Remedial Investigation Work Plan
Coleman Oil Yakima Bulk Plant

Site Name:	Coleman Oil Yakima Bulk Plant
Site Address:	1 East I Street, Yakima 98901
Ecology Site Cleanup ID:	13200
Facility/Site ID:	4233
Agreed Order:	DE 15639
ERTS ID Nos.:	663825, 670092

Prepared for:
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PBS Project No. 41392.000

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SUPPORTING INFORMATION

ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BTEX	Benzene, toluene, ethylbenzene, xylenes
COC	Contaminant/Chemical of Concern
CSID	Cleanup Site Identification number
CSM	Conceptual Site Model
CUL	clean-up levels
Ecology	Washington State Department of Ecology
FS	Feasibility Study
FOC	Fraction of Organic Carbon
FSID	Facility Site identification number
IAWP	Interim Action Work Plan
NAPL	Non-Aqueous Phase Liquid
MTCA	Model Toxics Control Act
PAHs	Polycyclic Aromatic Hydrocarbons
PCS	Petroleum Contaminated Soil
PID	Photoionization detector
QAPP	Quality Assurance Project Plan
RCW	Revised Code of Washington
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
TEE	Terrestrial Ecological Evaluation
TPH	total petroleum hydrocarbon
VCP	Voluntary Cleanup Program
VOCs	Volatile Organic Compounds
WAC	Washington State Administrative Code

1.0 INTRODUCTION

Coleman Oil entered an Agreed Order (No. DE 15639) with other potentially liable parties (PLPs) and the State of Washington Department of Ecology (Ecology). The effective date of the Agreed Order is March 29, 2018. The PLPs are currently:

- Coleman Oil Company, LLC (Coleman Oil)
- BNSF Railway Company (BNSF)
- Carol Jean Wondrack
- Wondrack Distributing, Inc.
- Chevron Environmental Management Company (Chevron)

This Order requires the PLPs to complete a Remedial Investigation (RI), Feasibility Study (FS), and to prepare Draft Cleanup Action Plan (DCAP) for the site identified by Ecology as the Coleman Oil Yakima Bulk Plant located at 1 East I Street in Yakima, Washington (the Site). Refer to Figure 1 Vicinity Map. PBS Engineering and Environmental Inc. (PBS) has completed this Remedial Investigation Work Plan (RIWP) for the Site. The property is currently developed as a petroleum storage and active fueling facility. Continued use as a bulk fueling facility is the only known future land use at this time.

1.1 Purpose of the RI Workplan

The purpose of the RI Work Plan is to detail methods and locations of proposed work intended to meet the objectives of the Remedial Investigation, as described in Task 3 of the Agreed Order Scope of Work. The methods and results of the work will be presented in the RI report.

The intent of the RI Report will be to define the nature and extent of contamination sufficient for the purpose of selection of an appropriate remedial action during the Feasibility Study. The proposed RI investigation program is anticipated to provide data sufficient to meet that objective; however, it is possible that data gaps will be identified that require additional data collection prior to completion of the RI phase of the project.

This RIWP was developed as required by Exhibit B of the Agreed Order, Scope of Work and Schedule.

1.2 Site Description

The site is located in the northeast quarter of Section 13, Township 13 North, Range 18 East of the Willamette Base and Meridian (W.M.). The site is located in an industrial and commercial area of Yakima. The site is generally flat.

1.3 Adjacent Properties

The eastern portion of the subject property is Yakima County Parcel Number 18131314070 and the western portion of the subject property is a part of Parcel Number 18131399997, which is the BNSF easement. The property to the east of the site (Parcel 18131314441) is occupied by a Jack in the Box restaurant. The property to the northeast of the site (Parcel 18131314440) is occupied by Tammy's Mexican restaurant. The parcels to the north of the site (Parcels 18131314057 and 18131314901) are occupied by Carrier Transports Inc., which is a dealer of semi-truck trailers. The parcel to the west and northwest (Parcel 18131399997) is the easement for the BNSF railroad tracks.

1.4 Site History, Ownership and Operation

The eastern portion of the parcel (tax parcel #18131314070) was acquired by Standard Oil Company in 1908. It was owned by Standard Oil Company and thereafter its successor in interest, Chevron U.S.A., until 1986 when it was acquired by Joseph E. Wondrack and Carol J. Wondrack. The eastern portion of the site has been owned by Carol Jean Wondrack since February 2010. The western portion of the site (part of tax parcel #18131399997) is owned by BNSF Railroad as successor in interest to the Northern Pacific Railway Company, which acquired its interest in the parcel from the United States of America, pursuant to Section 2 of the Northern Pacific Land Grant Act of 1864. Wondrack Distributing, Inc. operated the bulk fuel distributing facility located at the Site from 1976 to August 1, 2015. Since August 1, 2015, the bulk fuel distributing facility has been operated by the Coleman Oil Company.

Coleman Oil has made several modifications to the fuel transfer and storage infrastructure. Six aboveground storage tanks (ASTs) were removed from the north central and northeastern portions of the property. The four remaining ASTs are in the northwestern portion of the property. No underground product piping is utilized in the current system. Fuel at the ASTs is bottom loaded and unloaded at the south and eastern areas of the ASTs within secondary containment.

2.0 REGIONAL GEOLOGY AND HYDROGEOLOGY

The site is located in the Yakima Valley, which lies within the central portion of the Columbia River Plateau physiographic province. This province is comprised of a series of flood basalts covering much of central and eastern Washington. The basalt flows of the Columbia River Basalt Group (CRBG) are late Miocene Epoch and early Pliocene Epoch (between 17 and 6 million years ago) in age, forming an extensive volcanic plateau. The Yakima Valley lies between anticlinal ridges that generally trend east-west as part of the Yakima Fold Belt; which consists of basaltic lava flows that have faulted and folded from the late Tertiary to the present. Glacial outwash and river-deposited silt, sand and gravel deposits overlie the Columbia River Basalt.

The closest surface water to the site is the Yakima River, located approximately two miles to the northeast. The calculated groundwater flow direction is to the south-southeast, which is the approximate direction the Yakima River flows through this area of the valley.

The property is located within the flood plain of the Yakima River and is underlain in most areas by Quaternary-age alluvium and unconsolidated terrace deposits. The alluvium is composed of unconsolidated silt, sand, gravel, and cobble. It ranges in thickness from 0 to 120 feet with an average thickness of 20 feet (USGS, 2009). The underlying terrace deposits consist of coarse-grained gravel with discontinuous layers of silt, clay, sand, or cemented gravel. The terrace gravels generally occur at the surface away from the river, and beneath the alluvium adjacent to the river. The thickness of this unit ranges from 0 to 350 feet with an average thickness of 90 feet (USGS, 2009). These unconsolidated Quaternary deposits are overlain in some areas by artificial fill material up to 20 feet deep, and are underlain by consolidated, Tertiary-age, continental sediments, primarily of the Upper Ellensburg Formation.
https://fortress.wa.gov/ecy/publications/documents/1703008.pdf

The Yakima River basin aquifer system underlies about 6,200 square miles in south-central Washington. The aquifer system consists of basin-fill deposits occurring in six structural-sedimentary basins, the Columbia River Basalt Group (CRBG), and generally older bedrock. The basin-fill deposits were divided into 19 hydrogeologic units, the CRBG was divided into three units separated by two interbed units, and the bedrock was divided into four units (the Paleozoic, the Mesozoic, the Tertiary, and the Quaternary bedrock units). The thickness of the basin-fill units and the depth to the top of each unit and interbed of the CRBG were mapped. Only the surficial extent of the bedrock units was mapped due to insufficient data. Average mapped thickness of the different units ranged from 10 to 600 feet.

Lateral hydraulic conductivity (Kh) of the units varies widely indicating the heterogeneity of the aquifer system. Average or effective Kh values of the water-producing zones of the basin-fill units are on the order of 1 to 800 ft/d and are about 1 to 10 ft/d for the CRBG units as a whole. Effective or average Kh values for the different rock types of the Paleozoic, Mesozoic, and Tertiary units appear to be about 0.0001 to 3 ft/d. The more permeable Quaternary bedrock unit may have Kh values that range from 1 to 7,000 ft/d. Vertical hydraulic conductivity (Kv) of the units is largely unknown. Kv values have been estimated to range from about 0.009 to 2 ft/d for the basin-fill units and Kv values for the clay-to-shale parts of the units may be as small as 10-10 to 10-7 ft/d. Reported Kv values for the CRBG units ranged from 4×10-7 to 4 ft/d.
Source: https://wa.water.usgs.gov/projects/yakimagw/summary_of_results.htm

3.0 PREVIOUS SITE CHARACTERIZATION AND INTERIM ACTIONS

PBS completed site characterization investigations and interim cleanup actions at the Site beginning in June 2015. Investigations, interim actions and results are detailed in the Draft Data Summary Report for Coleman Oil Yakima Bulk Plant, PBS, dated May 18, 2018. The report includes figures, tabulated data, boring logs and sampling datasheets. A summary timeline is presented below:

Date	Activity	Summary
June 2015	Due Diligence Investigation	Complete push-probe soil borings/sampling to nine-foot depth to identify potential contamination concerns on the Site. TPHs, PAHs, lead and cadmium were identified in soil samples as contaminants of concern with concentrations exceeding the MTCA Method A Cleanup Levels.
March 2016	Diesel Fuel Release	A diesel fuel release from a subsurface line is confirmed. Site characterization and interim actions include stopping the release and conducting soil excavation work. Approximately 215 tons on PCS were excavated and disposed of off-site.
March 2016	Heat Oil Tank Removal	During excavation work a heat oil tank was discovered and decommissioned by removal.
April 2016	Well Installation	Three monitoring wells and one recovery well were installed on site. Monitoring wells are 2-inch diameter and screened from 15-25 feet bgs (MW1 – MW3). The recovery well is 4-inch diameter and screened from 15-30 feet bgs (RW1). Depth to water was approximately 19-feet.
May 2016	Groundwater Sampling	Static water levels ranged from 19.13 feet below top of casing (fbTOC) in MW1 to 19.18 fbTOC in MW2. Light, non-aqueous phase liquid (NAPL), in the form of diesel product, was identified in RW1 (4.2 feet thickness) and in MW3 (4.7 feet thickness).

Date	Activity	Summary
May to August 2016	NAPL Removal	NAPL was removed directly from RW1 and MW3 using a peristaltic pump. Continuous NAPL removal was unable to be achieved and pumping ceased when NAPL thickness in the well was less than an inch. Eight removal events were undertaken and approximately 4-gallons were removed from MW3 and 48-gallons from RW1.
May 2016 – May 2017	Vacuum Extraction	Vacuum extraction included the rapid removal of NAPL, contaminated groundwater and soil vapor from select wells using a vacuum rig with catchment vessel. Eleven events were undertaken and an approximate total of 3,600 gallons of liquid were removed. Based on observations of storage totes by the subcontractor, it is estimated that 10%, or 360 gallons of diesel product were removed. It is unknown what volume of the contaminant load was removed as vapor.
November 2016	Well Installation	Three additional monitoring wells (MW4-MW-6) were installed and constructed as the originals monitoring wells.
December 2016	Groundwater Sampling	Static water levels ranged from 17.40 fbTOC in MW6 to 23.73 fbTOC in MW3. NAPL identified by the project laboratory as diesel product, was identified in MW5 (0.30-feet thickness). NAPL determined to be mixed diesel and gasoline product was identified in MW2 (8-feet thickness) and MW3 (0.14-feet thickness). RW1 and MW1 were not sampled, but NAPL was observed at thicknesses of 0.25-feet and 1.14-feet, respectively.
December 2016	Vapor Intrusion Evaluation	Air samples were collected from outdoors, in the crawlspace and indoors in the office area. In general, contaminant concentrations indoors were similar to those detected outdoors.
June 2017	Aquifer Testing	A single well, rising head test was undertaken at MW4 and MW6 (No NAPL), for hydraulic conductivity determination.
June 2017	Groundwater Sampling	Static water levels ranged from 16.61 fbTOC in MW6 to 20.81 fbTOC in MW3. NAPL was identified in RW1 (1.48-feet thickness), MW1 (0.16-feet thickness), MW3 (2.87-feet thickness), and MW5 (0.66-feet thickness). NAPL in MW5 was identified as a diesel product and NAPL in MW3 was identified as mixed diesel and gasoline product.

Identified data gaps include:

- The vertical and lateral extent of identified soil contamination is not fully delineated.
- The extent of groundwater contamination is not defined.
- The extent of NAPL is not defined.
- Contaminants in soil gas and the soil vapor intrusion pathway should be more fully evaluated.
- Complete a terrestrial ecological evaluation (TEE) for the Site

4.0 PRELIMINARY CONCEPTUAL CONTAMINANT MIGRATION PATHWAYS

A preliminary conceptual site model (CSM) includes the identification of contaminants of concern and occurrence, impacted media and exposure pathways. The CSM will continue to be developed and will be more formally presented in the Remedial Investigation report.

Contaminants of Concern and Occurrence

The primary COCs are petroleum hydrocarbon contaminants (gasoline, diesel, oil and PAHs) and metals, which are associated with the former and current site use as a fuel storage and distribution facility.

The presence of NAPL indicates that the petroleum releases were of sufficient quantity to move vertically downward under the influence of gravity through the permeable pathways (e.g. unconsolidated soil, fractures, macropores) and ultimately encountered the water table. During the downward movement of NAPL through the soil, the presence of confining layers, subsurface heterogeneities, or other preferential pathways may result in irregular and complex lateral spreading and/or perching of NAPL. Once at the water table, the NAPL will spread laterally in a radial fashion as well as penetrate vertically downward into the saturated zone, displacing water to some depth proportional to the driving force of the vertical NAPL column (or NAPL head). Risks posed by mobile or residual NAPL can be assessed using a variety of site characterization and assessment methods.

Prior releases are likely related to the storage and handling of fuel, and may originate from the following:

- Aboveground and Underground storage tanks
- Piping
- Dispensers
- Surface spills from fuel transfer activities

Known releases include the March 2016 diesel fuel release and the November/December 2016 gasoline fuel release. Both releases are from subsurface pipes and the volume of each release is unknown.

On March 21, 2016, on site personnel noted what appeared to be fuel product seeping to the surface through a crack in the asphalt (<1-gallon). This observation was made when diesel fuel was being pumped through a subsurface line beneath that location. Operation of the pipe was ceased, and visually impacted soil was excavated and removed. Soil samples were collected from the base of the excavation, and the excavation was backfilled. The total depth of the excavation was 5 feet deep, and the approximate sample locations are presented on Figure 2. An underground storage tank (UST) was encountered within the excavation area along the south sidewall and was also removed as part of this response.

Additionally, a December 2016 release of gasoline product to the subsurface from a shallow pipe was confirmed through pressure testing by Coleman Oil personnel, and by the presence of a large amount of free product in the closest groundwater monitoring well (MW2). This release was reported to Ecology on December 14, 2016. This release was assigned Ecology ERTS #670092.

The sources of these releases have been identified and discontinued or removed. Bulk fuel is currently stored in new ASTs (2017) and underground storage and piping is no longer utilized.

Impacted Media

Fuel releases are confirmed to have impacted soil and groundwater on site. NAPL has been confirmed to be present.

- Petroleum impacted soil has been identified in near surface soils, below the prior underground fuel pipes and in proximity of the former dispenser fuel island.

- Petroleum impacted groundwater is present throughout the subject property. Depth to water and depth to NAPL measurements were taken in the existing on-site monitoring wells in April 2018. NAPL was observed in each of the seven wells and ranged in thickness from 0.05-feet in MW6 and 1.4-feet in RW1.

- Impact to soil vapor is suspected based on the prior VI Evaluation (PBS-December 2016), and NAPL at the groundwater interface.

- There is no surface water or sediment in the vicinity of the known releases and these media types are not being evaluated as impacted media.

Human Health Receptors

The following complete exposure pathway is identified:

- Dermal contact with impacted soil by site workers engaged in excavation activities.

The following exposure pathways are considered to be potentially complete:

- Vapor intrusion to indoor air. This pathway should be evaluated further should site use change. This pathway should be evaluated further should the site be occupied by workers who are not included in a company health and safety and medical monitoring plan.

- Groundwater ingestion. The potential for ingestion of contaminants in groundwater from drinking water should be further evaluated to determine that this pathway is not complete.

Ecological Receptors

Impacts to subsurface soil and groundwater, resulting from on-site petroleum hydrocarbon releases, are not currently considered to be a completed exposure pathway concern to ecological receptors, based on the following:

- The site is located in an industrial and commercial urban setting, which is currently zoned for such land uses.
- The site surface is comprised of structures and other hard scape materials (asphalt, concrete).
- The far western portion of the site adjoins the railroad, which is covered in railroad ballast (coarse gravel of approximately 1-foot thickness), which is maintained and replaced by the railroad.
- Overall, the site has no exposed soil, or existing habitat suitable for ecological receptors.
- The migration pathway of contaminated groundwater to surface water and/or sediment is not considered to be complete.

5.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project team members and roles and responsibilities for the remedial investigation activities are summarized below.

5.1 Project Communications

Personnel from the Department of Ecology and each of the PLPs is designated as a lead representative for communication.

Personnel	Project Role	Phone #	Email
WA State Department of Ecology			
Frank Winslow	Ecology Project Coordinator	509-454-7835	fwin461@ECY.WA.GOV
Coleman Oil			
Jim Cach	PLP Project Coordinator	509-396-2177	Jim@colemanoil.com
PBS Engineering			
Ken Nogeire	Coleman Oil's Consultant Project Manager	509-572-8163	Ken.nogeire@pbsusa.com
BNSF			
Shane DeGross	BNSF Lead	253-591-2567	shane.degross@bnsf.com
Wondrack			
John Schultz	Wondrack Lead	509-736-1330	jschultz@tricitylaw.com
Chevron			
Mark Horne	Chevron Lead	925-842-0973	MarkHorne@chevron.com

5.2 PBS Project Manager

The PBS project manager (PBS PM) is charged with ensuring that project activities comply with the RIWP. Duties include but will not be limited to:

- Developing, maintaining, and distributing project documents.
- Reviewing qualifications of proposed technical staff and subcontractors.
- Ensuring that field personnel are familiar with, and adhere to, proper sampling procedures, field measurement techniques, and sample identification and custody procedures.
- Ensuring that sufficient QA samples are collected.
- Reviewing the daily field activity reports.
- Planning and ensuring preparatory, initial, and follow-up inspections as needed.
- Reviewing tables and graphs of analytical data for reporting.
- The PBS PM will additionally act as the analytical data manager, who is charged with organizing, processing, and verifying analytical data generated from sampling activities.

Ken Nogeire, Washington-licensed hydrogeologist, or his designee will serve as the PBS PM for remedial investigation work.

5.3 Field Geologist

The PBS field geologist or engineer is charged with assisting with field documentation and field work under the guidance of the PBS Project Manager.

5.4 PBS Site Health and Safety

The PBS site safety officer (SSO) is responsible for ensuring that daily field activities are conducted safely and according to provisions of the HASP. The SSO has full stop-work authority if adverse conditions exist that threaten personnel health and safety. Ken Nogeire or a member of PBS' field personnel will serve as the SSO during field activities.

5.5 PBS Quality Assurance/Quality Control (QA/QC) Officer

The PBS QA/QC officer is responsible for planning and executing QC oversight of field and laboratory operations and for ensuring compliance with specified QC requirements. Responsibilities include offering guidance related to quality control issues and working with the PBS project manager to identify such issues and verify corrective actions.

Tom Mergy, Washington-licensed hydrogeologist will serve as the PBS QA/QC officer. He will delegate day-to-day duties to the PBS project manager, retaining the role of senior technical reviewer to ensure compliance with the RIWP.

6.0 PROPOSED REMEDIAL INVESTIGATIONS

The following remedial investigations are proposed at this time. The overall implementation of the remedial action will be adaptively managed based on the initial findings of this remedial investigation. Additional remedial actions, and data collection may be necessary to meet MTCA requirements and will be determined as data is collected. It is understood that Ecology will review and approve addendums to this RIWP, as the investigation process proceeds. This RWIP includes a historical file review, a subsurface investigation, collection of soil samples, installation of monitoring wells, groundwater sampling, and NAPL sampling.

6.1 Historical Land Use Review

1. Agency File Check: Using a commercial database search provider, obtain a search of federal, state, tribal, and local listings or records to identify hazardous substance violations, contaminant discharges, and other environmental concerns at varying distances based upon their relative potential impact to the property.
2. Historical Review: Review aerial photographs of the site and adjacent properties to assess previous site conditions and operations. Contact the local Fire Department for information regarding incident responses. Other historical information that may be reviewed includes Sanborn Maps, Historical Directories and County Assessor records.

6.2 Subsurface Investigation

PBS will meet a private utility locator and any interested stakeholders on site approximately one week prior to drilling activities. The purpose of this site visit is to mark drilling locations prior to submitting the required public utility notification. A private utility locating company will use a magnetometer and ground penetrating radar for the purpose of locating subsurface utilities in the vicinity of the boring locations. PBS will also be available to discuss the project in general, specific boring locations and review site plans. Prior to beginning drilling activities, the required public utility clearances notification will be completed.

The site-specific health and safety plan (HASP) will be prepared and reviewed with the drilling contractor prior to beginning site work. The HASP is included as Attachment A.

Soil Investigation

A maximum of 35 test borings will be sampled at depths of up to 25 feet to characterize soil conditions across the Site. The intent of this soil sampling is to obtain soil samples from the near surface elevation (0-2 feet) to document direct exposure to human and ecological receptors, and samples from the vadose zone to confirm vertical migration of petroleum products. It is likely that not all borings will reach the targeted depth of 25 feet, but efforts will be made to obtain as many samples at depth as possible. To maximize data collection efforts, a grid will be setup, and borings will be collected on approximately 15-to 20-foot intervals, making allowance on site infrastructure. Five grids, or decision units) were setup across the site, and represent the operational areas of the facility, and define areas of known releases, and historic contamination. Figure 2 presents the proposed soil sampling locations.

At each sampling location, the entire soil boring will be field screened, and analytical samples will be collected from the surface interval (0 – 2 feet), and at 2-foot intervals through the depth of the core. Very shallow cores, without signs of visual contamination will not be analyzed, but will be sent to the laboratory to be archived and can be analyzed pending the initial results. A direct push drilling rig (track mounted Geoprobe 7822 DT or similar) will be used for the test borings. PBS will field screen soil samples from the proposed locations by hand-held photoionization detector (PID) and by visual and olfactory means. Soil samples will be collected from soils exhibiting field indications of contamination or, in the absence of field indications of contamination, from representative intervals and/or at changes in lithology. PBS will log the soils, making note of grain size, color and odor, and other relevant observations.

Based on previous investigations it is not anticipated that groundwater will be reached with the direct push drilling method. However, should recoverable groundwater be encountered a groundwater “grab” sample will be collected by lowering a temporary well screen into the open borehole and collected by use of a peristaltic pump.

PBS Standard Operating Procedure (SOP) for drilling and soil sampling adds further detail and is included in Attachment B.

The approximate locations of proposed soil borings are presented on Figure 2 Sample Locations.

Monitoring Well Installation

Drill and install five additional on-site monitoring wells (MW7 – MW11). The monitoring wells will be constructed with 2-inch diameter, Schedule 40 PVC, and will be screened above the high-water elevation based on site data.

- Use sonic, or air rotary drill rig to advance borings to approximately 30-feet bgs. The water table is assumed to be 20-24 feet bgs based on known site data. The wells will be screened at 15 feet bgs.
- Collect two to three soil sample from each boring for laboratory analysis.
- Soil cuttings generated by the borings will be containerized in drums for off-site disposal.
- Once the wells are installed, they will be developed by performing a standard "surge and purge", using a surge block, bailer and development pump. Up to 15 gallons of groundwater will be removed from each well, with purge water contained in drums.

The approximate locations of proposed monitoring wells are presented on Figure 2 Sample Locations.

NAPL and Groundwater Sampling

Conduct a groundwater monitoring event (GME) on the monitoring well network (total of 11 wells) located at the project site as follows:

- Gauge depth to water (and depth to NAPL if present) in each well using an electronic inter-face probe.
- If NAPL is present at 2-inches thickness or greater, collect a sample with a disposable bailer, and submit for laboratory analysis. Based on the NAPL, no groundwater sample will be submitted for laboratory analysis.
- If NAPL is not measured, sampling will be conducted using low-flow sampling techniques to ensure minimal drawdown and agitation of well water and the loss of volatiles. This technique will also reduce the volume of purged groundwater needing to be disposed of at an off-site location. Groundwater field parameters (conductivity, pH, temperature, dissolved oxygen and oxidation-reduction potential) will be recorded during purging using a YSI Model 556MSP water-quality analyzer equipped with a flow-through cell. Once groundwater parameters have stabilized, which indicates groundwater is representative of the aquifer formation, a sample will be collected.

Soil Gas Bore Installation and Sampling

Install one soil gas bore on site (see Figure 2 for the proposed location).

- Using a direct push drill rig, advance one boring to 10-feet bgs and remove soil core (2-inch diameter) for disposal.
- Connect a 6-inch stainless steel screen to tubing and lower to placement within the bore at 8.5 to 9-feet bgs.
- Place coarse sand from 7 to 10-feet bgs within the bore (sample interval).
- Complete bore to the near surface with hydrated bentonite grout.
- Complete the bore with capped tubing and a concrete embedded flush mounted monument.

PBS Standard Operating Procedure (SOP) for soil gas sampling is included in Attachment B.

Sample and Analysis Plan
Sample Locations are present on attached Figure 2.

Location	Rationale for Assessment	Contaminants of Interest	Investigation	Sampling and Analysis Information
Grid 1: Vicinity of the formerly used canopy and dispensers	-Near surface contamination identified in 2015 soil assessment -Downgradient well to the south	TPH-Dx, TPH-Gx, PAHs, and select VOCs	Eight soil borings MW12: Install one off-site monitoring well south of Grid 1 Collect one groundwater sample	Screen samples (by PID, visible or olfactory means) Collect soil samples at 2-foot increments from each soil bore. Groundwater: TPHs, SVOCs, select VOCs, PCBs, and MTCA-5 metals
Upgradient 1: Far northwest corner of the property	Upgradient well	TPH-Dx, TPH-Gx, select VOCs, SVOCs, PCBs	MW7: Install one monitoring well Collect one groundwater sample	Groundwater: TPHs, SVOCs, select VOCs, PCBs, and MTCA-5 metals
Grid 2: North central and northeast area of the property	-Upgradient groundwater wells -Near surface contamination identified in 2015 soil assessment	TPH-Dx, TPH-Gx, SVOCs, PCBs, select VOCs, and metals	Six Soil Borings MW8 and MW9: Install 2 monitoring wells	Screen samples (by PID, visible or olfactory means) Collect soil samples at 2-foot increments from each soil bore. Soil Samples: TPHs, select VOCs, PAHs; Groundwater: TPHs, SVOCs, select VOCs, PCBs, and MTCA-5 metals
Grid 3: Southeast area of the property	-Near surface contamination identified in 2015 soil assessment -Downgradient groundwater delineation	TPH-Dx, TPH-Gx, PAHs, and select VOCs and metals	Five soil borings MW10: Install one monitoring well	Screen samples Collect two soil samples from approximately 4 and 12 feet bgs. Soil Samples: TPHs, select VOCs, PAHs and metals Groundwater: TPHs, select VOCs, MTCA-5 metals
Grid 4: Vicinity of former subsurface fuel line	Confirmed Nov/Dec 2016 gasoline release	TPH-Dx, TPH-Gx, PAHs, and select VOCs	Nine soil borings	Screen samples (by PID, visible or olfactory means) Collect soil samples at 2-foot increments from each soil bore. Soil Samples: TPHs, select VOCs, PAHs; Groundwater: TPHs, select VOCs, PAHs

Location	Rationale for Assessment	Contaminants of Interest	Investigation	Sampling and Analysis Information
Grid 5: Western edge	-Spatial distribution and delineation -Downgradient Well to the south	TPH-Dx, TPH-Gx, PAHs, and select VOCs	Five soil borings MW11: Install one off-site monitoring well south of Grid 5. Collect one groundwater sample	Screen samples (by PID, visible or olfactory means) Collect soil samples at 2-foot increments from each soil bore Soil Samples: TPHs and select VOCs Groundwater: TPHs, SVOCs, select VOCs, PCBs, and MTCA-5 metals
Vicinity of occupied office areas	Vapor Intrusion Evaluation	Select petroleum hydrocarbon VOCs	Install and sample soil gas from VB1	Soil Gas: select VOCs by TO-15

NAPL Distribution and Site Specific Hydrogeologic Conditions

PBS will develop a NAPL Conceptual Site Model (NCSM) based on the information obtained during the remedial investigation and proposed interim action pilot test methods. The NCSM is a component of the overall CSM for the Site. The LCSM is the collection of information that incorporates key attributes of the LNAPL body with site settings and hydrogeology to support site assessment and corrective action decision-making.

PBS will prepare an initial NCSM, in conjunction with the overall CSM to address the following:

- NAPL physical properties (density, viscosity, vapor pressure, etc.)
- NAPL body spatial distribution (vertical and horizontal delineation)
- NAPL mobility and body stabilization information
- NAPL recoverability information
- NAPL natural depletion processes

Historically, thickness of NAPL in a well was used to provide unit volume estimates of NAPL, the mobile NAPL interval, and as an indicator for the magnitude of recoverability. Now, it is better understood that higher resolution tools, such as laser induced fluorescence (LIF) or membrane interface probe (MIP) provide a better resolution of NAPL location, and in situ distribution and transmissivity provide a better indication of recoverability. These characterization methods will be evaluated for future use as part of the initial NSCM.

Off-Site Monitoring Well Evaluation

PBS will evaluate drilling and sampling monitoring wells on adjacent properties and/or City of Yakima right of ways to delineate the downgradient extent of contamination in the groundwater. Further inquire into ownership and access to the right of way or off-site properties will be identified at this stage. The placement of off-site wells, if needed will be addressed as a future scope item.

7.0 SCHEDULE

To be included in the finalized RIWP.

8.0 HEALTH AND SAFETY PLAN

A Health and Safety Plan (HASP) has been developed to identify and address hazards related to work activities presented in both this RIWP and the Interim Action Work Plan (IAWP). It is included as Attachment A.

9.0 SAMPLE AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

A Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) has been developed to meet the substantive requirements of MTCA, as presented in WAC 173-340-820 *Sampling and Analysis Plans*. The SAP supports both the this RIWP and the IAWP, as presented in Attachment C.

10.0 PERMITTING

The following are identified permitting or notification requirements:

- Northwest Utility Notification Center – In accordance with Chapter 19.122 RCW, notification shall be undertaken prior to any excavation work, including vertical borings.
- Well Construction Notice of Intent – At least 72 hours prior to installing monitoring well a NOI must be filed with the Depart of Ecology.
- Off-Site Soil Disposal – PCS exported from site must be disposed of to an appropriately licensed/permitted facility. If the disposal facility is in Yakima County approval shall be obtained from the Yakima Health District. Disposal documentation will be retained by Coleman Oil.
- Off-Site Fluids Disposal – Recovered fuel or contaminated groundwater exported from the site must be accepted by an appropriately licensed/permitted facility. Disposal documentation will be retained by Coleman Oil.

11.0 REPORTING

Tabulated data and figures will be submitted to Ecology along with other requested information. All new and recently collected sampling data will be submitted for entry into Ecology's Environmental Information Management System (EIM in accordance with WAC 173-340-840(5) and Ecology's Toxics Cleanup Program Policy 840: Data Submittal Requirements. Formal reporting will be included in the Remedial Investigation report. This report will also include the key findings from the Interim Action conducted separate from the Remedial Investigation. The RI Report will include but not be limited to include:

- Boring logs including observed lithologies, PID readings, sheen testing results, moisture content and saturation, and odors or staining.
- Tabulated historical and current soil and groundwater analytical data compared with MTCA Method A cleanup levels.
- Maps showing locations and depths of historical and current MTCA Method A cleanup level exceedances of primary site constituents in soil and groundwater.
- Table with all historical and current water level and product thickness data.
- Map showing the estimated areas and horizontal extent of LNAPL on groundwater.
- Cross sections showing hydrostratigraphy, water levels, product intervals, monitoring wells, and depths of MTCA Method A cleanup level exceedances of primary site constituents.
- Potentiometric surface map based on water levels from all site monitoring wells.
- Water level hydrographs showing water level and product level changes over time.
- Methods and results of product baildown testing.
- Depiction and discussion of conceptual site model presenting contamination migration between and within site media, and potential receptors.
- Conclusions regarding site constituents of concern (proposed elimination of secondary constituents not found at the site).
- Proposed site cleanup levels (based on exposure scenarios and supporting data).

- Identified data gaps.
- Further data acquisition, and expanded site investigation requirements.

12.0 CLOSURE

PBS has prepared this RIWP for use by the Coleman Oil Company. It will be submitted to the Department of Ecology as a requirement of the Agreed Order.

Sincerely,
PBS Engineering and Environmental Inc.

Digitally signed by Ken Nogeire
Date: 2018.08.16 16:21:39 -07'00'

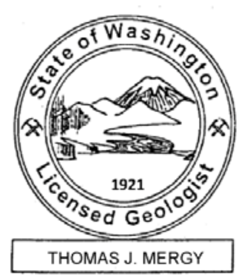
August 16, 2018

Ken Nogeire, LHG — Date
Senior Geologist/Hydrogeologist

Digitally signed by Nathan Williams, PE
Date: 2018.08.16 16:27:29 -07'00'

August 16, 2018

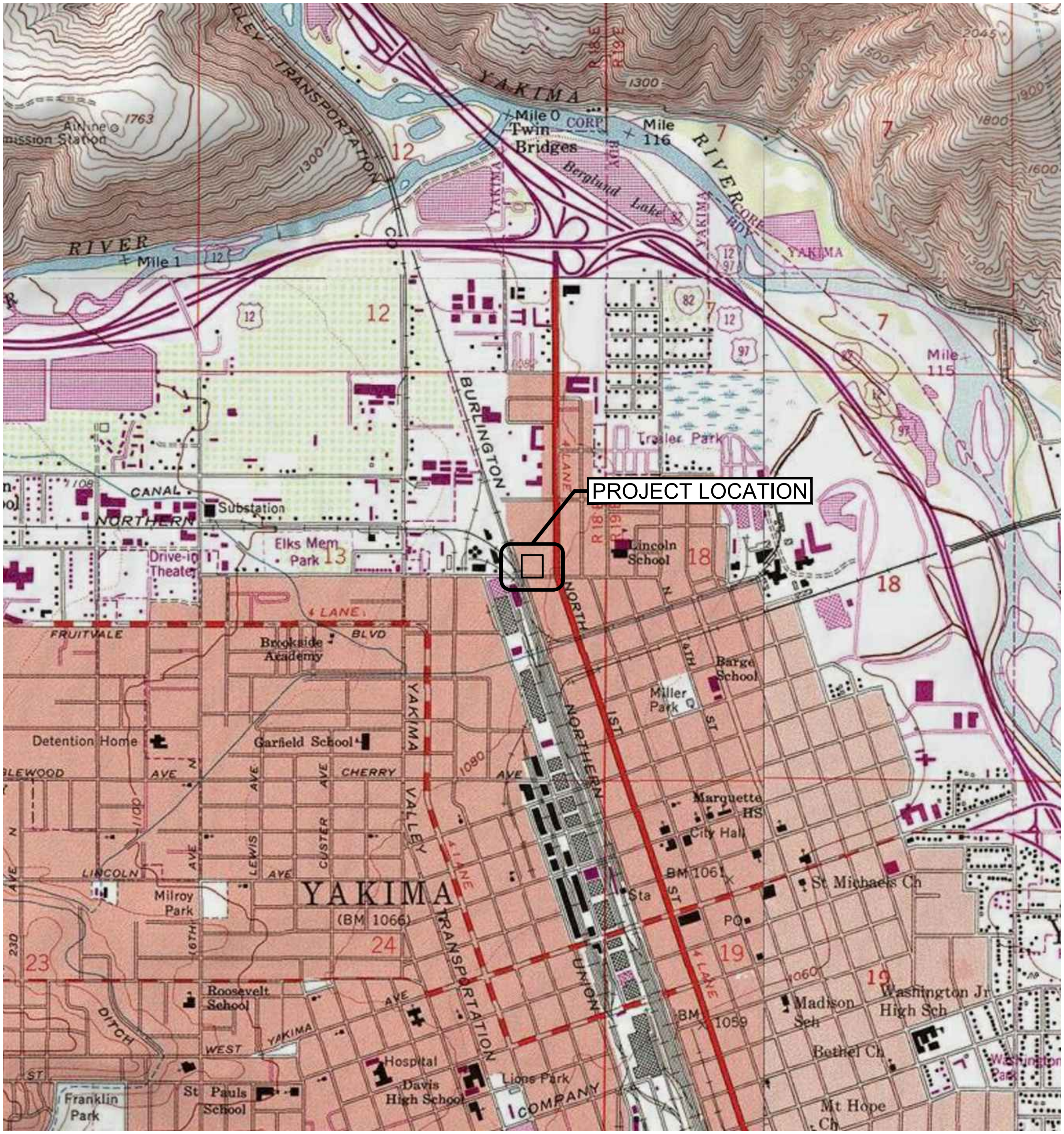
Nathan Williams, PE — Date
Senior Environmental Engineer



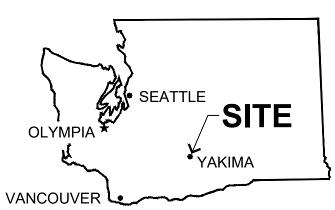
August 16, 2018

Thomas Mergy, LHG — Date
Senior Hydrogeologist
Environmental Services Manager

FIGURES



SOURCE: USGS YAKIMA WEST, WA QUADRANGLE 1985



WASHINGTON

Scale 1" = 2,000'

0' 1,000' 2,000' 4,000'

PREPARED FOR: COLEMAN OIL

PBS

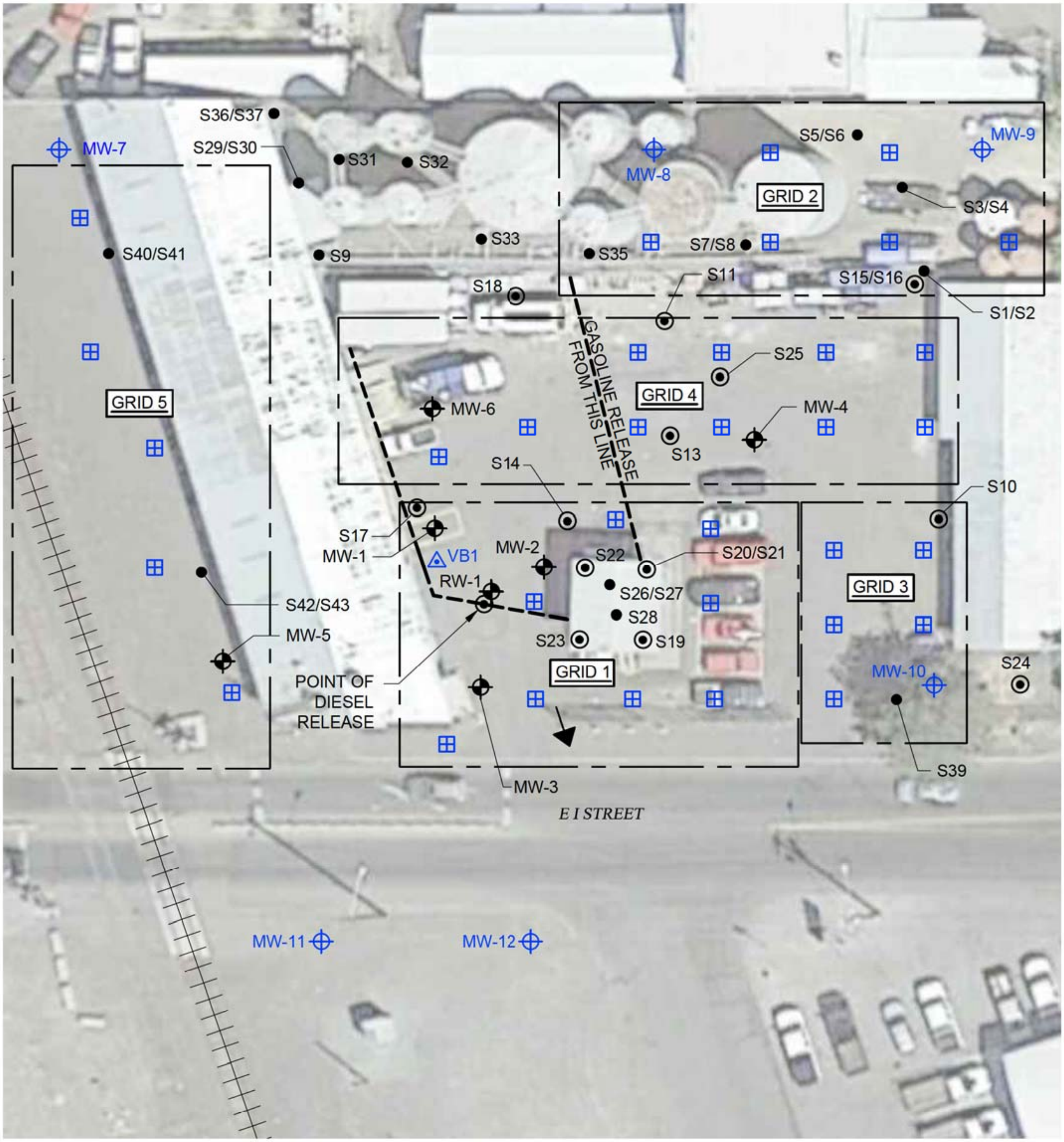
VICINITY MAP

1 EAST I STREET
YAKIMA, WASHINGTON

AUG 2018
41392.000

FIGURE
1

Filename: L:\Projects\41000\41392 Coleman Oil\CAD\Work Plan Figs\41392.000_FIG-1.dwg Layout Tab: VICINITY MAP User: Rebecca Snellings CAD Plot Date/Time: 8/16/2018 12:20:21 PM



SOURCE: © 2017 GOOGLE EARTH PRO

LEGEND

MW-1	EXISTING WELL NUMBER AND LOCATION (RW-1, MW-1 - MW-6)
MW-7	PROPOSED WELL NUMBER AND LOCATION (MW-7 - MW-12)
S1	NEAR SURFACE SOIL SAMPLE NUMBER AND APPROXIMATE LOCATION (APRIL 2015)
S11	SOIL BORING NUMBER AND APPROXIMATE LOCATION (APRIL 2015)
	PROPOSED BORING APPROXIMATE LOCATION
VB1	VAPOR BORE NUMBER AND LOCATION
	APPROXIMATE GROUNDWATER FLOW DIRECTION
	FORMER SUBSURFACE FUEL LINES

N

Scale 1" = 30'

0' 15' 30' 60'

PREPARED FOR: COLEMAN OIL

PBS

SITE PLAN: SAMPLE LOCATIONS

1 EAST I STREET
YAKIMA, WASHINGTON

AUG 2018
41392.000

FIGURE
2

Filename: L:\Projects\41000\41392 Coleman Oil\CAD\Work Plan Figs\41392.000_FIG-2.dwg Layout Tab: FIG-2_AUG2018 User: Rebecca Snellings CAD Plot Date/Time: 8/16/2018 4:01:14 PM

ATTACHMENT A

Health and Safety Plan

Site-Specific Health and Safety Plan
Investigative and Remedial Actions

PBS Project Name:	Coleman Oil Yakima Bulk Plant
PBS Project Number:	41392.000
Property Address:	1 East I Street, Yakima, WA 98901
Proposed Scope of Work:	Interim Actions for petroleum based NAPL testing/removal; Site Characterization drilling, well installation, soil, soil gas and groundwater sampling/monitoring
HASP Preparation Date:	June 27, 2018
HASP Preparer:	Ken Nogeire, LHG
HASP Reviewer:	Tom Mergy, LHG

All work that PBS employees perform is conducted under the PBS Safety Plan, which provides the basis upon which safety decisions should be made to maintain a safe and healthy work environment. All employees are required to read and abide by the contents in the PBS Safety Plan as a condition of employment.

A site-specific health and safety plan (HASP) is created to serve as a tool by which information about a project can be communicated to employees prior to field activities. As allowed under 29 CFR 1910.120(b)(1)(ii)(C), this HASP supplements the PBS Safety Plan and does not repeat standard operating procedures for safety and health. The information contained in this HASP is site-specific and directly applicable to the proposed scope of work.

The procedures and requirements contained in this HASP are intended for PBS personnel performing field activities. PBS Subcontractors have the sole responsibility for safety of their own personnel.

If field conditions change or are different than what was assumed during HASP preparation, this plan shall be modified to reflect the current conditions.

A. PROJECT CONTACTS

PBS Project Manager	Ensures that HASP is complete and employees are in compliance with HASP	
	Name:	Ken Nogeire
	Office #:	206.233.9639
	Mobile #:	509.572.8163
PBS Site Safety Officer	Responsible for implementation of HASP during field-related activities (PBS Project Manager may serve this role)	
	Name:	Ken Nogeire
	Office #:	206.233.9639
	Mobile #:	509.572.8163
Client Contact	Name:	Jim Cach
	Office #:	NA
	Mobile #:	208.791.6288

Emergency Telephone Numbers

Ambulance/Police/Fire...911
Poison Control Center...800.222.1222
National Response Center.......................................800.424.8802
EPA Environmental Response Team 206.553.1200

Utility Notification Center (Washington).............800.424.5555
Puget Sound Energy Gas - Emergency................888.225.5773
Washington OSHA Central (Tumwater)...............360.902.4200

B. NEAREST HOSPITAL / EMERGENCY MEDICAL CENTER

Facility Name: Memorial Hospital
Street Address: 2811 Tieton Dr.
City, State: Yakima, WA
Phone # : 509.575.8000

Route directions:

Head west on E. I Street

Turn left onto N. 5th Ave

At the traffic circle, take the first exit onto Fruitvale Blvd

Turn left onto N. 16th Ave

Turn right onto W. Tieton Dr (destination will be on your right)

C. CONTAMINANTS OF INTEREST

The proposed activities may encounter contamination in water (ground or surface), soil, or soil gas at the site. Suspect or known contaminants of interest are listed in Table 1.

Table 1. Potential Contaminants of Interest and Exposure Pathways

Substance	Potential Media			Concentrations (List value if known, include units)
	Soil	Water	Soil Gas	
Diesel-range	☑	☑	☑	NAPL
Gasoline-range	☑	☑	☑	NAPL
Heavy Oil-range	☑	☑	☐	NAPL
Waste Oil	☐	☐	☐	
Benzene	☑	☑	☑	NAPL
Toluene	☑	☑	☑	
Ethylbenzene	☑	☑	☑	
Xylenes	☑	☑	☑	
Naphthalene	☑	☑	☑	
PCBs	☐	☐	☐	
(list individual heavy metals)	☐	☐	☐	
(list individual PAHs)	☐	☐	☐	
(list individual VOCs)	☐	☐	☐	
	☐	☐	☐	
	☐	☐	☐	
	☐	☐	☐	

D. JOB HAZARD ANALYSIS (JHA)

Hazards at a job site typically fall into physical, chemical, and biological categories. A job hazard analysis (JHA) is a technique that focuses on job tasks as a way to identify and mitigate or eliminate hazards.

The duties for this job are:

- Gauge diesel and gasoline NAPL thickness
- Conduct NAPL removal/baildown
- Pumping Pilot Test
- Drilling oversite for soil assessment, soil vapor bore installation, monitoring well installation
- Sample soil, soil gas, groundwater and NAPL

The following table provides a JHA for the potential risks and hazards that may be present during field activities.

Table 2. Job Hazard Analysis

Field Activities	Risks / Hazards	Recommended Mitigation / Controls
Measuring, handling, extracting free petroleum products (gasoline and diesel)	Chemical exposure Fire / Explosion	• Review this hasp with the contractor. Discuss hazards and mitigation related to contractor equipment (rig grounding). • Discuss planned activities and free product with other onsite personnel. • Have a spill kit in the work area that includes absorbants and bags or bin. • Survey for possible ignition sources prior to opening wells • Use intrinicaly safe Interface probe to measure product thickness in well. • Reel up IP and lift hose up through papertowel to remove free liquid. Discard paper towel. • Wear nitrile gloves • Clear escape route and rendevous point.

Field Activities	Risks / Hazards	Recommended Mitigation / Controls
Work around and with large equipment (such as a drill rig)	Vehicular traffic and large equipment operation	• Communicate scope of work/tasks to equipment operators and ground personnel during daily tailgate meeting. • Verify where equipment operator wants ground personnel to stand. • Stay alert to vehicle operations; stay clear of them during movement. • Wear safety vest for high visibility. • Wear hard hat and safety-toed shoes; follow personal protective equipment (PPE) requirements in this HASP. • Communicate with subcontractor on information you need. • Pay attention to what is going on around you when taking photos or notes.
	Noisy environment	• Bring and wear hearing protection; follow PPE requirements in this HASP.
	Airborne debris from equipment movement or operation	• Stay clear of equipment when in operation . • Wear safety glasses if warranted; follow PPE requirements in this HASP. • Maintain upwind position when possible.
	Subsurface or overhead utilities may be encountered or impede field activities	• Coordinate with the subcontractor to have public and private utilities located prior to commencement of work. • Have property owner provide locations of on-site private utilities. • Utilize alternate drilling methods , such as hand augering or a vactor truck, if location and depth of utilities are unknown or pose a risk.
Carry monitoring and sampling equipment from field vehicle to work zone	Equipment may be heavy or awkward to lift and carry	• Plan your route to work zone. • Carry equipment in field vehicle to greatest extent possible. • Do not overload; make multiple trips if needed. • Get assistance to carry items.
Work in vicinity of and with contaminated media (soil, soil gas, groundwater)	Ingestion of or dermal contact with contaminants of concern (contaminated soil or groundwater)	• Wear gloves (typically nitrile); dispose of gloves as appropriate for site conditions. • Minimize time in contact with soil and groundwater. • Decontaminate or dispose of sampling equipment as appropriate for site condition. • Wash hands and face prior to eating.

Field Activities	Risks / Hazards	Recommended Mitigation / Controls
	Inhalation of vapors from contamination	• Monitor breathing space in work zone with photoionization detector (PID) and make adjustments to location or PPE as necessary. • Stand upwind of borehole/drill rig. • Communicate with subcontractor on PID readings and take appropriate action when necessary. • Do not stand directly over boreholes.
Working outside	Weather (heat, strong winds, cold)	• Check weather report when preparing for the field. • Bring weather-appropriate clothing and outerwear. • Refer to PBS safety procedure on heat and cold stress. • Stay hydrated and eat at regular intervals.
	Encounter angry tenants, neighbors, or transients	• If possible, have client/property representative alert tenants to site visit prior to it occurring. • Keep cell phone charged and available for quick use. • If known in advance to be a hazard, use the buddy system. • Do not engage people in discussion unless warranted.
	Disturbing dogs, larger animals, or insects	• Be alert for these conditions. • Do not disturb the animals; do not enter their areas. • Work with the property owner if access is needed.
	Encountering poisonous plants	• Know how to identify poisonous plants if known or suspected to be present at site. • Wear long pants and long sleeves, if warranted. • Have disposable gloves available to use. • Have steroid cream or similar product available in case there is accidental exposure.
	Slips, trips, or falls on uneven ground or due to equipment, cords, or other materials lying on ground	• Watch where you are walking. • Do not take shortcuts – determine the safest path before proceeding.
Driving to site	Accident	• Know where you are going. Have directions ready • Do not use mobile phone • Make sure vehicle has been serviced appropriately
Additional Observed Hazards	Railroad Operations	• Coordinate with BNSF when working within 25 feet of the railroad • Do not walk on,or cross tracks

Field Activities	Risks / Hazards	Recommended Mitigation / Controls
		•
		•

E. EMPLOYEE TRAINING REQUIREMENTS

- Review HASP; sign acknowledgement page
- Review site-specific work plan
- Attend tailgate safety meeting

F. AIR MONITORING REQUIREMENTS

Equipment:	NA
Calibration gas:	Isobutylene
Action Limit Concentration:	10 ppm
Minimum Frequency of Measurements:	Hourly during drilling activiites

G. PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE is selected based on the contaminant type(s), concentration(s) in applicable matrix (soil, water, air) and the known route(s) of entry into the human body. Project personnel are not permitted to use lower levels of protection from the specified levels of protection without the prior approval of the Site Safety Officer.

PPE Level:	Modified Level D
Safety Boots (toe protection):	Required
Hard Hat:	Required when working around heavy equipment
Safety Vest:	Required when personal visibility is necessary
Safety Glasses/ Goggles:	Required when working near drill rig
Hearing Protection:	Required when working around loud equipment.

Gloves:	Nitrile gloves used during sample collection (including purging and preparatory activities)
Level C PPE: (respirator and chemical-resistant clothing)	Not required for this project. If PID readings exceed action levels, this HASP must be modified to reflect requirements for proceeding under Level C PPE.

H. HAZWOPER-SPECIFIC REQUIREMENTS

Emergency Response Attachment 1 is a standard emergency response plan. Site-specific information is provided below. If site conditions warrant a detailed emergency response plan, this HASP must be modified to include it.

Decontamination Decontamination procedures should be described in a site-specific work plan. If site conditions warrant upgraded decontamination procedures, this HASP must be modified to include them.

Confined Space Entry Not expected on this project.

PBS employees are not allowed to enter permit-required confined spaces. Refer to PBS Safety Plan for more details.

Medical Surveillance Not specifically required for this project.
Refer to PBS Safety Plan for the corporate medical surveillance program.

Site Control / Work Zones Drilling locale must be made visible and only people working on the project are allowed near the drill rig and other heavy equipment.

If site conditions warrant separate work zones, this HASP must be modified to identify Exclusion (Hot), Decontamination (Warm), and Support (Cold) Zones.

I. ACKNOWLEDGEMENT PAGE

SITE: Coleman Oil – Yakima, Washington

PROJECT NUMBER: 41392

PBS Employees: *I have read this HASP and will abide by the requirements specified for this project.*

NAME	SIGNATURE	DATE

Non-PBS Employees: *I have attended a tailgate safety briefing or have been briefed on site hazards by the Site Safety Officer.*

NAME	SIGNATURE	COMPANY	DATE

ATTACHMENT 1 – STANDARD EMERGENCY RESPONSE PLAN

This standard Emergency Response Plan is provided to guide the Site Safety Officer (SSO) during emergency situations. Such situations include but are not limited to: fire or explosion, medical emergencies, and uncontrolled contaminant release.

The following emergency equipment shall be kept on site:

- A fire extinguisher will be kept in the PBS field vehicle. A fire extinguisher must also be kept in vicinity of drilling activities (typically the responsibility of the drilling contractor). The extinguisher will be Type ABC approved by the National Fire Prevention Association (NFPA). The extinguisher will be serviced or replaced yearly.
- A first-aid kit will be available in the PBS field vehicle.
- PBS employees will carry a mobile phone or other appropriate emergency communication device (e.g., satellite personal tracker) to the project site.

Plan Implementation

The Site Safety Officer (SSO) will have primary responsibility for directing activities in the event of an emergency situation. The SSO will evaluate the situation and will determine the need to implement the emergency procedures in concert with other personnel (may include client representatives and the Project Manager). Other field personnel will assist the SSO as required during the emergency.

If the Emergency Response Plan is implemented, the SSO or designees are responsible for alerting all personnel at the affected area by use of a signal device (such as a hand held air horn), visual, or shouted instructions, as appropriate.

Emergency Contacts

Contact phone numbers and hospital information must be provided in each site-specific health and safety plan (HASP). The HASP will be kept in the SSO’s vehicle or other unlocked location so that PBS field personnel and subcontractors can readily access it.

Fires

If a fire occurs, the area should be evacuated and a call placed to 911 for the local fire department. If immediate use of a fire extinguisher for a small, non-explosion-related fire can reduce the chance of injury or property damage, then it may be done with caution but is not required. If an explosion appears likely, evacuate the area immediately and call 911. The PM should be informed immediately of the situation.

Medical Emergencies

If a worker is seriously injured or becomes ill or unconscious, call 911. If a worker leaves the site to seek medical attention, another worker must accompany the patient to the medical facility.

When in doubt about whether medical attention is necessary, always seek medical attention as a conservative approach. Notify the PM of the outcome of the medical evaluation as soon as possible.

In the event that a seriously injured person is also heavily contaminated, inform the emergency personnel immediately prior to their transporting the person off-site. Less severely injured individuals may have their protective clothing carefully removed or cut off before transport to the hospital.

Spills or Leaks

PBS and its subcontractors will follow all applicable local, state, and federal regulations regarding petroleum or hazardous substance releases. Following any quantity of release, the PM (if not on site) will be notified, and notification will be made to regulatory agencies, as appropriate.

Emergency Notification, Documentation and Review

The PM and/or the SSO will notify the PBS Human Resources Manager as soon as possible after an emergency situation has been stabilized. The PM will also notify the appropriate client contacts and regulatory agencies, if applicable. If an individual is injured, the PM will complete and submit a PBS Accident Report within 24 hours.

The PM and a PBS senior manager will critique the emergency response action following the event. The results of the review will be used to improve future Emergency Response Plans and actions.

ATTACHMENT B

PBS Standard Operating Procedures
-Drilling and Soil Sampling Procedures
-Soil Gas Sampling

STANDARD OPERATING PROCEDURE
Drilling and Soil Sampling Procedures

1 PURPOSE

This Standard Operating Procedure (SOP) provides an overview of mobile drilling methods typically used during environmental investigations along with associated health and safety issues. This document outlines procedures to be followed by PBS personnel during drilling and soil sampling activities. Groundwater and soil gas sample collection through the use of drill rigs are covered under separate SOPs.

2 TYPES OF DRILL RIGS

There are three types of drilling methods that are typically used for environmental investigations: direct push, auger, and sonic. Each type of drilling method is described below. A fourth option, discussed in Section 2.4, is a hand auger tool.

2.1 Direct-Push Drilling

Direct-push drilling methods are a common drilling technology used in environmental investigations due to the small diameter borehole (two and one-quarter inch (2.25")) that generates significantly less investigation-derived waste (IDW). The rigs are hydraulically powered, and use static and percussion force to advance the drill rods. Limited access rigs are available for interior locations while track-mounted rigs allow for sampling in locations with unimproved roads.

The rods are equipped with disposable plastic liners that contain the soil retrieved for observation and sampling. The entire column of rods is removed from the ground each time to retrieve soil for sampling. The rod lengths can be 3, 4, or 5 feet. Because of this, if caving or excessive slough is a concern, the borehole may be temporarily cased to keep it clear and open during soil sample retrieval.

2.2 Hollow Stem Auger Drilling (HSA)

Hollow stem auger drilling methods use hollow corkscrew drilling flights to advance into the subsurface. The borehole is typically 11 inches in diameter, with the flights having a 6-inch inner diameter space in which to retrieve samples or construct wells. The hollow stem auger drill rigs have better capability to penetrate higher density deposits that the direct push probe method. Some direct-push rigs have the capacity to drill with hollow stem auger flights, but these rigs typically do not have the mechanical power to drill through challenging soil. The use of auger drill rigs for environmental investigations is typically for the installation and decommissioning of monitoring wells.

Soil sampling with an auger drill rig is conducted through the use of split spoon samplers or Shelby tubes deployed through the inner hollow space. Split spoon samplers are typically 2.5 feet in length and advanced by hammer weight blow into the undisturbed soil. Shelby tubes are typically used in soft deposits such as clays. Soil brought to the surface on the exterior of drilling flights is considered drill or soil cuttings. Soil samples should not be collected and analyzed from the cuttings because that soil may have come in contact with other soil or contamination from varying depths.

2.3 Rotosonic Drilling

Rotosonic drilling methods (hereafter referenced as sonic method) advance drill rod flights into the ground through the use of vibration, and full-size sonic rigs can advance rods through very challenging unconsolidated geologic formations including large cobbles. The borehole size varies but typically is 4 to 6 inches in diameter.

Due to the nature of the drilling technology, the soil can be disturbed by the vibrations, so consistency and compaction are unreliable. Soil is vibrated out of the lead flight into plastic bags for observation and sampling. The entire column of rods is removed from the ground each time to retrieve soil for sampling; if caving or excessive slough is a concern, the borehole may be temporarily cased to keep it clear during soil sample retrieval.

2.4 Hand Auger Tool

A fourth drilling option is the use of a hand auger tool, sometimes called a handheld auger. This tool, made of steel, is used to bore a hole in soil or sediments. It is intended for use only by hand and is powered by human force by twisting or screwing the tool into the soil. The soil is retrieved through a short barrel that attaches to the base of the auger rods. This tool is used for sites where the soil is relatively easy to penetrate, and when sampling is limited to the upper 5 to 10 feet of the shallow surface. Different barrels are available for coarse-grained or fine-grained material.

3 HEALTH AND SAFETY PLAN

A Health and Safety Plan (HASP) must be developed prior to fieldwork commencing. Typically, a site-specific HASP is prepared from a PBS template for drilling investigations. In all cases, pertinent safety information must be relayed to field personnel, including subcontractors, to communicate mandatory elements from the federal code for hazardous waste operations and emergency response (29 CFR 1910.120(b)(4)).

4 UTILITY LOCATES

Utility locates will be completed on all drilling projects including hand-augered sampling. The property owner or site manager should be interviewed regarding the potential location of buried utilities or other subsurface obstructions on the property. The call-in numbers are provided below. Alternately, PBS personnel can obtain log-ins to file locate requests on-line (Internet Ticket Processing, http://www.callbeforeyoudig.org/index.asp).

Oregon Utility Notification Center: 1-800-332-2344
Washington Utility Notification Center: 1-800-424-5555

The Utility Notification Center needs to be contacted at least 48 hours (two business days) in advance to locate utility-owned lines up to the meter (e.g., water, gas, electric), and public utilities within the public right-of-way (e.g., sewer). In addition, a private utility locating company is typically contracted to survey for private utilities such as utility lines from meters to buildings, drain lines, buried electric cables, or irrigation and sprinkler lines.

When filing utility notification requests, PBS personnel should be as specific as possible about where to locate. Washington law requires that the proposed excavation/drilling work areas are field-marked with white paint prior to the locating event.

When beginning a project, PBS personnel must carefully think through where boreholes can be safely drilled, considering both subsurface and overhead obstructions. A site walk may be prudent once the utilities have been marked and prior to the drilling fieldwork. If safe drilling conditions cannot be confirmed, the PBS Project Manager should determine if engineering controls should be implemented, such as shielding or shutting down utility and/or power lines.

SAFETY NOTE: Drill rig masts must be a safe distance from overhead power lines to prevent mast lines and power lines being moved together by wind. Occupational Safety and Health Administration (OSHA) rules for drillers require a minimum distance of 10 feet, with additional spacing required depending on the voltage carried by the power line. The drill rig subcontractor is responsible for ensuring sufficient clearance. However, PBS personnel should verify that potentially unsafe conditions do not exist.

5 SAFETY EQUIPMENT REQUIREMENTS

The following safety equipment is required for all drilling investigations:

- Hard hat
- Hearing protection (ear muffs or plugs, must be worn when drill rig is in operation)
- Safety-toe work boots
- Safety vest
- Gloves (typically disposable)
- Safety goggles or glasses
- Life vests (only when working over water)

6 FIELD EQUIPMENT AND SUPPLIES REQUIREMENTS

The following equipment is typically required for drilling projects when soil sampling will occur. Groundwater or soil gas sampling is discussed in separate SOPs. PBS personnel should confirm that the drilling contractor will provide decontamination water, soap, brushes, and buckets.

General field supplies/equipment includes:

- 5-gallon buckets
- Bags (garbage)
- Bags (plastic zipper-type)
- Camera
- Cellular telephone and phone numbers of client, project laboratory, subcontractors, etc.
- Field notebook or daily log
- Measuring tape
- Paper towels
- Pens
- Spray paint (optional)

Soil sampling supplies/equipment includes:

- Project proposal/scope of work
- Alconox/Liquinox or similar decontamination detergent
- Distilled water (for decontamination)
- Environmental borehole log forms
- Hand auger (if required by scope)
- Ice chest with blue ice or party ice
- Nitrile or other chemically compatible gloves
- Photoionization detector (PID)
- Sample chain-of-custody forms
- Sample containers (ask lab about sample volume, preservatives, etc.)
- Sampling spade or spoons (if required by scope)

7 PRE-DRILLING ACTIVITIES

The following tasks must be performed before beginning work:

- Conduct tailgate safety meeting with all field personnel, including visitors such as the client or regulator; review Health and Safety Plan.
- Install traffic cones/barrier tape or other barrier to control pedestrian and vehicle access to work area as necessary.

The drilling subcontractor is responsible to ensure that the area on which the rig is to be positioned is cleared of removable obstacles and the rig should be leveled if parked on a sloped surface. The cleared/leveled area should be large enough to accommodate the rig and supplies. PBS personnel must confirm that the work area is cleared and safe for work prior to initiating drilling activities.

8 SOIL SAMPLING PROCEDURES

8.1 Logging and Field Screening Soil

Upon retrieval of the soil, describe as per the Geo-Environmental Field Classification chart for soil (included as an attachment). Record observations on an environmental borehole log.

If conducting head-space screening with a PID, remove one-quarter to one-half cup of soil and place in a sealable plastic bag. Seal the bag, break up the soil, and let sit for a minimum of five minutes (in colder weather, either wait for 15 to 30 minutes or put into a warm car or room). The purpose of the headspace screening is to measure what is off-gassing from the sample, and sufficient time must be allowed for that to occur. After the appropriate interval, place the end of the PID probe into the bag (through a small opening in the "zipper") and record the peak value.

If performing sheen testing, place a small sample volume (preferably darker or stained material) in a bowl partially filled with water and observe sheen indicative of petroleum contamination.

8.2 Collecting Soil Samples for Laboratory Analysis

Prior to collecting a sample for laboratory analysis, the sampler should don new gloves. If there are multiple samples to be collected from a single borehole, the gloves should be replaced to avoid cross-contamination.

Collect soil samples using a gloved hand or a clean sampling tool and place directly into the sample jar(s). For volatile organic compounds (VOCs), pack the soil to minimize jar headspace, or field preserve for VOCs using EPA Method 5035 (the field kit is obtained from the laboratory). Label samples as described under Section 8.3 Sample Numbering. Place labeled sample container(s) in the cooler with ice.

8.3 Sample Identification

Sample labels will be completed and attached to the jars in the field to prevent misidentification. All sample labels will include the following information:

- Project name or number
- Sample identification
- Sample collection date and time

The sample identification is unique to a particular sample and the format must be consistently used for all samples collected at the site. The sample identification typically includes the sample location and the collection depth. The sample location is the soil boring number or otherwise designated sample location. Standard abbreviations for sample location types are:

- DP = Direct push
- MW = Monitoring well
- SB = Soil boring
- SE = Sediment
- SO = Surface soil
- SS = Soil sample
- TP = Test pit
- WP = Well point

Examples of sample identifications are: DP-5 (4'), SS-22 (1'), and MW-3 (15')

Other naming conventions may be used, as long as the labeling is consistent and each location is clearly identifiable.

9 BOREHOLE ABANDONMENT

The licensed driller is responsible for abandoning boreholes in compliance with state regulations. PBS personnel should ensure that this occurs, and that the sealing material (typically bentonite chips) is sufficiently hydrated for a proper seal. State regulations governing this are:

- Oregon Administration Rule (OAR) 690-240
- Washington Administrative Code (WAC) 173-160

10 DECONTAMINATION PROCEDURES

Minimizing the possibility of cross-contamination between samples is a critical component of a successful soil sampling project. This is achieved by consistent and thorough decontamination of sampling equipment, such as drill rods, sampling devices (split spoons, trowels, etc.), and other tools that may come in contact with soil to be sampled.

For drilling equipment, the drilling contractor is responsible for the decontamination procedures. Typically, a pressure washer with hot water or water with added detergent is used to clean drill rods and other equipment. The use of a steam cleaner is not appropriate because of the risk of burns, and steam cleaners do a poor job of removing soil particles from equipment.

For equipment and supplies used by PBS personnel, water with added detergent is typically used for decontamination. Alternately, disposable supplies, such as gloves and sampling scoops, can be used to avoid having to decontaminate them.

PBS field personnel should work with the PBS Project Manager to confirm the appropriate decontamination procedure for each project. For example, it may be important to know the source of the driller's water used for decontamination, and distilled or deionized water may need to be used to clean hand tools.

All water and sludge generated during decontamination will be captured for later disposal. Release of water directly onto the ground or into drains or catch basins is not allowed.

11 INVESTIGATION-DERIVED WASTE

Investigation-derived waste consists of soil cuttings, decontamination water, purge water (if groundwater is encountered), and personal protective equipment (e.g., nitrile gloves, rags, paper towels, Tyvex suits, disposable bailers, and tubing). All disposable personal protective equipment may be disposed of as general refuse unless otherwise instructed by the PBS Project Manager.

Soil cuttings are typically placed in 5-gallon buckets or other appropriate containers during the execution of the fieldwork, and transferred to 55-gallon drums as the project progresses. If appropriate, the cuttings may remain in buckets as long as tight-fitting lids are placed on each bucket. For some projects, the PBS Project Manager may request that decontamination/purge water be placed into the same drums as the soil, instead of keeping the two media separate. Depending on the type of contamination, this may result in cost savings for the client during disposal. Field personnel should confirm how to contain soil and water prior to each field event.

11.1 Drum Labeling

The storage containers must be labeled as hazardous, non-hazardous, or unknown pending laboratory results. The labels must be completed using an indelible marker and include:

- Date that the contents were generated
- Nature of the contents - for example:
  - Drill cuttings
  - Purged groundwater
  - Decontamination water and/or sludge
- Contact phone number in the event emergency response personnel need to identify the contents of the container.

Drums or other storage containers should be placed in as secure a location as possible, which may be a building if the exterior area is not secure from vandalism.

12 POST-DRILLING ACTIVITIES

Upon return to the office, PBS personnel should:

- Clean and calibrate equipment prior to placing back into storage. If there were any operational issues noted, they should be reported immediately to the equipment manager.
- Submit field borehole logs for electronic formatting for future reports.
- Submit the daily field notes to the PBS Project Manager for placement into the project file. If a field notebook was used, and that notebook is not dedicated to that project, a copy of those notebook pages should be submitted.

STANDARD OPERATING PROCEDURE
Sub-Slab Vapor and Soil Gas Sampling

PURPOSE

Vapor intrusion of volatile organic compounds (VOCs) into occupied structures is considered a critical migration pathway requiring assessment at contaminated sites. Specifically, regulators may require property owners to sample soil gas, sub-slab vapor, or indoor air to assess risk to building occupants.

This standard operating procedure (SOP) is intended to guide soil gas or sub-slab vapor sampling efforts when creating temporary sampling points when Method TO-15 or other analytical methods utilizing a Summa canister as the sampling media are required. The sampling points can be modified to produce a permanent sampling location. The sampling protocols for analysis of soil gas or sub-slab vapor by Method TO-17, which utilizes a sorbent tube as the sampling media (instead of a Summa canister), as well as the sampling of indoor air are presented as separate SOPs.

Soil gas and sub-slab vapor sampling is typically conducted based on prior results from other environmental studies, such as soil or groundwater sampling, or if historical uses indicate a human health risk could be present. A variety of issues can significantly affect the results of soil gas and sub-slab vapor sampling. Adherence to this SOP will help ensure that sampling results are valid and reliable. This SOP assumes that samples will be collected in Summa canisters. If other sampling media is used (such as tedlar bags), some of the steps in this SOP may not apply or may need to be modified.

Use one of the following two methods to conduct the sub-slab vapor or soil gas sampling

METHOD 1 – VAPOR PIN

1 EQUIPMENT LIST

The following table lists standard equipment and tools needed for soil gas and sub-slab vapor sampling. When renting a helium meter, ask the vendor for one that is intended for use in leak detection testing (e.g., MGD-2002 multi-gas leak locator). It should have the ability to purge the line quickly (the equipment company may provide a special filter for this), and preferably, a meter with an active pump (as opposed to passive venting). It does not need to be intrinsically safe UNLESS site conditions require this feature.

Equipment to get from lab	• 1 or 6 liter (L) Summa canister. • One extra Summa canister in the event that a canister fails in the field. • Flow regulator (also known as critical orifice) preset by lab for pre-determined sampling time, not to exceed a flow rate of 200 mL/min. • Vacuum gauge (for verifying vacuum prior to sampling, flow regulator may act in this role). • Tubing (new for each sample location). Must be Teflon, Nylaflow, Peek, or stainless tubing. Do NOT use polyethylene tubing. • Chain of custody and identification tags. • T-fitting (need one for each sampling location, including ferrules and hex nuts for each leg of T).

Other equipment	• Purging syringe (calibrated, typically for 50 to 60 milliliters [mL]). • Granular bentonite. • Disposable or washable containers (~16 ounces) for mixing bentonite and/or cement. • Water for mixing bentonite and cement. • Sand. • Silicone tubing. • Helium gas tank with regulator. • Helium meter (make sure that it measures in ppm by volume). • On-off valve (two per sampling location). • Vapor Pin with a silicon sleeve (or similar equipment). • Vapor Pin tool and hammer for installation and removal (or similar equipment). • Vapor Pin drill guide (for permanent installations). • Field notebook and/or field forms. • Helium shroud. • Weight for shroud, if needed. • Nuts and ferrules (if you did not receive from lab). • Cap for "shroud air tubing." • Water dam (e.g., 1.5-inch PVC coupler).
Tools	• Scissors. • Rotohammer/drill for drilling through concrete. • Drill bits (0.625-inch, 1.5-inch). • Crescent wrench (1/2 and 9/16 inch). • Whisk broom/dust pan. • Wet-dry vacuum. • Extra-thin knife/screwdriver. • Extension cord for rotohammer. • Wrench for helium regulator. • Generator (if power is not available)
Supplemental supplies	• Teflon tape (if seal leaks are sustained). • Purging pump with tubing (if purging syringe not used) and charging cord. • Fast setting concrete to patch floor. • Adhesive to repair carpet or tile.

2 LABORATORY

The lab will supply the Summa canisters, flow regulators, gauges, and tubing, and can also provide the purging syringe, if needed. Have the equipment arrive TWO business days prior to sampling, if possible. This allows the lab time to express-mail any additional, broken, or forgotten equipment.

As soon as the shipment is received, ensure that all equipment was provided and verify the vacuum of all Summa canisters. Order an extra gauge, if needed, to check the canisters for pressure prior to leaving the office. Knowing that the canister has sufficient initial vacuum allows for better trouble shooting in the field.

The following information must be provided to the lab to ensure shipment of the correct equipment:

- Size of canister (400 mL, 1 L, 6 L). A 1 L Summa will require a minimum of two times dilution of reporting limits. If this will cause your sample reporting limits to exceed screening criteria, use a larger Summa canister. You MUST know your reporting limits to determine the canister size.
- Type of canister certification (batch vs. individual). Batch certification is usually sufficient for sub-slab vapor and soil gas sampling projects.
- Method reporting limits.
- Tracer gas to be used (the lab must certify container for this prior to shipping). PBS uses Helium as a tracer gas.
- Sample time/flow rate.

Samples should be collected at a rate between 100 and 175 mL per minute (most guidance documents recommend that samples not be collected faster than 200 mL per minute). A flow rate greater than 200 mL/min runs the risk of introducing ambient air dilution to the sample. The sample time for grab samples is calculated by determining an acceptable sample flow rate (perhaps 150 mL/min) and multiplying that by the sample container size. For a 150 mL/min rate, a 1 L Summa canister would require approximately seven minutes. A 6 L Summa canister would require 40 minutes.

3 SUB-SLAB VAPOR INITIAL PROCEDURES

Order equipment as previously identified, and do the following prior to field activities:

- Determine the proposed locations for each sample.
- Confirm with the property owner/occupant that subsurface utilities will not be impacted when drilling through the slab in these locations.
- Conduct a private utility locates for your locations to check for subslab or subgrade obstructions.
- If possible, determine the slab thickness to confirm that a hand-operated drill can drill through it.
- Determine if carpeting or other flooring will need to be removed prior to drilling, or will require patching.
- Have the helium meter arrive the day before sampling.

Once at the site, sampling should occur as described below.

Drill Hole and Seal Tubing

These instructions assume that all samples will be collected using a Vapor Pin or similar equipment.

- Confirm concrete thickness, if possible, so you'll know when to expect the drill bit to break through bottom of slab.
- If the Vapor Pin will be installed for on-going monitoring (i.e., permanent installation), begin by drilling a hole 2 inches into the concrete using the 1.5-inch drill bit. This larger hole will be used to install a flush-mount cover. Then insert the Vapor Pin drill guide into this hole so that the smaller diameter drill hole will be centered. Continue with the directions below.

- Drill a hole through the slab using the 0.625-inch drill bit. Drill 1 to 3 inches into backfill or native material beneath the concrete slab.
- Use a 0.625-inch tube brush to clean concrete dust from the hole.
- Use the whisk broom or vacuum to remove concrete dust or loose material from around the drill hole.
- Install a Vapor Pin with a silicon sleeve (the silicon sleeve provides the seal) into the 0.625-inch drilled hole utilizing a dead weight hammer and the Vapor Pin installation/extraction tool (or similar equipment).
- If not drilling the 1.5-inch hole, place a small amount of hydrated bentonite on the concrete surface around the Vapor Pin and insert a water dam into the bentonite.
- Place a silicon mat with a circular cut-out for the Vapor Pin on the concrete surface around the sample point and water dam.
- Add a small piece of silicone tubing to the top of the Vapor Pin for attaching tubing later.
- Add a small amount of water to the inside of the water dam to ensure a good seal is in place.
- Place the shroud over the sample point and thread 0.25-inch tubing through a stopper in the shroud.
- Place a weight on the shroud to prevent it from being moved and compromising the seal integrity, if needed.

For temporary holes, allow 20 to 30 minutes for the hole to equilibrate. If collecting sub-slab gas samples at multiple locations, consider performing these initial activities at each location prior to continuing with the sampling.

4 SOIL GAS INITIAL PROCEDURES

Order equipment as previously identified. Prior to field activities, the following should occur:

- Determine the locations and depths for each sample.
- Determine if equipment, vehicles, or other stored items will need to be moved prior to the field event.
- Call in a public utility notification.
- Conduct a private utility locates for your locations to check for subgrade utilities/obstructions.
- Arrange for a driller to deploy a Post Run Tubing (PRT) sample system, or equivalent, or arrange with the driller to install a sample point using a hand auger.

Once at the site, sampling should occur as described below.

Drill Hole and Seal Tubing

- Drill a borehole hole using a PRT system, or equivalent. The bottom of the hole should be at least 5.5 feet below ground surface (bgs), as long as this is above the water table.
- Lift up on the drilling rod approximately 6 inches to create a void in the subsurface.
- Insert the PRT fitting to the 0.25-inch tubing and place down the hole. Once it reaches the bottom, screw the fitting onto the PRT sample point (note: the fitting uses left-hand threads).
- Determine the length of 0.25-inch tubing needed to conduct sampling at this location and cut it to that length. Do not forget that there must be enough tubing to go through the helium shroud, connect to the

purging T-valve and connect to the Summa canister. Be sure to cut the ends straight with no burrs or jagged edges.

- Mix bentonite with water for sealing.
- Place bentonite around the rod protruding from the ground.
- Insert bentonite evenly around tubing exiting the drill rod, making sure it penetrates fully into the rod. Thread the other tubing end through the helium shroud/stopper. Cover the loose tubing end with a plastic bag or cap to ensure it remains clean until it is connected to the Summa canister.
- Place the shroud over the drill rod and place more bentonite around the base to seal the shroud to the ground.

Sample Train Assembly

- Place the shroud over the sample point, and thread tubing through the shroud and shroud stopper.
- Place a weight on the shroud to prevent it from being moved and compromising the seal integrity, if needed.
- Attach an on-off valve to the end of the tubing, then place additional tubing on the other side of the valve. Turn the valve off.
- Install a T-fitting and a second on-off valve in-line with the sample tubing to allow for purging. Add tubing from the third leg of the T-fitting to the Summa canister.
- Connect the gauge and flow regulator to the Summa canister and tubing. Do not over tighten the fittings.
- Record the canister and flow regulator serial numbers on the field form.
- Ensure that all connections are tight and all valves are closed.

For temporary holes, wait 20 to 30 minutes to allow the hole to equilibrate. If a hand auger was used to install the sample point you must wait 48 hours.

5 LEAK DETECTION TESTING

Shut-in test and field/laboratory test for helium are two testing methods performed for leak detection.

Shut-in Test

Evaluate the integrity of the sample train by performing a vacuum shut-in test. Remove a sufficient volume of air from the sample train using the purging syringe to provide a vacuum of at least -15 inches of mercury (Hg). Observe the gauge for at least two minutes to detect any decrease in measured vacuum. The vacuum must be maintained for at least two minutes. If the vacuum is not maintained, check the fittings and retest.

Helium Test

At this point, you should have the shroud in place with the tubing from the Vapor Pin or soil gas sample point extending from the shroud, and the inlet hose from the helium tank extending into the shroud. Perform these actions:

- Fill the shroud with helium for several seconds and turn off the tank.
- Using the helium meter (meter), measure and record the helium concentration in the shroud in percent (%) or parts-per-million-volume (ppmv) (1% is equivalent to 10,000 ppmv). The target helium

concentration is 70 to 90%. Remove the meter from the shroud air tubing and cap the tubing. *Allow meter to clear back to zero.*

Sample Train Purging

- Open the on-off valve to the Vapor Pin or PRT sampling point tubing. The Summa canister remains closed.
- Determine the amount of air that requires purging within the sampling tubing.
    - Determine how much tubing you need to purge (round up to whole feet).
    - Multiply the number of feet by the volume of air within one unit foot of tubing (see multipliers below for various tubing sizes).
    - Determine how much you need to purge from the hole drilled through the concrete slab or PRT sampler (usually 6 inch length).
    - Add the tubing and hole purge volumes together.
    - You want to remove a minimum of two purge volumes, so multiply volume calculated by two.

Size of tubing (inches)	Air volume in mL per one unit foot
1/4	9.7
3/8	21.7
1/2	38.6
5/8	60.3
3/4	86.9
1	154.4

- Connect the purging syringe and turn the on-off valve to ON.
- Purge the calculated volume of air. Draw the air slowly through the syringe, approximating the sample collection flow rate, to minimize the effect of creating a vacuum that could compromise the connections or seals. If your sample collection rate is 150 mL/min, and you need to purge 50 mL, then take approximately 20 seconds to purge the 50 mL or as slowly as possible.
- If you need to purge more than one syringe volume, complete the first purge, turn the valve on the syringe to OFF, depress the syringe to purge the air out of the syringe, turn syringe valve to ON and repeat the purging process.
- When done purging, turn the on-off valve to OFF.
- Connect the meter to the sample point tubing (Vapor Pin or PRT) and allow the meter to run for approximately one minute. Measure the helium concentration.
- If elevated readings on the helium meter (greater than 5,000 ppmv [0.5%]) are detected, make adjustments to seals.
- Once all necessary adjustments have been made, record the helium measurement in the shroud on field sheet following adjustment to seals.

Once the leak detection testing has confirmed the Vapor Pin or PRT seal is sufficient, proceed to sample collection.

6 SAMPLE COLLECTION

- Confirm that all connections remain tight and all valves are closed.
- Close the on-off valve connected to the purging syringe.
- Open the Summa canister by turning its valve approximately one-half turn.
- Immediately record the vacuum on the gauge (it should stabilize very quickly) and the time. The gauge should measure approximately -30 inches Hg (please note that some gauges may read greater than -30 inches Hg). If the vacuum is less than -27 inches Hg, the canister may not have sufficient vacuum for sampling. In this case, select another canister. If another canister is not available, call the project manager and ask how they would like you to proceed.
- Allow the Summa canister to fill, keeping in mind the amount of time determined for sample collection (i.e., what you told the lab to set for a flow regulator time)
- At the mid-point of the sample collection, record the helium concentration in the shroud. Add additional helium if shroud concentration is below 50%, and record the new reading.
- The vacuum gauge should never drop below -5 inches Hg. If the vacuum readings are not matching up with the expected sampling time (the gauge is dropping faster or slower than expected), you will need to use your best judgment as to when to stop the sample collection (or call the lab or project manager to discuss).
- Once the sample has been collected, close the canister valve, be sure it is tightly closed (but do not over tighten), and record the vacuum reading and time.
- Record the helium concentration in the shroud.
- Remove the gauge and flow regulator and replace the canister fitting.
- Fill out the chain of custody and return the containers to the lab with the original chain of custody. Retain a copy of the chain of custody for the project files.

When collecting 6 L Summa canister samples, it is recommended that you monitor the vacuum gauge during the entire sample duration, which can take up to 50 minutes. If the gauge should drop below -5 inches Hg, the sample may be considered void; this can be prevented by watching the gauge. If the gauge drops to 0 inches Hg the sample will need to be re-taken using a new canister.

Drill Hole Abandonment

Once soil gas sampling is completed, the boring will be abandoned by the licensed drilling subcontractor who completed the borehole following applicable state requirements.

Once sub-slab vapor sampling is completed, the following should occur:

- Remove the water from the water dam.
- Clean out the remaining bentonite, cleaning as much as possible from the floor.
- If the sampling location is for one-time use, deploy the Vapor Pin extraction tool to remove the pin.
- Add a small amount of sand to fill the drill hole approximately 1 to 2 inches below the concrete surface (approximately 1 to 2 inches below the bottom of the "seat"). Do NOT overfill with sand as this may compromise your patch.

- Use the whisk broom to remove any loose material at the surface.
- Fill the upper 1 to 2 inches with a quick setting cement grout. Smooth or feather the surface to help create a bond between the slab and the grout.

If the Vapor Pin or similar equipment is for a permanent installation, the following should occur:

- Place a white cap over the tip of the Vapor Pin.
- Install a permanent cover over the capped Vapor Pin (plastic or metal).

7 POST FIELD ACTIVITIES

- Retain all paperwork provided by the lab, including the packing list and certifications. This information must be retained in the permanent project file.
- Decontaminate reusable fittings owned by PBS following the *Standard Operating Procedure for Vapor Pin Decontamination for Vapor Intrusion Assessments*. This includes the Vapor Pin drill guide and any brushes or other tools used for cleaning.
- Return all rental equipment.

Confirming Helium Detections Meet Regulatory Requirements

- Calculate average helium concentration in shroud by taking two or more readings before, during, and after sampling (be sure that meter is reading in ppm by volume).
- When lab results are received, if helium is detected, use this formula to confirm level of leakage:

  Level of leakage = lab-detected concentration / shroud concentration
- Be sure you are using the same units (ppm may not always equal ppmv – check your units).
- Some regulatory guidance documents allow up to 5 to 10% helium within a sample. Be sure to check your state's guidance for allowable levels. Oregon and Washington both allow up to 5% helium for a valid sample.

METHOD 2 – SEALED TUBING

1 EQUIPMENT LIST

The following table lists standard equipment and tools needed for soil or sub-slab gas sampling. When renting a helium meter, ask the vendor for one that is intended for use in leak detection testing. It should have the ability to purge line quickly (the equipment company may provide a special filter for this) and preferably, a meter with an active pump (as opposed to passive venting). It does not need to be intrinsically safe UNLESS site conditions require this feature.

Equipment to get from lab	• 1 or 6 liter (L) Summa canister. • One extra Summa canister in the event that a canister fails in the field. • Flow regulator (also known as critical orifice) preset by lab for pre-determined sampling time. • Vacuum gauge (for verifying vacuum prior to sampling). • Tubing (new for each sample location). Must be Teflon, Nylaflow, Peek, or stainless

	tubing. Do NOT use polyethylene, silicone, or any other type. • Chain of custody and identification tags. • T-valve (need one for each sampling location, including ferrels and hex nuts for each end of T).
Other equipment	• Purging syringe (calibrated, typically for 50 to 60 milliliters [mL]). • Granular bentonite. • Disposable or washable containers (~16 ounces) for mixing bentonite and/or cement. • Water for mixing bentonite and cement. • Sand. • Silicone tubing. • Weight for shroud. • Helium gas with regulator. • Helium meter (make sure that it measures in ppm by volume). • On-off valve (two per sampling location). • Vapor Pin with a silicon sleeve (or similar equipment). • Vapor Pin tool and hammer for installation and removal (or similar equipment). • Field notebook or field forms. • Helium shroud. • Nuts and ferrels (if you did not receive from lab). • Cap for "shroud air tubing." • Water dam (1.5-inch PVC coupler).
Tools	• Scissors. • Rotohammer/drill for drilling through concrete. • Drill bits (0.625-inch, 1.5-inch). • Crescent wrench (9/16 inch). • Whisk broom/dust pan. • Wet-dry vacuum. • Extra-thin knife/screwdriver. • Extension cord for rotohammer. • Plumber's wrench for helium regulator.
Supplemental supplies	• Teflon tape (if seal leaks are sustained). • Purging pump with tubing (if purging syringe not used) and charging cord.

2 LABORATORY

The lab will supply the Summa canisters, flow regulators, gauges, and tubing, and can also provide the purging syringe, if needed. Have the equipment arrive TWO business days prior to sampling, if possible. This allows the lab time to express-ship any additional or forgotten equipment.

As soon as the shipment is received, ensure that all equipment was provided and verify the vacuum of all Summa canisters. Order an extra gauge, if needed, to check the canisters for pressure prior to leaving the office. Knowing that the canister has sufficient initial vacuum allows for better trouble shooting in the field.

The following information must be provided to the lab to ensure shipment of the correct equipment.

- Size of canister (400 mL, 1 L, 6 L). A 1 L Summa will require a minimum of two times dilution of reporting limits. If this will cause your sample reporting limits to exceed screening criteria, use a larger Summa canister. You MUST know your reporting limits to determine the canister size.
- Type of canister certification (batch vs individual). Batch certification is usually sufficient for sub-slab or soil gas sampling projects.
- Method reporting limits.
- Tracer gas to be used (the lab must certify container for this prior to shipping).
- Sample time.

Samples should be collected at a rate between 100 and 175 milliliters (mL) per minute (most guidance documents recommend that samples not be collected faster than 200 mL per minute). A flow rate greater than 200 mL/min runs the risk of introducing ambient air dilution to the sample. The sample time for grab samples is calculated by determining an acceptable sample flow rate (perhaps 150 mL per minute) and multiplying that by the sample container size. For a 150 mL per minute rate, a 1 L Summa canister would require approximately seven minutes. A 6 L Summa canister would require 40 minutes.

3 SUB-SLAB GAS INITIAL PROCEDURES

Order equipment as previously identified, and do the following prior to field activities:

- Determine the proposed locations for each sample.
- Confirm with the property owner/occupant that subsurface utilities will not be impacted when drilling through the slab in these locations.
- Conduct a private utility locates for your locations to check for sub-slab or sub-grade obstructions.
- If possible, determine the slab thickness to confirm that a hand-operated drill can drill through it.
- Determine if carpeting or other flooring will need to be removed prior to drilling, or will require patching.
- Get the lab equipment delivered two days prior to sampling and ensure that all equipment was provided.

Once at the site, sampling should occur as described below.

Drill Hole and Seal Tubing

- Confirm concrete thickness, if possible, so you'll know when to expect the drill bit to break through the bottom of slab.

- Drill a hole using the 0.25-inch or 0.5-inch drill bit. Drill approximately two inches into slab backfill or native material beneath the concrete slab.
- Using a 0.5-inch or 0.75-inch drill bit, overdrill the hole by approximately one inch to create a “seat” for sealing the tubing. The drill bit used for overdrilling should be one size larger than the original hole (0.5-inch for a 0.25-inch initial hole, etc.).
- Use the whisk broom to remove concrete dust or loose material from around the drill hole.
- Test the 0.25-inch tubing to ensure it can be pushed completely down the hole. Once it reaches the bottom, keep track of that tubing length as you pull it back out. Ensure there is no material stuck in the bottom of the tubing (if there is, cut the tubing end off and repeat this step). Re-insert the tubing so that the bottom rests approximately one inch from the drilled bottom, making sure it is below the bottom of the slab. If the tubing rests at the bottom of the hole that is okay.
- Determine the length of 0.25-inch tubing needed to conduct sampling at this location and cut it to that length. Do not forget that there must be enough tubing to go through helium shroud, connect to the purging T-valve and connect to the Summa canister. Be sure to cut the ends straight with no burrs or jagged edges.
- Thread the other tubing end through the helium shroud/stopper, leaving enough tubing within the shroud to allow you to install the sealing material. Cover the loose tubing end with a plastic bag to ensure it remains clean until it is connected to the Summa canister.
- Mix bentonite to an appropriate consistency for sealing.
- Insert bentonite evenly around tubing, making sure it penetrates fully into the larger drill hole. Push down with fingers or appropriate tool to ensure a good seal. Take care not to scrape or puncture the tubing.
- At the surface, mound the bentonite against the tubing and smooth away from it to create a tight seal. It is appropriate to moisten the top of the bentonite mound to aid in creating a good seal.

For temporary holes, allow approximately 20 to 30 minutes for the bentonite to seal and the hole to equilibrate. If collecting sub-slab gas samples at multiple locations, consider performing these initial activities at each location prior to continuing with the sampling.

4 SOIL GAS INITIAL PROCEDURES

Order equipment as previously identified. Prior to field activities, the following should occur:

- Determine the locations and depths for each sample.
- Determine if equipment, vehicles, or other stored items will need to be moved prior to the field event.
- Arrange for a utility locate.
- Arrange for a driller to deploy a Post Run Tubing (PRT) sample system, or equivalent.

Once at the site, sampling should occur as described below.

Drill Hole and Seal Tubing

- Drill a hole using a PRT system, or equivalent. The bottom of the hole should be at least 5.5 feet below ground surface (bgs).
- Lift up on the drilling rod approximately 6 inches to create a void in the subsurface.
- Insert the screw on end to the 0.25-inch tubing and place down the hole. Once it reaches the bottom, screw the fitting onto the PRT sample point (note: the fitting uses left-hand threads).

- Determine the length of 0.25-inch tubing needed to conduct sampling at this location and cut it to that length. Do not forget that there must be enough tubing to go through the helium shroud, connect to the purging T-valve, and connect to the Summa canister. Be sure to cut the ends straight with no burrs or jagged edges.
- Mix bentonite to appropriate thickness for sealing.
- Insert bentonite evenly around tubing exiting the drill rod, making sure it penetrates fully into the rod. Thread the other tubing end through the helium shroud/stopper. Cover the loose tubing end with a plastic bag to ensure it remains clean until it is connected to the Summa canister.
- Place the shroud over the drill rod and place more bentonite around the base to seal the shroud to the ground.

For temporary holes, allow approximately 20 to 30 minutes for the bentonite to seal and the hole to equilibrate.

5 LEAK DETECTION TESTING

In order to perform the leak detection testing, have the shroud in place with the following setup and procedure:

- Tubing from drill hole.
- Tubing for measuring air within shroud (attach tubing onto appropriate fitting if not attached previously).
- Inlet hose from helium tank.
- If needed, place a brick or other weight on the shroud to prevent it from being moved and compromising the seal integrity.
- Fill the shroud with helium for several seconds and turn off the tank.
- Using the helium meter (meter), measure and record the helium concentration through the shroud air tubing in parts-per-million-volume (ppmv) (or know how to readily convert the reading to ppmv). The target helium concentration is 70 to 90 percent. Remove the meter from the shroud air tubing and cap the tubing. Allow meter to clear back to zero.
- Remove the helium tubing from the shroud and put a cap on the brass air fitting immediately.
- Connect the meter to the drill hole tubing and allow the meter to run for approximately a minute. Measure the helium concentration.
- Spray helium around fittings (T, on-off valve and flow regulator connections to Summa canister) and use the helium meter to monitor if any leaks are associated with these fittings.
- If indicated by elevated readings on the helium meter, make adjustments to seals.
- Once all necessary adjustments have been made, record the helium measurement in the shroud on field sheet following adjustment to seals.

Once the leak detection testing has confirmed the drill-hole seal is sufficient, proceed to sample collection.

6 SAMPLE COLLECTION

Sample Train Assembly and Purging

- Install the T-valve and on-off switch in-line with the sample tubing to allow for purging.
- Connect the gauge and flow regulator to the Summa canister and tubing. Do not overtighten the fittings.

- Record the can and flow regulator serial numbers on the field form.
- Ensure that all connections are tight and all valves are closed.
- Determine the amount of air that requires purging within the sampling tubing.
    - Determine how much tubing you need to purge (round up to whole feet).
    - Multiply the number of feet by the volume of air within one unit foot of tubing (see multipliers below for various tubing sizes).
    - You want to remove a minimum of two purge volumes, so multiply volume calculated by two.

Size of tubing (inches)	Air volume in mL per one unit foot
1/4	9.7
3/8	21.7
1/2	38.6
5/8	60.3
3/4	86.9
1	154.4

- Connect the purging syringe and turn the on-off switch to ON.
- Purge the calculated volume of air. Draw the air slowly through the syringe to minimize the effect of creating a vacuum that could compromise the connections or seals. If your sample collection rate is 150 mL per minute, and you need to purge 50 mL, then take approximately 20 seconds to purge the 50 mL or as slowly as possible.
- If you need to purge more than one syringe volume, complete the first purge, turn the switch on the syringe to OFF, depress the syringe to purge the air out of the syringe, turn syringe valve to ON and repeat the purging process.
- When done purging, turn the on-off switch to OFF.

Sample Collection

- Confirm that all connections remain tight and all valves are closed.
- Open the Summa canister by turning its valve approximately one-half turn.
- Immediately record the vacuum on the gauge (it should stabilize very quickly) and the time. The gauge should measure approximately -30 inches mercury (Hg). If the reading is not close to this value, the canister may not have sufficient vacuum for sampling. In this case, call the lab or select another canister.
- Allow the Summa canister to fill, keeping in mind the amount of time determined for sample collection (i.e., what you told the lab to set for a flow regulator time).
- The vacuum gauge should not drop below 3 inches Hg. If the vacuum readings are not keeping pace with the expected sampling time (either the gauge is dropping faster or slower than expected), you will need to use your best judgment as to when to stop the sample collection (or call the lab or project manager to discuss).
- Once the sample has been collected, record the vacuum reading and time.

- Close the canister valve. Be sure it is tightly closed (do not overtighten).
- Remove the gauge and flow regulator and replace the canister fitting.
- Fill out the chain of custody and return the containers to the lab with the original chain of custody. Retain a copy of the chain of custody for the project files.

When collecting 6L Summa canister samples, it is recommended that you watch the vacuum gauge the entire time (which can be up to 50 minutes). If the gauge should drop below 3 inches Hg, the sample may be considered void; this can be prevented by watching the gauge during sampling. If the gauge drops to 0 inches Hg the sample will need to be re-taken using a new canister.

Drill Hole Abandonment
Once sampling is completed at a sub-slab gas location, the following should occur:

- Clean out the remaining bentonite, scraping as much as possible from the drill hole "seat" and sidewalls (do not push down hole but instead place in bag for disposal).
- Add a small amount of sand to fill the drill hole to approximately two inches below the concrete surface (approximately two inches below the bottom of the "seat"). Do NOT overfill with sand as it may compromise your seal.
- Use the whisk broom to remove any loose material at the surface.
- Fill the upper three inches with a quick setting cement grout. Smooth or feather the surface to help create a bond between the slab and the grout.

For soil gas sampling locations, the drill rig operator should abandon the sample point as required by state regulations (Oregon Administrative Rule 690-240 or Washington Administrative Code 173-160).

POST FIELD ACTIVITIES

Retain all paperwork provided by the lab, including the packing list and certifications. This information must be retained in the permanent project file.

Reusable fittings owned by PBS must be decontaminated following PBS' *Standard Operating Procedure for On-Off Valve Decontamination for Vapor Intrusion Assessments*.

ASSESSING LEAK DETECTION RESULTS

Regulatory guidance in Oregon and Washington allow up to 5 percent helium within a sample. To confirm that helium detections meet this regulatory requirement, the following will occur:

- Calculate average helium concentration in shroud ("shroud concentration") by taking two or more readings before and after sampling (the measurements should have been recorded in ppmv).
- When we receive lab results, if helium is detected, use this formula to confirm level of leakage.

  Level of leakage = lab-detected concentration / shroud concentration
- Be sure you are using the same units (ppm may not always equal ppmv: check your units).

ATTACHMENT C

Sampling and Analysis Plan
Quality Assurance Project Plan

Sampling and Analysis Plan
Quality Assurance Project Plan

TABLE OF CONTENTS

1.0 INTRODUCTION

The Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) have been developed to meet the substantive requirements of MTCA, as presented in WAC 173-340-820 *Sampling and Analysis Plans*. The SAP/QAPP supports both the RIWP and the IAWP, as required by Exhibit B of the Agreed Order, *Scope of Work and Schedule*.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project team members and roles and responsibilities for interim action and remedial investigation activities are summarized below.

2.1 Project Communications

Personnel from the Department of Ecology and each of the PLPs is designated as a lead representative for communication.

Personnel	Project Role	Phone #	Email
WA State Department of Ecology			
Frank Winslow	Ecology Project Coordinator	509-454-7835	fwin461@ECY.WA.GOV
Coleman Oil			
Jim Cach	PLP Project Coordinator	509-396-2177	Jim@colemanoil.com
PBS Engineering			
Ken Nogeire	Coleman Oil's Consultant Project Manager	509-572-8163	Ken.nogeire@pbsusa.com
BNSF			
Shane DeGross	BNSF Lead	253-591-2567	shane.degross@bnsf.com
Wondrack			
John Schultz	Wondrack Lead	509-736-1330	jschultz@tricitylaw.com
Chevron			
Mark Horne	Chevron Lead	925-842-0973	MarkHorne@chevron.com

3.0 SAMPLING AND ANALYSIS

3.1 Soil Investigation

A total of fourteen (14) test borings will be advanced to depths of 12 feet (or deeper if conditions allow) on the Site to characterize soil conditions across the Site. A direct push drilling rig (track mounted Geoprobe 7822 DT or similar) will be used for the test borings. PBS will field screen soil samples from the proposed locations by hand-held photoionization detector (PID) and by visual and olfactory means. Soil samples will be collected from soils exhibiting field indications of contamination or, in the absence of field indications of contamination, from representative intervals and/or at changes in lithology. PBS will log the soils, making note of grain size, color and odor, and other relevant observations.

Based on previous investigations it is not anticipated that groundwater will be reached with the direct push drilling method. However, should recoverable groundwater be encountered a groundwater "grab" sample will be collected by lowering a temporary well screen into the open borehole and collected by use of a peristaltic pump.

PBS Standard Operating Procedure (SOP) for drilling and soil sampling adds further detail and is included in Attachment B of the RIWP.

The approximate locations of proposed soil borings are presented on Figure 2 of the RIWP: Sample Locations.

3.2 NAPL and Groundwater Sampling

Conduct a groundwater monitoring event (GME) on the monitoring well network (total of 11 wells) located at the project site as follows:

- Gauge depth to water (and depth to NAPL if present) in each well using an electronic inter-face probe.
- If NAPL is present at 2-inches thickness or greater, collect a sample with a disposable bailer for visual inspection in the field. Based on the NAPL, no groundwater sample will be submitted for laboratory analysis.
- If NAPL is not measured, sampling will be conducted using low-flow sampling techniques to ensure minimal drawdown and agitation of well water and the loss of volatiles. This technique will also reduce the volume of purged groundwater needing to be disposed of at an off-site location. Groundwater field parameters (conductivity, pH, temperature, dissolved oxygen and oxidation-reduction potential) will be recorded during purging using a YSI Model 556MSP water-quality analyzer equipped with a flow-through cell. Once groundwater parameters have stabilized, which indicates groundwater is representative of the aquifer formation, a sample will be collected.

3.3 Soil Gas Sampling

Install one soil gas bore on site (see Figure 2 of RIWP for the proposed location).

- Using a direct push drill rig, advance one boring to 10-feet bgs and remove soil core (2-inch diameter) for disposal.
- Connect a 6-inch stainless steel screen to tubing and lower to placement within the bore at 8.5 to 9-feet bgs.
- Place coarse sand from 7 to 10-feet bgs within the bore (sample interval).
- Complete bore to the near surface with hydrated bentonite grout.
- Complete the bore with capped tubing and a concrete embedded flush mounted monument.

PBS Standard Operating Procedure (SOP) for soil gas sampling is included in Attachment B of the RIWP.

3.4 Sample and Analysis Plan

Sample Locations are present on attached Figure 2 of the RIWP.

Location	Rationale for Assessment	Contaminants of Interest	Investigation	Sampling and Analysis Information
Grid 1: Vicinity of the formerly used canopy and dispensers	-Near surface contamination identified in 2015 soil assessment -Downgradient well to the south	TPH-Dx, TPH-Gx, PAHs, and select VOCs	Eight soil borings MW12: Install one off-site monitoring well south of Grid 1 Collect one groundwater sample	Screen samples (by PID, visible or olfactory means) Collect soil samples at 2-foot increments from each soil bore. Groundwater: TPHs, SVOCs, select VOCs, PCBs, and MTCA-5 metals
Upgradient 1: Far northwest corner of the property	Upgradient well	TPH-Dx, TPH-Gx, select VOCs, SVOCs, PCBs	MW7: Install one monitoring well Collect one groundwater sample	Groundwater: TPHs, SVOCs, select VOCs, PCBs, and MTCA-5 metals
Grid 2: North central and northeast area of the property	-Upgradient groundwater wells -Near surface contamination identified in 2015 soil assessment	TPH-Dx, TPH-Gx, SVOCs, PCBs, select VOCs, and metals	Six Soil Borings MW8 and MW9: Install 2 monitoring wells	Screen samples (by PID, visible or olfactory means) Collect soil samples at 2-foot increments from each soil bore. Soil Samples: TPHs, select VOCs, PAHs; Groundwater: TPHs, SVOCs, select VOCs, PCBs, and MTCA-5 metals
Grid 3: Southeast area of the property	-Near surface contamination identified in 2015 soil assessment -Downgradient groundwater delineation	TPH-Dx, TPH-Gx, PAHs, and select VOCs and metals	Five soil borings MW10: Install one monitoring well	Screen samples Collect two soil samples from approximately 4 and 12 feet bgs. Soil Samples: TPHs, select VOCs, PAHs and metals Groundwater: TPHs, select VOCs, MTCA-5 metals
Grid 4: Vicinity of former subsurface fuel line	Confirmed Nov/Dec 2016 gasoline release	TPH-Dx, TPH-Gx, PAHs, and select VOCs	Nine soil borings	Screen samples (by PID, visible or olfactory means) Collect soil samples at 2-foot increments from each soil bore. Soil Samples: TPHs, select VOCs, PAHs; Groundwater: TPHs, select VOCs, PAHs

Location	Rationale for Assessment	Contaminants of Interest	Investigation	Sampling and Analysis Information
Grid 5: Western edge	-Spatial distribution and delineation -Downgradient Well to the south	TPH-Dx, TPH-Gx, PAHs, and select VOCs	Five soil borings MW11: Install one off-site monitoring well south of Grid 5. Collect one groundwater sample	Screen samples (by PID, visible or olfactory means) Collect soil samples at 2-foot increments from each soil bore Soil Samples: TPHs and select VOCs Groundwater: TPHs, SVOCs, select VOCs, PCBs, and MTCA-5 metals
Vicinity of occupied office areas	Vapor Intrusion Evaluation	Select petroleum hydrocarbon VOCs	Install and sample soil gas from VB1	Soil Gas: select VOCs by TO-15

Sample Containers

The testing laboratory will provide sample containers for soil, soil gas and groundwater sampling. PBS personnel responsible for sampling will inspect sampling containers and coolers prior to use. Sample containers will be kept away from fuels and solvents.

Sample Identification

A unique identification number will be assigned to all samples at the time of collection, and a complete label will be attached to each sample container during sample collection. All sample identification numbers and sample depths will be keyed to the sample location (for example, BH1-12 indicates boring 1 with a sample collected from 11-12 feet bgs.

Sample Custody, Delivery, and Schedule

The chain-of-custody (COC) protocol begins with sample collection and ends with sample disposal and creates a document for each sample during this time frame. Under no circumstance is there to be a break in custody. Samples will be stored on ice in an ice chest and shipped to the lab within 48 hours of collection. The sample collector is responsible for prompt shipping of samples and the laboratory Quality Assurance Project Manager (QA PM) is responsible for extracting the samples within the acceptable time limits for each sampling method.

A COC form will be completed by PBS personnel for each group of samples submitted to the laboratory and will remain with the samples until receipt by the laboratory. Prior to samples being delivered to the shipper, PBS will sign, date, and time the COC under “relinquished by.” Coolers will be packaged and sealed to ensure that no liquids can escape during shipment.

Upon delivery of the cooler to the analytical laboratory, custody transfers from PBS to the lab’s staff. The lab employee will sign, date, and time the COC under “received by.” The laboratory will note the condition of received samples on the COC, including temperature if appropriate. The laboratory’s QA PM is responsible for laboratory sample handling and storage, and ultimate disposal of samples.

4.0 QUALITY CONTROL

Quality control field samples may include duplicates and trip blanks and are dependent on the type of media being sampled and the analyses being performed. PBS will collect one duplicate sample for each 10 samples. A trip blank will accompany all shipments sent to the laboratory.

4.1 PBS Quality Assurance/Quality Control (QA/QC) Officer

The PBS QA/QC officer is responsible for planning and executing QC oversight of field and laboratory operations and for ensuring compliance with specified QC requirements. Responsibilities include offering guidance related to quality control issues and working with the PBS project manager to identify such issues and verify corrective actions.

The PBS QA/QC officer or designee will have sufficient authority, including stop-work authority, to ensure that project activities comply with applicable specifications of this QAPP. This authority applies equally to all project activities, whether performed on or off site, by PBS or its subcontractors and suppliers. The QA/QC officer or designee will be physically on site, when necessary, to provide oversight to field sampling work.

Thomas Mergy, Washington-licensed hydrogeologist, will serve as the PBS QA/QC officer. He will delegate day-to-day duties to the PBS project manager, retaining the role of senior technical reviewer to ensure compliance with the SAP and QAPP. The PBS project manager will provide additional QA/QC oversight and work with the lab to ensure compliance.

4.2 PBS Project Manager

The PBS project manager (PBS PM) is charged with ensuring that project activities comply with the SAP and QAPP requirements. Duties include but will not be limited to:

- Developing, maintaining, and distributing project documents.
- Reviewing qualifications of proposed technical staff and subcontractors.
- Ensuring that field personnel are familiar with, and adhere to, proper sampling procedures, field measurement techniques, and sample identification and custody procedures.
- Ensuring that sufficient QA samples are collected.
- Planning and ensuring field activity conforms with the SAP and QAPP.

The PBS PM will additionally act as the analytical data manager, who is charged with organizing, processing, and verifying analytical data generated from sampling activities. Duties will include, but will not be limited to:

- Reviewing sample submittal documents and laboratory log-in records to ensure proper analyses.
- Reviewing analytical reports and validating analytical results.
- Acting as liaison with the laboratory to address data accuracy or quality issues.
- Creating tables of analytical data for reporting.

Ken Nogeire, Washington-licensed hydrogeologist or his designee will serve as the PBS PM for this project.

4.3 Field Geologist

The PBS field geologist or engineer charged with assisting with field documentation and field work under the guidance of the PBS Project Manager, ensuring that project activities are conducted in accordance with this SAP and QAPP.

4.4 PBS Site Health and Safety

The PBS site safety officer (SSO) is responsible for ensuring that field activities are conducted safely and according to provisions of the HASP. The SSO has full stop-work authority if adverse conditions exist that threaten personnel health and safety.

5.0 PERSONNEL QUALIFICATIONS AND TRAINING

5.1 PBS Engineering and Environmental Inc.

Field staff shall be qualified to perform assigned tasks, which is accomplished by establishing and enforcing minimum qualification requirements, verifying personnel proficiency, and implementing a formal training program for the designated task. Field sampling personnel conducting or observing sampling activities are to be trained and certified in accordance with established PBS protocols, including unanticipated field conditions. All personnel engaged in site activities will have completed the OSHA HAZWOPER 40-hour health and safety training and have current annual 8-hour refresher training.

5.2 Laboratory Qualifications

The selected analytical laboratory for this project is Friedman and Bruya (F&B). F&B is Washington Department of Ecology (Ecology)-certified for the selected analytical procedures they will perform for this project.

A copy of the relevant laboratory Quality Assurance Manual is maintained at the lab and has been reviewed by PBS. Laboratory certifications for both laboratories are included with this QAPP. Key laboratory personnel will have at minimum the following requirements:

Laboratory Director/Supervisor

The laboratory director/supervisor shall have at least five years of related laboratory experience including three years of laboratory management experience and possess a Bachelor of Science in chemistry or a related field.

Inorganic and Organic Chemists

Inorganic and organic chemists shall have at least one year of related inorganic/organic experience in, respectively, inductively coupled plasma-atomic emission spectrometry (ICP) or atomic absorption spectrometry (AA), and high-performance liquid chromatography (HPLC). Both shall possess a Bachelor of Science in chemistry or a related field.

Inorganic and Organic Interpretation Chemists

Inorganic and organic interpretation chemists shall have at least two years' experience performing, respectively, ICP or AA, and HPLC analyses. Both shall possess a Bachelor of Science in chemistry or a related field.

Preparation Technician

All inorganic and organic preparations shall be performed by an analyst with at least one year of method-related experience, and work accomplished shall be under the supervision of a chemist.

QA/QC Chemist

The QA/QC chemist shall have a minimum of three years' experience with hazardous waste projects.

6.0 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

QA/QC samples are collected and analyzed to assess the quality of the sampling and analysis by both the field personnel and the laboratory. For samples sent to the laboratory, field QA samples will be collected as follows:

Laboratory	QA/QC Sample	Purpose	Frequency
Analysis by F&F Lab	MS/MS	Accuracy	5%
Analysis by F&B Lab (as requested)	Field Duplicate	Precision	10%

Field Duplicates

Field duplicates are used to document sampling and laboratory analysis reproducibility or precision. One duplicate sample will be collected and analyzed for every ten samples collected. Field duplicates will be collected for all media sampled (soil, NAPL, and groundwater). Field duplicates will be issued unique sample identifications that will not allow F&B to identify the source.

Matrix Spike and Matrix Spike Duplicate (MS/MSD)

MS/MSD samples are used to evaluate matrix interference and to a lesser extent, determine laboratory accuracy. The sampling location in which the MS/MSD samples are collected will change with each event.

Trip Blanks

Trip blanks will be placed in every cooler with VOCs and will be analyzed to document instances where false positive results are observed.

7.0 SAMPLE DOCUMENTATION AND CUSTODY

Collected samples are to be handled in a manner that ensures their integrity and traceability to the sampling location. This is achieved through the use of trained field and laboratory personnel; controlled field, transport, and laboratory conditions; and implementation of rigorous sample preparation, containerization, preservation, storage, packaging, transportation, and custody procedures. Sample custody procedures are designed to ensure that the following objectives are met:

- Each sample is identified uniquely and correctly.
- Each sample is traceable to its source/point of origin.
- Sample representativeness is preserved.
- Sample alteration, such as by preservation or filtration, is documented.
- A record of sample integrity is established and maintained throughout the custody process.
- Sample custody is to be maintained and documented in the field, during shipment, and at the analytical laboratory.

A permanent record for each sample will be documented by sample labels, chain of custody, sampler receipt (completed by the lab).

Sample Labels

A label is affixed to each sample bottle prior to transportation to the laboratory. The label and the sample number will not indicate whether a sample is a duplicate. Information on sampling labels will include:

- Site Name
- Sample Number
- Date
- Time

The label will be identified upon receipt by the laboratory and cross-referenced to the COC record. When the samples arrive at the laboratory following shipment, the sample custodian will receive the samples. Any inconsistencies will be noted on the custody record. Laboratory personnel will notify PBS immediately if any inconsistencies exist in the paperwork associated with the samples. PBS will verify the sample custodian has accurately transcribed sample names from the COC and notify of any discrepancies.

Chain-of-Custody Records

COC forms will accompany sample containers during transit to, and upon receipt by, the laboratory. The COC form will be submitted with the sampling package to the lab. PBS will retain an electronic copy (returned by the lab) with the project files.

The COC will be filled out using indelible ink and will include the following:

- Project name and number
- The signatures of sampling personnel
- Sample identification number, which includes sample location code
- Sampling dates and times
- Total number of containers per sample location
- Analyses to be performed on each sample
- Sample relinquisher, date, and time
- Hazards associated with samples
- Any remarks and/or special instructions

The samples will be picked up and transported to the lab (F&B). Transfer of sample custody will occur as follows:

- PBS will sign, date, and enter time on the COC form under "Relinquished by."
- Lab will sign under "Received by" and enter date and time.

Sample Receipt Form

The laboratory directly logs samples into their computer tracking system and notes problems in sample packaging, chain-of-custody, and sample preservation. The following will occur during sample receipt:

- The deliverer and the time of arrival are documented in the log. The number of items is checked with the actual number received to ensure that all samples arrived.
- Notation is made as to whether the sample container was sealed.

- The container is opened, the internal ambient temperature is taken by use of an included temperature blank, and the samples itemized. All deviations are noted and reported to the sample coordinator.

Documentation
All completed forms should be reviewed and maintained by the PBS PM. Corrective actions taken upon discovery of anomalies are to be documented. All QC records are to ultimately be maintained as part of the project QC file.

Corrections to Documentation
The PBS PM is responsible for ensuring that the requisite QC records are generated and controlled. The QA/QC officer will verify that these controls are implemented as follows:

- Measurements and observations are recorded at the time they are made.
- Documentation is orderly, legible, and traceable to relevant items/conditions.
- Documentation includes sufficient information to be readily interpreted by staff other than those responsible for its generation.
- Changes or revisions to a record are made in a manner that preserves the original data, such as by drawing a single line through a hard copy entry or maintaining historical records of electronic entries/files.
- Changes to records are signed (or initialed) and dated.
- As a minimum standard, changes to a record are subject to the same review and approval protocols as the original entry.
- Records adequately document digressions from specified procedures, QA plan, or work plan, and identify authorization for the digression.
- Project documents and records, including photographic and electronic records, are protected from loss, damage, misuse, or deterioration.

8.0 SAMPLE PACKAGING AND SHIPPING

Samples will be transferred to the selected laboratory for analysis via sturdy waterproof coolers. All samples will be packaged and shipped upon sample completion. Each cooler will be packed as follows:

- Ensure sample lids are tight and containers are sufficiently cushioned to prevent breakage.
- Evidence of sample custody shall be traceable from the time the sample is taken until the filled sample bottles are received by the laboratory.
- The laboratory will be notified of the sample shipment and the estimated date of arrival.

Laboratory Addresses and Points of Contact:
PBS Contact: PBS Project Manager (Ken Nogeire)
509.572.8163

Contracting Analytical Laboratory:
Friedman and Bruya Laboratory
3012 16th Avenue West
Seattle, Washington 98119
206.285.8282
Laboratory Project Manager: Eric Young

9.0 LABORATORY ANALYTICAL PROCEDURES

Project samples are to be prepared, extracted, and analyzed per specifications of the project SAP - QAPP. SOPs for the laboratory are maintained internally in their operations and quality assurance manuals. The analytical laboratory is to demonstrate achievement of the specified detection/quantitation limits and method performance criteria. Project samples are to be prepared, extracted, and analyzed by the specific analytical laboratory identified herein.

Specified methods are to be implemented as published. Modifications to approved procedures, alternate procedures, or additional procedures are to be pre-approved in writing by PBS. If non-standard methods are considered, the analytical laboratory shall provide, upon request, method validation data for consideration. Where deemed necessary to fulfill the requirements of the project, a request for approval for an alternate or modified method is to be made by PBS. QAPP-specified QC requirements are to be followed explicitly.

9.1 Calibration Procedures and Frequency

Measurement and test equipment is to be calibrated to the appropriate traceable standards. Records of these activities are to be generated by the laboratory individual performing the activity and retained by the laboratory. The SW-846 Method protocols are to be regarded as establishing the minimum calibration goals. Calibration procedures and instrumentation shall be consistent with the sample analysis requirements of this project and the applicable EPA approved methods.

9.2 Internal Quality Control Checks

Method Quality Control

Method QC includes the analyses and activities required to ensure that the analytical system is in control prior to and during an analytical run. Method QC requirements for this project are specified within each method. These include, but are not limited to, the following: laboratory blanks (method and instrument), laboratory control spikes, surrogate spikes, matrix spikes, laboratory duplicates and/or matrix spike duplicate pairs, LCS, field duplicates, and field blanks.

Internal quality control checks are designed to establish technically sound criteria for each measurement parameter, which shall serve to accept, qualify, or reject data in a uniform and systematic manner. Ten percent of the total number of a given type of sample shall be devoted to internal QC checks. These checks include blanks, laboratory control spikes, duplicates, matrix spikes, reference standards, and performance evaluation samples.

10.0 DATA QUALITY OBJECTIVES

The overall data quality objective is to provide data of known and sufficient quality to evaluate the physical extent and concentration ranges of chemicals of potential concern from analysis of samples, and to assure compliance with environmental and health-related agencies.

10.1 QA Objectives for Chemical Data Management.

Chemical analyses shall meet data quality objectives for precision, accuracy, and completeness. Accuracy goals, measured by the LCS and to a lesser extent, the MS recovery and the surrogate recovery, are determined by the laboratory and are based upon QC limits established in published EPA methods. The completeness goal for the sediment analytical data is 95 percent. Actual data quality objectives will be listed in each analytical report generated by the laboratory. Data quality objectives are applicable to all samples submitted to the laboratory, including primary samples, duplicates, and MS/MSDs.

10.2 Calculation of Data Quality Objectives—Analytical Precision

Field Duplicate

Precision indicated by analysis of the field duplicate will be expressed as the relative percent difference (RPD) between a sample and its field duplicate. RPD is calculated as follows:

$$\text{RPD (\%)} = \left| \frac{X_1 - X_2}{(X_1 + X_2)/2} \right| \bullet 100\%$$

where: X_1 = measured concentration in the first sample
X_2 = measured concentration in the second sample

Laboratory Duplicate

Two sample aliquots of the same sample are taken in the analytical laboratory and analyzed separately with identical procedures. Analyses of the sample and duplicate give a measure of the precision associated with laboratory procedures, but not with sample collection, preservation, or storage procedures. Precision is expressed as RPD (%).

Analytical Accuracy

The accuracy of the laboratory procedure will be estimated from the analyses of the percent recovery of the LCS and to a lesser extent, the MS/MSD sample. Accuracy is calculated based on the percentage of the spike recovered (REC) in the analysis as follows:

$$\text{\% REC} = \left(\frac{Xs - Xu}{SA}\right) \bullet 100\%$$

where: X_s = measured amount in the spiked sample
X_u = measured amount in the unspiked sample
SA = spiked amount

Several EPA methods do not include an MS/MSD analysis. The accuracy for analytical procedures that do not include an MS analysis will be monitored by the percent difference of the true value for a LCS from its measured value. Accuracy is calculated based on the percentage difference of the LCS in the analysis as follows:

$$\%D = (TV - R) / TV \bullet 100\%$$

where: TV = true value of laboratory control sample
R = result

Completeness

Completeness will be calculated and expressed as the percentage of number of samples that were judged to be valid (i.e., not rejected) and acceptable for all intended data use. Completeness (%C) is calculated for each type of measurement/analysis as follows:

$$\%C = \frac{(SE - SR)}{SE} \bullet 100\%$$

where: *SE* = number of samples collected
SR = number of samples rejected

Sensitivity
Sensitivity is to be expressed in terms of detection and quantitation limits for each type of measurement/analysis.

- The analytical laboratory is to notify the PBS PM if the laboratory anticipates or experiences any difficulties in achieving the detection/quantitation limits specified.
- Matrix effects should be considered in assessing the analytical laboratory's compliance with sensitivity specifications. The laboratory is to provide a detailed discussion of all failures to meet sensitivity specifications in the project narrative.
- If a sample dilution results in non-detect values for analytes that had been detected in the original analysis, then the results of the original run and the dilution are to be reported with the appropriate notations in the project narrative.

Representativeness
Representativeness expresses the degree to which sample data represent the characteristics of a population of samples, parameter variations at a sampling point, or an environmental condition. Representativeness is to be ensured in the field through implementation of appropriate sample collection, preservation, handling, and techniques. In the laboratory, representativeness is to be ensured by meeting method hold times and appropriate subsampling or aliquot techniques. Representativeness is to be assessed through results of duplicate field and laboratory samples.

11.0 DATA REDUCTION, REVIEW, AND REPORTING

Conversion of raw data into reported results is to be performed by the laboratory's QC chemist as detailed in the analytical methods. Laboratory SOPs include automated or manual data reduction procedures, equations, conversion factors, significant figures, and reporting units. Suspected outliers are to be reviewed for calculation and transcription errors, instrument malfunctions, and verification of measurement. If no errors are found, statistical methodology can be performed to determine whether the data point is to be rejected or retained. The PBS PM will be responsible for inspection of reported results for laboratory data.

11.1 Data Review

General
Data review is independent of the intended use of the data and determines the technical merit of the data by comparing QC results to method and Ecology-specified criteria. Data are reviewed for traceability, documentation, calculations, transcription errors, and evaluation of data deliverables for contract compliance.

Field Parameters
Field staff are to review their data and implement any necessary corrective actions prior to submitting data for use. All field data must be within the acceptance criteria specified in the SAP before being used for decision-making purposes. Any corrective actions should be noted in the daily report.

11.2 Data Tracking and Reporting

Data Tracking

The submittal from the analytical laboratory will be tracked and reviewed by the PBS PM. Final data will be included in the reporting memorandum.

Electronic Data

The format for electronic data delivery from the laboratory will be a customized electronic data deliverable (EDD) package. The information in the EDD will be checked against each input source using input file structure comparison, comparison of requested and reported data, sample number verification, parameter spelling check, reporting unit consistency, consistency between electronic and validated results, independent spot checks of electronic and hard copy data, detection limit specifications, and other internal consistency checks of the data. The output from the database will also to be checked by the PBS PM to determine if it makes sense from an historical perspective, is representative, and agrees with previous data collected or literature reported values. No project data will be released for use until QC checks have been performed and discrepancies resolved.

11.3 Quality Control Reports

Data Review—Laboratories

Laboratory data are to be reviewed by F&B’s laboratory QC chemist prior to delivery as prescribed in the analytical laboratory's approved Quality Management Plan. Data will be reviewed following contract laboratory program function guidelines using SW-846 method requirements, SOPs, and the DQOs. Data reviews by the laboratory QC chemist will include data on initial and continuing calibration, blanks, laboratory control spikes, duplicates, controls, surrogates, and MS/MSD. The reviews will include an assessment of accuracy, precision, representativeness, calibration, comparability, sensitivity, and completeness, any performance or system audit results, and any significant QA problems encountered. Data that are qualified (flagged) during analysis or review will be noted as such in reports where they are used.

Data Review—PBS

The PBS PM will conduct the initial data review for PBS. The sample parameter quantification level data will be reviewed and include cross-checking data from original, duplicate, and MS/MSD samples for consistency; and review of sample data flagged by the laboratory. The data will be compared with Ecology requirements and DQOs before being submitted.

If there are no qualifiers, that will indicate that the data are acceptable both qualitatively and quantitatively. If data need to be flagged during the QC data review, the qualifiers outlined in the following table will be used. Under certain circumstances, additional flags may be used if necessary.

Qualifier	Reason
B	Results are estimated because the compound was detected in an associated blank.
C2	RPD between the primary column and the confirmation column results exceed the laboratories RPD criteria. The higher result was reported. The results are acceptable both qualitatively and quantitatively.
E	Results exceeded the concentration range for the instrument. Data are not acceptable for any purpose.

Qualifier	Reason
J	Results are estimated, and the data are valid for limited purposes. The results are qualitatively acceptable.
N	Analysis was not performed.
R	Reported value is "rejected." Resampling or reanalysis may be necessary to verify the presence or absence of the compound. Data are not acceptable for any purpose.
U	Reported value is below method reporting limit. The results are qualitatively acceptable.

12.0 PREVENTIVE MAINTENANCE

The laboratory's preventive maintenance program is described in their Quality Assurance Manual, which is maintained at the laboratory. Equipment used by PBS personnel in the field for sampling, measuring, and analysis will be maintained following manufacturer's recommended practices.

13.0 PERFORMANCE AND SYSTEM AUDITS

Laboratory and field audits may be scheduled and performed at the direction of the PBS PM.

14.0 CORRECTIVE ACTIONS BY LAB

Documentation for corrective actions implemented by the laboratory is to be generated and retained in the laboratory's project file.

14.1 Corrective Action Documentation

This documentation is to be made accessible to the PBS PM. Corrective actions are required for the following conditions:

- QC data outside the defined acceptance windows for precision or accuracy.
- Blanks or LCS that contain contaminants above acceptable levels stated in the DQOs.
- Undesirable trends in spike or surrogate recoveries or RPD between spiked duplicates.
- Unusual changes in method reporting limits.
- Deficiencies identified during internal or external audits, or from the results of performance evaluation samples.
- Project management inquiries concerning data quality.

The following corrective actions should be taken for common problems:

Incoming Samples

Problems noted during sample receipt are to be documented on the Cooler Receipt Form. The PBS PM is to be notified for problem resolution.

Sample Holding Times

If maximum holding time is or may be exceeded by the laboratory, the PBS PM must be notified for problem resolution. Resampling may be necessary for the requested parameters.

Instrument Calibration

Sample analysis may not proceed until initial calibrations meet method criteria. Calibrations must meet method time requirements or recalibration must be performed. Continuing calibrations that do not meet accuracy criteria should result in a review of the calibration, rerun of the appropriate calibration standards, and reanalysis of samples affected back to the previous acceptable calibration check.

Practical Quantitation Limits

Appropriate sample clean-up procedures must be employed to attempt to achieve the practical quantitation limits as stated in the method. If difficulties arise in achieving these limits due to a particular sample matrix, the laboratory should notify the PBS PM of the problem for resolution. Dilutions are to be documented in the case narrative along with the revised practical quantitation limits for those analytes directly affected. Analytes detected above the method detection limits but below the practical quantitation limits are to be reported as estimated values and qualified "J."

Method Quality Control

Results related to method QC, including blank contamination, duplicate measurement reproducibility, MS/MSD recoveries, surrogate recoveries, LCS recoveries, and other method-specified QC measures are to meet the laboratory's SOPs and DQOs specified in this plan; otherwise, the affected samples may be reanalyzed and/or re-extracted and reanalyzed within method-required holding times to verify the presence or absence of matrix effects. In order to confirm matrix effects, QC results must observe the same direction and magnitude (ten times) bias. The PBS PM should be notified as soon as possible to discuss appropriate corrective action.

Calculation Errors

Reports must be reissued if calculation and/or reporting errors are noted with any given data package. The case narrative is to state the reason(s) for re-issuance of a report.

15.0 PLAN AMENDMENTS

This combined SAP and QAPP will serve as the primary plan governing all field and reporting activities related to this limited sampling at the Coleman Oil Yakima. If any portion of this plan warrants or requires amendment, the changes shall be communicated by either issuing a revised plan in its entirety, or preparing an addendum describing the changes and implementation schedule.