
- Labeled compound recovery (isotope dilution methods only); and
- Ion ratios for detected compounds (high resolution GC/MS methods only).

Data qualifiers will be assigned based on outcome of the data validation. Data qualifiers are limited to and defined as follows:

- U—The analyte was analyzed for but was determined to be non-detect above the reported sample quantitation limit, or the quantitation limit was raised to the concentration found in the sample due to blank contamination.
- J—The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
- UJ—The analyte was not detected above the reported quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- R—The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified.
- DNR—Do not report from this analysis; the result for this analyte is to be reported from an alternative analysis.

In cases of multiple analyses (such as an undiluted and a diluted analysis) performed on one sample, the optimal result will be determined and only the determined result will be reported for the sample.

The scope and findings of the data validation will be documented and discussed in the Data Validation Report(s). The Data Validation Report(s) will be appended to the RI report.

B3.9 Preventative Maintenance Procedures and Schedules

Preventative maintenance in the laboratory will be the responsibility of the laboratory personnel and analysts and ensured by the laboratory project manager. This maintenance includes routine care and cleaning of instruments and inspection and monitoring of carrier gases, solvents, and glassware used in analyses. Details of the maintenance procedures are addressed in the respective laboratory SOPs.

Precision and accuracy data are examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance will be performed when an instrument begins to change as indicated by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet one or another of the method-specific QC criteria.

Maintenance and calibration of instruments used in the field for sampling (e.g., PID for evaluating presence of VOCs in soil samples, and the YSI meter for measuring field parameters during ground water sampling) will be conducted regularly in accordance with manufacturer recommendations prior to use.

B3.10 Performance and System Audits

The project manager has responsibility for reviewing the performance of the laboratory QA program; this review will be achieved through regular contact with the analytical laboratory’s project manager. To ensure comparable data, all samples of a given matrix to be analyzed by each specified analytical method will be processed consistently by the same analytical laboratory.

B3.11 Data and Records Management

Records will be maintained documenting all activities and data related to field sampling and chemical analyses.

B3.11.1 Field Documentation

Raw data received from the analytical laboratory will be reviewed, entered into a computerized database, and verified for consistency and correctness. The database will be updated based on data review and independent validation if necessary.

The following field data will be included in the database:

- Sample location coordinates
- Sample type (i.e., ground water or soil)
- Soil or ground water sampling depth interval

Information regarding whether concentrations represent total phase (unfiltered samples) or dissolved phase (filtered samples) will be compiled and stored in the database. Data will be submitted to Ecology’s Environmental Information Management (EIM) database once data have been reviewed and validated.

B3.11.2 Analytical Data Management

Raw data received from the analytical laboratory will be reviewed, entered into a computerized database, and verified for consistency and correctness. The database will be updated based on data review and independent validation if necessary.

The following field data will be included in the database:

- Sample location coordinates
- Sample type (i.e., ground water or soil)
- Soil or ground water sampling depth interval

Information regarding whether concentrations represent total phase (unfiltered samples) or dissolved phase (filtered samples) will be compiled and stored in the database. Data will be submitted to Ecology’s Environmental Information Management (EIM) database once data have been reviewed and validated.

B4 References for Appendix B

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Table B-1 - Analytical Methods, Sample Containers, Preservation, and Holding Times

Project No. 160092, 4700 Brooklyn Avenue
Seattle, Washington

Sample Matrix	Analytical Parameter	Analytical Method	Sample Container	No. Containers	Preservation Requirements	Holding Time
Soil	Gasoline Range TPH	NWTPH-Gx	Method 5035A, 40-mL vials	4	4°C ±2°C, Freeze within 48 hours to <-7°C	14 days
	Diesel and Motor Oil Range TPH	NWTPH-Dx/SW846 Method 3630 (Silica Gel Cleanup)	4 ounce jar	1	4°C ±2°C	14 days for extraction; 40 days for analysis
	BTEX	Method 8021 B	Method 5035A, 40-mL vials	4	4°C ±2°C, Freeze within 48 hours to <-7°C	14 days
	EPH/VPH	NWEPH/NWVPH	4 Ounce Jar/Method 5035A, 40-mL vials	5	4°C ±2°C, Freeze within 48 hours to <-7°C	14 days
	MTBE, EDC, EDB, Naphthalene	Method 8260	Method 5035A, 40-mL vials	4	4°C ±2°C, Freeze within 48 hours to <-7°C	14 days
	Polychlorinated Biphenyls (PCBs)	Method 8082	4-ounce jar	1	4°C ±2°C	6 months
	Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)	Method 8270	4-ounce jar	1	4°C ±2°C	6 months
	Cadmium, Chromium, Lead, Nickel, Zinc	Method 6020	4-ounce jar	1	4°C ±2°C	6 months
Water	Gasoline Range TPH	Method NWTPH-Gx	40-mL VOA vials	3	4°C ±2°C, HCl pH < 2	14 days
	Diesel and Motor Oil Range TPH	NWTPH-Dx/SW846 Method 3630 (Silica Gel Cleanup)	500-mL amber glass bottle	1	4°C ±2°C	7 days for extraction, 40 days for analysis
	VOCs (including MTBE)	Method 8260	40-mL VOA vials	3	4°C ±2°C, 1 with HCl pH < 2, 2 without HCl	14 days for analysis
	EPH/VPH	NWEPH/NWVPH	1000-mL amber/40-mL VOA vials	4	4°C ±2°C, HCl pH < 2	7 days for extraction, 40 days for analysis/14 days for anlaysis
	Lead	Method 6020	500-mL HDPE bottle	1	4°C ±2°C, $HN0_3$ pH < 2 (after field filtration)	28 days

Notes:
HCL = hydrochloric acid
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis
BTEX = benzene, toluene, ethylbenzene, xylenes
MTBE = methyl tert-butyl ether

Table B-2 - QC Parameters Associated with PARCCS

Project No. 160092, 4700 Brooklyn Ave
Seattle, Washington

Data Quality Indicators	QC Parameters
Precision	RPD values of:
	(1) LCS/LCS Duplicate
	(2) MS/MSD
	(3) Field Duplicates
Accuracy/Bias	Percent Recovery (%R) or Percent Difference (%D) values of:
	(1) Initial Calibration and Calibration Verification
	(2) LCS
	(3) MS
	(4) Surrogate Spikes
	Results of:
	(1) Instrument and Calibration Blank
	(2) Method (Preparation) Blank
	(3) Trip Blank
	(4) Equipment Rinsate Blank (if appropriate)
Representativeness	Results of All Blanks
	Sample Integrity (Chain-of-Custody and Sample Receipt Forms)
	Holding Times
Comparability	Sample-specific Reporting Limits
	Sample Collection Methods
	Laboratory Analytical Methods
Completeness	Data Qualifiers
	Laboratory Deliverables
	Requested/Reported Valid Results
Sensitivity	MDLs and MRLs

Notes:

LCS = laboratory control sample
MDL = method detection limit
MRL = method reporting limit
MS/MSD = matrix spike/matrix spike duplicate
QC = Quality Control
PARCCS = Precision, Accuracy, Representativeness, Comparability, Completeness, Sensistivity

Table B-3 - Measurement Quality Objectives for Water Samples

Friedman and Bruya, Inc

Project No. 160092, 4700 Brooklyn Avenue
Seattle, Washington

Analyte Name	MDL(A)	MRL	LCS/LCS %R(A)	RPD (%)	Surrogate %R(A)
Volatile Organic Compounds (VOCs) by SW8260C (µg/L)					
1,1,1,2-Tetrachloroethane	0.040	0.2	80 – 128	≤40	n/a
1,1,1-Trichloroethane	0.041	0.2	79 – 124	≤40	n/a
1,1,2,2-Tetrachloroethane	0.060	0.2	80 – 120	≤40	n/a
1,1,2-Trichloro-1,2,2-Trifluoroethane	0.043	0.2	76 – 124	≤40	n/a
1,1,2-Trichloroethane	0.129	0.2	80 – 120	≤40	n/a
1,1-Dichloroethane	0.053	0.2	80 – 120	≤40	n/a
1,1-Dichloroethene	0.054	0.2	74 – 120	≤40	n/a
1,1-Dichloropropene	0.034	0.2	80 – 120	≤40	n/a
1,2,3-Trichlorobenzene	0.110	0.5	80 -125	≤40	n/a
1,2,3-Trichloropropane	0.131	0.5	80 – 120	≤40	n/a
1,2,4-Trichlorobenzene	0.107	0.5	77 – 127	≤40	n/a
1,2,4-Trimethylbenzene	0.024	0.2	80 – 122	≤40	n/a
1,2-Dibromo 3-Chloropropane	0.366	0.5	79 – 129	≤40	n/a
1,2-Dibromoethane (Ethylene Dibromide)	0.075	0.2	80 – 120	≤40	n/a
1,2-Dichlorobenzene	0.036	0.2	80 – 120	≤40	n/a
1,2-Dichloroethane	0.072	0.2	80 – 121	≤40	n/a
1,2-Dichloropropane	0.035	0.2	80 – 120	≤40	n/a
1,3,5-Trimethyl Benzene	0.015	0.2	80 – 120	≤40	n/a
1,3-Dichlorobenzene	0.036	0.2	80 – 120	≤40	n/a
1,3-Dichloropropane	0.062	0.2	80 – 120	≤40	n/a
1,4-Dichlorobenzene	0.040	0.2	80 – 120	≤40	n/a
2,2-Dichloropropane	0.052	0.2	72 – 133	≤40	n/a
2-Butanone	0.814	5.0	73 – 123	≤40	n/a
2-Chloro Toluene	0.024	0.2	80 – 120	≤40	n/a
2-Chloroethylvinyl Ether	0.250	1.0	62 – 130	≤40	n/a
2-Hexanone	0.902	5.0	80 – 129	≤40	n/a
4-Chloro Toluene	0.016	0.2	80 – 120	≤40	n/a
4-Isopropyl Toluene	0.026	0.2	80 – 124	≤40	n/a
4-Methyl-2-Pentanone	0.974	5.0	80 – 125	≤40	n/a
Acetone	2.057	5.0	64 – 125	≤40	n/a
Acrolein	2.476	5.0	60 – 124	≤40	n/a
Acrylonitrile	0.604	1.0	76 – 123	≤40	n/a
Benzene	0.027	0.2	80 – 120	≤40	n/a
Bromobenzene	0.060	0.2	80 – 120	≤40	n/a
Bromochloromethane	0.061	0.2	80 – 120	≤40	n/a

Table B-3 - Measurement Quality Objectives for Water Samples

Friedman and Bruya, Inc

Project No. 160092, 4700 Brooklyn Avenue
Seattle, Washington

Analyte Name	MDL$^{(A)}$	MRL	LCS/LCS %R$^{(A)}$	RPD (%)	Surrogate %R$^{(A)}$
Volatile Organic Compounds (VOCs) by SW8260C (µg/L)					
Bromodichloromethane	0.051	0.2	80 – 122	≤40	n/a
Bromoethane	0.041	0.2	77 – 122	≤40	n/a
Bromoform	0.062	0.2	62 – 149	≤40	n/a
Bromomethane	0.252	1.0	68 – 130	≤40	n/a
Carbon Disulfide	0.037	0.2	77 – 124	≤40	n/a
Carbon Tetrachloride	0.044	0.2	71 – 139	≤40	n/a
Chlorobenzene	0.023	0.2	80 – 120	≤40	n/a
Chloroethane	0.086	0.2	68 – 133	≤40	n/a
Chloroform	0.027	0.2	80 – 120	≤40	n/a
Chloromethane	0.095	0.5	77 – 122	≤40	n/a
cis 1,3-dichloropropene	0.061	0.2	80 – 127	≤40	n/a
cis-1,2-Dichloroethene	0.043	0.2	78 – 120	≤40	n/a
Dibromochloromethane	0.048	0.2	80 – 120	≤40	n/a
Dibromomethane	0.145	0.2	80 – 120	≤40	n/a
Dichlorodifluoromethane	0.052	0.2	68 – 133	≤40	n/a
Ethyl Benzene	0.037	0.2	80 – 120	≤40	n/a
Hexachloro-1,3-Butadiene	0.073	0.5	80 – 135	≤40	n/a
Iodomethane (Methyl Iodide)	0.227	1.0	76 – 123	≤40	n/a
iso-propyl Benzene	0.021	0.2	80 – 120	≤40	n/a
Methylene Chloride	0.485	1.0	71 – 125	≤40	n/a
Methyl-tert-butyl ether	0.073	0.5	79 – 121	≤40	n/a
Naphthalene	0.118	0.5	80 – 128	≤40	n/a
n-Butyl Benzene	0.025	0.2	80 – 125	≤40	n/a
n-Propyl Benzene	0.023	0.2	80 – 120	≤40	n/a
sec-Butyl Benzene	0.024	0.2	80 – 121	≤40	n/a
Styrene	0.045	0.2	80 – 121	≤40	n/a
tert-Butyl Benzene	0.026	0.2	80 – 121	≤40	n/a
Tetrachloroethene	0.047	0.2	80 – 120	≤40	n/a
Toluene	0.040	0.2	80 – 120	≤40	n/a
trans 1,3-Dichloropropene	0.081	0.2	79 – 132	≤40	n/a
trans-1,2-Dichloroethene	0.048	0.2	75 – 120	≤40	n/a
trans-1,4-Dichloro 2-Butene	0.324	1.0	47 – 147	≤40	n/a
Trichloroethene	0.049	0.2	80 – 120	≤40	n/a
Trichlorofluoromethane	0.037	0.2	74 – 135	≤40	n/a
Vinyl Acetate	0.069	0.2	74 – 120	≤40	n/a
Vinyl Chloride	0.069	0.2	74 – 120	≤40	n/a
m,p-xylene	0.052	0.4	80 – 120	≤40	n/a
o-Xylene	0.035	0.2	80 – 120	≤40	n/a

Table B-3 - Measurement Quality Objectives for Water Samples

Friedman and Bruya, Inc

Project No. 160092, 4700 Brooklyn Avenue
Seattle, Washington

Analyte Name	MDL[(A)]	MRL	LCS/LCS %R[(A)]	RPD (%)	Surrogate %R[(A)]
Volatile Organic Compounds (VOCs) by SW8260C (µg/L)					
1,2-Dichloroethane-d4	n/a	n/a	80 – 130	≤40	80 – 120
1,2-Dichlorobenzene-d4	n/a	n/a	80 – 120	≤40	80 – 120
Toluene-d8	n/a	n/a	80 – 120	≤40	80 – 120
4-Bromofluorobenzene	n/a	n/a	80 – 120	≤40	80 – 120
Gasoline Range Hydrocarbons by NWTPH-Gx (µg/L)					
Gasoline Range Hydrocarbons	0.057	0.25	80 – 120	≤40	n/a
Bromobenzene	n/a	n/a	77 – 120	≤40	n/a
Diesel and Motor Oil Range Hydrocarbons by NWTPH-Dx with Silica Gel Cleanup (µg/L)					
Diesel Range Hydrocarbons	39	100	61-104	≤40	n/a
Oil Range Hydrocarbons	10	200	60 – 130	≤40	n/a
o-Terphenyl	n/a	n/a	50 – 150	≤40	n/a
Metals					
Lead	0.046	0.1	80 – 120	≤20	n/a

Notes:

(A) = Based on current laboratory control criteria. Some values may vary slightly between instruments and can be subject to change as the laboratory updates the charted values periodically.

%R = percent recovery

LCS/LCSD = laboratory control samples and laboratory control sample duplicate

MDL = method detection limit

MRL = method reporting limit

n/a = not applicable

RPD = relative percent difference

µg/L = microgram per liter

(--) = No PSL identified

Table B-4 - Measurement Quality Objectives for Soil Samples

Friedman and Bruya, Inc.

Project No. 160092, 4700 Brooklyn Ave
Seattle, Washington

Analyte Name	MDL$^{(A)}$	MRL	LCS/LCS %R$^{(A)}$	RPD (%)	Surrogate %R$^{(A)}$
Volatile Organic Compounds (VOCs) by SW8260C (mg/kg)					
1,1,1,2-Tetrachloroethane	0.000233	0.001	80 – 120	≤40	n/a
1,1,1-Trichloroethane	0.000226	0.001	78 – 133	≤40	n/a
1,1,2,2-Tetrachloroethane	0.000253	0.001	71 – 120	≤40	n/a
1,1,2-Trichloro-1,2,2-Trifluoroethane	0.000287	0.002	72 – 142	≤40	n/a
1,1,2-Trichloroethane	0.000286	0.001	77 – 120	≤40	n/a
1,1-Dichloroethane	0.000203	0.001	65 – 139	≤40	n/a
1,1-Dichloroethene	0.000336	0.001	73 – 138	≤40	n/a
1,1-Dichloropropene	0.000312	0.001	80 – 123	≤40	n/a
1,2,3-Trichlorobenzene	0.000305	0.005	76 – 122	≤40	n/a
1,2,3-Trichloropropane	0.000517	0.002	75 – 120	≤40	n/a
1,2,4-Trichlorobenzene	0.000332	0.005	75 – 130	≤40	n/a
1,2,4-Trimethylbenzene	0.00023	0.001	77 – 125	≤40	n/a
1,2-Dibromo-3-Chloropropane	0.000586	0.005	61 – 128	≤40	n/a
1,2-Dibromoethane (Ethylene Dibromide	0.000176	0.001	79 – 120	≤40	n/a
1,2-Dichlorobenzene	0.000293	0.001	77 – 120	≤40	n/a
1,2-Dichloroethane	0.000191	0.001	77 – 120	≤40	n/a
1,2-Dichloropropane	0.000162	0.001	74 – 120	≤40	n/a
1,3,5-Trimethylbenzene	0.000254	0.001	77 – 126	≤40	n/a
1,3-Dichlorobenzene	0.000227	0.001	76 – 120	≤40	n/a
1,3-Dichloropropane	0.000209	0.001	77 – 120	≤40	n/a
1,4-Dichlorobenzene	0.000232	0.001	75 – 120	≤40	n/a
2,2-Dichloropropane	0.000292	0.001	77 – 137	≤40	n/a
2-Butanone	0.000513	0.005	64 – 120	≤40	n/a
2-Chloroethyl Vinyl Ether	0.000276	0.005	20 – 157	≤40	n/a
2-Chlorotoluene	0.0003	0.001	76 – 120	≤40	n/a
2-Hexanone	0.000439	0.005	62 – 128	≤40	n/a
4-Chlorotoluene	0.000277	0.001	75 – 121	≤40	n/a
4-Isopropyl Toluene	0.000236	0.001	78 – 131	≤40	n/a
4-Methyl-2-Pentanone	0.00042	0.005	70 – 124	≤40	n/a
Acetone	0.000482	0.005	48 – 132	≤40	n/a
Acrolein	0.003809	0.05	60 – 130	≤40	n/a
Acrylonitrile	0.001026	0.005	59 – 124	≤40	n/a
Benzene	0.000296	0.001	80 – 120	≤40	n/a
Bromobenzene	0.000153	0.001	75 – 120	≤40	n/a
Bromochloromethane	0.000323	0.001	69 – 133	≤40	n/a
Bromodichloromethane	0.000254	0.001	80 – 122	≤40	n/a
Bromoethane	0.00044	0.002	74 – 132	≤40	n/a
Bromoform	0.000297	0.001	63 – 120	≤40	n/a
Bromomethane	0.000187	0.001	40 – 172	≤40	n/a
Carbon Disulfide	0.000559	0.001	72 – 146	≤40	n/a

Analyte Name	**MDL$^{(A)}$**	**MRL**	**LCS/LCS %R$^{(A)}$**	**RPD (%)**	**Surrogate %R$^{(A)}$**
Carbon Tetrachloride	0.000213	0.001	76 – 136	≤40	n/a
Chlorobenzene	0.000219	0.001	80 – 120	≤40	n/a
Chloroethane	0.000462	0.001	53 – 154	≤40	n/a
Chloroform	0.000234	0.001	75 – 126	≤40	n/a
Chloromethane	0.000263	0.001	65 – 129	≤40	n/a
cis-1,2-Dichloroethene	0.00024	0.001	75 – 124	≤40	n/a
cis-1,3-Dichloropropene	0.000226	0.001	80 – 124	≤40	n/a
Dibromochloromethane	0.000266	0.001	77 – 123	≤40	n/a
Dibromomethane	0.000147	0.001	80 – 120	≤40	n/a
Dichlorodifluoromethane	0.000207	0.001	67 – 142	≤40	n/a
Ethyl Benzene	0.000202	0.001	80 – 120	≤40	n/a
Hexachloro-1,3-Butadiene	0.00041	0.005	72 – 135	≤40	n/a
Iodomethane (Methyl Iodide)	0.000215	0.001	34 – 181	≤40	n/a
Isopropyl Benzene	0.000233	0.001	77 – 127	≤40	n/a
Methylene Chloride	0.000635	0.002	61 – 128	≤40	n/a
Methyl-t-butyl ether (MTBE)	0.000231	0.001	68 – 124	≤40	n/a
Naphthalene	0.000429	0.005	71 – 122	≤40	n/a
n-Butylbenzene	0.000262	0.001	75 – 134	≤40	n/a
n-Propyl Benzene	0.000272	0.001	76 – 126	≤40	n/a
s-Butylbenzene	0.00024	0.001	77 – 127	≤40	n/a
Styrene	0.000138	0.001	80 – 122	≤40	n/a
t-Butylbenzene	0.000306	0.001	77 – 125	≤40	n/a
Tetrachloroethene	0.000257	0.001	76 – 131	≤40	n/a
Toluene	0.000151	0.001	78 – 120	≤40	n/a
Volatile Organic Compounds (VOCs) by SW8260C (mg/kg)					
trans-1,2-Dichloroethene	0.000266	0.001	73 – 131	≤40	n/a
trans-1,3-Dichloropropene	0.000216	0.001	80 – 126	≤40	n/a
trans-1,4-Dichloro-2-Butene	0.000437	0.005	62 – 127	≤40	n/a
Trichloroethene	0.000212	0.001	80 – 120	≤40	n/a
Trichlorofluoromethane	0.000266	0.001	57 – 161	≤40	n/a
Vinyl Acetate	0.000381	0.005	54 – 138	≤40	n/a
Vinyl Chloride	0.000235	0.001	74 – 134	≤40	n/a
m,p-Xylene	0.000392	0.001	80 – 123	≤40	n/a
o-Xylene	0.000224	0.001	80 – 120	≤40	n/a
1,2-Dichloroethane-d4	n/a	n/a	80 – 149	≤40	80 – 122
1,2-Dichlorobenzene-d4	n/a	n/a	80 – 120	≤40	80 – 120
Toluene-d8	n/a	n/a	77 – 120	≤40	80 – 120
4-Bromofluorobenzene	n/a	n/a	80 – 120	≤40	80 – 120

Table B-4 - Measurement Quality Objectives for Soil Samples

Friedman and Bruya, Inc.

Project No. 160092, 4700 Brooklyn Ave
Seattle, Washington

Analyte Name	MDL[(A)]	MRL	LCS/LCS %R[(A)]	RPD (%)	Surrogate %R[(A)]
Gasoline Range Hydrocarbons by NWTPH-Gx (mg/kg)					
Gasoline Range Hydrocarbons	0.057	0.25	80 – 120	≤40	n/a
Bromobenzene	n/a	n/a	49 – 143	≤40	n/a
Diesel and Motor Oil Range Hydrocarbons by NWTPH-Dx with Silica Gel Cleanup (mg/kg)					
Diesel Range Hydrocarbons	1.28	5	60 – 108	≤40	n/a
Oil Range Hydrocarbons	1.57	10	60 – 130	≤40	n/a
o-Terphenyl	n/a	n/a	50 – 150	≤40	n/a
Polychlorinated Biphenyls (PCBs; mg/kg)					
PCB Arochlors	0.0021	0.1	55-130	≤20	n/a
Carcinogenic Polycyclic Aromatic Hydrocarbons					
benzo[a]pyrene	0.000065	0.01	51-118	≤20	24-168
benzo[a]anthracene	0.000088	0.01	51-115	≤20	24-168
benzo[b]fluoranthene	0.000182	0.01	56-123	≤20	24-168
benzo[k]fluoranthene	0.000194	0.01	54-131	≤20	24-168
chrysene	0.000165	0.01	55-129	≤20	24-168
dibenz[a,h]anthracene	0.00025	0.01	50-141	≤20	24-168
indeno[1,2,3-cd]pyrene	0.000183	0.01	49-148	≤20	24-168
Metals					
Lead	n/a	0.1	80-120	≤20	75-125
Cadmium	0.0198	1	70-130	≤20	n/a
Copper	0.189	1	70-130	≤20	n/a
Nickel	0.0335	1	70-130	≤20	n/a
Zinc	0.089	1	70-130	≤20	n/a

Notes:

[(A)] = Based on current laboratory control criteria. Some values may vary slightly between instruments

%R = Percent recovery

LCS/LCSD = Laboratory control samples and laboratory control sample duplicate

MDL = Method detection limit

mg/kg = milligram per kilogram

MRL = Method reporting limit

n/a = not applicable

RPD = Relative percent difference

Table B-5 Measurement Quality Objectives for Water Samples

Eurofins Lancaster Laboratories

Project No. 160092, 4700 Brooklyn Avenue
Seattle, Washington

Analyte	Groundwater					
	Analytical Method	MDL	LOD	LOQ	LCS	RPD
		(ug/L)			(%)	
Petroleum Hydrocarbons (µg/L)						
Gasoline-Range Hydrocarbons	NWTPH-Gx	50	100	250	75-135	≤ 30
Diesel-Range Hydrocarbons	NWTPH-Dx	45	90	100	32-115	≤ 20
Heavy Oil-Range Hydrocarbons	NWTPH-Dx	100	250	250	--	--
Volatile Organic Compounds (VOCs) by SW8260C (µg/L)						
Benzene	USEPA 8260B	0.5	1	1	78-120	≤ 30
Ethylbenzene	USEPA 8260B	0.5	1	1	78-120	≤ 30
Toluene	USEPA 8260B	0.5	1	1	80-120	≤ 30
Total Xylenes	USEPA 8260B	0.5	1	1	80-120	≤ 30
Methyl tert-butyl ether	USEPA 8260B	0.5	1	1	75-120	≤ 30
Vinyl Chloride	USEPA 8260B	0.5	1	1	63-121	≤ 30
Cis-1,2-Dichloroethene	USEPA 8260B	0.5	1	1	80-120	≤ 30
1,2 Dichloroethane (EDC)	USEPA 8260B	0.5	1	1	66-128	≤ 30
1,2-Dibromoethane (EDB)	USEPA 8011	0.0	0.02	0.03	60-140	≤ 20
Metals						
Lead	USEPA 6010	6.2	15	15	80-120	≤ 20

Notes:

LCS = laboratory control sample (supplied by Eurofin Lancaster Labs)

LOD = limit of detection (supplied by Eurofin Lancaster Labs)

LOQ = limit of quantitation (supplied by Eurofin Lancaster Labs; equivalent to PQLs or RLs)

MDL = method detection limit (supplied by Eurofin Lancaster Labs)

RPD = relative percent difference (supplied by Eurofin Lancaster Labs)

µg/L = Micrograms per liter

-- Not applicable or available

Table B-6 - Measurement Quality Objectives for Soil Samples

Eurofins Lancaster Laboratories

Project No. 160092, 4700 Brooklyn Avenue
Seattle, Washington

Analyte	Soil					
	Analytical Method	MDL	LOD	LOQ	LCS	RPD
		(mg/kg)			(%)	
Petroleum Hydrocarbons (mg/kg)						
Gasoline Range Hydrocarbons	NWTPH-Gx	1.000	2.000	5.000	80-120	≤ 30
Diesel-Range Hydrocarbons	NWTPH-Dx	3	6	7	61-115	≤ 20
Heavy Oil-Range Hydrocarbons	NWTPH-Dx	10	20	30	--	--
Volatile Organic Compounds (mg/kg)						
Benzene	USEPA 8260B	0.0005	0.002	0.005	80-120	≤ 30
Ethylbenzene	USEPA 8260B	0.001	0.002	0.005	80-120	≤ 30
Toluene	USEPA 8260B	0.001	0.002	0.005	80-120	≤ 30
Total Xylenes	USEPA 8260B	0.001	0.002	0.005	80-120	≤ 30
Vinyl Chloride	USEPA 8260B	0.001	0.002	0.005	59-120	≤ 30
Cis-1,2-Dichloroethene	USEPA 8260B	0.001	0.002	0.005	8-120	≤ 30
1,2 Dichloroethane (EDC)	USEPA 8260B	0.001	0.002	0.005	70-133	≤ 30
1,2-Dibromoethane (EDB)	USEPA 8260B	0.001	0.002	0.005	80-120	≤ 30
Metals						
Lead	USEPA 6010	0.55	1.5	1.5	80-120	≤ 20

Notes:

LCS = laboratory control sample (supplied by Eurofin Lancaster Labs)
LOD = limit of detection (supplied by Eurofin Lancaster Labs)
LOQ = limit of quantitation (supplied by Eurofin Lancaster Labs; equivalent to PQLs or RLs)
MDL = method detection limit (supplied by Eurofin Lancaster Labs)
RPD = relative percent difference (supplied by Eurofin Lancaster Labs)
mg/kg = milligrams per kilogram
-- Not applicable or not available