



December 4, 2024

Mr. Nicholas Lines  
P.O. Box 622  
Pine, CO 80470

**Subject: Cleanup Work Plan  
Former Pro Lube #1 – 400 10<sup>th</sup> Avenue South, Great Falls, Montana  
DEQ Facility ID 07-01930 (TID 18417); Release 3624; WPID 34962  
AWS Project 11022.6**

Dear Mr. Lines,

Air Water Soil, LLC (AWS) is pleased to present this Cleanup Work Plan (CWP) to complete a cleanup pilot study at the Former Pro Lube #1 petroleum release site (hereafter, “the Site”). The Site is located at 400 10th Avenue South in Great Falls, Montana (see Figure 1 provided in Appendix A).

AWS has prepared this CWP on your behalf in response to a November 4, 2024, *Additional Corrective Action Work Plan Required* letter issued by the Montana Department of Environmental Quality Petroleum Tank Cleanup Section (DEQ). AWS has prepared this CWP in general conformance with the guidelines given for a CWP in DEQ’s *Montana Cleanup Guidance for Petroleum Releases* draft document dated November 2020.

## **SITE DESCRIPTION**

The Site is currently occupied by an automotive services business that no longer utilizes petroleum storage systems. All former underground storage tank (UST) systems have been removed from the Site property (see Figure 2 provided in Appendix A).

Previous investigations have resulted in the drilling of numerous soil boreholes and construction of several monitoring wells at and around the Site. Drilling has identified natural deposits of clay, with sand and silt, to variable depths from 7 feet to greater than 15 feet below ground surface (bgs). These unconsolidated sediments are underlain by interbedded siltstone and shale bedrock.

The unconsolidated sediments are laterally continuous below the Site. Construction has altered the sediments and has introduced more permeable gravel fill materials into the subsurface.

Groundwater occurs at depths from 9 to 11 feet bgs. Saturated conditions are laterally continuous and groundwater elevations indicate a shallow aquifer flow generally towards the northwest. However, localized conditions, such as groundwater accumulation in the former UST basin fill material, results in altered flows towards the north.

**Air Water Soil, LLC**

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## BACKGROUND

Petroleum Release 3624 has been extensively investigated per the requirements of the DEQ. Below is the known summary of background information regarding the release and previous investigations:

- In 1998, Glacier Engineering, P.C. (Glacier) and Dave Kuglin Construction (Kuglin) were retained by Pro-Lube, Inc. to remove USTs and piping at the Site under removal permit #99-0224.
- On December 15, 1998, while removing one 10,000 gallon and two 6,000-gallon USTs from the Site, Glacier and Kuglin confirmed the presence of petroleum impacted soil and reported the incident to DEQ, who subsequently assigned the release number 3624.
- Confirmation soil samples collected from the 6,000-gallon tank perimeters revealed elevated levels of Diesel Range Organics and Total Extractable Hydrocarbons. This prompted the DEQ to request further investigations onsite to determine possible impacts to groundwater.
- In August 2001, Glacier completed a remedial investigation (RI) to determine the magnitude of potential petroleum impacts below the Site. A single soil boring was installed and was subsequently completed as monitoring well MW-1 (see Figure 2). Soil and groundwater sample analyses confirmed both gasoline and diesel fuel impacts. Residual concentrations of petroleum in soil and groundwater exceeded DEQ guidelines.
- In August 2013, CTA Environmental (CTA) completed a second RI and installed four additional monitoring wells at the Site. As shown in Figure 2, monitoring wells MW-2, MW-3, MW-4, and MW-5 were completed in and around the former UST basin. Visually impacted soil was identified in monitoring wells MW-3 and MW-4 between 9 and 11 feet below ground surface (bgs) and in MW-5 between 6.5 and 7.5 feet bgs. Laboratory analyses of soil samples, however, confirmed only minor concentrations of residual gasoline and diesel fuel contaminants. Groundwater measurements identified a northerly flow direction. Analyses of groundwater samples from all five monitoring wells further confirmed minimal petroleum impacts, with elevated benzene only identified above DEQ guidelines in monitoring well MW-1.
- CTA completed groundwater monitoring programs in September 2015 and March 2017. Measurements continued to show a north-northwest groundwater flow direction. Analyses of groundwater samples identified residual concentrations of gasoline contaminants, exceeding DEQ guidelines, in wells MW- 1, MW-3, and MW-4. In a 2017 report, CTA presented an evaluation of remedial alternatives to address groundwater contamination. Their analysis resulted in enhanced bioremediation being selected as a favorable remediation alternative.
- In February 2019, CTA completed two soil boreholes in the former UST basin (i.e., SB-1 and SB-2) and installed monitoring wells MW-6 and MW-7. All four borings encountered residual petroleum impacted soil. Only soil samples from well MW-6, at 10 to 12 feet bgs, contained benzene concentrations exceeding DEQ guidelines.

- CTA finalized their semi-annual groundwater monitoring program and presented results in a November 2019 report. The groundwater results continued to show gasoline contamination above DEQ guidelines in wells MW-1, MW-6, and MW-7. Most of the contaminated groundwater was present west of the former UST basin. The extent of the groundwater plume west of monitoring well MW-6, however, had not been defined. Furthermore, CTA continued to recommend enhanced bioremediation as a remediation strategy.
- AWS completed a supplemental RI in 2023, that included the installation of monitoring well MW-8 to define the west extent of the groundwater plume (see Figure 2). Continued groundwater monitoring established the extents of the groundwater plume to be limited to the vicinity of wells MW-1, MW-6, and MW-7. The findings were presented in an August 15, 2023, report. AWS recommended that an enhanced bioremediation pilot study be designed and implemented to determine the effectiveness of this technology to address residual contaminants in the groundwater environment.

## **CLEANUP OBJECTIVES**

The objective of this CWP is to complete a pilot-scale test to evaluate the effectiveness of enhanced bioremediation in reducing the petroleum contaminant mass below the Site. Specifically, the concentrations of benzene and naphthalene in wells MW-1, MW-6, and MW-7 will be targeted for reduction.

## **CLEANUP METHOD CHOSEN**

Past sampling results have shown that anaerobic conditions dominant in the groundwater environment regarding natural attenuation of petroleum contaminants. The data suggests that biological metabolism may be enhanced by sulfate and nutrient addition. Thus, AWS will implement a pilot-scale study to gravity feed a sulfate and nutrient rich injectate directly to the subsurface.

## **CLEANUP WORK PLAN TASKS**

In order to achieve the stated cleanup objectives, AWS has prepared the scope of work for this CWP to include the following 11 tasks: 1) CWP Preparation; 2) Project Administration; 3) Mobilization; 4) Injection Well Installation; 5) Injection Well Development; 6) Gravity Injections; 7) Groundwater Monitoring; 8) Laboratory Analyses; 9) Data Validation; 10) Release Closure Plan Update; and, 11) Report Preparation.

AWS's proposed methods for these tasks are described in the following sections. Copies of referenced Standard Operating Procedure (SOP) documents are provided in Appendix D.

### **Task 1 – Cleanup Work Plan Preparation**

AWS's CWP and associated cost estimate (Appendix C) have been created in general conformance with the guidelines given for a CWP in DEQ's *Montana Cleanup Guidance for Petroleum Releases* draft document dated November 2020. CWP preparation included

correspondence and planning, estimating costs to implement each task, creating figures, and preparing this document.

### **Task 2 – Project Administration**

Project administration activities will include:

- Correspondence with project stakeholders throughout the period of performance.
- Coordinating the schedule for on-site activities.
- Completing a permit application and obtaining approval for the injections through the United States Environmental Protection Agency Region 8 Underground Injection Control program.
- Subcontracting the driller to construct the injection wells.
- Scheduling AWS's field personnel and activities.
- Procuring and coordinating equipment and supplies, as necessary, to complete the scope of work.
- Tracking the project budget.

### **Task 3 – Mobilization**

Mobilization includes labor and vehicle mileage costs for project travel necessary to complete the cleanup work plan tasks. This generally includes AWS personnel's travel to and from the site, as well as preparation time of up to 1 hour per mobilization event, as applicable. Field activities will be combined to reduce mobilization events and costs, where feasible. For this CWP, the anticipated mobilization events necessary to complete the cleanup work plan tasks are summarized as follows:

- Injection Well Installation
  - 1 mobilization
  - Staff Scientist
- Injection Well Development
  - 1 mobilization
  - Tech II
- Groundwater Monitoring Event #1 – Pre-Injection
  - 2 mobilizations
  - Tech II
- Injection Event #1
  - 1 mobilization
  - Staff Scientist
- Injection Event #2
  - 1 mobilization
  - Staff Scientist

- Groundwater Monitoring Event #2 – Post-Injection, 3-5 Weeks
  - 1 mobilization
  - Tech II
- Groundwater Monitoring Event #3 – Post-Injection, 7-10 Weeks
  - 2 mobilizations
  - Tech II

#### **Task 4 – Injection Well Installation**

To accommodate gravity feeding of injectate directly to the subsurface, AWS will utilize three new injection wells. The locations for the three injection wells are shown in Figure 2.

AWS solicited injection well drilling and construction proposals from Boland Drilling Company (Boland) and two other qualifying contractors. The bid information is provided in Appendix C, and as shown, Boland’s proposed fee is the lowest.

At least 2 full business days prior to initiating the subsurface investigation, AWS will submit a subsurface utility locate request through Montana811 (aka “Call Before You Dig” or “One-Call”). Montana811 will subsequently coordinate surface marking of public underground utilities at the Site. Note that public utility lines located on the service sides of meters, and any other privately owned underground utilities, are generally excluded and may not be surface marked through the Montana811 utility locate process. In the event AWS is unable to field verify the locations of known private utilities within the project area, additional coordination and subcontracted search services may be required.

Boland will advance the three injection well boreholes using a Mobile B-61 hollow-stem auger drill rig with an air-assisted gravity hammer which allows for collection of continuous soil core samples using split-spoon samplers. AWS will record observations of lithology and the presence or absence of visual and/or olfactory evidence of petroleum impacts on field forms during the work.

Soil samples will be collected following the procedures outlined in *AWS SOP-02 – Soil Sample Collection*, including collection of splits for field analysis and splits for potential laboratory analyses. Field splits will be analyzed following *AWS SOP-03 – Field Measurement of Total Volatile Organic Compounds (VOCs)*.

Laboratory samples will be containerized from the potential laboratory splits as summarized below. The actual number of samples to be collected will depend on observations and conditions at the time of sampling. For this CWP, AWS anticipates the following samples will be collected:

- Worst-Case Total VOCs (3 grab samples): 1 grab sample will be collected from the interval exhibiting the highest total VOC concentration in each boring. This sample will not be collected for a given boring with no exceedances of 100 ppm total VOCs, and for which no visual evidence of impacts is observed.

- **Bottom of Hole (3 grab samples):** 1 grab sample will be collected from the bottom of each borehole, if different from the samples above.

Laboratory samples will be containerized, preserved, and transported to the analytical laboratory following *AWS SOP-08*, and in accordance with the referenced analytical methods, using vessels and preservatives provided by the laboratory. AWS anticipates transporting all soil samples directly to the laboratory using a commercial courier service (e.g., FedEx). Laboratory analyses to be requested are discussed in Task 8 of this CWP.

Reusable downhole equipment will be decontaminated by the driller before initiating each soil boring, as appropriate. Decontamination may not be necessary following completion of boreholes which did not exhibit evidence of petroleum contamination. Reusable sampling equipment will be decontaminated following *AWS SOP-01*.

Drill cuttings will be handled following the procedures outlined in *AWS SOP-56*. Boland will drum all drill cuttings and will transport them to the Havre Landfill for final disposal.

### **Task 5 - Injection Well Development**

The three new injection wells will be developed in accordance with *AWS SOP-05* (Appendix D). New, 4-inch nominal diameter disposable bailers will be used to develop each well.

### **Task 6 – Gravity Injections**

AWS has designed an injectate solution consisting of magnesium sulfate heptahydrate (i.e., Epsom Salt), Nutrimens™ amendment manufactured by Tersus Environmental, and clean water. The solution will be gravity injected equally between the three new injection wells. Two injection events will be implemented over a 2-day time frame.

The total quantities of the solution components that will be gravity injected over the 2-day injection period will be as follows:

90 pounds Magnesium Sulfate Heptahydrate  
300 milliliters Tersus Nutrimens™  
60 gallons clean water

Depth to Water (DTW) will be measured in wells MW-1, MW-3, MW-6, and MW-7 before and after each injection event to help determine if the solution is spreading throughout the targeted treatment area.

### **Task 7 – Groundwater Monitoring**

Groundwater monitoring will be completed in accordance with the following schedule:

<i>Identifier</i>	<i>Description</i>
<b>Event #1: Pre – Injection</b>	Completed after injection well installation and prior to gravity injection startup.
<b>Event #2: Post – Injection, 3-5 Weeks</b>	Completed within 3 to 5 weeks after completion of both injection events.
<b>Event #3: Post – Injection, 7-10 Weeks</b>	Completed within 7 to 10 weeks after completion of both injection events.

Groundwater monitoring will be completed in accordance with *AWS SOP-06* (Appendix D). This groundwater monitoring plan is intended to evaluate the current status of groundwater contamination below the Site and determine the effectiveness of the pilot scale injections.

The locations of the 8 existing monitoring wells are illustrated in Figure 2. The wells to be gauged and monitored as part of this CWP, and the analytical parameters to be evaluated for each, are summarized by event in the groundwater monitoring analytical plan presented in Appendix B.

DTW and depth to product (DTP) will be measured following the procedures outlined in *AWS SOP-04* and groundwater monitoring will be completed in accordance with *AWS SOP-06 – Groundwater Sampling*. AWS will utilize a peristaltic pump system to obtain samples for this project. Natural samples will be collected from each of the specified monitoring wells, along with duplicate samples, as tabulated in the groundwater monitoring analytical plan.

Laboratory samples will be containerized, preserved, and transported to the analytical laboratory following the procedures outlined in *AWS SOP-08*, and in accordance with the referenced analytical methods, using vessels and preservatives provided by the analytical laboratory. Laboratory analyses to be requested are discussed in Task 8 of this CWP.

Reusable monitoring and sampling equipment will be decontaminated following *AWS SOP-01* prior to use in each monitoring well. Unused water evacuated from each well will be handled in accordance with *AWS SOP-56*.

### **Task 8 – Laboratory Analyses**

Laboratory analyses of soil and groundwater will occur after completion of their associated task. Details for these analyses are as follows:

#### ***Soil Analyses***

AWS will request that Energy Laboratories, Inc. (Energy) analyze soil samples for Volatile Petroleum Hydrocarbons (VPH) and Extractable Petroleum Hydrocarbon (EPH) Screen in accordance with the RBCA Document. Soil samples exhibiting EPH Screen concentrations greater than the DEQ screening criterion of 200 milligrams per kilogram (mg/kg) will be further analyzed for EPH fractions in accordance with the RBCA Document.

### ***Groundwater Analyses***

AWS will request that Energy analyze groundwater samples for the testing suite presented in Appendix B. Analyses will include determining concentrations of VPH contaminants and the concentration of the lead scavenger 1,2-dichloroethane (DCA) in wells MW-6 and MW-7. Supplemental analyses will also be completed to assess natural attenuation parameters. Duplicate samples, collected for data validation purposes, will only be analyzed for VPH contaminants.

### **Task 9 – Data Validation**

Upon receipt of final laboratory analytical results for the soil and groundwater sampling events, AWS will complete data validation in accordance with DEQ's *Data Validation Summary Form*. Data will be validated to assess the precision, accuracy, repetitiveness, comparability, and completeness of the reported parameters.

### **Task 10 – Release Closure Plan Update**

Following completion of all field tasks and receipt of final analytical data, AWS will update the previous Release Closure Plan (RCP) for Release 3624. This will include assessing all available data for the Site. Available data will be evaluated to help determine an appropriate remediation plan to address residual contamination from the petroleum release. The updated RCP will also aid in identifying data gaps which will need to be addressed for Release 3624.

### **Task 11 – Report Preparation**

Following completion of Tasks 2 through 10, including receipt and review of all final analytical data, AWS will prepare a Cleanup Report (CR) in general conformance with the guidelines given for a CR in DEQ's *Montana Cleanup Guidance for Petroleum Releases* draft document dated November 2020. The CR will include a discussion of the pilot-scale cleanup method, the RCP, and will present conclusions and recommendations derived from the pilot-scale testing, as appropriate.

Data will be presented in tabular form and select information will be presented on a site diagram(s). The report will be submitted to you and DEQ electronically, in Portable Document Format (PDF); a hard copy will not be prepared or provided.

### **SCHEDULE**

AWS will initiate the scope of work following our receipt of your authorization to proceed, which shall follow our receipt of DEQ approval of this CWP. The actual project schedule will be contingent on various conditions which are indeterminable at the time of preparation of this document, including but not limited to approval from all listed parties, weather, and availability of AWS personnel. AWS will coordinate with you, DEQ and other stakeholders as appropriate.



## FEE

AWS's fee for completing the scope of work described in this work plan will be assessed on a time-and-materials basis, in accordance with the attached Cost Estimate (Appendix C). Our estimated total fee for completing the scope of work detailed in this work plan is approximately **\$41,092**. Our cost estimate has been prepared using AWS's current, PTRCB-approved 2024 labor and equipment rates and reimbursable costs. The services provided will be invoiced using rates approved by the PTRCB for the current billing period.

Actual costs may vary depending on a variety of factors, including but not limited to unforeseen delays or other necessary but unexpected changes to the scope of work. AWS will coordinate changes to the scope of work with you and DEQ, as appropriate.

## LIMITATIONS

The scope of work included in this work plan has been prepared for you and includes only those services described above. This work plan does not include remedial or disposal services, or costs for such services, beyond those listed specifically in the scope of work.

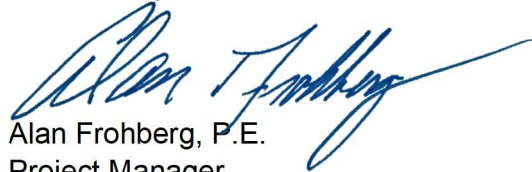
AWS cannot and does not warrant that the scope of services described in this work plan will be adequate to identify all potential environmental conditions or latent conditions at the Site. Our scope of work will be performed with a standard of care meeting or exceeding that of other environmental consultants performing similar work in the area.

## ACCEPTANCE

A complete copy of this CWP will be submitted on your behalf to Mr. Donnie McCurry with DEQ. After his review and approval, AWS will confirm your approval before proceeding to complete the scope of work presented herein.

Please contact us in our Great Falls office (406.315.2201) if you have any questions or concerns regarding this project. We appreciate your business and look forward to working with you on this project.

Respectfully Submitted,



Alan Frohberg, P.E.

Project Manager

[alan@airwatersoil.com](mailto:alan@airwatersoil.com)

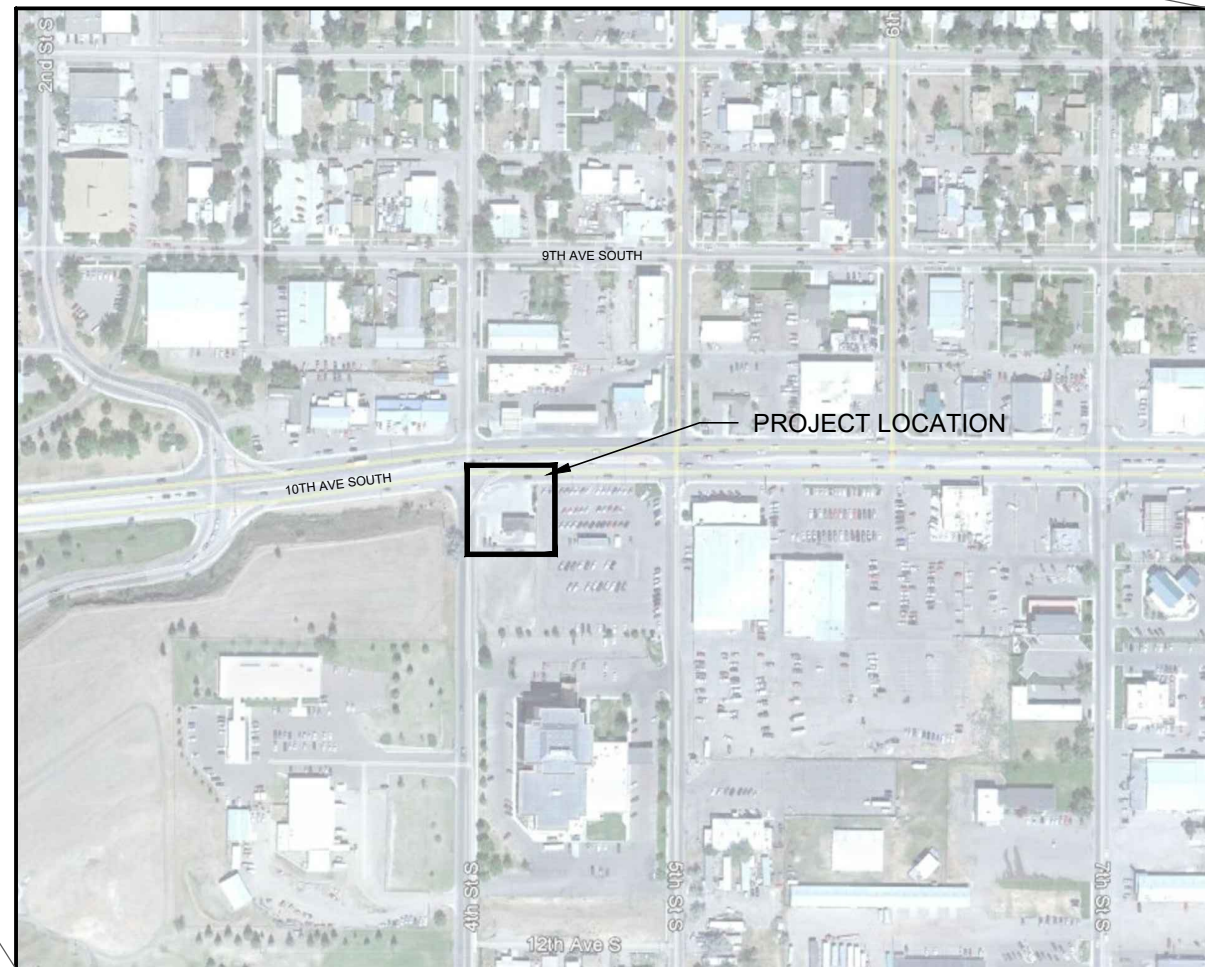
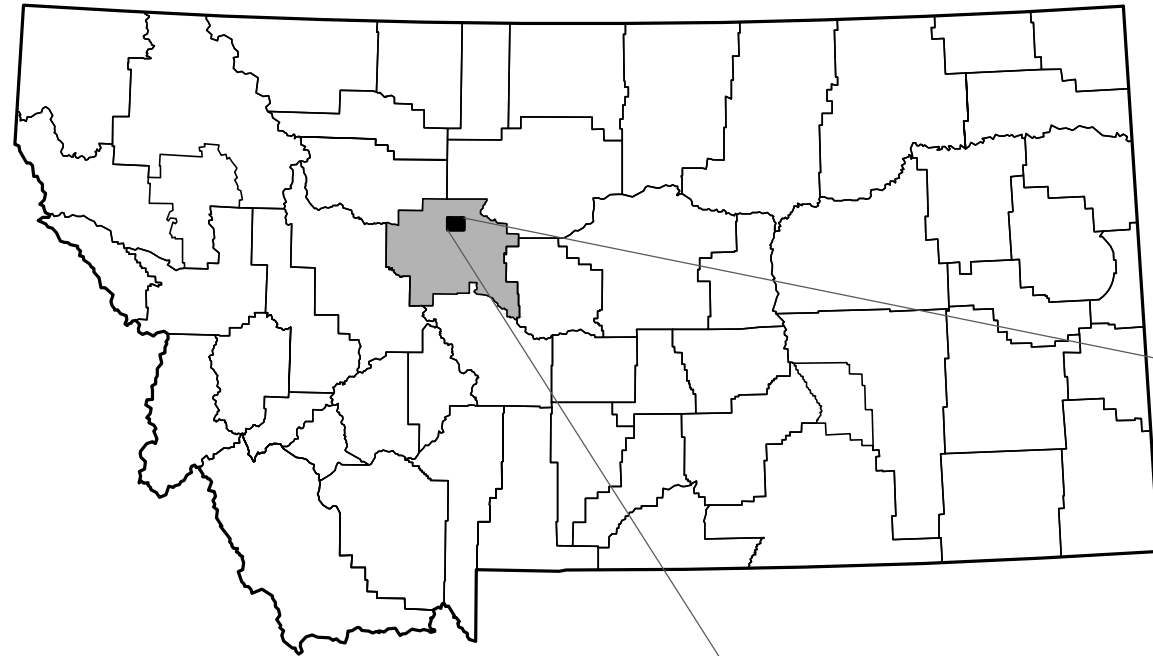
Appendices: A – Figures  
B – Groundwater Monitoring Analytical Plan  
C – Cost Estimate  
D – Standard Operating Procedures

cc: Mr. Donnie McCurry, Montana DEQ PTCS, P.O. Box 200901, Helena, MT 59620.  
Transmitted via DEQ FTP server.



**APPENDIX A**  
**Figures**

GREAT FALLS, CASCADE COUNTY, MONTANA



PROJECT LOCATION



NORTH

1  
FIG 1

**SITE VICINITY MAP**

DEQ FACILITY ID 07-01930; RELEASE 3624; WP ID 34962

400 10TH AVENUE SOUTH, GREAT FALLS, MONTANA

FORMER PRO-LUBE #1

CLEANUP WORK PLAN

NICK LINES

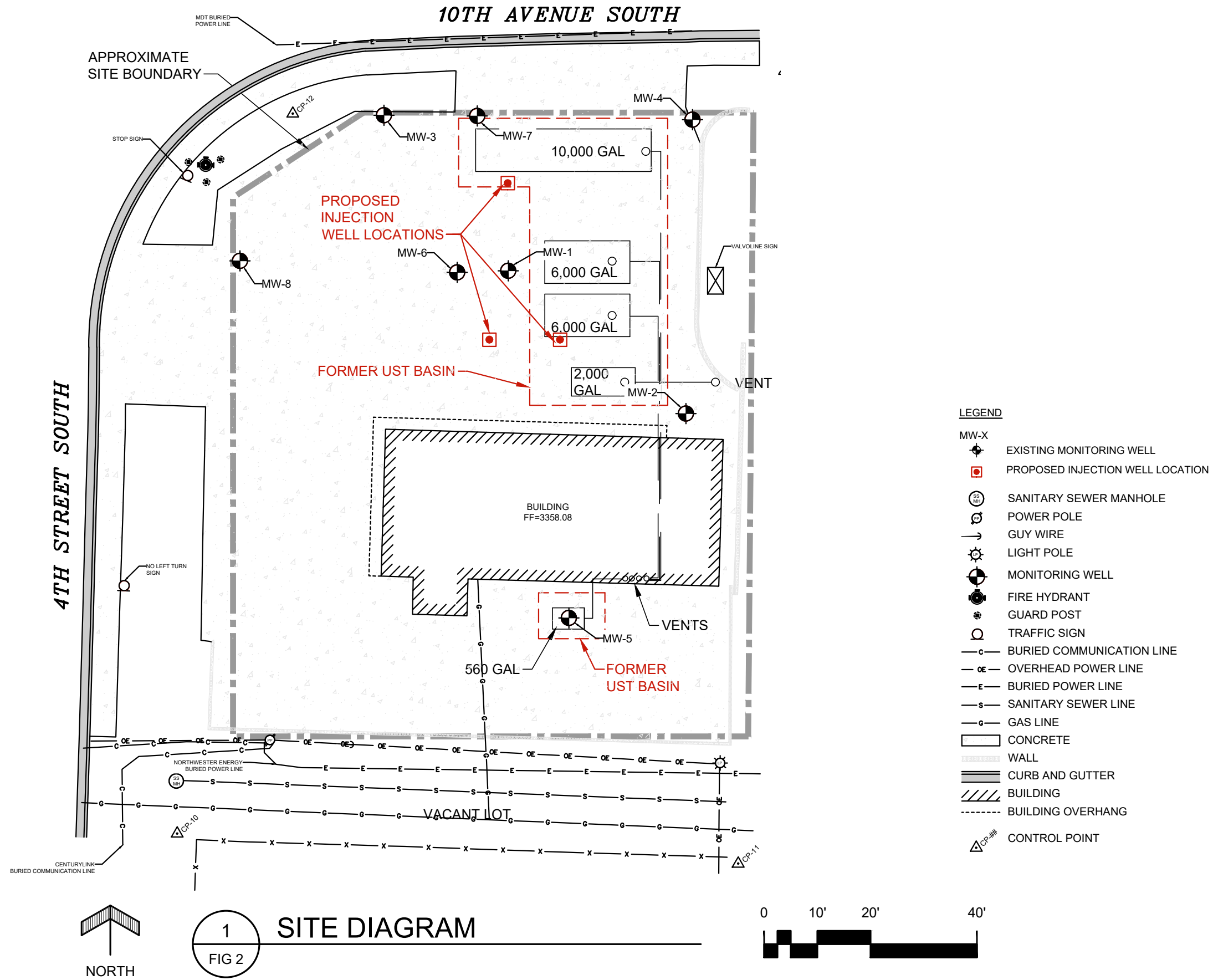
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DRAWN BY  
DRESCH  
CHECKED BY  
FROHBERG

SITE VICINITY  
MAP

FIGURE  
**1**





## **APPENDIX B**

### **Groundwater Monitoring Analytical Plan**



**GROUNDWATER MONITORING  
ANALYTICAL PLAN**

**Cleanup Work Plan**

**Former Pro Lube #1 – 400 10th Avenue South, Great Falls, Montana**

**DEQ Facility ID 07-01930 (TID 18417); Release 3624; WPID 34962**

<b>Wells</b>	<b>Depth to Water (DTW)</b>	<b>Volatile Petroleum Hydrocarbons (VPH) (MT VPH Method)</b>	<b>Extractable Petroleum Hydrocarbons (EPH) Screen (MT EPH Method)</b>	<b>EPH Fractions (MT EPH Method)</b>	<b>1,2-dichloroethane (DCA) (Method 8260B)</b>	<b>Ethylene Dibromide (EDB) (Method 8011)</b>	<b>Alkalinity (Method A2320B)</b>	<b>Dissolved Methane (Method SW8015M)</b>	<b>Sulfates (Method E300.0)</b>	<b>Sulfides (Method A4500-SF)</b>	<b>Nitrogen, Nitrate + Nitrite (Method E353.2)</b>	<b>Dissolved + Total Iron and Manganese (Methods E200.7/E200.8)</b>
<b>Event #1 - Pre-Injection</b>												
MW-1	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-2	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-3	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-4	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-5	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-6	✓	✓	--	--	✓	--	✓	✓	✓	✓	✓	✓
MW-7	✓	✓	--	--	✓	--	✓	✓	✓	✓	✓	✓
MW-8	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
Duplicate	--	✓	--	--	--	--	--	--	--	--	--	--
<b>Event #2 - Post-Injection, 3-5 Weeks</b>												
MW-1	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-6	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-7	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
<b>Event #3 - Post-Injection, 7-10 Weeks</b>												
MW-1	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-2	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-3	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-4	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-5	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
MW-6	✓	✓	--	--	✓	--	✓	✓	✓	✓	✓	✓
MW-7	✓	✓	--	--	✓	--	✓	✓	✓	✓	✓	✓
MW-8	✓	✓	--	--	--	--	✓	✓	✓	✓	✓	✓
Duplicate	--	✓	--	--	--	--	--	--	--	--	--	--



**APPENDIX C**  
**Cost Estimate**



**APPENDIX D**  
**Standard Operating Procedures**





# STANDARD OPERATING PROCEDURE

## Field Sampling Equipment Decontamination

AWS SOP-01

### EQUIPMENT:

- Disposable gloves (e.g., latex, nitrile)
- Eye protection
- Phosphorus-free detergent concentrate (e.g., Alconox®, Liquinox®)
- Concentrated alcohol (e.g., isopropyl, methanol) to make 10% solution
- Concentrated nitric acid to make 10% solution
- Deionized (DI), distilled, or potable tap water
- Spray bottles, collapsible dispensers, buckets, basins
- Scrub brushes
- Disposable wet-wipes
- Paper towels
- HEPA-filtered vacuum
- Garbage bags

### PROCEDURE:

Decontamination of asbestos sampling tools and equipment is generally accomplished using HEPA-filtered vacuums, disposable wet-wipes, or water and paper towels. Cleaning is continued until visible contaminants are removed to prevent cross contamination between samples, and to prevent potential fiber exposure.

Decontamination of petroleum investigation sampling equipment generally includes a 3-step process: 1) detergent scrub; 2) alcohol/acid rinse; and 3) water rinse.

Prepare detergent solution by mixing detergent concentrate with potable water in a large cooler or basin. Keep this mixture free from contaminants; draw small portions out into smaller basins/buckets as needed. Prepare 10% alcohol-in-water and 10% nitric acid-in-water solutions in collapsible containers and/or spray bottles. Methanol and nitric acid solutions should be prepared using DI or distilled water.

Decontamination should be performed in an area upwind of the contamination zone or otherwise reasonably free from contaminants of concern. Gross contaminants/debris should be removed from equipment and left in the sampling area(s) if practicable. Remove remaining gross contamination by scrubbing equipment with detergent solution in a small basin. Empty basin and refill with fresh detergent solution as necessary. Rinse with alcohol solution, nitric acid solution (when sampling for metals), and DI/distilled water.

Dry decontaminated equipment using paper towels or place in an area as free from contaminants of concern as practicable and allow to air dry.

Caution should be used to avoid direct contact with contaminated materials; gloves and eye protection should be worn during preparation of decontamination fluids and during decontamination of sampling equipment. Decontamination fluids should be prepared in a location as free from contamination as practicable.



# STANDARD OPERATING PROCEDURE

## Field Sampling Equipment Decontamination

**AWS SOP-01**

### **DISPOSAL:**

All disposable items (soiled wipes, used paper towels, vacuum filters, etc.) should be deposited into a garbage bag and properly disposed. Decontamination waste from asbestos decontamination may require disposal as asbestos waste.

Decontamination fluids for petroleum investigations do not need to be collected under most circumstances. Spread decontamination fluids over a paved surface, if practicable.



# STANDARD OPERATING PROCEDURE

## Soil Sample Collection

AWS SOP-02

### EQUIPMENT:

- Shovels, spades, hoes, trowels, etc.
- Stainless steel mixing bowl
- Stainless steel hand auger
- Excavation equipment (e.g., backhoe, trackhoe)
- Drill rig sample equipment (e.g., steel split spoons, MacroCore® tubes)
- Field forms
- Disposable gloves and decontamination fluids (per AWS SOP-01)
- Leak-tight cooler with ice

### GENERAL:

Soil samples should be described according to the procedures outlined in the Unified Soil Classification System (USCS – method ASTM D2487) or the Soil Conservation Service (SCS) classification system. Soil texture should be classified by either the USCS or USDA classification.

Pertinent soil sample information should be recorded on sampling forms or on specific documents identified in the SAP. Information should be recorded in a way to facilitate preparation of an overall soil sample summary. Information to be recorded for individual soil samples typically includes the following:

- Sample name/I.D.
- Collection date and time
- Sample type (grab/composite; natural/duplicate)
- Sample location, including diagram reference, if applicable
- Sample preservation, if applicable
- Analysis(es) to be performed
- Notation of deviations from SOP, if applicable

Decisions regarding sample collection and analyses will be guided by project-specific parameters and conditions. Collection and analysis of soil samples for evaluation of suspected or confirmed petroleum releases will generally be completed in accordance with the Montana Department of Environmental Quality (DEQ) *Final February 2024 Montana Risk-Based Corrective Action Guidance for Petroleum Releases (RBCA)*. Sampling requirements stipulated in the RBCA are shown in *Table B – Testing Procedures for Soils and Water* from the RBCA, which is presented on the following page of this SOP.

Decontamination will be completed following procedures outlined in AWS SOP-01.



# STANDARD OPERATING PROCEDURE

## Soil Sample Collection

AWS SOP-02

Petroleum Product	VPH	EPH Screen	EPH Fractionation	EPH for PAHs	RCRA Metals + Zinc	EPA Method 8260B – Oxygenates /VOCs	Lead Scavengers
Gasoline/Aviation Gasoline	R						SS
Diesel (#1 & #2)	R	R	X	SS			
#1 - #2 Heating Oils	R	R	X	SS			
#3 - #6 Fuel Oils		R	X	X			
Used/Waste Oil	R	R	X	X	SS	R	SS
Kerosene, Jet Fuel (Jet-A, JP-4, JP-5, JP-8, etc.)	R	R	X	SS			
Mineral/Dielectric Oils		R	X				
Heavier Wastes		R	X	X			
Crude Oil	R	R	X	X			
Unknown Oils/Sources	R	R	X	X	SS	R	SS

**Table B - Testing Procedures for Soils and Water**

R - required analysis

X - analysis to be run if the EPH screen concentration in is >200 mg/kg TEH or >1,000 µg/L TEH in soil and water, respectively.

SS - Site-specific determination.

### SURFACE SAMPLING:

Surface soil samples are collected from the surface to depths of approximately 6 inches below ground surface (bgs), unless otherwise specified in the project specific SAP. Sufficient sample will be collected for the analysis that will be performed, but generally, this will be less than 1 quart. Soil samples will be collected in either wide mouth glass jars or re-sealable polyethylene bags (Ziploc® or equivalent).

Samples should be collected from an area of approximately 1 square foot or less using shovels, trowels, etc., as appropriate. Where composite samples are desired for petroleum samples, care should be taken to minimize volatilization while mixing. Field mixing may be accomplished in the mixing bowl or in a sealed Ziploc bag for EPH and metals samples. Field compositing should not be completed for VPH or VOC samples. Aliquots may be containerized individually and submitted for laboratory compositing, if necessary.

If a sod or duff layer is present, this layer should be peeled back to the top of the mineral soil. Likewise, larger aggregate (e.g. > ¾" diameter) should generally be removed from the sample.

The sample must be well mixed, with a representative portion placed in the sample container. Quarter the sample in the bowl/bag and place an equal volume of soil from each quarter in the sample container(s) provided by the laboratory. Label sample containers (location, depths, etc.) and place on ice as quickly as practicable and keep cool until receipt by laboratory. Transfer to laboratory using chain-of-custody (COC) protocol and overnight shipping or direct delivery, if applicable.



# STANDARD OPERATING PROCEDURE

## Soil Sample Collection

AWS SOP-02

### SUBSURFACE SAMPLING:

Ensure subsurface utilities, including any private utilities (e.g., electrical for signs, water & controls for irrigation, etc.) have been surface-marked prior to initiation of subsurface sampling activities. Consider utilizing “daylighting” techniques where utility locations are unknown.

Arrange for disposal of cuttings/waste material prior to initiation of sampling (e.g., return to boring/excavation; transport/dispose at a landfill; etc.), including waste manifesting, if appropriate. Where waste materials must be temporarily left on site, arrange for storage in drums, lined berms, etc., as appropriate.

Ensure equipment (drill rigs, backhoes, trackhoes, etc.) can safely access the areas to be sampled. Minimize damage to the surface (landscaping, pavement, etc.) as feasible, or arrange for repair prior to on-site activities.

Subsurface sampling will generally be completed using a hand auger, excavator, or drill rig. Sampling procedures for each type of equipment are described below. Sample collection, homogenization, compositing, transfer to sampling containers, and transmittal to the laboratory should follow the same procedures as outlined for collection of surface samples.

**Hand auger:** Auger holes can be drilled at a consistent diameter or in a telescoping manner, if contamination between sample intervals is a concern. The telescoping method includes advancing the largest auger to an approximate depth of 3 feet bgs, collecting specified depth increment samples as the auger is advanced. Install temporary casing (e.g., new or decontaminated PVC) with a diameter slightly smaller than the borehole to keep the hole open and reduce possible cross-contamination between depth intervals. Using the next size smaller bucket auger, repeat the process. Record lithology from recovered cuttings throughout. Select sample intervals for field screening and packaging for laboratory analysis in accordance with procedures described in the SAP. Return cuttings to the boring as feasible, or abandon the boring with hydrated bentonite chips. Restore the site in accordance with the project plan.

**Drill Rig:** Retrieve sampler from driller. Split spoon samplers are generally utilized by advancing alternating larger samplers (~3-inch diameter) and small samplers (~1.5-inch diameter), both being approximately 2.5-feet long, using hollow-stem auger drilling methods. MacroCore® samples are generally obtained by advancing 4-foot-long sample tubes of approximately 1.5-inch diameter using a direct-push drilling method. In either case, record lithology and percent recovery from cores retrieved. Collect at least 1 sample interval from each recovered interval for field screening, and select sample intervals for packaging for laboratory analysis in accordance with procedures described in the SAP. Return cuttings to the boring as feasible, or abandon the boring with hydrated bentonite chips. Restore the site in accordance with the project plan.

**Excavations:** Excavate to the prescribed depth. If the excavation depth exceeds 5 feet, OSHA construction standards for shoring or sloping must be followed to prevent accidental injury. Sampling personnel should enter the excavation only as necessary, and always with care, during and after excavation. Soil profile descriptions shall be made from a freshly



# STANDARD OPERATING PROCEDURE

## Soil Sample Collection

**AWS SOP-02**

scraped surface along the excavation wall or base, as feasible. Soil samples shall be collected from depth intervals specified in the SAP.

After sampling is completed, the excavation should be backfilled with excavation material in the reverse order that it was excavated so topsoil material is returned to the surface. Alternatively, if excavated material is being disposed, backfill with imported fill material. Backfill material should be mechanically compacted to extents feasible, or in accordance with project-specific requirements in the SAP. Restore the site in accordance with the project plan.

### **PREPARATION AND PRESERVATION:**

All soil samples will be packaged and preserved in accordance with the respective analytical method(s), using containers and preservatives provided by the analytical laboratory, where applicable. Samples will be placed in coolers with ice (or refrigerators) as soon as practicable following collection and will be kept cool until received by the laboratory, as required for the respective method(s).

Samples will be containerized and shipped using chain-of-custody protocol, as outlined in AWS SOP-08. This includes placement of custody seals on coolers (or on individual sample containers).

Standard analytical methods, sample container and preservation requirements, and analytical hold times are presented in *Table A – Soil Sampling and Preservation Protocol* on the following page of this SOP. The provided *Table A* has been taken from DEQ's *Final February 2024 RBCA*.



# STANDARD OPERATING PROCEDURE

## Soil Sample Collection

AWS SOP-02

Parameter	Analytical Method	Sample Container/ Preservation	Holding Time
<b>Soil Samples</b>			
VPH	Montana Method VPH	60 mL or 40 mL VOA vials or 4 oz wide mouth jar. Collect at least 10 g of soil, cool to 4 ±2° C. Must be preserved at the lab in methanol within 48 hours of collection. or Methanol preservation in the field. 1 mL methanol for every g soil, +/- 25%; lab can provide appropriate vials with methanol for easy collection; cool to 4 ±2° C.  If preserving with methanol in the field, a sample containing no methanol must also be submitted for determining moisture percentage.	28 Days to analysis from collection.  If collecting in the field without methanol, lab preservation in methanol w/in 48 hours and 28 days to analysis from collection.
EPH Screen	Montana Method EPH	4-oz wide-mouth amber glass jar, cool to 4±2° C	Extracted within 14 days of collection. Analyzed within 40 days of extraction.
EPH Fractionation with or without PAH's	Montana Method EPH (PAHs: 8270))	One 4-oz glass jar, cool to (4 ± 2) °C	Following EPH Screen 14-day to extraction, 40 days to analysis.
VOCs/Oxygenates/ 1,2 DCA/lead scavengers EDB	EPA Method 8260 /SW-846-5035A	One 4-oz. glass jar, cool to (4 ± 2) °C  Preserve in methanol in field or at lab within 48 hours of collection.	48 hours to lab extraction. 14-day hold time from collection  MeOH preservation: 14 days to extraction and analysis from collection.
RCRA Metals plus zinc (Except Hg)	EPA Method 6010 or 6020	One 4-oz. plastic or glass jar, no preservation	6 months
Mercury (Hg)	EPA Method 7471 B	One 4-oz. plastic or glass jar, no preservation	28 days
% Moisture-required for all soil samples	USDA Handbook 60 method 26 (or equivalent)		

**Table A - Soil Sampling and Preservation Protocol**

Alternate approved versions of the methods are allowed.



# STANDARD OPERATING PROCEDURE

## Field Measurement of Total Volatile Organic Compounds

AWS SOP-03

### EQUIPMENT:

AWS measures total volatile organic compounds (VOC) using a photoionization detector (PID) with a 10.6 electron volt (eV) lamp, following a “heated headspace” method. The PID should be fully charged the day prior to field usage, and extra batteries or field chargers should be available, as feasible. Calibration equipment and supplies should be included in the field kit based on the recommendations of the manufacturer. These generally include a cylinder of compressed calibration gas, a pressure/flow regulator, and an activated carbon “zero” filter.

Field screening sample containers may consist of either heavy zip-top plastic bags (e.g., Ziploc® Freezer bags or equivalent) or glass canning jars fitted with aluminum foil under the metal lid rings. Plastic bags and aluminum foil should never be reused. When using canning jars, the jars and rings should be decontaminated between sample analyses (see AWS SOP-01). Whether plastic bags or glass jars are used, sample vessels and sample amounts should be consistent in composition and volume for all field total VOC samples collected for a given project. This will facilitate consistent sample headspace for all field screening samples, increasing data reliability.

Use of personal protective equipment (e.g., disposable latex or nitrile gloves, eye protection, etc.) and decontamination fluids and equipment should be consistent with AWS SOP-01 and AWS SOP-02.

### CALIBRATION:

The PID should be field calibrated prior to use at least once per day, at a minimum. Bump testing and/or recalibration should be completed if the accuracy of field data are questioned by the operator, or if the duration of field activities following initial calibration exceeds 8 hours.

In an upwind or otherwise vapor-free atmosphere, turn the instrument on and initiate the calibration procedure per the manufacturer’s instructions. Ensure the calibration span setting in the instrument matches that of the calibration gas. The calibration span gas utilized for field screening of total VOCs at petroleum release investigation projects is 100 parts per million (ppm) isobutylene in air.

### PROCEDURE:

Collect soil samples following AWS SOP-02, including labeling of field screening sample containers with the appropriate sample name/identification (ID). Field screening samples are often collected from the same locations as laboratory samples. In such instances, the portions to be containerized for field screening are referred to as field “split” samples.

Ensure field split samples are kept out of direct sunlight, allowing them to warm to approximately 70-80 degrees Fahrenheit (°F) as determined by feel (approximately room temperature). This may be accomplished by placing the sample vessel on the floor board of a running vehicle with the heater turned on. In this scenario, caution should be used to avoid exposing vehicle occupants to VOCs (roll-down windows to provide cross-ventilation). To ensure data precision, warm all samples for a given project to approximately the same temperature over approximately the same amount of time, if practicable.





# STANDARD OPERATING PROCEDURE

## Field Measurement of Total Volatile Organic Compounds

**AWS SOP-03**

Attach the sample probe to the PID and allow the instrument to complete its warm-up cycle, if necessary. Opening the sample vessel as little as possible, insert the probe into the “headspace” of the sample vessel. This can be accomplished by opening the zip-top plastic bag enclosure approximately ¼-inch or by poking the probe through the foil jar cover. In either instance, avoid inserting the sample probe directly into the soil. Samples should be analyzed in order of assumed impacts, beginning with the samples inferred to be least impacted and finishing with the samples inferred to be most-impacted.

Continually observe the instrument readout and record the highest concentration (or use the instruments “Max” function, if available, taking care to reset the instrument’s “Max” value after each sample reading). Sample name/ID and observed total VOC concentrations should be recorded in a way to facilitate preparation of an overall soil sample and field screening data summary for the project.

Heated and analyzed soil samples must never be containerized for laboratory analysis. Laboratory samples must be split from the original sample and containerized and preserved separately, immediately following collection. Alternatively, laboratory samples may be collected and containerized separately following completion of field analyses.

### **MAINTENANCE:**

The instrument should always be stored in the case provided by the manufacturer when not in use. Maintenance and storage of the instrument and batteries should be conducted in accordance with the manufacturer’s recommendations.

Periodic instrument maintenance should be completed as recommended by the manufacturer, including occasional partial disassembly and removal, cleaning, or replacement of in-line filters and or lamps. Other failed components should be replaced as necessary as well. Some maintenance may need to be completed by the manufacturer or authorized service center.



# STANDARD OPERATING PROCEDURE

## Field Measurement of Depth to Groundwater

AWS SOP-04

### EQUIPMENT:

- Electric Water Level Indicator (well probe)
- Electronic Oil-Water Interface Probe (interface probe)
- Extra batteries
- Field sampling forms
- Decontamination equipment

### CALIBRATION:

The well probe and interface probe should be checked annually at a minimum, or more frequently as needed, for proper operation prior to completing field activities. The well probe should be checked by lowering the probe into a cup of clean water and confirming the probe's proper response. The interface probe should be checked by lowering the probe into a cup containing both vegetable oil and clean water, and where the oil and water have had time to separate into two distinct layers, and confirming the probe's proper response to each layer.

### GENERAL:

Measure the depth to water in all wells, using the well probe, from the north quadrant of the top of the well casing or from a designated measuring point, as appropriate. Measure and record vertical distance from measuring point to ground level (unless measuring point has been surveyed for elevation). Make sure the measuring point is labeled or marked on the well casing so future measurements can be made from the same location. Obtain a depth to water from the established measuring point to the nearest hundredth of a foot. Record data on appropriate field forms.

Decontaminate the well probe between each well in accordance with AWS SOP-01 and/or the project-specific SAP.

If free-product petroleum is known or suspected to be present in a well, an interface probe should be used to measure the depth to water and thickness of free product in the well.

Using the interface probe, measure the depth to the top of free-product below the designated measuring point. Continue to lower the probe until the bottom of the product/top of groundwater interface is reached. Record both measurements on field forms. Product thickness can be calculated by subtracting the depth to the top of free-product measurement from the depth to groundwater/free-product interface measurement.

Decontaminate the interface probe between each well in accordance with the AWS SOP-01 and/or the project-specific SAP.



# STANDARD OPERATING PROCEDURE

## Monitoring Well Development

AWS SOP-05

### EQUIPMENT:

- 5-gallon bucket graduated in quarter gallons
- Electric Oil-Water Interface Probe (interface probe)
- Bailer(s)
- Disposable bailer rope or reusable Teflon cable on a reel
- Field forms
- Decontamination equipment

### GENERAL:

Groundwater will be allowed to equilibrate in the new monitoring well for several days before development. Immediately prior to initiation of development activities, depth to water (DTW) will be measured relative to the previously established measuring point using an interface probe, in accordance with AWS SOP-04 and/or the project-specific SAP. DTW data will be recorded on field forms and will be used to calculate the casing water volume for well development purposes.

A new, disposable, polyethylene bailer will be used to develop the new well. A surge and bail technique will be used to remove sediment from the filter pack. Bailed water and sediment will be contained in a graduated 5-gallon bucket and DTW measurements will be intermittently collected after bailing events to monitor infiltration of groundwater into the well. If sufficient groundwater infiltration to the well occurs, development will continue until purge water turbidity is visibly decreased, or until 10 casing volumes of water have been evacuated. Following development of the well, the post-development DTW will be measured. DTW measurements, purge volumes, and visual observations (qualitative turbidity descriptions) will be recorded on a field form.

If free product petroleum is present in the new well, it will not be developed. In this instance, the thickness of the free product layer would be measured with the interface probe and the measurement recorded on a field form. If the interface probe measurement is inconsistent or if the interface probe is unavailable, an approximate measurement of visible product thickness will be determined using a bailer and tape measure. Recovery, sampling, and analysis of free product petroleum will not be performed under this scope of work.

If specified in the SAP to be completed during the evacuation process, collect water samples for field determinations of temperature, specific conductivity, and pH. Continue developing the well until field parameters stabilize to within  $\pm 5\%$  on 3 consecutive measurements. Report field observations and volume of water removed on the field forms.

Dispose purge water in accordance with AWS SOP-56.



# STANDARD OPERATING PROCEDURE

## Groundwater Sampling

AWS SOP-06

### EQUIPMENT:

- 5-gallon bucket graduated in gallons
- Low-flow cell or 12-ounce glass jar
- Hydrogen potential (pH) and temperature meter
- Specific conductance (SC) meter
- Dissolved oxygen (DO) meter
- Oxidation/reduction potential (ORP) meter
- Turbidity meter
- Coolers and ice
- Sample bottles
- Sampling pump – Peristaltic or Bladder-type with controller and compressor
- Disposable bladders (if using bladder pump)
- Disposable tubing
- Bailer(s)
- Bailer rope or Teflon cable reel
- Preservatives
- Disposable in-line filters or filter apparatus with filter media
- Field sampling forms
- Decontamination equipment and indelible marker
- Fluids
- Stopwatch
- Electronic Oil-Water Interface Probe (interface probe)
- Graduated vessel

### MAINTENANCE:

All equipment should be inspected for damage and proper functionality (including battery charge) prior to use in the field. Unstable or “drifting” measurement readouts may be indicative of damaged probes/sensors, especially if the problem persists following recalibration. Damaged or improperly functioning equipment should be repaired or replaced as appropriate.

All meters, probes, pumps, sampling equipment, and sample vessels should be decontaminated in accordance with AWS SOP- 01 and following completion of sampling.

### CALIBRATION:

Instruction manuals should always be kept with meters, especially sections pertaining to calibration and trouble shooting. Keep spare batteries with each meter. Calibration fluids appropriate for the anticipated sample ranges (pH 4.01 buffer solutions for acidic samples) should be kept with meters and should not be used if marked expiration dates have been exceeded. Several small sample vessels should be kept with meters for calibration and sample analyses.

Calibration of individual meters will vary; calibration should always be performed in accordance with the manufacturer’s recommendations. In general, most meters should be calibrated at the beginning of each field day, at a minimum. Additional calibrations may be necessary if meter readings become questionable. Performance of “bump testing” to



# STANDARD OPERATING PROCEDURE

## Groundwater Sampling

**AWS SOP-06**

determine whether meters are within acceptable calibration ranges is advisable for sampling events longer than approximately 6 hours.

DO meters calibrate with barometric pressure. ORP and SC meters may only require periodic calibration using calibration solutions appropriate for the anticipated sample ranges. Two or three-point calibration is advisable for most pH meters; for two-point calibrations, consideration should be given to the anticipated sample range. Turbidity meters use four standards for calibration (800 NTU, 100 NTU, 20 NTU, and 0.02 NTU), if 20, 100, or 800 NTU drifts more than 10% the solution needs to be replaced. Temperature sensors for most meters do not require calibration.

### **PROCEDURE:**

AWS will complete groundwater sampling in accordance with the procedures presented below. Where applicable, groundwater sampling procedures will also be completed in accordance with the current version of DEQ's *Groundwater Sampling Guidance*.

**Initial Measurements** - Begin by determining the depth-to-water (DTW) in accordance with the AWS SOP-04, and/or the project-specific SAP. If DO is a desired field analysis, gently lower the DO meter's probe, calibrated per manufacturer's guidelines, to just beyond the DTW observed in the previous step. Once submerged, readings will begin trending in a consistent increasing or decreasing manner, until a transitional point is reached and the initial trend is reversed. This transitional point should be recorded on the appropriate sampling form as the pre-purge DO.

**Well Purging** - Purging must be performed on all wells prior to sample collection. Well purging will be accomplished using a peristaltic pump, bladder pump, or with a disposable polyethylene bailer. The specific purging method shall be chosen based on the following: DTW; diameter of well; existing well configuration; contaminant(s) of concern; and/or, the project-specific SAP. Sampling is generally not conducted when free product (e.g., light non-aqueous phase liquid, or LNAPL) is present.

Where pumping methods are used, field water quality indicators (WQIs) will be observed and recorded in approximate five-minute intervals. Evacuation of fluids will continue until DO, pH, SC, ORP, and turbidity readings stabilize. Stabilized readings will include changes of no more than 0.1 standard unit (su) for pH and no more than 3 percent (%) for SC, no more than 10 percent (%) for DO and turbidity, and 10 millivolts (mV) for ORP.

Where bailer methods are used, purging should remove at least three (3) casing volumes of fluid from the well and until stabilized WQIs are achieved. The following equation is used to calculate well casing volume in gallons:

$$V = 3.14 \times (r^2) \times h \times 7.48$$

Where: V = volume (gallons)  
r = well radius (feet)  
h = height of water column in well (feet)



# STANDARD OPERATING PROCEDURE

## Groundwater Sampling

**AWS SOP-06**

The radius of the well pack will be used for the well radius ( $r$ ) for calculating volumes. For example, a 2-inch diameter PVC monitoring well installed in a 6-inch diameter borehole with sand filter pack would use a well radius of 3 inches or 0.25 feet.

The height of the water column ( $h$ ) is calculated as the total well depth minus the DTW measurement for the well.

WQIs will be observed during bailing of each well, if feasible. Stabilized readings will include changes of no more than 0.1 su for pH, no more than 3% for SC, no more than 10% for DO or turbidity, and no more than 10 mV for ORP. If WQIs have not stabilized after five (5) casing volumes have been evacuated, it is at the discretion of the AWS field technician whether to collect a sample or to continue purging.

The actual pumping duration and/or volume of water purged from the well, along with the WQI readings, must be recorded on appropriate sampling forms for all methods of purging.

Wells with documented or expected low yield/slow recovery may require sample collection without prior purging due to limited available water volume.

If the recovery of a low-yield well exceeds 2 hours after purging, a sample shall be extracted as soon as sufficient volume is available in the well. At no time will a monitoring well be pumped dry if the recharge rate causes formation water to cascade down interior portions of the well casing, causing an accelerated loss of volatile organics and change in pH.

**General Well Sampling** - Wells must be sampled from the least contaminated to the most contaminated, if known. Open well and measure DTW in accordance with the AWS SOP-04. Decontaminate all sampling/down-well equipment in accordance with the AWS SOP-01. Use disposable nitrile gloves throughout decontamination and sampling procedures and use new gloves for each sampling point.

The actual pumping duration and/or volume of water removed from the well, along with all WQI readings, must be recorded on appropriate sampling forms for all methods of sampling.

**Low-Flow Method** - The goal of low flow purging and sampling is to collect water samples that reflect the total mobile organic and inorganic loads transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. During this procedure, emphasis is placed on minimizing hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations.

WQIs are monitored during purging to identify stabilized conditions to determine when sample collection may begin. Stabilized readings will include changes of no more than 0.1 su for pH, no more than 3% for SC, no more than 10% for DO or turbidity, and no more than 10 mV for ORP.



# STANDARD OPERATING PROCEDURE

## Groundwater Sampling

**AWS SOP-06**

The low-flow method should be implemented with a positive-lift pump (e.g., peristaltic or bladder pump). The pump intake should be located within the well-screen interval and at a depth that will remain under water at all times. It is recommended that the intake depth and pumping rate remain the same for all sampling events. The following equation is used to calculate the pump intake depth or sampling depth:

$$SD = DTW + [(TD - DTW) \div 3]$$

Where: SD = Sampling depth (feet)  
DTW = Depth to water (feet)  
TD = Total well depth (feet)

Note this equation places the pump intake in the upper one-third of the water column and should be modified to sample from deeper depths, accordingly (e.g., if wanting to sample from the middle of the water column, replace the value of 3 with 2 in the equation).

The low-flow cell should be set up over the 5-gallon bucket so that the pump tubing discharge flows into the cell and overflows into the bucket. The pH, temperature, SC, and ORP (if used) meters should be set up to monitor water quality in the low-flow cell during purging and sampling.

Disposable tubing should be cut to a length that extends from the down-well bladder pump, or sampling depth for peristaltic pump, to the low-flow cell discharge point.

DTW should be measured before installing the pump and continuously recorded during purging at consistent intervals (e.g., 5 or 10 minutes). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump to ensure drawdown of less than 0.3 foot or stabilization of the water level. If the minimal drawdown that can be achieved exceeds 0.3 foot, but remains stable, continue purging until the three (3) casing volumes are removed and/or water quality parameters stabilize.

The final purge volume must be greater than the stabilized drawdown volume plus the pump's tubing volume. If the drawdown has exceeded 0.3 foot and WQIs have stabilized, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are collected.

**Bailer Method** – Removal of water from the well by bailing will be accomplished using a new, disposable, polypropylene (or other material specified in the SAP), bailer and a spool of polypropylene rope or equivalent bailer cord (e.g., Teflon-coated stainless-steel cable). The length of the bailer and cord should be long enough so that the bailer intake reaches the middle of the well-screen section, but should be long enough to evacuate water from the lower one-third of the well depth if needed.



# STANDARD OPERATING PROCEDURE

## Groundwater Sampling

**AWS SOP-06**

Bailing should be a semi-continuous procedure of removing water from the upper one-half of the water column. Care should be taken not to disturb sediment in the bottom of the well.

Bailed water should be gently poured into a decontaminated, 12-ounce glass jar equipped with pH, temperature, SC, and ORP (if used) meters to monitor water quality. Bailing will continue until the purging requirements stated previously are achieved.

**Domestic Well Sampling** – If an active domestic or irrigation well needs to be sampled, then the water needs to be initially purged. First, the total volume of water in the well casing is calculated using equation provided on Page 2 of this SOP. Thereafter, a minimum of three (3) casing volumes of water need to be evacuated from the well prior to sampling.

Well purging should be accomplished by opening a faucet connected to the well pump. A faucet location should be selected as close to the well pump as possible. The faucet shall not be located after water treatment systems such as softeners or filtration units.

Flow from the faucet should be measured using a graduated vessel and stopwatch. Several measurements should be taken to monitor possible changing flows during the purging procedure.

If desired, WQIs may be monitored in the discharged fluid during the well purging.

**Collecting Water Samples** - Label each sample container with project number, sample location, well owner, date, time, sampler's initials, preservative, and analysis required. Wear new disposable nitrile gloves immediately prior to obtaining the sample.

For low-flow samples, several inches should be cut from the end of the sample effluent tubing (i.e., removing the portion in contact with the flow-through monitoring cell) before collecting water samples. A disposable in-line filter should be attached to the cut end of the tubing, as needed, prior to collection of filtered samples.

For domestic well sampling, pump flow should be reduced so that a constant minimal flow is achieved from the faucet. Samples should be collected directly from the faucet and not through rubber hoses. Filtered samples may be obtained by using a filter apparatus fitted with new filter media.

When using a bailer, take care to minimize degassing or contamination of the sample by submerging and withdrawing the bailer slowly to avoid splashing. Do not place the bailer on the ground. Filtered samples may be obtained by using a filter apparatus fitted with new filter media.

Add preservatives to the sample container prior to sample collection. Remove water from the well and transfer sample water directly into sample bottles (using an in-line filter or filter apparatus, as necessary), maintaining a slow linear flow with as little agitation as possible.





# STANDARD OPERATING PROCEDURE

## Groundwater Sampling

**AWS SOP-06**

For volatile analyses, fill vials at the rate of about 100 milliliters per minute (24 seconds for 40 mL vial) or less. Fill each sample vial completely so the water forms a convex meniscus at the top to ensure no air space exists in the vial after it has been capped. After filling, immediately cap, invert, and gently tap the vial to check for trapped air. If air bubbles are present, un-cap vial, add more sample water and repeat procedure. If air bubbles continue to be present after repeated filling attempts, cap the vial, keep for laboratory analyses, and note the condition on the field form.

For inorganics samples not requiring preservatives, rinse sample containers three (3) times with sample water before final collection. Do not rinse containers for organics analysis.

Water samples should be preserved as described in the following table:

PARAMETER	NUMBER	CONTAINER	PRESERVATION	MAXIMUM HOLDING TIME UNTIL EXTRACTION / ANALYSIS
VOCs	3	40 mL glass VOA	6°C and HCL	14 days
VPH	2	40 mL glass VOA	6°C and HCL	14 days for extraction/ 28 days for analysis
EPH	2	1000 mL glass bottle	6°C	14 days for extraction/ 28 days for analysis
SVOCs	2	1000 mL glass bottle	6°C	7 days for extraction/ 40 days for analysis
Metals	1-2*	250 mL plastic bottle	6°C and HNO <sub>3</sub>	6 months 28 days for mercury
Inorganics	1	Varies	varies	Varies – contact laboratory

NOTE: VOCs – Volatile Organic Compounds; VPH – Volatile Petroleum Hydrocarbons; EPH – Extractable Petroleum Hydrocarbons; SVOCs – Synthetic Volatile Organic Compounds; mL – milliliter; °C – degrees Celsius; HCL – hydrochloric acid; HNO<sub>3</sub> – nitric acid. \*Filtered and/or Unfiltered.

Replace well cap and lock (if present) when sampling is complete.

Replace all appurtenances on the domestic well, if present prior to work, when sampling is complete.

Prepare all necessary chain-of-custody forms, sampling forms, and other documentation.

Prepare and ship samples in accordance with AWS SOP-08.



# STANDARD OPERATING PROCEDURE

## Sample Packaging and Shipping

AWS SOP-08

### CHAIN-OF-CUSTODY (COC) PROCEDURES:

A chain-of-custody (COC) form must be prepared for all samples collected in the field for laboratory analysis. Multiple samples from the same sampling event, relating to a specific single project, may be included on a COC form. Samples from more than one project should not be included on the same COC form. The sampler should use a COC form provided by the laboratory performing sample analyses.

Completed COC forms must be maintained from the time of sample collection until the time of sample delivery to the analytical laboratory. The completed COC form should accompany the samples through analysis and final disposition. A copy(ies) of the COC form(s) should be maintained in the project file.

Information to be included on the COC form will include, but is not limited to:

- Project number / name
- Sampler's name and signature
- Date and time of sample collection, per sample
- Unique sample name/identification (ID)
- Number of containers per sample
- Sample media (e.g., soil, water, vapor)
- Sample preservative (if applicable)
- Requested analysis(es)
- Comments or special instructions to the laboratory

All samples must be assigned unique sample names/IDs. The information on the COC form, including the ID for a specific sample, must correspond to the information recorded by the sampler on the field forms, and the sample ID label on the sample container, for the respective sample.

A sample is considered under a person's control when it is in their possession. When custody of a sample is relinquished by the sampler, the sampler will sign and date the COC form and note the time that custody was relinquished. The person receiving custody of the sample will also sign and date the form and note the time that the sample was accepted into custody. The goal is to provide a complete record of control of the samples. Should the chain be broken (signed by the relinquisher, but not receiver, or vice versa), the integrity of the sample is lost and the reliability of the resulting analytical data may be degraded.

Samples must be packaged and shipped (or directly transported) to the laboratory following the procedures described below. If an overnight shipping service is used to transport the samples to the laboratory, custody of the samples must be relinquished to the shipping service. If possible, have the shipping service sign the COC form prior to placing the COC form in the sample cooler. If this is not possible (i.e., form placed in sealed cooler), a note should be included on the COC that the shipping company will receive the samples with the COC form inside the sample container.

### PACKAGING:

All environmental samples should be packaged and shipped using the following procedures:



# STANDARD OPERATING PROCEDURE

## Sample Packaging and Shipping

**AWS SOP-08**

- Label all sample containers with indelible ink (on the side of the container, not on the cap or lid).
- Place labeled sample containers in a sturdy outer shipping box or cooler. When samples must remain refrigerated, use a well-insulated cooler containing an adequate amount of ice, making sure the cooler drain plug is taped shut (if applicable). Water ice should be used whenever feasible. Use of dry ice is more likely to result in freezing of samples, and use of reusable (e.g., “blue”) ice packs is likely to result in samples exceeding the allowable temperature range.
- Place soil and water sample containers in an upright position and wrap the containers with cushioning material for stability during transport. Samples should not be loose; the cooler and packed samples should be able to withstand rough handling during shipment without sample container breakage. If feasible, all sample containers and ice bags should be placed inside at least 1 heavy plastic bag, inside the cooler. The top of the outer bag should be twisted and taped in a “goose neck” fashion to help prevent leaks. It is advisable to place absorbent materials in the outer bag when liquids (including water ice) will be shipped.
- Fill out the appropriate shipping forms and place the paperwork in a Ziploc® bag (or equivalent) and tape it to the inside lid of the shipping container. Shipping forms usually include: 1) a COC form, documenting the samples included in the shipment; 2) an analysis request form, specifying the laboratory analyses for each sample (these are usually on the same form but may be separate).
- If more than one cooler is used per COC, put a photocopy in each of the additional coolers and mark them as a copy. Clearly identify on the COC (and copies) the total number of coolers included in the sample group.
- Complete and apply a custody seal to the exterior of each cooler where the lid meets the cooler container. Close and seal the cooler using clear packing tape. Secure the shipment label with address, phone number and return address clearly visible.

### **SHIPPING HAZARDOUS MATERIALS / WASTE:**

Hazardous materials need to be shipped using procedures specified under Federal Law.

Transportation regulations for shipping of hazardous substances and dangerous goods are defined by the U.S. DOT in 49 CFR, Subchapter C, Part 171 (October 1, 1988); IATA and ICAO. These regulations are accepted by Federal Express and other ground and air carriers.

According to U.S. DOT regulations, environmental samples are classified as Other Regulated Substances (ORS). ORS are articles, samples, or materials that are suspected or known to contain contaminants and/or are capable of posing a risk to health, safety, or property when transported by ground or air. Samples, substances, or materials from sources other than material drums, leachate streams, and sludges should be considered as ORS or environmental samples. Materials shipped under the classification of ORS must not meet any of the following definitions:

- Class 1: explosives
- Class 2: gases (compressed, liquefied, dissolved under pressure, or refrigerated)
- Class 3: flammable liquids
- Class 4: substances susceptible to spontaneous combustion



## STANDARD OPERATING PROCEDURE

### Sample Packaging and Shipping

**AWS SOP-08**

- Class 5: oxidizing substances
- Class 6: poisonous (toxic and infectious)
- Class 7: radioactive materials
- Class 8: corrosives.

Coordinate special shipping or direct-delivery arrangements with the Project Manager for samples meeting any of the definitions above.



# STANDARD OPERATING PROCEDURE

## Disposal of Investigation-Derived Waste

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### EQUIPMENT:

- Disposal drums (typically steel)
- Adjustable wrench, end wrench, or ratchet/socket for drum lids
- Buckets
- Funnels
- Plastic sheeting (typically 6-mil or heavier)
- Utility knife or scissors
- Shovels (flat, spade, etc.)
- Plastic garbage bags

### SOLID WASTE:

Solid investigation-derived waste (IDW) generally includes small quantities of soil generated from drilling or test pit excavations. Larger quantities of waste generated from remedial actions are excluded from this SOP.

Soil cuttings are typically placed back in the holes from which they originated, thereby negating the need for disposal. Similarly, if drill or test pit cuttings do not demonstrate evidence of contamination, as determined through visual or olfactory observations, or through field analysis of total volatile organic compounds (VOC; see AWS SOP-03), the cuttings may instead be spread on unpaved areas of the site. In such instances, coordinate with project stakeholders (e.g., the client, site owner, regulatory personnel, etc.) to determine acceptable areas for placement.

Cuttings which demonstrate evidence of contamination must be transported to an appropriate solid waste disposal facility, such as a licensed landfill or permitted land farm. Characterization of cuttings waste should be completed in accordance with the requirements of the disposal facility selected for the project, as requirements often vary by facility.

Contaminated cuttings may be temporarily stored at the site in steel drums, or stockpiled on paved surfaces or plastic sheeting, when characterization has been completed in advance. Care should be taken to limit the potential for runoff of contaminant from uncovered stockpiles in the event of a precipitation event. For example, berms under plastic sheeting around the perimeter of the stockpile will help prevent runoff. In any case, stockpiled cuttings should be loaded and transported for disposal as quickly as feasible.

Alternatively, when advanced characterization is not feasible, the cuttings may be placed in steel drums and temporarily stored at the site. In some cases, temporary storage of stockpiled soil may be required, in which case stockpiles should be placed on and covered by plastic sheeting, with covered berms utilized as appropriate to limit the potential for runoff of contaminant. Coordinate the temporary storage approach and locations with project



## STANDARD OPERATING PROCEDURE

### Disposal of Investigation-Derived Waste

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stakeholders, and complete waste characterization, transport, and disposal as promptly as feasible.

General trash and personal protective equipment waste shall be cleansed of any gross contaminated soil accumulation and shall be placed in plastic garbage bags and properly disposed at a licensed solid waste disposal facility.

#### **LIQUIDS:**

Liquid IDW includes purge water generated during well development and groundwater monitoring activities. Purge water shall be assessed in accordance with the Montana Department of Environmental Quality (DEQ) flow chart provided below.

Purge water assessed via the DEQ flow chart and determined not to contain known contaminants may be spread on the ground surface near the source well or boring. Where feasible, such purge water will be surface applied on paved surfaces. Purge water shall not be poured into storm water inlets, sewer manholes, natural drainages, or surface water bodies.

Purge water which is assessed via the DEQ flow chart and is determined to be contaminated shall be contained in drums and disposed at a licensed liquid waste disposal facility in accordance with that facility's disposal requirements. Alternatively, options for disposal of contaminated purge water may be discussed with DEQ in accordance with the flow chart on the following page. Temporary on-site storage of liquid waste in drums should be coordinated with project stakeholders. Characterization of liquid waste should be completed in accordance with the requirements of the disposal facility selected for the project, as requirements often vary by facility. Waste characterization and disposal should be completed as quickly as feasible.

