

March 10, 2026

Mr. Ernest Dale Roo  
Big Sky Tire & Auto  
495 Highway 93 North, P.O. Box 629  
Eureka, MT 59917

Delivered via email:

Prepared by Brandon Kingsbury  
Tetra Tech, Inc.  
825 W Custer Ave.  
Helena, MT 59602

**SUBJECT: Remedial Investigation Work Plan, V2  
Big Sky Tire & Auto  
495 Highway 93 North, Eureka, Montana  
DEQ Facility ID 27-02343 (TID 24114); Release 6648, Work Plan 35141  
Tetra Tech Project Number 103PA0239**

Dear Mr. Roo:

Tetra Tech, Inc. (Tetra Tech) is pleased to submit this work plan to conduct a remedial investigation (RI) to investigate the release at Big Sky Tire & Auto located at 495 Highway 93 North, Eureka, Lincoln County, Montana (subject property) (Figure 1). This work plan has been prepared in response to a request from Reed Miner of the Montana Department of Environmental Quality (DEQ) in correspondence dated January 22, 2026 (DEQ, 2026). In this workplan, it is expected that Tetra Tech accomplish the following tasks:

- *Collect environmental samples to determine the extent and magnitude of petroleum contamination.*
- *Analyze samples for petroleum constituents as required by the Risk-Based Corrective Action Guidance for Petroleum Releases.*
- *Validate all laboratory analytical data using DEQ's Data Validation Summary Form found online under the Guidance dropdown at the PTCS webpage.*
- *Discuss ongoing WP tasks and results with DEQ's project manager; submit written agreed-upon WP modifications as required to complete the WP objectives.*
- *Prepare a Release Closure Plan (RCP); discuss results with DEQ's project manager. DEQ expects the RCP completion to cover the Release investigation information. Use the RCP format found online under the Guidance dropdown at the PTCS webpage.*
- *Prepare and submit a Remedial Investigation Report detailing the results of the investigation. The RI report must include all format sections outlined in the RI Guidance document. Include*

*a brief explanation for each section that had no work conducted or information collected; and include the following.*

- *Use standardized DEQ WP and report formats found under the Guidance dropdown at the PTCS webpage.*
- *Submit WP and reports electronically following the Petroleum Tank Cleanup Section submittal requirements found under the Guidance dropdown.*

## **FACILITY HISTORY/RELEASE BACKGROUND AND FACILITY CONDITIONS**

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Big Sky Tire & Auto is located at 495 US Highway 93 and is surrounded by a mixture of commercial and residential properties, located at the northern end of the town of Eureka in Lincoln County, Montana (Figures 1 and 2). The facility is owned by EJ Properties Limited Liability Company (LLC) and is operated as Big Sky Tire & Auto by Ernest Dale Roo. The facility currently operates as an auto repair and maintenance shop, and previously operated as a petroleum service station. Currently there are no tanks in operation at the subject property. Historically, there have been ten underground storage tanks (UST) present at the subject property. One 4,000-gallon gasoline tank, one 2,000-gallon gasoline tank, and one 500-gallon diesel tank were all installed in May 1964, and an additional 4,000-gallon gasoline tank was installed in May 1975. These four tanks were removed in May 1989. A 6,000-gallon heating oil tank was installed at the subject property in May 1982 and was removed in November 2023. Following the removal of the historical tanks that were installed in the 1960s, six additional USTs were installed at the subject property in the same UST basin, including one 12,000-gallon premium unleaded gasoline tank, one 12,000-gallon midgrade unleaded gasoline tank, one 12,000-gallon regular unleaded gasoline tank, one 6,000-gallon RD #1 diesel tank, one 15,000-gallon DSL #2 diesel tank, and one 12,000-gallon RD #2 diesel tank. It is not reported when these tanks were installed, but they were all last used in October 2023 and subsequently removed in November 2023 (DEQ 2023a). Currently, the facility consists of the main store building with several maintenance garage bays. The former UST basin still exists in the northwestern corner to the rear of the subject property and all tanks have been removed. Historically, one gasoline dispenser island was located beneath a canopy north of the existing main store building, and two diesel dispensers were located behind the existing main store building just south of the UST basin, but the canopy and all dispensers no longer exist at the subject property.

According to the Montana Bureau of Mines and Geology (MBMG) 1:500,000 geologic map of Montana, the subject property is primarily underlain by Mesoproterozoic Missoula Group sediments and Pleistocene glacial till deposits with poorly sorted clasts ranging from silty sands to cobbles (MBMG 2007). According to the U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Web Soil Survey, the subsurface at the subject property consists of glaciofluvial sediments, primarily comprised of well drained silty sandy loam with varying amounts of clay after about 10 inches below ground surface (bgs) (USDA NRCS 2025). Based on well data collected from wells nearby the subject property, anticipated depth to potable groundwater at the subject property is between 37 and 80 feet bgs (MBMG Ground Water

Information Center [GWIC] 2026). Additionally, a domestic water well located at the subject property was sampled as part of a previous remedial investigation conducted by All Tank Compliance in December 2025 with a static water level measured at 88 feet bgs. Tetra Tech anticipates however that a shallower groundwater bearing unit is present between 15 and 30 feet bgs. Based on a review of topography, groundwater flow at the subject property is likely to the south - southwest towards the Tobacco River.

A petroleum hydrocarbon release was first detected in contaminated soils at the time of dispenser and tank removal in November 2023. 28 soil samples were collected in the area of the UST basin, the former gasoline dispenser islands, and the former diesel dispenser islands. As discussed in the 24-Hour Initial Release Response Report, two of the 28 soil samples collected exceeded DEQ Risk Based Screening Levels (RBSL) for toluene, C9-C10 aromatics, and C11-C22 aromatics. These exceedances were observed in the area immediately southeast of the former gasoline dispenser island and immediately south the southernmost former diesel dispenser island (DEQ 2023b). A water sample was collected from a domestic well located just southwest of the former southern diesel dispenser island that produced no exceedances of DEQ RBSLs. As the contamination is associated with multiple dispenser islands, both gasoline and diesel are the primary contaminants of concern at the subject property. The amount of product estimated to have been released into the environment has not been reported and is likely attributed to accidental spills and overfills that have occurred over the lifetime of this fuel station.

As such, Tetra Tech proposes installation of monitoring wells in and between the two source areas within the near-down gradient extent of anticipated groundwater impacts to provide an initial assessment of impacted media.

The following sections summarize Tetra Tech's proposed scope of work and schedule to complete the requested tasks. The Montana Remedial Investigation Guidance for Petroleum Releases Workplan & Report Preparation Cost Considerations, and the Cost Estimate Breakdown are provided in Attachment A.

## **WORK PLAN OBJECTIVES**

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The primary objective of this work plan associated with the proposed remedial investigation to complete soil sampling, and groundwater sampling and monitoring is to define the extent and magnitude of petroleum contamination at the subject property. Specific goals include:

- Assessment of source mass in soils within the two identified release areas associated with the former gasoline and diesel dispenser islands. Criteria includes an evaluation of soil data against DEQ Tier 1 direct contact commercial, direct contact construction, and leaching to groundwater screening levels.
- Obtaining water level measurements to determine trends in seasonal water level elevations and flow directions.
- Assess concentrations of VPH and EPH to determine the extent and magnitude of contaminants of concern in groundwater. Criteria includes comparing data to risk-based screening levels and human health standards.
- Assess groundwater concentrations of VPH and EPH spatially to determine if free product is present and establish the general extent of the dissolved phase plume.

Criteria includes an evaluation of groundwater gradient and flow direction based on the installation of three wells.

- Confirm the presence of any receptors and assess those receptors for potential impacts. Information from utility locates and discussions with the city will be used to establish the location and depth of potential receptors.
- Produce a conceptual site model based on the data gathered as part of the investigation.
- Provide recommendations and begin developing an RCP to explore remedial alternatives that will bring the release to closure. The RCP will be established based on the data collected as part of this investigation in combination with previous investigation data. The RCP will include alternatives to bring the release to closure based on effectiveness or reliability, implementation, safety, effects on public health and the environment, cost, advantages vs disadvantages, and time to completion. As this is the first subsurface investigation following tank sampling, the RCP will reflect preliminary recommendations at this stage and will be further refined as additional information is collected during future investigations.

## **SCOPE OF WORK**

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This project's general scope of work includes installing three soil borings and completing the borings as groundwater monitoring wells. Soil samples will be collected from each soil boring to collect baseline data. After the monitoring well installation, static water levels will be measured, and groundwater samples will be collected from all monitoring wells on site to collect baseline data. A remedial investigation report (RIR) will be prepared, including completing the Release Closure Plan (RCP). The following details describe the methods to be used for this investigation:

### ***SUBSURFACE INVESTIGATION***

- Install three monitoring wells to assess petroleum impacts to groundwater. One well should be placed in each of the two identified release areas in order to assess the area of maximum soil contamination associated with the gasoline and diesel dispenser islands. A third well should be placed in between and upgradient of the two release areas to assess the lateral extent of contamination at the subject property. To reduce cross contamination, drilling will commence at the boring with the lowest anticipated petroleum impacts and end with the boring with highest anticipated petroleum impacts. Drilling augers and split spoons will be decontaminated thoroughly in accordance with the SOP.
- Log soil borings and obtain laboratory and field soil samples during the installation of the monitoring wells. Soils will be classified using the Unified Soil Classification System by either an environmental engineer, geologist, or environmental scientist. Laboratory samples will be collected from the area of maximum contamination based on photo-ionization detector (PID) readings collected from field samples, the soil/groundwater interface, and the base of the boring. Basal soil samples will serve to assess the extent of soil contamination to the greatest depth possible, however, a basal soil sample may not be collected if PID readings from that interval show negligible VOC content. Rather, a sample may be collected to identify the lower vertical extent of contamination.

- Conduct an underground utility locate using the Montana 24-hour Utility Notification Center. A private utility locate will also be employed to locate utilities within the proposed soil boring areas. Once utilities are located, Tetra Tech will map the location of the utilities and provide discussion regarding potential impacts to the utility corridors, if applicable. Additional correspondence with city and county public works staff may be necessary to determine specific depths of utility corridors.
- Based on a review of surrounding topography and well logs, the groundwater flow direction is anticipated to range from the south to the southeast. Therefore, the proposed boring and monitoring well locations are anticipated to be cross-gradient from the source of the release and either within the contaminant source zone or down-gradient from the release points (Figure 2) to establish a flow network.
- The soil borings will be installed using hollow-stem auger drilling techniques to a maximum depth of 30 feet below ground surface (bgs). Because depth to groundwater is currently unknown, PID measurements in the field and observations of soil moisture content will determine the true depth of the borehole. Wells will be drilled to at least 5 feet deeper than the soil/groundwater interface to accommodate the installation of a 10-foot well screen, which may result in a well shallower than 30 feet. Exact locations will be determined after an assessment of site-specific access, underground utility locates, location of tank system components, and safety. To assess petroleum hydrocarbon impacts, soil borings will be continually logged and sampled to a maximum depth of 30 feet bgs. Drilling bids are presented in Attachment B.
- Field samples will be collected continuously, at 2.5-foot intervals, from each borehole using a split-spoon sampler and logged for soil type, density, moisture content, color, and evidence of VOCs, petroleum hydrocarbon staining, and odor. Field samples will be reserved to collect PID measurements using standard headspace screening techniques from each sample interval, after which they will be disposed of along with impacted drill cuttings as described below. Sampling and decontamination of materials will be completed in accordance with the SOP.
- Up to three laboratory soil samples will be collected from each soil boring using a split-spoon sampler for laboratory analysis. One sample will be collected in the zone of greatest petroleum impacts (as identified during field screening), one sample will be collected from the soil/groundwater interface (as identified during drilling), and one sample will be collected from the base of the boring if field PID measurements justify sampling this interval. If PID readings from the base of the borehole show negligible VOC content, a sample from this interval will not be collected. If any borings are installed in previously excavated materials only native soil samples will be submitted to the lab for analysis. Each soil sample will be placed in clean laboratory-supplied containers and submitted to Energy Laboratories in Helena, Montana. The soil samples will be analyzed for volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH) screen using the Massachusetts Department of Environmental Protection method (MADEP 2017 & 2019). Per Montana DEQ guidance, if the EPH concentration in the soil exceeds 200 milligrams per kilogram (mg/Kg), then an EPH fractionation analysis is required (DEQ, 2024a). For cost-estimating purposes, it will be assumed that two soil samples from each boring will also be analyzed for

EPH fractionation. Therefore, a maximum of nine natural soil samples will be collected for analysis plus one duplicate sample. Sampling and decontamination of materials will be completed in accordance with the SOP.

- Impacted drill cuttings, as identified by field screening, will be containerized on-site within 55-gallon drums. A composite soil sample will be collected from the containerized soil and submitted for laboratory analysis of VPH, EPH, and Resource and Conservation and Recovery Act (RCRA) total metals per landfill disposal requirements. Drums will be stored onsite in a protected area, until receipt of waste characterization results have been reviewed and approved by an accredited solid waste facility. Drums will be shipped to the solid waste facility as soon as transportation and disposal have been arranged.

### **MONITORING WELL INSTALLATION**

- Each soil boring will be completed as a permanent monitoring well with two-inch diameter Schedule 40 PVC materials (Figure 2). A 10-foot well screen will be installed with 0.010 slot size screen that is approximately centered at the soil/groundwater interface. The exact screening interval and length may change based on field observations and the location of the soil-groundwater interface; however, the well screen will always be installed with the top positioned approximately three feet above the first appearance of moisture in the soil column to accommodate for seasonal fluctuation. A sand pack of 10-20 silica sand will be placed adjacent to the well screen from the total depth of the boring to approximately two feet above the well screen. A threaded cap will be installed on the bottom of the screen casing. Bentonite chips will be placed from the sand pack to approximately one-foot bgs. The monitoring wells will be completed with an eight-inch diameter flush-mount steel protector casing concreted in place. The top of the PVC casings will be fitted with two-inch diameter water-tight locking plugs. The subcontractor bids for monitoring well installation are provided in Attachment B. Monitoring wells will be named MW-1 through MW-3.
- Each monitoring well will be developed using a surge block and water pumping technique. The well will be surged and pumped until the pumped water is sediment free and clear. Development water will be containerized and disposed of in accordance with the *Disposal of Untreated Water from the Monitoring Wells Flow Chart* and disposed of appropriately following receipt of laboratory results (DEQ, 2015).
- The latitude, longitude, and vertical elevation of each new monitoring well PVC casing will be surveyed by and overseen by a licensed engineer or conducted by a licensed surveyor to an accuracy of 0.01 feet above mean sea level datum.

### **GROUNDWATER MONITORING**

- Groundwater monitoring will be conducted once. Groundwater monitoring is expected to occur during the spring of 2026 to determine baseline concentrations. For cost-estimating purposes, it is assumed that three monitoring wells will be sampled during the event. The locations of each proposed well are displayed in Figure 2.
- Depth to groundwater will be measured from each monitoring well using a decontaminated electronic oil/water interface meter. The meter will be decontaminated between each well

using Liquinox® soap solution and clean potable water rinse.

- Each monitoring well will be purged with low-flow, slow-purge pumping method using a peristaltic pump and dedicated polyethylene tubing. During purging, field instruments will analyze the water for several field parameters, including pH, temperature, dissolved oxygen, specific conductivity, oxidation-reduction potential, and turbidity. Water levels will be monitored during purging and at each field reading interval (anticipated every 3 - 5 minutes) to assess drawdown. Samples will be collected based on stabilization of field parameters as defined in Table 1 of the groundwater sampling SOP, if the available well volume allows for this method. Well volume will be calculated prior to sampling to determine whether volume is sufficient to allow for complete parameter stabilization prior to sampling, and if not, the well will be purged of the maximum volume of water while still reserving enough to be sampled. If drawdown exceeds 0.3 feet, then the well will be allowed to recharge prior to sampling. Purge water will be containerized in accordance with the *Disposal of Untreated Water from Monitoring Wells Flow Chart* and disposed of appropriately following receipt of laboratory results (DEQ, 2015). The pump will be decontaminated between wells using a Liquinox solution followed by a triple rinse technique. Additionally, a new sample tube will be installed between each well.
- A groundwater sample will be collected from each monitoring well using a peristaltic pump and dedicated polyethylene tubing. Groundwater samples will be analyzed for VPH and EPH via the methods listed above. In accordance with DEQ guidance, if the EPH concentration in water exceeds 1,000 micrograms per liter ( $\mu\text{g/L}$ ), then an EPH fractionation analysis is required (DEQ, 2024a). For cost estimating purposes it is assumed that one water sample will be analyzed for EPH fractions. A total of 3 natural water samples will be collected with one duplicate.

## **DATA VALIDATION**

Each analytical data package will include a level III or IV summary report that cross-references the sample identification with the laboratory identification and identifies variations from standard operating procedures; laboratory analytical results; quality control data, which may include but is not limited to surrogate recoveries, initial and continuing calibration blanks and spikes, method blanks, laboratory control samples, and spikes, and matrix spike and matrix spike duplicates; FID chromatograms; chain of custody form(s); and a sample receipt checklist.

Additionally, data validation will be included with the remedial investigation report and will follow DEQ's data validation guidelines (DEQ 2018). It is anticipated that two separate data validations will need to be completed for this project. One for soil sampling data and one for the groundwater monitoring event.

## **REMEDIAL INVESTIGATION REPORT PREPARATION**

Tetra Tech will prepare a RIR presenting findings and conclusions, soil and groundwater investigations, and groundwater monitoring activities. The report will include results from field screening activities, figures depicting site features and well locations, well completion details and

logs, a summary of soil sampling results, groundwater elevations, groundwater potentiometric surface map, groundwater flow direction and gradient, a summary of groundwater analytical results, and discussion on the vertical and aerial extent of impacts based on the investigation data. Cumulative groundwater and soil analytical results will be tabulated in order to compare data collected as part of this sampling event to data from previous site investigations. A discussion on impacts to receptors will be provided in the report including impacts to utilities, corridors, wells, surface and subsurface soil, and groundwater. Tetra Tech will also prepare a RCP, which will be appended to the RIR, to evaluate impacts to receptors, any data gaps, and the potential for closure of the release.

## **SCHEDULE AND BUDGET**

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Tetra Tech will initiate this work upon receiving approval from the Montana DEQ. Should release 6648 be deemed eligible for Petroleum Tank Release Compensation Board reimbursement, costs from this scope of work will be applied to the PTRCB copay. The work described above will be conducted on a unit cost basis per the attached *Montana Remedial Investigation Guidance for Petroleum Releases Workplan & Report Preparation Cost Considerations, Groundwater Monitoring and Sampling Unit Cost Worksheets, and Cost Estimate Breakdown* included in Attachment A.

## AUTHORIZATION

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The work described in this plan will be conducted per the terms and conditions in the Master Services Agreement and Task Order for work plan 35141 between Ernest Dale Roo of Big Sky Tire & Auto and Tetra Tech, dated January 26, 2026. If you have questions or comments regarding this work plan, don't hesitate to call us at (406) 437-9869. For your convenience, we have forwarded a copy of this work plan to DEQ for their review. We will not begin this work until we have approval from DEQ. We appreciate the opportunity to provide you with environmental consulting services.

Sincerely,

**Tetra Tech, Inc.**



Brandon Kingsbury, PG  
Project Manager

Cc: Reed Miner, Montana DEQ, rminer@mt.gov

Enclosures

Figures

Attachment A: Cost Estimates

Attachment B: Drilling Bids

Attachment C: Standard Operating Procedures

## REFERENCES

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- Montana Bureau of Mines and Geology (MBMG). 2007. Geologic Map of Montana 1:500,000 Scale: Yaak River Quadrangle.
- MBMG Ground Water Information Center (GWIC). 2026. Groundwater Monitoring Map Viewer.
- Massachusetts Department of Environmental Protection (MADEP). 2017. Method for Determination of Volatile Petroleum Hydrocarbons (VPH). Revision 0. January.
- Massachusetts Department of Environmental Protection (MADEP). 2019. Method for Determination of Extractable Petroleum Hydrocarbons (EPH). Revision 2.1. December.
- DEQ. 2015. Disposal of Untreated Purge Water from Monitoring Wells. Flow Chart prepared by Montana DEQ. July 27.
- DEQ. 2018. Montana DEQ - Waste Management and Remediation Division Data Validation Summary Form. Version 1.3.0, Revised January 26, 2018.
- DEQ. 2023a. Tank Piping Closure Form. Facility ID #27-02343. Tank No. 5 though 10.
- DEQ. 2023b. 24-Hour Initial Release Response Report. Big Sky Tire and Auto, Facility ID 27-02343, TREADS ID 24114.
- DEQ. 2024a. Montana Tier 1 Risk-Based Corrective Action Guidance for Petroleum Releases. February.
- DEQ. 2024b. Petroleum Release Notification – 30 Day Form. Big Sky Tire and Auto.
- DEQ. 2026. Work Plan Requested to Investigate Petroleum-Contaminated Media at the Big Sky Tire and Auto, 495 US Highway 93 N, Eureka, Lincoln County, Montana; Facility ID 27-02343 (TID 24114), Petroleum Release 6648, Work Plan 35141. January 22, 2026.
- U.S. Department of Agriculture National Resources Conservation Service (USDA NRCS). 2025. Web Soil Survey Map Viewer. Spatial data last updated August 2025. Accessed February 2026.



## FIGURES



**Notes:**

Service Layer Credits: World Imagery: Vantor  
 Hybrid Reference Layer: Esri Community Maps Contributors, Montana State Library, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/  
 NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, USFWS  
 World Hillshade: Esri, USGS



Analyst: M. Zilinsky  
 Date: 2/5/2026

**Big Sky Tire and Auto**  
 Eureka, Lincoln County, Montana

**Figure 2**  
**Site Features**



**Notes:**  
 Service Layer Credits: Hybrid Reference Layer: Esri Community Maps Contributors, Montana State Library, © OpenStreetMap, Microsoft, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, USFWS  
 World Imagery: Microsoft, Vantor  
 World Hillshade: Esri, USGS



**Tt TETRA TECH**

Analyst: M. Zilinsky  
 Date: 2/10/2026

**Big Sky Tire and Auto**  
 495 US Highway 93 N  
 Eureka, Lincoln County, Montana  
 Facility ID 27-02343  
 TID 24114  
 Petroleum Release 6648

**Figure 2**  
**Site Features**



**ATTACHMENT A**  
Cost Estimate



## **ATTACHMENT B**

Drilling Bids

# Petroleum Tank Release Compensation Board

## Soil Boring/Monitoring Well Installation Unit Cost Worksheet

### Contractor Information

Company Name: Boland Drilling  
 Address: 4701 N Star Blvd  
 City, State, Zip: Great Falls, MT 59405  
 Cost Estimator: Chris Boland  
 Signature: *Chris Boland*

Phone: 406-761-1063  
 Date: mo/day/year 3/2/2026

### Project Information and Specifications

Big Sky Tire & Auto  
 Eureka, MT

Facility ID #  
 Release #  
 WP ID #

### Type of Drilling Equipment

Hollow-Stem Augers	x
Air Rotary	
Direct Push	
Other (please specify)	

### Soil Boring

Number of Borings	3
Boring Diameter (inches)	8
Depth (per boring - ft)	30

Surface: Concrete Asphalt Barren  
 Soil Disposal: Onsite Stockpile Drums  
 Abandonment: Bentonite Soil Cuttings

### Soil Sampling

Continuous Soil Sampling	x
Interval Soil Sampling (specify interval)	
No Sampling	

### Monitoring Well Specifications

Number of Wells	3
Surface: Concrete Asphalt Barren	
Depth (per well)	30
Estimated Depth to Groundwater (ft)	
Boring Diameter (inches)	8
Casing Diameter and type (inches)	2" pvc
Surface Completion: <u>Flush Mount</u> Aboveground	

### Cost Estimate Explanation:

- Mobilization/Demobilization: Includes all costs and mileage to transport equipment, materials, and personnel to and from the site location. More than one mobilization event of either the drilling rig or support vehicle will require justification and pre-approval by the DEQ-PRS and Board staffs. This item should be estimated on a per mile unit rate
- Soil Boring Installation: Includes all costs (labor, equipment, and materials) to drill, collect soil samples and abandon soil borings, as well as decontaminate equipment. Drilling costs should be estimated using a per foot unit rate. Unit cost should include handling of contaminated soil by stockpiling or placing in drums. Assume level "C" personal protective equipment.
- Monitoring Well Installation: Includes all costs (labor, equipment, and materials) to drill, collect soil samples, and complete monitoring well to specifications and according to Montana Well Drillers Board rules, as well as decontaminate equipment. Drilling costs should be estimated using a per foot unit rate. Unit cost should include handling of contaminated soil by stockpiling or placing in drums. Assume level "C" personal protective equipment.
- Drilling Standby: Drilling standby should be estimated on an hourly basis. Prior approval and justification for accumulating standby time is needed prior to billing.
- Well Development: Includes all costs (labor, equipment, and materials) to develop monitoring wells. This task should be estimated using a per well unit rate.
- Monitoring Well Abandonment: Includes all costs (labor, equipment, and materials) to properly abandon a well location according to the Montana Well Drillers Board rules. Abandonment costs should be estimated using a per well unit rate.

### Soil Boring/Monitoring Well Installation Unit Cost Worksheet

TASK	UNIT COST	NUMBER OF UNITS	TOTAL COST
<b>Mobilization/Demobilization (1)</b>			
Mobilization/Demobilization: Drilling Rig	\$ 3.00 /mile	540	\$ 1,620.00
Mobilization/Demobilization: Support Vehicle	\$ 1.50 /mile	540	\$ 810.00
<b>Soil Boring Installation (2)</b>			
Drilling (0'-50' range per boring)	\$ 48.00 /foot	90	\$ 4,320.00
Drilling (50'-100' range per boring)	/foot		\$ -
Other (please specify) _____			\$ -
<b>Monitoring Well Installation (3)</b>			
Drilling (0'-50' range per well)	\$ 38.00 /foot	90	\$ 3,420.00
Drilling (50'-100' range per well)	/foot		\$ -
Other (please specify) _____			\$ -
<b>Drilling Standby (4)</b>			
-prior approval needed	\$ 125.00 /hour	0	\$ -
<b>Well Development (5)</b>			
Well Development	\$150 /hour	0	\$ -
<b>Monitoring Well Abandonment (6)</b>			
Abandonment	\$ 350.00 /well	0	\$ -
<b>Lodging may only be paid at actual costs when documented by receipts.</b>			
<b>Per Diem</b>			
Lodging: number of individuals =	2	\$ 200.00 /person per day	2 \$ 800.00
Food: number of individuals =	2	\$ 30.50 /person per day	2 \$ 122.00

**TOTAL PROJECT EXPENSE \$ 11,092.00**

D.O.T. Drums

\$120 x 5 = 600

Total - 11,692.00

Additional Conditions/Comments/Costs:

Drill and construct 3 monitor wells to 30' each at Big Sky Tire and Auto, Eureka, MT

If you require assistance, call 406-841-5090.

Submit completed form to:

Petroleum Tank Release Compensation Board PO Box 200902, Helena MT 59620-0902

# O'KEEFE DRILLING

*Environmental*

P.O. Box 3810 - Butte, MT 59702  
Office: (406) 494-3310 Fax: (406) 494-3301  
Email: info@okeefedrilling.com

Client: Tetra Tech  
Attention: Brandon Kingsbury  
Project: Eureka, MT

Date: 14-Jan-2026  
Phone: 406-437-9869  
Cell: 239-994-0474

PROJECT SPECIFICATIONS:			
Type of Rig:	<u>Mobile B-60x</u>	Number of Wells:	<u>3</u>
Location:	<u>Eureka, MT</u>	Expected Footage:	<u>30</u>
Formation:	<u>Gravels/sands</u>	Well Size:	<u>2</u>
Sampling:	<u>Yes, every 5'</u>	Screen Length:	<u>10</u>
Decontamination:	<u>No</u>	Screen Size:	<u>0.01</u>
Other Details:	<u>Flushmount</u>		
	<u>Asphalt</u>		

### Soil Boring/Monitor Well Installation

#### Unit Cost Worksheet

Task	Unit Cost	Number of Units	Total Cost
<b>Mobilization/Demobilization</b>			
Drill Rig/Support Vehicle	\$ 6.00	Miles 620	\$ 3,720.00
<b>Per Diem</b>			
<i>Crew Members</i>			
Motel (Actual Cost)	2 \$ 200.00	Per Person Per Day 3	\$ 1,200.00
Food	2 \$ 55.00	Per Person Per Day 4	\$ 440.00
<b>Soil Boring Installation</b>			
8.75 Drilling 0-50 ft range	\$ 34.00	Per Foot 90	\$ 3,060.00
<b>Monitor Well Installation -</b>			
2" Drilling 0-50 ft range	\$ 38.00	Per Foot 90	\$ 3,420.00
<b>Drilling Standby &amp; Safety Meeting</b>			
Prior Approval Needed	\$ 250.00	Per Hour	\$ -
<b>Other:</b>			
Decon	\$ 250.00	Per Hour	\$ -
<b>Total Project Expenses</b>			<b>\$ 11,840.00</b>

\*\*\*Client is responsible for any line locates. Locate number can then be given to O'Keefe Drilling who then will request a ticket default.

\*\*\*\*This bid is subject to change as warranted when the addition of prior unexpressed need for additional certifications, medical monitoring, sampling, containerization or other unforeseen change in the scope of work.

\*\*\*\*\*If a client cancels a project 24 business hours before the project is supposed to start, a \$500.00 per day fee will be invoiced if we are unable to fill in that timeframe

**From:** [Jr Cantrall](#)  
**To:** [Kingsbury, Brandon](#)  
**Subject:** Re: Big Sky Tire and Auto - Eureka Montana - Bid Needed  
**Date:** Wednesday, January 14, 2026 8:32:20 AM

**CAUTION:** This email originated from an external sender. Verify the source before opening links or attachments.

Good Morning Brandon!

Unfortunately I do not have Hollow Stem capabilities. I only have the geoprobe that can set a 3/4" pre pack screened well, or I can set a 1" well with a natural filter pack( no silica sand). One day I will have a bigger drill rig.

On Tue, Jan 13, 2026 at 12:36 PM Kingsbury, Brandon  
<[BRANDON.KINGSBURY@tetrattech.com](mailto:BRANDON.KINGSBURY@tetrattech.com)> wrote:

Hi JR,

Can you please send me an estimate within the next week to complete three wells to 20 feet with 10 feet of screen in Eureka? The plan would be to do the work later this spring or summer. I'm thinking the subsurface would require a hollow-stem auger, so that would be the preferred drilling method.

Thanks!

**Brandon Kingsbury, P.G.** | Project Manager | Senior Geologist

Direct (406) 437-9869 | Business (406) 442-5588 | Mobile (239) 994-0474 |

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James "JR" Cantrall  
Northern Lights Drilling  
208-818-5856



## **ATTACHMENT C**

**QA/QC & SOPS**

**SOP APPROVAL FORM**

TETRA TECH, INC.

EMI OPERATING UNIT

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

**GENERAL EQUIPMENT DECONTAMINATION**

**SOP NO. 002**

**REVISION NO. 5**

Last Reviewed: August 2021



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Quality Assurance Approved

*August 2021*

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Date

## 1.0 BACKGROUND

All nondisposable field equipment must be decontaminated before and after each use at each sampling location to obtain representative samples and to reduce the possibility of cross-contamination.

### 1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for decontaminating equipment in the field.

### 1.2 SCOPE

This SOP applies to decontaminating general nondisposable field equipment. All sampling equipment must be thoroughly cleaned before each use to prevent contamination of samples.

### 1.3 DEFINITIONS

**Alconox:** Phosphate-containing soap, obtained in powder form and dissolved in water

**Deionized (DI) Water:** DI water is water that has been treated to remove all ions – typically, that means all of the dissolved mineral salts and metal ions.

**Liquinox:** Phosphate-free soap, obtained in liquid form for mixing with water

**Luminox:** Specialized detergent with the capability of removing oils and organic contamination, also phosphate-free and liquid

### 1.4 REFERENCES

U.S. Environmental Protection Agency (EPA). 1992. “RCRA Ground-Water Monitoring: Draft Technical Guidance.” Office of Solid Waste. Washington, DC. EPA/530 R 93 001. November.

EPA. 2020a. “Management of Investigation-Derived Waste.” LSASDPROC-202-R4. May 8.  
<https://www.epa.gov/quality/management-investigation-derived-waste>

EPA. 2020b. “Field Equipment Cleaning and Decontamination.” LSASDPROC-205-R4. June 22.  
[https://www.epa.gov/sites/production/files/2016-01/documents/field\\_equipment\\_cleaning\\_and\\_decontamination205\\_af.r3.pdf](https://www.epa.gov/sites/production/files/2016-01/documents/field_equipment_cleaning_and_decontamination205_af.r3.pdf)

### 1.5 REQUIREMENTS AND RESOURCES

The equipment and supplies to conduct decontamination may include the following:

- Scrub brushes

- Large wash tubs or buckets
- Squirt or spray bottles
- Alconox or Liquinox (Note: Alconox contains phosphates, and phosphates have been banned in many household cleaning products based on their adverse effect on the environment.)
- Tap water
- Distilled water
- DI water
- Plastic sheeting
- Aluminum foil
- Isopropanol (laboratory grade) or Luminox

## **2.0 PROCEDURES**

This section describes procedures for decontamination of personal protective equipment (PPE) as well as equipment for drilling and monitoring well installation, borehole soil sampling, general sampling, water level measurement, and groundwater sampling. PPE (as outlined in the site-specific health and safety plan) should be used during decontamination procedures. Special handling of used PPE and wastewater generated from decontamination procedures may be required if the type of contamination is considered hazardous according to the Resource Conservation and Recovery Act (RCRA).

Any special handling should also be outlined in the site-specific health and safety plan or the sampling and analysis plan. At a minimum, no eating, drinking, smoking, or any other hand-to-mouth contact should be allowed during decontamination activities.

Some clients may have additional requirements for decontamination procedures. For example, phosphate-free detergent may be a requirement and, therefore, it would not be appropriate to use Alconox.

Source water for decontamination should be selected based on site-specific conditions and contaminants. In general, laboratory DI water is preferred for decontamination of instruments and sampling devices. Standard distilled water, readily available at grocery stores, may be appropriate at other times. However, distilled water may still contain unacceptable levels of inorganic ions. Decontamination of heavy equipment such as drill rigs will typically use tap water or similar source water, often used in combination with a steam or hot-water cleaning unit. During procurement, Tetra Tech personnel should specify the source of decontamination water to be used by the subcontractors and ensure that it is consistent with investigation goals. Refer to the site-specific sampling and analysis plan for details concerning source water.

In general, conduct field activities to move from cleaner to more contaminated locations to minimize the potential for cross contamination between locations.

### **2.1 PERSONAL PROTECTIVE EQUIPMENT DECONTAMINATION**

Personnel working in the field are required to follow specific procedures for decontamination prior to leaving the work area so that contamination is not spread off site or to clean areas. Refer to the site-specific health and safety plan as the first resource for types of PPE; not all types of PPE nor methods for decontamination discussed below will be appropriate for every site. All used disposable protective clothing, such as Tyvek, coveralls, gloves, and booties, will be containerized for later disposal.

Decontamination water will be containerized in 55-gallon drums or similar sealable containers (refer to Section 3.0).

Personnel decontamination procedures will be as follows:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Wash neoprene boots (or neoprene boots with disposable booties) with Liquinox or Alconox solution and rinse with clean water. Remove booties and retain boots for subsequent reuse.
3. Remove outer gloves and place into plastic bag for disposal.
4. Remove Tyvek or coveralls. Containerize Tyvek for disposal and place coveralls in plastic bag for laundry before reuse.
5. Remove air purifying respirator (APR), if used, and place the spent filters in a plastic bag for disposal. Filters should be changed daily or sooner, depending on use and application. Place the respirator into a separate plastic bag after it has been cleaned and disinfected according to the instructions for the respirator.
6. Remove disposable gloves and place them in plastic bag for disposal.
7. Thoroughly wash hands and face in clean water and soap.

## **2.2 DRILLING AND MONITORING WELL INSTALLATION EQUIPMENT DECONTAMINATION**

All drilling equipment should be decontaminated at a designated location on site before drilling operations begin, between borings, and at completion of the project. Decontamination may be conducted on a temporary decontamination pad constructed at a satellite location within the site. The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Decontamination pads may be constructed of concrete, wood, or plastic sheeting, depending on the site-specific needs and plans. Wash waters and contaminated soil generated during decontamination should be considered investigation-derived waste (IDW) and, thus, should be collected and containerized for proper disposal.

Monitoring well casing, screens, and fittings are assumed to be delivered to the site in a clean condition. However, they may be steam cleaned and placed on polyethylene sheeting on site before they are used downhole, if required by the site-specific work plan. The drilling subcontractor will typically furnish the steam cleaner and water.

The drilling auger, bits, drill pipe, any portion of drill rig that is over the borehole, temporary casing, surface casing, and other equipment used in or near the borehole should be decontaminated by the drilling subcontractor as follows:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Remove loose soil using shovels, scrapers, wire brushes, and any related material.
3. Steam clean or pressure wash to remove all visible dirt. Use appropriate PPE (for example, a face shield and Tyvek/coveralls) as necessary.
4. If equipment has directly or indirectly contacted contaminated media and is known or suspected of being contaminated with oil, grease, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), or other hard-to-remove organic materials, rinse equipment with laboratory-grade isopropanol or Luminox solution.
5. To the extent possible, allow components to air dry; drying helps limit the spread of contamination through contact. Equipment should be dried and stored upwind of contaminated areas to minimize potential cross-contamination.
6. All wastewater from decontamination procedures should be containerized.

### **2.3 BOREHOLE SOIL SAMPLING DOWNHOLE EQUIPMENT DECONTAMINATION AND GENERAL SOIL SAMPLING EQUIPMENT DECONTAMINATION**

All soil sampling equipment should be decontaminated before use and after each sample as follows:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Scrub the split-barrel sampler and sampling tools in a wash bucket or tub using a stiff, long-bristle brush with a solution of tap water with Liquinox or Alconox.
3. Rinse equipment thoroughly with tap water or distilled water.
4. Perform a final rinse with DI or distilled water. Refer to the site-specific sampling and analysis plan for requirements for DI or distilled water.
5. Place cleaned equipment in a clean area on plastic sheeting or aluminum foil and allow to air-dry. Clean, dry equipment should be stored in clean equipment cases to minimize potential cross-contamination. If the equipment does not have a case, it should be stored on a clean surface upwind of contaminated areas to minimize potential cross-contamination.
6. Containerize all water and rinsate; also, containerize disposable, single-use sampling equipment.

## **2.4 WATER LEVEL MEASUREMENT EQUIPMENT DECONTAMINATION**

Field personnel should decontaminate the water-level indicator or interface probe before inserting and after removing it from each well. The following decontamination procedures should be used:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Wipe the tape and probe with a disposable Alconox- or Liquinox-impregnated cloth or paper towel. Spray the probe with Alconox or Liquinox solution to ensure that all ports on the probe are cleaned.
3. If immiscible layers are encountered, the interface probe may require steam cleaning or washing with laboratory-grade isopropanol or Luminox solution.
4. Rinse with distilled or deionized water, including spraying the probe with rinse water.
5. Store clean, dry equipment in clean equipment cases to minimize potential cross-contamination. If the equipment does not have a case, it should be stored on a clean surface upwind of contaminated areas to minimize potential cross-contamination.
6. Containerize all water and rinsate for proper disposal.

## **2.5 GROUNDWATER SAMPLING EQUIPMENT**

The following procedures are to be employed to decontaminate equipment used for groundwater sampling. Decontamination is not necessary when using disposable (single-use) or dedicated (reused but only at a single sample point) pump tubing or bailers. Decontamination procedures for reused equipment are described below.

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Remove and containerize any purge water in the pump and tubing and dispose of tubing.
3. Dismantle the pump as much as possible and scrub components in a wash bucket or tub using a stiff brushes of appropriate size with a solution of tap water with Liquinox or Alconox.
4. Rinse pump components thoroughly with tap water or distilled water.
5. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard-to-remove organic materials, rinse the pump and tubing with laboratory-grade isopropanol or Luminox solution.
6. Perform a final rinse with DI or distilled water.
7. Allow components to air dry.
8. Wrap pump in aluminum foil or a clean plastic bag for storage.
9. Containerize the used tubing and decontamination wash waters for proper disposal.

### **3.0 INVESTIGATION-DERIVED WASTE**

IDW can include disposable, single-use PPE and sampling equipment, soil cuttings, purge water, and decontamination wash waters and sediments. Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage will be provided in project-specific documents, or separate direction will be provided by the project manager. Make sure to consult with a qualified professional before making any waste characterization decisions. The following guidelines are provided for general use:

1. Assume that all IDW generated from decontamination contains the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.
2. Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility.
3. Label IDW storage containers with the facility name and address, date, contents, company generating the waste, and an emergency contact name and phone number.
4. Temporarily store the IDW in a protected area that provides access to the containers and allows for spill/leak monitoring, sampling of containers, and removal after the disposal method has been identified.

**SOP APPROVAL FORM**

TETRA TECH, INC.

EMI OPERATING UNIT

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

**ORGANIC VAPOR AIR MONITORING**

**SOP NO. 003**

**REVISION NO. 4**

Last Reviewed: May 2020



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Date

## **1.0 BACKGROUND**

Exposure to airborne organic contaminants can present a significant threat to worker health and safety. Identifying and quantifying these contaminants through air monitoring is essential for reconnaissance activities. Reliable measurements of airborne organic contaminants are necessary for selecting or upgrading personal protective equipment (PPE), delineating areas where protection is needed, assessing the potential health effects of exposure, and evaluating the need for specific medical monitoring. Organic vapor air monitoring is also commonly used as a screening tool to identify relatively impacted environmental media and to provide a real-time basis for selecting samples for chemical analysis.

Various types of air monitoring instruments are available to measure organic vapors. Common organic vapor monitoring instruments used by Tetra Tech include photoionization detectors (PID), organic vapor analyzer (OVA), flame ionization detectors (FID), and multigas meters that combine organic and inorganic vapor monitoring. It should be noted that this standard operating procedure (SOP) discusses only some of the air monitoring instruments available to field personnel. The particular type of meter or monitoring system to be used should be identified in the project work plan or field sampling plan and selected on a site-specific basis depending on the data collection needs, the types of organic vapors to be monitored, and the sampling procedures to be used.

### **1.1 PURPOSE**

This SOP establishes the general requirements and procedures for using various instruments to conduct organic vapor air monitoring in the field. It also discusses general factors to consider when conducting organic vapor air monitoring.

### **1.2 SCOPE**

This SOP applies to general procedures for calibrating and operating organic vapor air monitoring instruments in the field. The project work plan or field sampling plan should identify the types of instruments to be used and the actual project-specific field parameters to be measured. The project-specific health and safety plan should identify chemical-specific action levels for health and safety purposes. For each type of air monitoring instrument, the manufacturer's manual should be consulted for specific operating instructions.

### **1.3 DEFINITIONS**

**Flame ionization:** A process by which a sample gas is ionized with a flame, allowing a count of carbon atoms to measure organic vapor concentration.

**Flame ionization detector (FID):** A portable instrument used to detect, measure, and provide a direct reading of organic vapor concentrations in a gas sample that is ionized with a flame.

**Ionization potential:** The amount of energy needed to strip an electron from the orbit of its resident molecule, expressed in electron volts.

**Organic vapor:** Airborne compounds composed of carbon, hydrogen, and other elements with chain or ring structures.

**Organic vapor analyzer (OVA):** A portable instrument used to detect, measure, and provide a direct reading of the concentration of a variety of trace organic gases in the atmosphere through flame ionization.

**Photoionization:** A process involving the absorption of ultraviolet light by a gaseous molecule, leading to ionization.

**Photoionization detector (PID):** A portable instrument used to detect, measure, and provide a direct reading of the concentrations of a variety of trace organic gases in the atmosphere through photoionization.

**Breathing zone:** The area where field workers would be inhaling potentially impacted air, generally from about 3 to 5 feet above the ground surface. The breathing zone will vary depending on the types of work activities being performed. Air monitoring is conducted in this zone to ensure that it is representative of the air being breathed by field team members.

**Head space:** The vapor mixture trapped above a solid or liquid in a sealed vessel.

## 1.4 REFERENCES

National Institute for Occupational Safety and Health (NIOSH). 2007. "Pocket Guide to Chemical Hazards." Department of Health and Human Services, Centers for Disease Control and Prevention. Publication 2005-149. September.

## 1.5 REQUIREMENTS AND RESOURCES

The following items are typically required to monitor organic vapors in air using this SOP:

- Organic vapor air monitoring meter
- Manufacturer-supplied calibration gas
- Manufacturer-supplied calibration kits including tubing and regulators

- Resealable plastic bags for conducting soil head space measurements (if applicable)
- Sample jars for conducting water head space measurements (if applicable)
- Sharpie or similar type of permanent marker
- Container to collect soil or water used for head space measurements (if applicable)
- Logbook or field data sheets (may be in an electronic format)

## **2.0 APPLICATIONS, DETECTION METHODS, AND LIMITATIONS**

All direct-reading instruments have inherent constraints in their ability to detect gaseous organic compounds. They usually detect or measure only specific classes of chemicals. Generally, they are not designed to measure or detect airborne concentrations below 1 part per million (ppm). Finally, many direct-reading instruments that have been designed to detect one particular substance also detect other substances, causing interference and possibly resulting in false readings. The following subsections discuss general application, detection methods, and limitations when using a PID and an OVA FID.

### **2.1 APPLICATION**

The PID can be used to detect total concentrations of many organic and some inorganic gases and vapors. It can also be used in conjunction with other detection devices such as colorimetric indicator detector tubes to identify specific compounds (see SOP No. 065, Colorimetric Indicator Detectors [Dräger Tubes]).

When set in the survey mode, the OVA FID can detect the total concentration of many organic gases and vapors. In the gas chromatography (GC) mode, the OVA FID can identify and measure the concentrations of specific compounds. In the survey mode, all organic compounds are ionized and detected at the same time. In the GC mode, volatile species are ionized and detected separately.

Each type of unit (PID or FID) has some limitations in the detection of various categories of compounds or for specific organic compounds. Examples are described below in Section 2.2. The user manual for the specific instrument should be used to confirm its applicability for measurements of the organic vapors of concern at the site.

### **2.2 DETECTION METHODS**

The PID ionizes molecules using ultraviolet (UV) radiation and can be used with a variety of electron voltage lamps best matched to the compound of concern at a site. The UV radiation strips electrons from the molecules, producing ions that produce a current proportional to the number of ions generated. The PID is more sensitive to aromatic and unsaturated compounds than the OVA FID. The PID is nonspecific for gas and vapor detection for organic and some inorganic compounds. The PID is also sensitive to 0.1 ppm of benzene. Sensitivity is related to the ionization potential of the compound being monitored. PIDs will only detect compounds that have ionization energies similar to the energy of the photons the detector uses. Gases with ionization potential values below the electron volt (eV) output of the lamp will be detected. The most common PID lamp used is the 10.6 eV lamp because it detects most volatile organic compounds; however, 9.5 eV and 11.7 eV lamps are also commonly available. It is recommended that

the ionization potential of the chemicals of concern be known in order to select the most appropriate lamp for a specific project. Ionization potential information can be obtained from the vendor, in the manufacturer's manual, or on line.

Organic gases and vapors are flame-ionized in the OVA FID. The ions produce a current that is proportional to the number of carbon atoms present. The current is interpreted by a deflection on the instrument's meter. In the survey mode, the OVA FID functions as a nonspecific total hydrocarbon analyzer. In the GC mode, the OVA FID can provide a tentative qualitative and quantitative identification of gases and vapors. The OVA FID is most sensitive to saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes), and aromatic hydrocarbons. The OVA FID is not suitable for inorganic gases such as chlorine, hydrogen cyanide, and ammonia. The OVA FID is also less sensitive to aromatics and unsaturated compounds than the PID. However, the OVA FID is less sensitive to high humidity than the PID. Gases and vapors that contain substituted function groups such as hydroxide (OH-) reduce the detector's sensitivity. Finally, if the operator monitors for a specific gas or vapor, the operator should use a calibration standard and GC column specific to that particular gas or vapor.

### **2.3 LIMITATIONS**

The PID cannot be used to:

- Detect methane
- Detect a compound that has a higher energy level than the ionization potential of the PID light source
- Respond accurately to a mixture of gases or vapors
- Respond accurately in high humidity or very cold weather
- Respond accurately when interference from other sources is present

The OVA FID cannot be used to:

- Detect organic vapors at temperatures below 40°F (4°C)
- Identify specific organic vapors when operated in the survey mode; results must be reported relative to the calibration standard used (for example, as methane equivalents).
- Detect inorganic gases and vapors; the instrument also gives a lower response to oxygen-containing organic compounds (such as alcohols, ethers, and aldehydes) and nitrogen-containing organic compounds (such as amines, amides, and nitriles).
- Detect high organic contaminant concentrations or detect contaminants in oxygen-deficient atmospheres; operation in these conditions requires system modification.

### **3.0 PROCEDURES**

The procedures outlined in this SOP are general and typically apply to various types of monitoring instruments used to measure organic vapors in air. General procedures for testing and calibrating the instruments are presented first, followed by procedures for using the instruments and making field measurements, guidelines for recording information accurately, and a discussion of variables that may affect outdoor air monitoring. The particular monitoring instrument should be identified in the project work plan or field sampling plan and should be operated in accordance with the manufacturer's instruction manual.

#### **3.1 TESTING AND CALIBRATION PROCEDURES**

Each air monitoring instrument should be calibrated according to manufacturer's specifications. General procedures applicable to most equipment are as follows:

- Equipment should be thoroughly cleaned, and then calibrated and tested before the startup of sampling at each site.
- Equipment should be calibrated and tested using manufacturer-provided calibration gas and calibration connector kits.
- Batteries should be charged before startup of field work, and the battery charge level should be checked at the start of each day. The battery charge life will vary depending on the particular monitoring instrument used, the application, and environmental conditions such as temperature. Some instruments are equipped with an adapter that will allow the unit to be plugged into a car charger.
- It is recommended that extra batteries be kept on hand when conducting field work.
- The PID can typically run continuously on a fully charged battery for at least 8 hours. The PID battery should be recharged for 14 hours.
- The OVA FID can typically run continuously on a fully charged battery for 8 hours alone or for 3 hours with a strip chart recorder. The OVA FID battery must be recharged every 8 hours or replaced, as needed.
- Calibration and testing of field equipment should be documented every time it is performed. Calibration and testing information should be recorded in field logbooks (or field data sheets, if applicable).
- If testing and calibration measurements are out of tolerance, the instrument must be serviced or repaired.

#### **3.2 FIELD MEASUREMENT PROCEDURES**

Each air monitoring instrument should be operated according to manufacturer's specifications. The actual field procedures will vary depending on the type of air monitoring to be conducted. Almost all PIDs and

OVA FIDs have a recommended warm-up period (see the manufacturer's operations manual for the specific type of meter to be used). Similarly, many instruments are affected by moisture, humidity, and dust. The use of an external filter on the probe tip is recommended in these situations. Finally, many instruments include a data logging option that can be used, if desired. A general procedural summary for air monitoring associated with health and safety and field screening applications is presented below.

### **3.2.1 Health and Safety Monitoring**

The site-specific health and safety plan will specify the types of contaminants of concern, health and safety related action levels, and the types of PPE necessary. The goal of air monitoring for health and safety purposes is to ensure that field work is conducted in accordance with the health and safety plan and to identify conditions where upgrading the level of PPE may be necessary. General procedures for conducting health and safety air monitoring for organic vapors are as follows:

- Following the instrument manual, calibrate and test air monitoring equipment.
- Approach the sampling location from the upwind direction.
- Monitor organic vapors in the breathing zone (multiple levels of monitoring may be required depending on the work being performed).
- Monitor down-hole vapor concentrations, if drilling.
- Take readings at a frequency appropriate for the types of tasks being conducted, the types of organic vapors expected, and the levels of organic vapors being detected (monitor at a more frequent rate if organic vapors are detected and they are near the site-specific action levels specified in the health and safety plan).
- Record information in a field logbook, on field data sheets, or on an air monitoring log sheet (record site name, date and time, sampling location, PID or FID readings, and pertinent weather information). A negative (non-detect) result should also be recorded to demonstrate that the measurement was taken.
- Upgrade the level of PPE, implement engineering controls, or stop work if organic vapors are sustained in the breathing zone above action levels specified in the site-specific health and safety plan.

### **3.2.2 Field Screening**

The site-specific work plan or field sampling plan will specify the media to be sampled, the sampling methods and procedures to be used, and field screening requirements. Typically, the goals of air monitoring for field screening purposes are to identify relatively higher organic vapor concentrations in soil, groundwater, or other media to select subsequent sampling locations, or to select environmental samples to send to a laboratory for chemical analysis. General procedures for conducting field screening air monitoring for organic vapors are as follows:

- Following the instrument manual, calibrate and test air monitoring equipment.
- Work from the upwind direction, when possible.
- If samples are collected at low temperatures, they may require some warming to allow organic compounds to volatilize. Care must be taken for samples not to be overheated, allowing any organic vapors to escape.
- Directly screen soil cores or drill cuttings by running the tip of the meter along the soil surface while taking care not to get soil into the probe.
- Depending on sampling protocol, dig into or freshly “break” the soil and measure vapors at the newly exposed surface.
- When collecting soil samples for head space measurements, place soil in a resealable plastic bag, record the sampling location and depth on the bag with a Sharpie or other type of permanent marker, wait at least 5 minutes for vapors to accumulate (the bag may be placed in direct sunlight or in a warm area while waiting), shake the bag vigorously, and then insert the probe into the bag without placing the tip directly in the soil (while taking care not to let vapors escape).
- Directly screen purged well water (or surface water) by running the tip of the meter along the water surface while taking care not to get water into the probe.
- When collecting water samples for head space measurements, place water in a jar and tightly close the lid, record the sampling location and depth on the jar with a Sharpie or other type of permanent marker, wait at least 5 minutes for vapors to accumulate (the jar may be placed in direct sunlight or in a warm area while waiting), shake the jar vigorously, and then slightly open the lid and insert the probe into the jar without placing the tip directly in the water (while taking care not to let vapors escape).
- Record information in a field logbook, on field data sheets, or on an air monitoring log sheet (record site name, date and time, sampling location, PID or FID readings, and pertinent weather information). A negative (non-detect) result should also be recorded to demonstrate that the measurement was taken.

### **3.3 ACCURATE RECORDING AND INTERPRETATION**

Direct-reading instruments must be operated and the data interpreted by individuals who understand the operating principles and limitations of the instruments. At hazardous waste sites, where unknown and multiple contaminants are frequently encountered, instrument readings should be interpreted conservatively.

The following guidelines promote accurate recording and interpretation:

- Calibrate instruments in accordance with the manufacturer’s instructions before and after every use.
- Conduct additional monitoring at any location where a positive response occurs.
- Report a reading of zero as nondetectable (ND) rather than as “clean.” Quantities of chemicals

may be present but at concentrations that are not detectable by the instrument.

- Repeat the air monitoring survey using other detection devices.

### **3.4 VARIABLES AFFECTING OUTDOOR AIR MONITORING**

Complex environments containing many substances, such as those associated with hazardous waste sites, pose significant challenges to accurately and safely assess airborne contaminants. Several independent and uncontrollable variables (most notably temperature and weather conditions) can affect airborne concentrations. These factors must be considered when conducting air monitoring and interpreting data. The following environmental variables must be considered:

- **Temperature:** An increase in temperature increases the vapor pressure of most chemicals.
- **Wind speed:** An increase in wind speed can affect vapor concentration near a free-standing liquid surface. Dust and particulate-bound contaminants are also affected.
- **Rainfall:** Water from rainfall can essentially cap or plug vapor emission routes from open or closed containers, saturated soil, or lagoons, thereby reducing airborne emissions of certain substances.
- **Moisture:** Dusts, including finely divided hazardous solids, are highly sensitive to moisture. Moisture can vary significantly with respect to location and time and can also affect the accuracy of many sampling results.
- **Background vapor emissions:** Vapor emission from other activities in the area of the field investigations can also affect readings. Operations such as vehicle maintenance or fueling facilities can affect readings associated with perimeter monitoring. Permanent markers can also influence instrument responses, so pens should be tightly capped and stored away from instruments.
- **Work activities:** Work activities often require the mechanical disturbance of contaminated materials, which may change the concentration and composition of airborne contaminants and contribute to airborne emissions. Organic air emissions at a work site can also occur from operation of gasoline or diesel engines.

These conditions should be reported with organic vapor readings to provide a more accurate interpretation of monitoring results.

**SOP APPROVAL FORM**

TETRA TECH, INC.

EMI OPERATING UNIT

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

**SOIL SAMPLING**

**SOP NO. 005**

**REVISION NO. 4**

Last Reviewed: August 2021



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Quality Assurance Approved

*August 2021*

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Date

## **1.0 BACKGROUND**

Soil is sampled for three main reasons: (1) for chemical analysis in the laboratory, (2) for physical analysis in the laboratory, or (3) for evaluation in the field (for example, visual classification, assessment of staining, and field screening). These three sampling objectives can be achieved separately or in combination. Sampling locations are typically chosen to provide information in both the horizontal and vertical directions. A sampling and analysis plan or a site-specific quality assurance project plan (QAPP) is used to outline sampling methods and to provide a preliminary rationale for sampling locations. Sampling locations may be adjusted in the field based on the screening or sampling methods used and the physical features of the area.

### **1.1 PURPOSE**

This standard operating procedure (SOP) establishes the requirements and procedures for soil sampling. Soil is sampled to evaluate the chemical and physical characteristics of surface and subsurface soils.

### **1.2 SCOPE**

This SOP describes procedures for soil sampling in different areas using various implements. It includes procedures for test pit, surface soil, and subsurface soil sampling and describes a variety of soil sampling devices.

### **1.3 DEFINITIONS**

**Aliquot:** A portion of a larger whole, especially a sample taken for chemical analysis or other treatment; in particular, the discrete portions of a composite sample.

**Bucket Auger:** A type of auger that consists of a cylindrical bucket 10 to 72 inches in diameter with teeth arranged at the bottom.

**Composite Sample:** A sample that consists of soil combined from more than one discrete location (also called an aliquot). Typically, composite samples consist of soil obtained from several locations and homogenized in a stainless-steel or Teflon bowl, tray, or plastic bag.

**Core Sampler:** A thin-walled cylindrical metal tube with diameter of 0.5 to 3 inches, a tapered nosepiece, a “T” handle to facilitate sampler deployment and retrieval, and a check valve (flutter valve) in the headpiece.

**Direct-push technology (DPT):** Investigation tools that drive or push small-diameter rods and tools (typically not exceeding 4 inches in diameter) into the subsurface by hydraulic or percussive methods. Geoprobe Systems is a manufacturer of DPT equipment, and its brand name is often used interchangeably with “DPT.”

**EnCore Sampler:** A disposable volumetric sampling device. It comes in sample sizes of 5 and 25 grams. It is a hermetically sealed, single-use soil sampler made from a high-tech, inert polymer. EnCore samplers are used to collect soil samples with zero headspace, as required for volatile organic compound (VOC) analysis (including purgeable total petroleum hydrocarbons). Each sample is collected using a reusable “T” handle.

**Grab Sample:** A sample collected from a discrete location or depth.

**Hand Auger:** An instrument attached to the bottom of a length of pipe that has a crossarm or “T” handle at the top. The auger can be closed-spiral or open-spiral.

**Spatulas or Spoons:** Stainless-steel or disposable instruments for collecting loose unconsolidated material.

**Split-Spoon (or Split-Barrel) Sampler:** A thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to drill rods.

**Terra Core Sampler:** A disposable volumetric sampling device. It comes in sample sizes of 5 and 10 grams and is part of a sampling kit. It is a single-use sampler used to collect soil samples with zero headspace, as required for VOCs. Each sample is collected with the disposable coring device. However, unlike the EnCore sampler, the sample is placed directly into a 40-milliliter (mL) glass volatile organics analysis (VOA) vial after the soil is collected. The VOA vial is included in the sampling kit.

**Thin-Wall Tube Sampler:** A steel tube (1 to 3 millimeters thick) with a tapered bottom edge for cutting. The upper end is fastened to a check valve that is attached to drill rods.

**Trier:** A tube cut in half lengthwise with a sharpened tip that allows for collecting sticky solids or loosening cohesive soils.

**Trowel:** A metal or disposable tool with a scooped blade 4 to 8 inches long and 2 to 3 inches wide with a handle.

**VOA Plunger:** A disposable, plastic, single-use soil device to collect samples for analysis of VOCs.

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## **1.5 REQUIREMENTS AND RESOURCES**

Soil sampling requires the use of one or more of the following types of equipment:

- Spoon and spatula
- Trowel
- Shovel or spade
- Trier
- Core sampler
- EnCore sampler
- Terra Core sampler
- VOA plunger
- Hand auger
- Bucket auger
- Split-spoon
- Thin-wall tube

In addition, the following equipment may also be needed for various methods:

- Sample containers, labels, and chain-of-custody forms
- Logbook and field forms
- Stakes or flags for marking sample locations
- Tape for measuring recovery
- Soil classification information, including Munsell Color Chart

- Wax or caps for sealing ends of thin-wall tube
- “T” Handles
- Stainless-steel or Teflon bowls, aluminum pans, or other vessels for composite sampling (made from material that will not interfere with the planned analyses)
- Plastic sheeting
- Decontamination equipment
- Drilling equipment
- Backhoe
- Health and safety equipment

## **2.0 PROCEDURES**

This SOP presents procedures for collecting test pit, surface soil, and subsurface soil samples. The site sampling plan will specify which of the following procedures will be used.

Soil samples for chemical analysis should be collected in order of decreasing volatility, with samples for VOCs collected first. Samples for physical analysis can be containerized after the chemical samples have been containerized. Typical physical analyses conducted include (1) grain size distribution, (2) moisture content, (3) saturated permeability, (4) unsaturated permeability, and (5) Atterberg limits. Additionally, visual descriptions of samples, using the Unified Soil Classification System (USCS, ASTM D2488-17e1), should be recorded. Field tests such as head-space analysis can also be conducted using a photoionization detector or a flame ionization detector before samples are collected for chemical or physical analysis.

Soil samples for chemical analysis can be collected either as grab samples or as composite samples. A grab sample is collected from a discrete location or depth. A composite sample consists of soil combined from more than one discrete location. Typically, composite samples consist of soil obtained from several locations (aliquots) and homogenized in a stainless steel or Teflon bowl, tray, or plastic bag. Refer to the site-specific QAPP for the methodology for composite sample collection, including number and location of aliquots. Samples for VOC analysis should not be composited.

All non-disposable equipment used for soil sampling should be decontaminated between sampling locations in accordance with SOP 002, General Equipment Decontamination.

### **2.1 SOIL SAMPLE COLLECTION PROCEDURES**

Soil samples can be collected as discrete samples for VOC analysis using specialized equipment for preservation in the laboratory or in the field. Samples for VOC analysis should not be composited. Soil samples collected for non-VOC analysis can be collected as either grab or composite samples using standard equipment.

#### **2.1.1 Procedure for Preserving and Collecting Soil Samples for VOC Analysis**

Samples collected for VOC analysis using traditional methods, such as collection in a jar with no preservation, are shown to yield nonrepresentative results based on loss of VOCs. Soil samples collected for analysis for VOCs should be collected so that an undisturbed aliquot can be submitted for analysis. The aliquot should be taken directly from the sampling device and put in the sample container. EPA SW-846 Method 5035 is the preferred method for collecting samples for analysis for VOCs.

There are several options for collecting samples under Method 5035, including a variety of sampling devices, preservatives, and containers (including the potential presence of stir bars in the containers). The sampling team should work with the analytical laboratory to identify the anticipated range of concentrations, the window for sample delivery to the laboratory from the field, and the data quality objectives for the project.

Soil may be collected using any method described in Sections 2.3 or 2.4 that results in an undisturbed soil core. Once the soil is collected, a sampling device such as an EnCore sampler, a Terra Core sampler, syringe, stainless-steel spoon, plunger, or other device may be used to collect the sample into the container. The container may be unpreserved or may be pre-preserved with methanol, sodium bisulfate, or other solvents. Table 1 lists some of the options for Method 5035.

**TABLE 1**  
**METHOD 5035 SUMMARY**

<b>Option</b>	<b>Procedure</b>	<b>Advantages</b>	<b>Disadvantages</b>
1	Collect two 40-milliliter (mL) vials with about 5 grams (g) of sample and one 2-ounce (oz) glass jar with a septum lid for screening, percent moisture, and preservative compatibility.	<ul style="list-style-type: none"> <li>Screening conducted by laboratory</li> </ul>	<ul style="list-style-type: none"> <li>48-hour holding time for unpreserved samples</li> <li>Sample containers must be tared</li> </ul>
2	Collect three EnCore samplers and one 2-oz glass jar with a septum lid for screening and percent solids.	<ul style="list-style-type: none"> <li>Lab conducts all preservation and preparation procedures</li> </ul>	<ul style="list-style-type: none"> <li>48-hour holding time for unpreserved samples</li> </ul>
3	Collect two 40-mL vials with 5 g of sample and preserve with methanol or sodium bisulfate and one 2-oz glass jar with a septum lid for screening and percent solids.	<ul style="list-style-type: none"> <li>Longer holding time</li> </ul>	<ul style="list-style-type: none"> <li>Hazardous materials used in the field</li> <li>Sample containers must be tared</li> </ul>
4	Collect one 2-oz glass jar with septum lid for analysis and percent solids.	<ul style="list-style-type: none"> <li>Lab conducts all preservation and preparation procedures</li> </ul>	<ul style="list-style-type: none"> <li>May have significant loss of constituents of concern</li> </ul>

Because the EnCore and Terra Core samplers are most commonly used, specific procedures for these devices are included below. For other sampling devices, the laboratory should be consulted to ensure their correct use.

**EnCore Sampler:** Soil samples collected for VOC analysis that are to be preserved at the laboratory may be obtained using a hand-operated, hermetically sealed sample vial such as an EnCore sampler. Each sample is collected using a reusable sampling handle (“T” handle) that can be provided with the EnCore

sampler when it is requested and purchased. Using the EnCore sampler eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each EnCore sampler.

Collect the soil sample in the following manner for each EnCore sampler. Typically, three EnCore samplers will be collected per sample location.

- The EnCore sampler is loaded into the “T” handle with the plunger fully depressed.
- Press the “T” handle into the soil to be sampled. The plunger will be forced upward as the cavity fills with soil.
- When the sampler is full, rotate the plunger and lock it into place using the “T” handle. If the plunger does not lock, then it is not filled with soil. Soft soil may require several plunges or soil may be forced against a hard surface such as a decontaminated sample trowel to ensure headspace has been eliminated.
- Remove soil from the outside of the sampler so a tight seal can be made between the sample cap and the O-ring.
- With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler.
- Remove any surface soil from outside of the sampler and place the sampler in the foil bag provided with the sampler. Seal the bag and label it with sample location information.
- Decontaminate the “T” handle between sample locations.
- Place samples on ice immediately and deliver them to the laboratory within 48 hours.

**Terra Core Sampler:** Terra Core disposable samplers may be used instead of EnCore samplers. These devices are used when samples will be preserved and have the advantage of a longer holding time. Each Terra Core sampling kit typically comes with one Terra Core sampler that collects either a 5- or a 10-gram aliquot into multiple pre-preserved containers that may also have stir bars. The sample containers will also typically be tared at the laboratory before sampling. Because the vials are pre-weighed, no additional labels should be added. Sampling information should be written directly on the label already on the vial.

Collect the soil sample in the following manner for each Terra Core sampler. Typically, multiple containers with different preservatives will be filled for each sample.

- With the plunger seated in the handle, push the sampler into freshly exposed soil until the sample chamber is filled.

- Wipe any excess soil and debris from the exterior of the sampler and remove any soil that extends beyond the mouth of the sampler.
- Rotate the plunger that was seated in the handler top 90 degrees until it aligns with the slots in the body.
- Place the mouth of the sampler into the desired 40-mL VOA vial and extrude the sample by pushing the plunger down. Quickly place the lid back on the VOA vial.
- After all vials provided have been filled, the sampler is now contaminated and must be disposed of unless additional duplicate or matrix spike sampling will be collected at the same location.
- Place the samples on ice immediately and ensure that samples are delivered to the laboratory within the holding time allowed for the preservation regime.

### **2.1.2 Procedure for Collecting Soil Samples for Non-VOC Analysis**

Samples collected for non-VOC analysis may be either grab or composite samples as follows. When collecting a grab sample, transfer a portion of soil to be analyzed to a stainless-steel or Teflon bowl, disposable inert plastic tray, or plastic bag. Avoid or remove vegetation and small stones. When a composite sample is collected, collect four to five discrete soil samples of roughly equal volume, based on the sample design in the QAPP. Remove roots, vegetation, sticks, and stones larger than the size of pea gravel (about ¼- to ½-inch diameter). Thoroughly mix the soil with a stainless-steel spoon to obtain as uniform a texture and color as practicable. Transfer the mixed soil to the appropriate sample containers and close and label the containers. Place the sample containers on ice; ice may not be required for some analytes such as metals, but samples should be iced as a best practice.

## **2.2 TEST PIT AND TRENCH SOIL SAMPLING**

Test pit and trench soil samples are collected when a complete soil profile is required or as a means of locating visually detectable contamination. This type of sampling provides a detailed description of the soil profile and allows for multiple samples to be collected from specific soil horizons. The sampling team should ensure that the sampling area is clear of utility lines, subsurface pipes, and poles before any test pit or trench is excavated with a backhoe.

A test pit or trench is excavated by incrementally removing soil with a backhoe bucket. The excavated soil is placed on plastic sheeting well away from the edge of the test pit. A test pit should not be excavated to depths greater than 4 feet unless its walls are properly sloped or stabilized. No personnel may enter any test pit or trench excavation more than 4 feet deep; such action would constitute confined space entry and must conform with Occupational Safety and Health Administration (OSHA) regulations at Title 29 *Code of Federal Regulations* (29 CFR) § 1910.

Personnel entering the test pit may be exposed to toxic or explosive gases and oxygen deficient environments. Air monitoring is required before they may enter the test pit, and use of appropriate respiratory gear and protective clothing is mandatory. At least two persons must be present at the test pit before sampling personnel may enter the excavation and begin soil sampling. Refer to project-specific health and safety plans for required safety procedures for excavations.

Soil samples can also be obtained directly from the backhoe bucket or from the excavated material after it has been removed and deposited on plastic sheeting. The sampling personnel may direct the backhoe excavator to obtain material from the selected depth and location within the excavation. The backhoe operator will set the backhoe bucket on the ground in a designated location, at a sufficient distance from the excavation to allow the sampler safe access to the bucket. The backhoe operator must disengage the controls and signal to the sampler that it is safe to approach the bucket. Collect the soil sample from the center of the backhoe bucket to reduce the potential for cross-contamination of the sample.

Test pits are not practical for sampling at depths greater than 15 feet. If soil samples are required from depths greater than 15 feet, samples should be obtained using test borings instead of test pits. Test pits are also usually limited to a few feet below the water table. In some cases, a pumping system may be required to control the water level within the pits.

Access to open test pits should be restricted by flagging, tape, or fencing. If a fence is used, it should be erected at least 6 feet from the perimeter of the test pit. The test pit should be backfilled as soon as possible after sampling is completed.

Various equipment may be used to collect soil samples from the walls or bottom of a test pit. A hand auger, bucket auger, or core sampler can be used to obtain samples from various depths. A trier, trowel, EnCore sampler, Terra Core sampler, VOA plunger, or spoon can be used to obtain samples from the walls or pit bottom surface.

### **2.3 SURFACE SOIL SAMPLING**

Surface soil samples can be used to investigate contaminants that exist in the near-surface environment. Contaminants detected in the near-surface environment may extend to considerable depths, potentially migrating to groundwater, surface water, the atmosphere, or biological systems. Sampling depths for surface soil are typically those that can be reached without use of a drill rig, DPT, or other mechanized equipment. Surface soil sample depths typically extend up to depths of less than 2 feet below ground surface (bgs). However, the definition of “surface soil” and the resultant sample depths may vary based

on risk assessment or other project requirements. Be aware of these site-specific constraints and follow the requirements of the QAPP to select the depths for surface soil samples.

The surface soil sampling equipment presented in this SOP is best suited for sampling to depths of 0 to 6 feet bgs. The sample depth, analytical suite, soil type, and soil moisture will also dictate the most suitable sampling equipment. The sampling locations should be cleared of any surface debris such as twigs, rocks, and litter before samples are collected. Surface soil samples may be grab samples or composite samples, and samples may be collected for analysis from the sample device following the procedures described in Section 2.1. Samples collected using EPA SW-846 Method 5035 may only be collected from an undisturbed core.

Excess soil remaining after sample containers are filled should be retained for disposal or returned to the borehole as required by the site-specific investigation-derived waste (IDW) plan.

Table 2 presents various surface soil sampling equipment and their effective depth ranges, operating means (manual or power), and sample types collected (disturbed or undisturbed).

**TABLE 2**  
**SURFACE SOIL SAMPLING EQUIPMENT**

<b>Sampling Equipment</b>	<b>Effective Depth Range (feet below ground surface)</b>	<b>Operating Means</b>	<b>Sample Type</b>
Hand Auger	0 to 6	Manual	Disturbed
Bucket Auger	0 to 4	Power	Disturbed
Core Sampler	0 to 4	Manual or Power	Undisturbed
Trier	0 to 1	Manual	Undisturbed
Spoon/Spatula	0 to 0.5	Manual	Disturbed
Trowel	0 to 1	Manual	Disturbed

The procedures for using these various types of sampling equipment are discussed below.

### **2.3.1 Hand Auger**

A hand auger equipped with extensions and a “T” handle is used to obtain samples from depths of up to 6 feet bgs. It is possible to hand auger deeper than 6 feet. However, hand-augering below this depth is uncommon because of the time, effort, and cost effectiveness when sampling to depths greater than 6 feet bgs. If necessary, a shovel may be used to excavate the topsoil to reach the desired subsoil level. If topsoil is removed, its thickness should be recorded. Samples obtained using a hand auger are disturbed in their collection; establishing the exact depth where samples are obtained is difficult.

The hand auger is screwed into the soil at an angle of 45 to 90 degrees from horizontal. When the entire auger blade has penetrated the soil, the auger is removed from the soil by lifting it straight up without turning it, if possible. If the desired sampling depth has not been reached, the soil is removed from the auger and deposited onto plastic sheeting. This procedure is repeated until the desired depth is reached and the soil sample is obtained. The auger is then removed from the boring and the soil sample is collected directly from the auger into an appropriate sample container.

### **2.3.2 Bucket Auger**

A bucket auger, similar to the hand auger, is used to obtain disturbed samples from depths of up to 4 feet bgs. A bucket auger should be used when stony or dense soil is sampled that prohibits the use of a hand-operated core or screw auger. A bucket auger with closed blades is used in soil that cannot generally be penetrated or retrieved by a core sampler.

The bucket auger is rotated while downward pressure is exerted until the bucket is full. The bucket is then removed from the boring, the soil collected is placed on plastic sheeting, and this procedure is repeated until the appropriate depth is reached and a sample is obtained. The bucket is then removed from the boring and the soil sample is transferred from the bucket to an appropriate sample container.

### **2.3.3 Core Sampler**

A hand-operated core sampler (Figure 1), similar to the hand auger, is used to obtain samples from depths of up to 4 feet bgs in uncompacted soil. The core sampler is capable of retrieving undisturbed soil samples and is appropriate when low concentrations of metals or organics are of concern. The core sampler should be constructed of stainless steel. A polypropylene core sampler is generally not suitable for sampling dense soils or sampling at greater depths.

The core sampler is pressed or driven (for example, using a slide hammer) into the soil at an angle of 45 to 90 degrees from horizontal and is rotated when the desired depth is reached. The core is then removed, and the sample is placed into an appropriate sample container.

### **2.3.4 Trier**

A trier (Figure 2) is used to sample soil from depths up to 1 foot bgs. A trier should be made of stainless steel or polypropylene. A chrome-plated steel trier may be suitable when samples are to be analyzed for organics and heavy metal content is not a concern.

Samples are obtained by inserting the trier into soil at an angle of up to 45 degrees from horizontal. The trier is rotated to cut a core and is then pulled from the soil being sampled. The sample is then transferred to an appropriate sample container.

### **2.3.5 Shovel**

A shovel or spade may be used to obtain large quantities of soil that are not readily obtained with a trowel. A shovel is used when soil samples from depths of up to 6 feet bgs are to be collected by hand excavation; a tiling spade (sharpshooter) is recommended for excavation and sampling. A standard steel shovel may be used for excavation; either a stainless-steel or polypropylene shovel may be used for sampling. Soil excavated from above the desired sampling depth should be stockpiled on plastic sheeting. Soil samples should be collected from the shovel and placed into the sample container using a stainless-steel scoop, plastic spoon, or other appropriate tool.

### **2.3.6 Trowel**

A trowel is used to obtain surface soil samples that do not require excavation beyond a depth of 1 foot. A trowel may also be used to collect soil subsamples from profiles exposed in test pits. Use of a trowel is practical when sample volumes of approximately 1 pint (0.5 liter) or less are to be obtained. Excess soil should be placed on plastic sheeting until sampling is completed. A trowel should be made of stainless or galvanized steel. It can be purchased from a hardware or garden store. Soil samples to be analyzed for organics should be collected using a stainless-steel trowel. Samples may be placed directly from the trowel into sample containers.

## **2.4 SUBSURFACE SOIL SAMPLING**

Subsurface soil sampling is accomplished in conjunction with borehole drilling for depths greater than approximately 6 feet bgs. Subsurface soil sampling is frequently coupled with exploratory boreholes or monitoring well installation. As described above for surface soil, the definition of “subsurface soil” may vary based on risk assessment or other project requirements. Be aware of site-specific constraints and follow the requirements of the QAPP to select the depths for subsurface soil samples. Surface soil samples may also be collected using these methods as part of a larger sampling event that includes subsurface soil sampling.

Subsurface soil may be sampled using a drilling rig, power auger, or DPT. Selection of sampling equipment depends on geologic conditions and the scope of the sampling program. All sampling tools should be decontaminated before and after each use. All three of the methods described below may be used to collect undisturbed samples from unconsolidated soils. Subsurface soil samples may be grab

samples or composite samples, and samples may be collected for analysis from the sample device following the procedures described in Section 2.1. Samples collected using EPA SW-846 Method 5035 may only be collected from an undisturbed core.

Excess soil remaining after sample containers are filled should be retained for disposal or returned to the borehole as required by the site-specific IDW plan.

#### **2.4.1 Split-Spoon Sampler**

Split-spoon samplers are available in a variety of types and sizes. Site conditions and project needs, such as large sample volume for multiple analyses, dictate the specific type of split-spoon sampler to be used. Figure 3 shows a generic split-spoon sampler.

The split-spoon sampler is advanced into the undisturbed soil beneath the bottom of the casing or borehole using a weighted hammer and a drill rod. The relationship between hammer weight, hammer drop, and number of blows required to advance the split-spoon sampler in 6-inch increments indicates the density or consistency of the subsurface soil. After the split-spoon sampler has been driven to its intended depth, it should be removed carefully to avoid loss of sample material. A catcher or basket should be used to help retain the sample in noncohesive or saturated soil.

After the split-spoon sampler is removed from the casing, it is detached from the drill rod and opened. If samples for VOC analysis are to be collected, the sample device (for example, the EnCore sampler) should be filled with soil taken directly from the split-spoon sampler. Samples for other specific chemical analyses should be taken as soon as the VOA sample has been collected. The remainder of the soil recovered can then be used for visual classification of the sample and homogenized and containerized for physical analysis.

#### **2.4.2 Thin-Wall Tube Sampler**

A thin-wall tube sampler, sometimes called the Shelby tube (Figure 4), is used to collect soil samples for geophysical analysis. Tube samplers are best suited for collecting cohesive soils such as clays and silts. The tube sampler may be pressed or driven into soil inside a hollow-stem auger flight, wash bore casing, or uncased borehole. The tube sampler is pressed into the soil, without rotation, to the desired depth or until it meets refusal. If the tube cannot be advanced by pushing, it may be necessary to drive it into the soil without rotation using a hammer and drill rod. The tube sampler is then rotated to collect the sample from the soil and removed from the borehole.

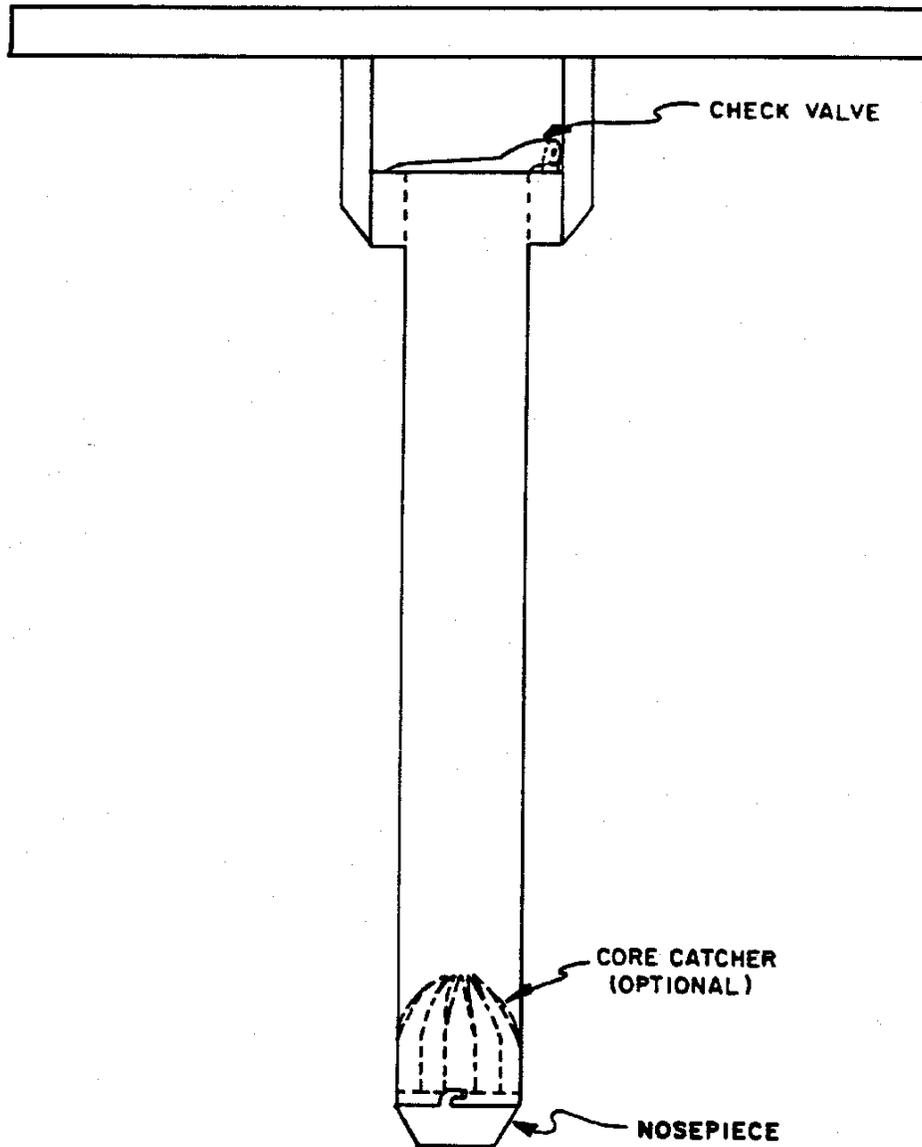
After the tube sampler is removed from the drilling equipment, the tube sampler should be inspected for adequate sample recovery. The sampling procedure should be repeated until an adequate soil core is obtained (if the tube sampler can retain the sample material). The soil core obtained should be documented in the logbook. Any disturbed soil is removed from each end of the tube sampler. If chemical analysis is required, samples for VOC analysis must be collected immediately after the tube sampler is withdrawn. The sample device (for example, the EnCore sampler) should be filled with soil taken directly from the tube sampler. Before use, and during storage and transport, the tube sampler should be capped with a nonreactive material. The tube is sealed using plastic caps for physical sampling parameters. The top and bottom of the tube sampler should be labeled and the tube sampler should be stored accordingly.

### **2.4.3 Direct-Push Technology Methods**

In many cases, DPT is less expensive and faster than collecting soil samples with a standard drilling rig. In addition, the use of DPT causes minimal disturbance to the ground surface and generates little to no soil cuttings. DPT drill rigs, as well as traditional drill rigs, often use clear polyvinyl chloride (PVC) sleeves or brass liners inside of split-spoon or thin-wall tube samplers for collecting soil samples.

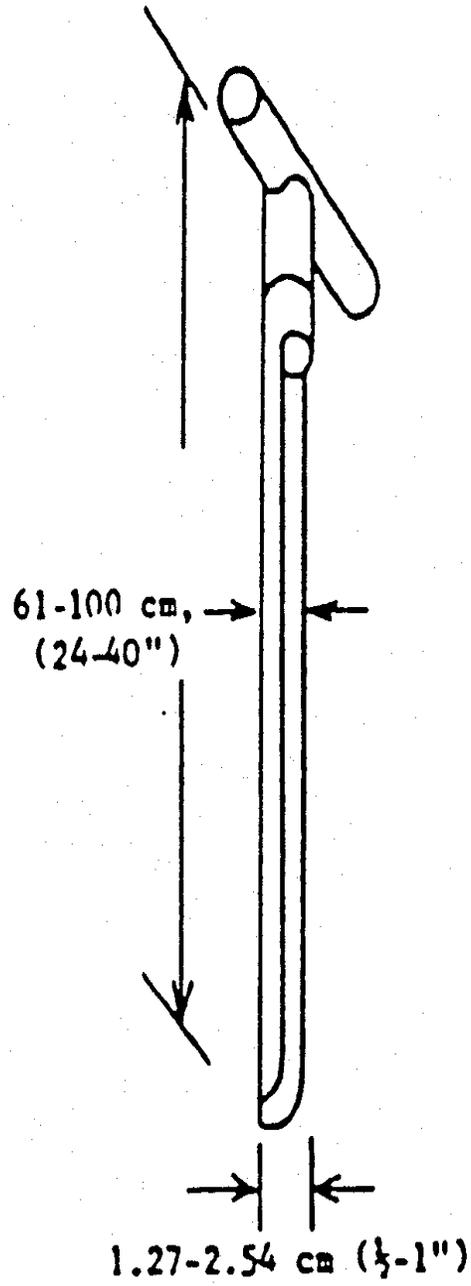
The sample sleeve is extruded from the sampling rod when the sampling rod is retrieved from the ground. The sleeve is sliced lengthwise twice to open the sleeve. Soil samples can be collected directly from the opened sleeve. If samples for VOC analysis are to be collected, the sample device (for example, the EnCore sampler) should be filled with soil taken directly from the opened DPT sampler. Samples for other specific chemical analysis should be collected after the VOC sample. The remainder of the recovered soil can then be used for visual classification of the sample and homogenized and containerized for physical analysis.

**FIGURE 1**  
**HAND-OPERATED CORE SAMPLER**

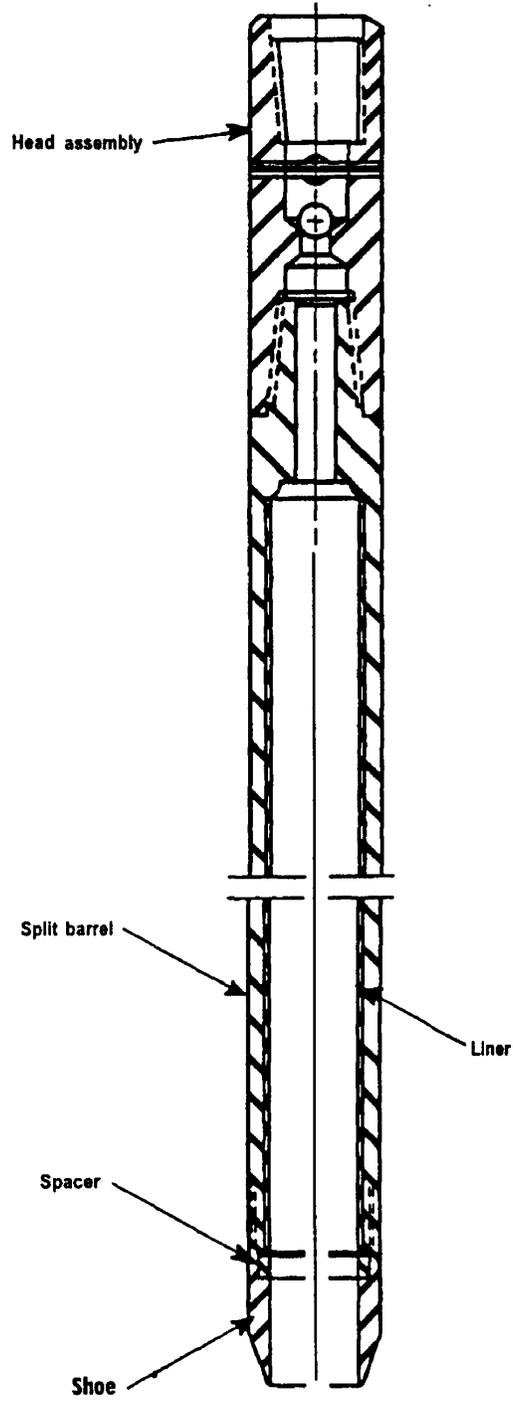


**FIGURE 2**

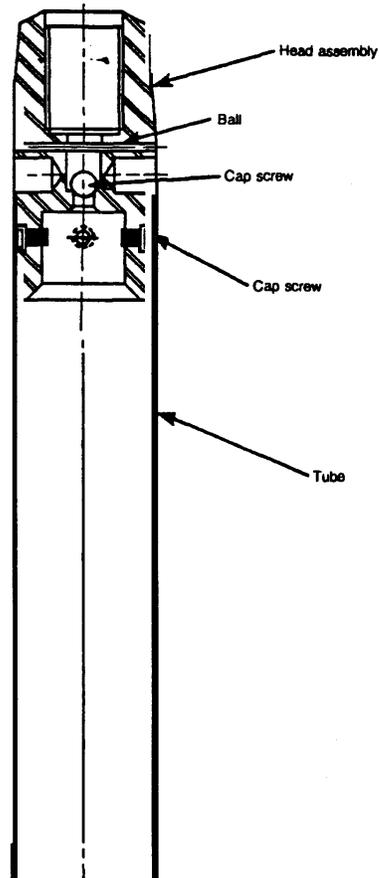
**TRIER**



**FIGURE 3**  
**GENERIC SPLIT-SPOON SAMPLER**



**FIGURE 4**  
**THIN-WALL TUBE SAMPLER**



**SOP APPROVAL FORM**

TETRA TECH, INC.

EMI OPERATING UNIT

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

**GROUNDWATER SAMPLING**

**SOP NO. 010**

**REVISION NO. 5**

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Quality Assurance Approved

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Date

## **1.0 BACKGROUND**

Groundwater sampling may be required for a variety of reasons, such as to examine potable or industrial water supplies, check for and track contaminant plume movement in the vicinity of a land disposal or spill site, conduct regulatory compliance monitoring, or examine a site where historical information is minimal or nonexistent, but where groundwater may be contaminated.

Groundwater is usually sampled through an in-place well, either temporarily or permanently installed. However, it can also be sampled anywhere groundwater is present, such as in a pit or a dug or drilled hole.

Occasionally, a well will not be in the preferred location to obtain the sample needed (for example, to track a contaminant plume). In such a case, a temporary or permanent well will have to be installed. SOP No. 020 (Monitoring Well Installation) provides guidance for installing new monitoring wells.

An experienced and knowledgeable person (preferably a hydrogeologist) will need to locate the well and supervise its installation so that the samples ultimately collected will be representative of the groundwater. Personnel installing wells should work under the supervision of a registered professional, and the requirements of the state where the work is being performed should be followed as to the specific requirements for the registered professional and their level of involvement and oversight.

### **1.1 PURPOSE**

This standard operating procedure (SOP) establishes the requirements and procedures for measuring the quality of groundwater entering, leaving, or affected by site activities through groundwater sampling. The samples are obtained by retrieving water from a well screened in the aquifer or aquifers underlying a site.

### **1.2 SCOPE**

This SOP provides general guidance for groundwater sampling activities conducted in the field. SOP No. 015 (Groundwater Sampling Using Low-Flow Methodology) provides additional specific guidance for using low-flow methods to collect groundwater samples. The sampling methods referred to in this SOP are not a comprehensive list of all possible sampling methods. For other sampling methods, such as the use of passive diffusion bags, the manufacturer's instructions or other SOPs should be consulted.

### **1.3 DEFINITIONS**

**Bailer:** A cylindrical sampling device with valves on either end, used to extract water from a well. Bailers are usually constructed of an inert material such as stainless steel or polytetrafluoroethylene (Teflon) or of

easily decontaminated plastic, such as polyvinyl chloride (PVC) or polyethylene. Bailers may be reusable (decontaminated between use), disposable, or dedicated to a single well (and typically stored in the well). The bailer is lowered and raised by means of a cable that may be cleaned and reused, or by disposable rope. Temporary wells, such as those installed with direct-push technology (for example, Geoprobe screen points) are sometimes sampled with tubing to which a check valve has been attached. This tubing is functionally a bailer, and similar precautions should be taken.

**Electrical Water Level Indicator:** An electrical device that has a light or sound alarm connected to an open circuit, used to measure the depth to liquid. The circuit is closed when the probe intersects a conducting liquid. The wire used to raise and lower the probe is usually graduated.

**Immiscible Phase:** A liquid phase that cannot be uniformly mixed or blended with water. Heavy immiscible phases (also known as dense nonaqueous phase liquids, or DNAPLs) sink, and light immiscible phases (also known as light nonaqueous phase liquids, or LNAPLs) float on water.

**Interface Probe:** An electrical probe that measures the distance from the surface to air-water, air-immiscible, or immiscible-water interfaces. Similar in operation to an electrical water level indicator, these instruments are typically used when the thickness of an immiscible layer must be measured.

**Purge Volume:** The volume of water that needs to be removed from the well prior to sampling to ensure that the sample collected is representative of the formation groundwater.

**Riser Pipe:** The length of well casing above the ground surface.

**Total Well Depth:** The distance from the reference measuring point (top of well casing or ground surface) to the bottom of the well.

**Water Level:** The level of water in a well, measured as depth to water or as elevation of water, relative to a reference mark or datum.

#### 1.4 REFERENCES

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## **1.5 REQUIREMENTS AND RESOURCES**

There are various options available to obtain groundwater samples. The procedures are outlined in the following section. The equipment needed to accomplish these procedures includes the following:

1. Organic vapor detector with a flame ionization detector (FID) or a photoionization detector (PID)
2. Pipe wrench and other tools needed to open monitoring wells (socket wrench, screwdriver, mallet, etc.); keys to well locks
3. Electrical water level indicator or interface probe
4. Purging device (type needed depends on well depth, casing diameter, and type of sample desired; see sampling devices below)
5. Graduated cylinder or bucket
6. Sampling device (type needed depends upon depth to water, well diameter, and type of sample analysis desired)
  - o Bailer
  - o Bladder pump
  - o Stainless steel submersible (non-oil-bearing) pump
  - o Existing dedicated equipment
  - o Peristaltic pump
7. Sample containers
8. Wastewater containers for purge water

9. Field logbook and field forms

10. Stopwatch

Additional equipment is required to complete measurement of field parameters (for example, pH, specific conductance, and temperature) of the groundwater in the well. Refer to Tetra Tech SOP 061 (Field Measurement of Groundwater Indicator Parameters) or individual field parameter SOPs as appropriate.

## **2.0 PROCEDURES**

Prior to sampling, a site-specific sampling plan should be developed. The plan should take into consideration the site characteristics and should include:

1. Specific, repeatable well measurement techniques and reference points for measuring the depth to water and the depth to the bottom of the well
2. Specific method of purging and selection of purging equipment
3. Specific methods and equipment for measurements of field parameters
4. Specific method of sample collection and the sampling equipment that will be used
5. Specific parameters for which samples will be analyzed
6. Order in which sample bottles will be filled, based on the analytical parameters

The following sections discuss procedures for approaching the well, establishing a sample preparation area, making preliminary well measurements, purging the well, and collecting samples.

### **2.1 APPROACHING THE WELL**

In general, all wells should be assumed to pose a health and safety risk until field measurements indicate otherwise. Approach the well from the upwind side. Record well appearance and the general condition of the protective casing, surface seal, and surrounding area in the logbook.

Once at the well, the lead person should systematically use the organic vapor detector to survey the immediate area around the well (from the breathing zone to the top of the casing to the ground). If elevated FID or PID readings are encountered, retreat to a safe area and instruct the sampling team to either let vapors dissipate and approach the well again or put on the appropriate level of personal protective equipment (PPE), as specified in the site-specific health and safety plan. See SOP No. 003 (Organic Vapor Air Monitoring) for additional air monitoring guidance.

Some monitoring wells have the potential to contain pressurized headspace—for example, through the generation of gases from contaminated groundwater, biological processes, degradation of contaminants, or simply based on location such as near a landfill or in areas that intersect lithological abnormalities; or through intentional artificial means such as those associated with air sparging systems. Injection or extraction wells may be artificially pressurized and may remain so for several days after the system has been turned off. Over-pressuring presents a hazard to people opening these wells. Employ the following practices to minimize these hazards:

1. Wear safety glasses to protect the eyes. If site-specific observations and conditions indicate that the wells may be pressurized, wear a full-face shield over the safety eye protection.
2. Do not place the face or any other part of the body over the well when opening because this may place you in a strike zone.
3. Open the well cover at arm's length, then step away and allow the well to off gas and stabilize.

Upon opening the well casing, the lead person should systematically survey the air inside the well casing, above the well casing in the breathing zone, and in the immediate area around the well. Any positive PID or FID readings should be recorded in the logbook or on field forms. If elevated FID or PID readings in the breathing zone are encountered (see the health and safety plan for action levels), retreat and put on appropriate PPE. It is important to remember that action levels are based on readings in the breathing zone, not within the well casing. Representative organic vapor detector readings should be recorded in the logbook. Also look out for insects or other animals that may nest in well openings, and refer to the health and safety plan for site-specific hazards.

## **2.2 ESTABLISHING A SAMPLE PREPARATION AREA**

The sample preparation area is generally located upwind or to either side of the well. If elevated readings are encountered using an organic vapor detector, this area should be taped off and the sample preparation area should be located upwind of the well, where ambient conditions are measured. Plastic sheeting or a tarp should be laid down around the well head and under the sample preparation area to prevent discharge of groundwater to soil and to protect tubing from touching the ground.

## **2.3 MAKING PRELIMINARY WELL MEASUREMENTS**

Several preliminary well measurements should be made prior to initiating sampling of the well. These include measuring the water level and total well depth, evaluating the presence of immiscible phases, and calculating purge volumes. All preliminary measurements will be recorded in the logbook or a groundwater sampling data sheet as they are gathered (examples of typical data sheets are included as an exhibit to this SOP). SOP No. 014 (Static Water Level, Total Well Depth, and Immiscible Layer Measurement) provides additional information concerning these preliminary measurements.

### **2.3.1 Water Level and Total Well Depth Measurements**

Tetra Tech typically uses an electric water level indicator for water level and total well depth measurements. This device sounds an alarm or triggers a light when the measuring probe touches the water surface, thus closing an electrical circuit. The electric cable supporting the probe is usually graduated to 0.01 foot and can be read at the well site directly. The distance between the static water level

and the marked or notched location at the top of the riser pipe is measured. If the casing is not marked or notched, the measurement should be taken from the north side of the casing. The height of the riser pipe above ground surface, as obtained from well location survey data, is then subtracted from the total reading to calculate the depth to static water. To improve accuracy, three separate readings should be made, and the values averaged. This helps to eliminate any errors caused by kinks or bends in the cable, which may change in length when the water level indicator is raised and lowered, or from water level probes catching on flaws or joints in the sides of the casing.

After sampling is completed, the total well depth can be measured by lowering the probe into the well until resistance is met, indicating that the probe has reached the bottom of the well. The total well depth is then read to the 0.01-foot fraction. The distance between the bottom of the well and the marked or notched location on the riser pipe is calculated. The height of the riser pipe above the ground surface, as obtained from well survey data, is then subtracted from the total reading to calculate the depth to the bottom of the well. To improve accuracy, three separate readings should be made, and the readings averaged. If the bottom of the well feels “soft” (suggesting sediment accumulation in the well), a note should be made in the logbook or on field forms. If a well is known to have a soft bottom, the total well depth measurement should be made after the sample is collected to minimize sediment disturbance and turbid samples.

### **2.3.2 Evaluating Whether Immiscible Nonaqueous-Phases Liquids are Present**

If immiscible, nonaqueous-phase liquids (NAPL) are known or are strongly suspected to be present, based on previous or nearby groundwater sampling, the following measurement activities should be undertaken. Organic liquids are measured by lowering an interface probe slowly to the surface of the liquid in the well. When the audible alarm sounds, record the depth. If the alarm is continuous, a floating immiscible layer has been detected. To measure the thickness of this layer, continue lowering the probe slowly until the alarm changes to an oscillating signal. The oscillating signal indicates that the probe has detected an aqueous layer. Record this depth as the depth to water and calculate the thickness and the volume of the immiscible layer.

Continue lowering the probe into the well to evaluate whether dense immiscible phases (sinkers) are present. If the alarm signal changes from oscillating to a continuous sound, a heavier immiscible layer has been detected; record this depth.

Continue lowering the probe to the bottom of the well and record the total depth. Calculate and record the sinker phase volume and total water volume in the well (see equation in Section 2.3.3). If immiscible

phases are present, immediately refer to Section 2.5.3 or 2.5.4 of this SOP for sample collection procedures.

### **2.3.3 Calculation of Standing Water in the Well**

If the presence of immiscible phases does not need to be determined, measure the depth to water and the total depth of the well as described in Section 2.3.1. Once these measurements have been made and recorded, calculate the total volume of water in the well. The volume of water in the well is based on the following formula:

$$V = \pi r^2 h \times 7.48$$

where

- V = static volume of water in the well (gallons)
- r = inside radius of the well (feet)
- h = length of water in the well (total well depth minus depth to water) (feet)
- 7.48 = conversion factor (cubic feet to gallons)

Common well sizes and corresponding volumes are as follows:

- 1-inch well = h x 0.041 gallons per foot (gal/ft)
- 2-inch well = h x 0.163 gal/ft
- 3-inch well = h x 0.367 gal/ft
- 4-inch well = h x 0.652 gal/ft

## **2.4 PURGING THE WELL**

Once the water level is measured and the volume of water in the well is known, purging may begin. Wells are purged to eliminate stagnant water residing in the casing and screen that has undergone geochemical changes or loss of volatile chemicals. At the end of purging, the water being drawn from the well should be representative of groundwater in the aquifer.

Turbidity is often elevated during purging by the disturbance of formation materials at the borehole walls. As many contaminants (metals and many organic compounds) will sorb to the formation particles, a sample including these particles will not represent the dissolved concentrations of the contaminants. Thus, a secondary goal of purging is to reduce the turbidity to the point that the sample will represent the dissolved concentration of contaminants.

The amount of water to be purged will depend on site-specific program requirements, individual well yield characteristics, or stabilization of field parameters measured during purging. In some cases, a standard volume is purged (for example, three well volumes). Field parameters (for example, pH, specific conductance, and temperature) should be measured prior to purging and at standard intervals (for example, after each well volume or every 3 to 5 minutes). All field parameter data should be recorded in the field logbook, on field forms, or in electronic applications. Refer to specific Tetra Tech SOP 061 as appropriate for more detailed procedures for measuring these field parameters.

The most common methods for purging wells are:

1. Bailers
2. Bladder pumps
3. Submersible pumps
4. Dedicated pumps or other dedicated equipment
5. Peristaltic pumps

As previously stated, the minimum purging volume is typically three casing volumes, unless a low-flow sampling strategy has been chosen. SOP No. 015 (Groundwater Sampling Using Low-Flow Methodology) provides additional specific guidance for using low-flow methods (including purging methods) to collect groundwater samples. Exceptions to a three-well-volume purge standard also may be made in the case of low-yield or slow-recharging wells. When purging low-yield wells, purge the well until the water level is equal to the top of screen elevation (if possible). Samples should be collected no sooner than 2 hours after purging and when sufficient groundwater volume is available.

The well should be purged until measured field parameters, such as pH or specific conductance have stabilized. If any field parameter has not stabilized, additional purging should be performed. To be considered stable, field parameters should change by no more than the stabilization criteria listed on Table 1 between each well volume purged or within the purging interval specified in the sampling plan (for example, every 5 minutes). If the above conditions have not been met after a specified period of time, purging will be considered complete and sampling can begin. Refer to the field sampling plan or quality assurance project plan (QAPP) for specified time period. Record the final well stabilization parameters on the Groundwater Sampling Data Sheet, and indicate if the well purging was considered complete based on stabilized parameters or exceeding the specified period of time.

**TABLE 1**  
**STABILIZATION CRITERIA FOR WATER QUALITY PARAMETERS**

<b>Parameter</b>	<b>Stabilization Criterion</b>
pH	± 0.1 unit
Specific Conductance	± 3 percent
Oxidation-Reduction Potential	± 20 millivolts
Turbidity	± 10 percent (when greater than 5 nephelometric turbidity units [NTU]); considered stable if less than 5 NTU
Dissolved Oxygen	± 10 percent when greater than 0.5 milligram per liter (mg/L); considered stable if less than 0.5 mg/L
Temperature	± 3 percent

At no time should the purging rate be high enough to cause groundwater to cascade back into the well, as this could result in excessive aeration and potential stripping of volatile constituents.

The actual volume of purged water can be measured using several acceptable methods:

1. When bailers are used, the actual volume of each bailer's contents can be measured using a calibrated bucket if the volume is not specified on the packaging.
2. If a pump is used for purging, the pump rate can be measured by using a container of known volume or with graduated measurements, a stopwatch, and the duration of pumping time necessary to purge the known volume.

## **2.5 SAMPLE COLLECTION**

This section first describes general groundwater sample collection procedures. This section also describes procedures for collecting groundwater samples for volatile organic analysis (VOA) and for collecting samples when light or heavy immiscible layers are present in a monitoring well. Samples of light and heavy immiscible layers should be collected before the well is purged. Site-specific sampling plans may indicate that, based on the presence of NAPL, no groundwater sample is to be collected.

### **2.5.1 General Groundwater Sampling Procedures**

The technique used to withdraw a groundwater sample from a well should be selected based on the parameters for which the sample will be analyzed. To ensure that the groundwater samples are representative, it is important to avoid physically altering or chemically contaminating the sample during collection, withdrawal, or containerization. If the samples are to be analyzed for volatile organic compounds, it is critical that air does not become entrained in the water column.

In some cases, it may become necessary to use dedicated equipment already in the well to collect samples. This is particularly true of high-volume, deep wells (>150 feet) where bladder pumps are

ineffective and bailing is impractical. If existing equipment must be used, however, identify the make and model of the pump and obtain information on component construction materials from the manufacturer or facility representatives. If an existing pump is to be used for sampling, make sure the flow volume can be reduced so that a reliable VOA sample can be taken. Record the specific port, tap, or valve from which the sample is collected. If nondedicated sampling equipment is used, the least contaminated wells should be purged and sampled first and most contaminated wells should be purged and sampled last (if past sampling data are available to make this determination).

General sampling procedures are as follows:

1. Clean sampling equipment should not be placed directly on the ground. Use a plastic drop cloth or feed line from clean reels. Never place contaminated lines back on reels.
2. A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled, and the gloves should be donned immediately prior to sampling. The gloves should be changed any time during sample collection when their cleanliness is compromised.
3. Sample containers for samples suspected of containing high concentrations of contaminants or NAPLs shall be stored separately to minimize cross-contamination.
4. Check the operation of the bailer check valve assemblies to confirm free operation.
5. Lower sampling equipment slowly into the well to avoid degassing the water and damaging the equipment.
6. Pump flow rates should be adjusted to eliminate intermittent or pulsed flow. The settings should be selected during the purging operations. In general, pumping rates should be set to the lowest rate that allows a smooth flow.
7. A separate sample volume should be collected to measure necessary field parameters. If samples are being collected with a pump, a flow-through cell should be used to measure water quality parameters.
8. Samples should be collected and containerized following procedures outlined in the project-specific field sampling plan, QAPP, and in the order of the parameters' volatilization sensitivity. Table 2 lists the preferred collection order for common groundwater parameters.

**TABLE 2**

**ORDER OF PREFERRED SAMPLE COLLECTION**

1.	Volatile organic analysis (VOA)
2.	Purgeable organic halogens (POX)
3.	Total organic halogens (TOX)
4.	Cyanide
5.	Extractable organics
6.	Purgeable organic carbon (POC)

7.	Total metals
8.	Dissolved metals
9.	Total organic carbon (TOC)
10.	Phenols
11.	Sulfate and chloride
12.	Nitrate and ammonia
13.	Radionuclides

Intermediate containers should never be used to prepare VOA samples and should be avoided for all parameters in general. All VOA containers should be filled at a single sampling point or from a single bailer volume. Also refer to site-specific sampling plan for other sample handling requirements that may be unique to a site or to specific chemical constituents.

### **2.5.2 Collection of Volatile Organics Samples**

This section discusses in detail the collection of samples for VOA using either a bailer or bladder pump. Other pumps (such as positive displacement) can be used. The following factors are critical to the collection of representative samples for VOA: ensuring that no air has become entrained in the water column, achieving low pump flow rates (less than 100 milliliters [mL] per minute, if possible), avoiding flow surges, and adjusting sample preservatives if they are found to cause reactions with the sample.

#### **2.5.2.1 Collection with Bailers**

Samples for VOA should be collected from the first bailer removed from the well after purging is complete. The most effective method requires two people. One person should retrieve the bailer from the well and pour its contents into the appropriate number of 40-mL VOA vials held by the second person. When filling the vials, overflow slightly, so that a convex meniscus forms on the top of the vial. Each vial should be capped, inverted, and gently tapped to check if any air bubbles are present. If a bubble exists, unscrew the cap and add more water, or discard and repeat if vials are not pre-preserved. If bubbling persists in a vial containing acid preservative, the sample may need to be collected without the preservative and the laboratory notified to add preservative upon receipt. The sample should be transferred from the bailer to the sample container in a manner that will limit the amount of agitation to reduce the loss of VOCs from the sample.

Always fill VOA vials from a single bailer volume. If the bailer is refilled, samples cannot be considered duplicates or splits.

### **2.5.2.2 Collection with a Pump**

To successfully perform VOA sampling with a pump, the following steps should be completed:

1. Following manufacturer's directions, activate the pump. The discharge and recharge settings should be manually set and adjusted to pump at optimum flow rates. Reduce water flow rate for VOA sample collection to the lowest flow rate that allows a smooth flow.
2. Disconnect the discharge tubing from the flow-through cell, then collect VOA sample from discharge tubing. VOA vials should be placed beneath the discharge tubing while avoiding direct contact between the vials and the tubing. Never place tubing past the mouth of the VOA vial. The pump control should be adjusted as necessary to maintain a trickle of water to obtain a meniscus in the vial.
3. Continue with non-VOA sampling. The pump flow rate can be increased for non-volatile analytes as long as the discharge does not become turbid.

### **2.5.3 Sampling of Light Immiscible Floaters**

The approach used when collecting a sample of a floating layer depends on the depth to the floating layer and the thickness of that layer. If the thickness of the floater is 2 feet or greater, a bottom-filling valve bailer should be used. Slowly lower the bailer until contact is made with the floater surface, and lower the bailer to a depth less than that of the floater-water interface depth as measured by preliminary measurements with the interface probe.

When the thickness of the floating layer is less than 2 feet and the depth to the surface of the floating layer is less than 15 feet, a peristaltic pump can be used to extract a sample.

When the thickness of the floating layer is less than 2 feet and the depth to the surface of the floating layer is beyond the effective lift of a peristaltic pump (greater than 20 to 25 feet), a bailer can be modified to allow filling from the top only (an acceptable alternative is to use a top-loading Teflon or stainless-steel bailer). Disassemble the bailer's bottom check valve and insert a piece of 2-inch-diameter Teflon sheet between the ball and ball seat. This will seal off the bottom valve. Remove the ball from the top check valve, thus allowing the sample to enter from the top. To overcome buoyancy when the bailer is lowered into the floater, place a length of 1-inch stainless steel pipe on the retrieval line above the bailer (this pipe may have to be notched to allow sample entry if the pipe remains within the top of the bailer). As an alternative, use a top-loading stainless-steel bailer. Lower the device, carefully measuring the depth to the surface of the floating layer, until the top of the bailer is level with the top of the floating layer. Lower the bailer an additional one-half thickness of the floating layer and collect the sample. This technique is the most effective method of collection if the floating layer is only a few inches thick.

#### **2.5.4 Sampling of Heavy Immiscible Sinkers**

The best method for collecting a sample of a sinker is the use of a double check valve bailer. The key to sample collection is controlled, slow lowering and raising of the bailer to and from the bottom of the well. Sample collection methods are equivalent to those described in Section 2.5.3 above.

**EXHIBIT 1**

**EXAMPLE GROUNDWATER SAMPLING DATA SHEETS**



## GROUNDWATER SAMPLING DATA SHEET

Monitoring Well No.: \_\_\_\_\_ Date: \_\_\_\_\_

Project Name: \_\_\_\_\_ Project No.: \_\_\_\_\_

Sampler: \_\_\_\_\_

Depth to Well Bottom: \_\_\_\_\_ ft Well Volume: \_\_\_\_\_

1-inch well = water column (ft) x 0.041 gal/ft

2-inch well = water column (ft) x 0.163 gal/ft

3-inch well = water column (ft) x 0.367 gal/ft

4-inch well = water column (ft) x 0.653 gal/ft

Depth to Water: \_\_\_\_\_ ft

Water Column: \_\_\_\_\_ ft

Well Diameter: \_\_\_\_\_ in

Immiscible Layers (Y/N): \_\_\_\_\_ Well Volume: \_\_\_\_\_ gal

Time	Vol. Purged	Water Level	pH	Conductivity (µmhos/cm)	Temperature (°C/°F)	Turbidity NTU	DO mg/L	Other
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____

Purge start time \_\_\_\_\_ Method of Purging  Pump (specify type below)  Bailer (specify type below)

Purge end time \_\_\_\_\_ Purged Dry (y/n)? \_\_\_\_\_

Total Volume Purged: \_\_\_\_\_ How Measured? \_\_\_\_\_

QA/QC Sample Collected Here?  Duplicate  Matrix Spike  Equip. Blank  No QA/QC Sample

Date and Time of Sample Collection: \_\_\_\_\_ Sample Number(s): \_\_\_\_\_

Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



**GROUNDWATER SAMPLING DATA SHEET**

Site Name \_\_\_\_\_ Project Number \_\_\_\_\_  
 Well Number \_\_\_\_\_ Date \_\_\_\_\_  
 Field Personnel \_\_\_\_\_  
 Weather Conditions \_\_\_\_\_

Well Depth \_\_\_\_\_ ft Well Diameter \_\_\_\_\_ in  
 Static Water Level \_\_\_\_\_ ft  
 Length of Water Column \_\_\_\_\_ ft  
 TOC Elevation \_\_\_\_\_ ft amsl Groundwater Elevation \_\_\_\_\_ ft amsl

Standing Well Volume \_\_\_\_\_ gal  
 2-in: Multiply length of column by 0.163 Immiscible Layer (yes/no) \_\_\_\_\_  
 4-in: Multiply length of column by 0.653  
 6-in: Multiply length of column by 1.47

Began Purging (time) \_\_\_\_\_ Ended Purging (time) \_\_\_\_\_  
 Volume Purged \_\_\_\_\_ gal  
 Purged Dry (yes/no) \_\_\_\_\_

Well Sampling Method Bailed (check one): \_\_\_\_\_ Pumped (check one): \_\_\_\_\_ Other (describe): \_\_\_\_\_  
 Teflon \_\_\_\_\_ Submersible \_\_\_\_\_  
 PVC \_\_\_\_\_ Bladder \_\_\_\_\_  
 Stainless \_\_\_\_\_ Peristaltic \_\_\_\_\_

Groundwater Quality Parameter Measurements for Stabilization							
Parameter	1	2	3	4	5	6	7
Time (24 hr)							
pH (std. Units)							
Conductivity (uS/cm)							
Temperature (F)							
Turbidity (NTU)							
Other							

Instruments used in measuring groundwater quality parameters: \_\_\_\_\_

Note any visual observations relevant to the site, monitoring well, or groundwater quality that may be useful in analyzing the groundwater sampling data: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**SOP APPROVAL FORM**

TETRA TECH, INC.

EMI OPERATING UNIT

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

**PACKAGING AND SHIPPING SAMPLES**

**SOP NO. 019**

**REVISION NO. 8**

Last Reviewed: August 2020



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Quality Assurance Approved

August 11, 2020

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Date

## 1.0 BACKGROUND

In any sampling program, the integrity of a sample must be ensured from its point of collection to its final disposition. This standard operating procedure (SOP) describes procedures for packaging and shipping samples. Steps in the procedures should be followed to ensure sample integrity and to protect the welfare of persons involved in shipping and receiving samples.

### 1.1 PURPOSE

This SOP establishes the requirements and procedures for packaging and shipping nonhazardous environmental samples. It has been prepared in accordance with the U.S. Environmental Protection Agency (EPA) “Contract Laboratory Program Guidance for Field Samplers.” Procedures described in this SOP should be followed for all routine sample packaging and shipping of nonhazardous samples. If procedures are to be modified for particular contract- or laboratory-specific requirements, modified procedures should be clearly described in site-specific plans such as work plans, field sampling plans (FSP), or quality assurance project plans (QAPP). Deviations from the procedures in this SOP must be documented in a field logbook. This SOP assumes that samples are already in the appropriate sample jars and that the sample jars are labeled.

***This SOP does not cover the packaging and shipment of Dangerous Goods or Hazardous Materials.***

The shipment of Dangerous Goods (by air) and Hazardous Materials (by ground) requires specialized training. If you have NOT received this training in the last 2 years, you are NOT qualified to package or ship these materials and may be personally liable for any damages or fines. Contact one of Tetra Tech’s shipping experts for assistance. Instructions to access the training course, shipping experts, and health and safety (H&S) contacts, and general information on packaging and shipping hazardous substances and dangerous goods can be obtained by checking the links provided in [Section 1.4](#) (References) and communicating with appropriate Tetra Tech H&S contacts listed on the EMI Operating unit internal H&S web site.

### 1.2 SCOPE

This SOP applies to packaging and shipping of environmental and nonhazardous samples. This SOP does not address shipping dangerous goods or hazardous materials.

### 1.3 DEFINITIONS

**Airbill:** An airbill is a shipping form (such as a FedEx shipping form) acquired from the commercial shipper and is used to document shipment of the samples from the sampler to the designated analytical laboratory (see [Figure 1](#)).

**Blank:** A blank is any sample that is used to assess cross-contamination from sampling and sample management procedures. A typical blank sample will consist of distilled or deionized (DI) water (water sampling) or an air filter cartridge (air sampling) that is then analyzed by the laboratory to evaluate whether cross-contamination has been introduced. Each blank is assigned its own unique sample number. Blanks collected in the field include trip blanks, field blanks, and equipment blanks, all intended to assess potential cross-contamination. For example, a trip blank checks for contamination during sample handling, storage, and shipment from the field to the laboratory. Field blanks assess the contamination of water or soil from ambient air. Equipment blanks (also known as rinse blanks) assess contamination from incomplete decontamination procedures.

**Chain-of-Custody form:** A chain-of-custody form is used to document the transfer of custody of samples from the field to the designated analytical laboratory (see [Figure 2](#)). The chain-of-custody form is critical to the chain-of-custody process and is used to identify the samples in each shipping container to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. A copy of the chain-of-custody form is shipped with the samples and accompanies them from sampler to laboratory (see [Figure 3](#)).

**Custody seal:** A custody seal is a tape-like seal and is used to indicate that samples are intact and have not been disturbed during shipping or transport after the samples have been released from the sampler to the shipper (see [Figure 4](#)). The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been packaged for shipping (see [Figure 5](#)).

**Environmental samples:** Environmental samples include drinking water, groundwater, surface water, soil, sediment, treated municipal and industrial wastewater effluent, indoor and ambient air, nonhazardous bulk materials, soil gas, dust, asbestos, and biological specimens. Environmental samples typically contain low concentrations of contaminants and, when handled, require only limited precautionary procedures.

**Nonhazardous samples:** Nonhazardous samples are those samples that do not meet the definition of a hazardous sample AND do not need to be packaged and shipped in accordance with the International Air Travel Association's (IATA) "Dangerous Goods Regulations" (DGR) or U.S. Department of Transportation's "Hazardous Materials Regulations" defined in Title 49 *Code of Federal Regulations* (CFR).

The following definitions are provided to further distinguish environmental and nonhazardous samples from dangerous goods and hazardous samples:

**Dangerous goods:** Dangerous goods are articles or substances that can pose a significant risk to health, safety, or property when transported by air; they are classified as defined in Section 3 of the DGR (IATA 2020).

**Hazardous samples:** Hazardous samples include dangerous goods and hazardous substances. Hazardous samples shipped by air should be packaged and labeled in accordance with procedures specified by the DGR; ground shipments should be packaged and labeled in accordance with the Hazardous Material Regulations.

**Hazardous substance:** A hazardous substance is any material, including its mixtures and solutions, that is listed in 49 CFR 172.101 and its quantity, in one package, equals or exceeds the reportable quantity listed in Table 1 to Appendix A of 49 CFR 172.101.

## 1.4 REFERENCES

General Awareness, H&S Contacts, and Course Training Information (Tetra Tech, Inc., EMI Operating Unit. Intranet) On-line address: <https://int.tetrattech.com/sites/EMI/hs/Pages/Dangerous-Goods-Shipping.aspx>

International Air Transport Association (IATA). 2020. "Dangerous Goods Regulations. 2020." For sale at: <https://www.iata.org/en/publications/dgr/>. Updated annually, with new edition available late in year.

U.S. Environmental Protection Agency (EPA). 40 CFR, 763 Subpart F, Asbestos Hazards Emergency Response Act (AHERA).

EPA. 2014. "Contract Laboratory Program Guidance for Field Samplers." EPA 540-R-014-013. October. On-line address: [https://www.epa.gov/sites/production/files/2015-03/documents/samplers\\_guide.pdf](https://www.epa.gov/sites/production/files/2015-03/documents/samplers_guide.pdf).

EPA. 2020. "Packing, Marking, Labeling and Shipping of Environmental and Waste Samples." EPA Region 4, LSASDPROC-209-R4. February 23. On-line address: <https://www.epa.gov/sites/production/files/2015-06/documents/Shipping-Environmental-and-Waste-Samples.pdf>

## 1.5 REQUIREMENTS AND RESOURCES

The procedures for packaging and shipping samples require the following:

- Coolers (insulated ice chest) or other shipping containers appropriate to sample type
- Ice
- Bubble wrap or similar cushioning material
- Chain-of-custody forms and seals
- Airbills

- Resealable plastic bags for sample jars and ice
- Tape (strapping and clear)
- Large plastic garbage bags for lining the cooler
- Temperature blank sample bottle filled with distilled water can be included in the cooler if appropriate to sample type
- Trip blank samples used to check for volatile contamination during sample handling in the field should accompany sample containers during shipment from laboratory to field (empty containers) and from field to laboratory (filled containers). It should remain in the cooler with sample containers during the sampling event. Trip blanks should be requested from the laboratory when containers are initially ordered.

## **2.0 PROCEDURES**

The following procedures apply to packaging and shipping nonhazardous and environmental samples.

### **2.1 PACKAGING SAMPLES**

After they have been appropriately containerized and labeled, environmental samples should be packaged as described in this section. This section covers procedures for packing samples for delivery by commercial carrier (air or ground) and hand delivery of environmental samples (by employee or courier), as well as shipping asbestos and air quality samples. Note that these instructions are general; samplers also should be aware of client-specific requirements concerning the placement of custody seals or other packaging provisions.

#### **2.1.1 Packaging Samples for Delivery by Commercial Carrier (Air or Ground)**

Samples shipped by commercial carriers should be packed for shipment using the following procedures and in compliance with all carrier requirements:

##### **Preparing the sample:**

1. Allow a small amount of headspace in all bottles, or as instructed by the laboratory (except volatile organic compound [VOC] containers with a septum seal) to compensate for any changes in pressure and temperature during transfer.
2. Be sure the lids on all bottles are tight (will not leak). Lids maybe taped or sealed with custody seals as added protection or as required. For any sample containers that are not marked with a tare weight by the laboratory, cover the completed sample label on the container with clear tape to protect the label.
3. Place sample containers in resealable plastic bags.

##### **Preparing the cooler:**

1. Secure and tape the drain plug of the cooler with fiber or duct tape.
2. Line the cooler with a large plastic garbage bag before samples, ice, and absorbent packing material are placed in the cooler.
3. Wrap the sample containers in bubble wrap or line the cooler (bottom and sides) with a cushioning material to prevent breakage of bottles or jars during shipment.
4. If required by the laboratory for the analytical method, add a sufficient quantity of ice to the cooler to cool samples to 4 °C ( $\pm 2$  °C). Ice should be double bagged in resealable plastic bags to prevent the melted ice from leaking out. If required, include one temperature blank (a sample bottle filled with distilled water) per cooler.

5. For VOC samples only, include one trip blank for VOC analysis per shipment matrix in each cooler.
6. Fill all remaining space between the bottles or jars with bubble wrap.
7. As each container is placed in the cooler, verify the sample information on the chain-of-custody form. The samples listed on the chain-of-custody form must match exactly with the contents of the cooler.
8. Securely fasten the top of the large garbage bag with tape (preferably plastic electrical tape).
9. If more than one cooler is being shipped, mark each cooler as "1 of 2," "2 of 2," and so forth.
10. Place the chain-of-custody forms (see [Figure 2](#)) into a resealable plastic bag, and tape the bag to the inner side of the cooler lid (see [Figure 3](#)). If you are shipping more than one cooler, copy the chain-of-custody form so that there is one copy of all forms in each cooler. The samples listed on the chain-of-custody form must match exactly with the contents of the cooler. Tape any instructions for returning the cooler to the inside of the lid.
11. Close the lid of the cooler and tape it shut by wrapping strapping tape around both ends and hinges of the cooler at least once.
12. Place two signed custody seals (see [Figure 4](#)) on opposite sides of the cooler, ensuring that each one covers the cooler lid and side of the cooler (see [Figure 5](#); note that in contrast to the figure, the seals should be placed on the opposite sides of the cooler and offset from each other, rather than directly across from each other as shown in [Figure 5](#)). Place clear plastic tape over the custody seals so that the cooler cannot be opened without breaking the seal.
13. Shipping containers should be marked "THIS END UP." Arrow labels, which indicate the proper upward position of the container, may also be affixed to the container. As appropriate, the containers should also be labeled for Saturday delivery or other special requirements.
14. Ship samples overnight using a commercial carrier such as FedEx. As a best practice, electronic sample shipping labels should be prepared by the shipping agency's employees, at the direction of Tetra Tech employees or sampling personnel. This allows the sampling personnel to confirm special shipping requirements, such as Saturday delivery, and verify that samples will be shipped that day (that is, the last shipment of the day has not already occurred). If this is not possible, the airbill can be prepared by hand (see [Figure 1](#)), but samples should still be handed over directly to shipping agency employees and shipping details should be verified. The shipping label should be placed on the outside of the container.
15. A copy of the receipt with sample tracking number should be retained by the sampling personnel and delivery should be verified the next day.

### **2.1.2 Hand Delivery of Environmental Samples (by Employee or Courier)**

Samples hand-delivered to the laboratory should be packed for shipment using the following procedures:

#### **Preparing the sample:**

1. Bottles can be filled completely with sample (required for VOC containers with a septum seal).

2. Be sure the lids on all bottles are tight (will not leak).

### **Preparing the cooler:**

1. Secure and tape the drain plug of the cooler with fiber or duct tape.
2. Wrap the sample containers in bubble wrap or line the cooler (bottom and sides) with a cushioning material to prevent breakage of bottles or jars during shipment.
3. As each container is placed in the cooler, verify the sample information on the chain-of-custody form. The samples listed on the chain-of-custody form must match exactly with the contents of the cooler.
4. If required for by the laboratory for the analytical method, add a sufficient quantity of ice to the cooler to cool samples to 4 °C. Ice should be double bagged in resealable plastic bags to prevent the melted ice from leaking out. If required, include one temperature blank (a sample bottle filled with distilled water) per cooler.
5. For VOC samples only, include one trip blank for VOC analysis per shipment matrix in each cooler.
6. If more than one cooler is being shipped, mark each cooler as “1 of 2,” “2 of 2,” and so forth.
7. Place the chain-of-custody form (see [Figure 2](#)) in a resealable plastic bag and tape to the inside of the cooler lid (see [Figure 3](#)), close the lid, and seal with custody seals (see [Figure 5](#); note that in contrast to the figure, the seals should be placed on the opposite sides of the cooler and offset from each other, rather than directly across from each other as shown in [Figure 5](#)). Place clear plastic tape over the custody seals so that the cooler cannot be opened without breaking the seal. Transfer the cooler to the courier. When samples will be delivered directly to the laboratory, it is sufficient to close the cooler and hand-deliver it with the chain-of-custody form.
8. Include any instructions for returning the cooler to the inside of the lid.
9. If the cooler is being transferred to a courier, the shipping containers should be marked “THIS END UP,” and arrow labels, which indicate the proper upward position of the container should be affixed to the container.

### **2.1.3 Shipping Asbestos Samples**

Asbestos samples shipped by commercial carriers should be packed for shipment using the following procedures and in compliance with all carrier requirements:

1. Place each asbestos sample in a small resealable plastic bag or Whirl-pak sealable bag. Seal the bags carefully and place the sample bags in a larger resealable plastic bag.
2. Select a rigid shipping container and pack the samples upright in a noncontaminating, nonfibrous medium such as a bubble pack to minimize excessive movement during shipping.
3. Avoid using expanded polystyrene because of its static charge potential. Also avoid using particle-based packaging materials because of possible contamination.

4. Affix custody seals to the samples or outer sample bag so that the bags cannot be opened without breaking the seal.
5. Insert the chain-of-custody form in the box. Include a shipping bill and a detailed listing of samples shipped, their descriptions and all identifying numbers or marks, sampling data, shipper's name, and contact information.
6. Ship bulk samples in a separate container from air samples. Bulk samples and air samples delivered to the analytical laboratory in the same container will be rejected.
7. For each sample set, designate which are the ambient samples, which are the abatement area samples, which are the field blanks, and which is the sealed blank if sequential analysis is to be performed.
8. Hand-carry samples to the laboratory in an upright position if possible; otherwise, choose that mode of transportation least likely to shake the samples in transit.
9. Address the package to the laboratory sample coordinator by name when known and alert him or her of the package description, shipment mode, and anticipated arrival as part of the chain-of-custody and sample tracking procedures. This information will also help the laboratory schedule timely analysis for the samples when they are received.

#### **2.1.4 Shipping Air Samples**

Packaging and shipping requirements for air samples vary depending on the media used to collect the samples and the analyses required. Sampling media typically include Summa canisters and Tedlar bags for whole air samples, filters for metals and particulate matter, and sorbent tubes for organic contaminants. This section of the SOP provides general guidelines for packaging and shipping air samples collected using these media. The project FSP or QAPP should also be reviewed for any additional project-specific requirements or instructions.

#### **Summa Canister Samples**

1. Close the canister valve by tightening the knob clockwise or flipping the toggle switch. Replace the brass cap on the canister inlet.
2. If a flow controller was used to collect the air sample over a specified time interval, the flow controller should be removed before replacing the brass cap.
3. Fill out the sample tag on the canister with the sample number and the date and time of collection. Include the identification number of the flow controller on the sample tag if one was used. Make sure the information on the sample tag matches the chain-of-custody form.
4. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final Summa canister vacuum readings; Summa canister identification number; and flow controller identification number.

5. Package the Summa canister (and flow controller) in its original shipping box with the original packaging material. Tape the box shut and apply custody seals if required. Note: Summa canisters should never be packaged with ice.
6. Summa canister shipments typically include several canisters, and may include more than one shipping box. The chain-of-custody form for the shipment should be sealed within one of the shipping boxes. If more than one box is being shipped, mark each box as "1 of 2," "2 of 2," and so forth.
7. Ship the samples by a method that will meet the holding time. Summa canister samples should be analyzed within 30 days of sample collection.

### **Tedlar Bag Samples**

1. Before removing it from the sample port, close the Tedlar bag by tightening the valve clockwise. The bag should only be approximately half-full to allow for pressure changes during shipping and handling of the sample. Keep the Tedlar bag out of direct sunlight to preserve the sample.
2. Fill out the label on the bag with the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
3. Complete the chain-of-custody form.
4. Package the Tedlar bag in a shipping box with appropriate packing material to prevent the bag from being punctured or damaged. Multiple bags can be packaged in the same box. Tape the box shut and apply custody seals if required. Note: Tedlar bag samples should not be cooled or packaged with ice, although they can be shipped in an ice chest to protect the samples.
5. Tedlar bag shipments may include more than one shipping box. The chain-of-custody form for the shipment should be sealed within one of the shipping boxes. If more than one box is being shipped, mark each box as "1 of 2," "2 of 2," and so forth.
6. Ship the samples using priority overnight delivery. Tedlar bag samples should be analyzed within 3 days of sample collection.

### **Filter Cassette Samples**

1. Disconnect the filter cassette from the air sampling pump and replace the plastic caps on the inlet and outlet openings.
2. Attach a label to the sample that includes the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
3. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final air flow rates (or average flow rate); volume of air sampled; and sampling pump identification number.
4. Package the filter cassettes in a shipping box (such as a FedEx box). Use an appropriate packing material (such as bubble wrap) to separate the samples and prevent damage.
5. Place the chain-of-custody form within the box, seal the box, and apply custody seals if required. Filter cassette samples typically do not need to be cooled, but check the field sampling plan (FSP) or Quality Assurance Project Plan (QAPP) for project-specific requirements.

6. Ship the samples by a method that will meet the holding time.

### **Sorbent Tube Samples**

1. Disconnect the sample tube from the air sampling pump and seal both ends of the tube with plastic caps.
2. Complete a sample label that includes the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
3. If the tube is small and the label cannot be attached to the tube, the tube can be placed in a small resealable plastic bag and the label can be attached to the bag or placed inside the bag with the tube.
4. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final air flow rates (or average flow rate); volume of air sampled; and sampling pump identification number.
5. Packaging requirements for the sample tubes will depend on the analysis required, and the sampler should check the FSP or QAPP for project-specific requirements (for example, tubes may need to be wrapped in aluminum foil to prevent exposure to light). Packaging containers and methods include (1) shipping boxes (as described under filter cassette samples), (2) small sample coolers filled with double-bagged ice, and (3) small sample coolers filled with blue (reusable) ice.
6. Place the chain-of-custody form within the box or container, seal the box or container, and apply a custody seal if required.
7. If coolers are used for shipping, tape instructions for returning the cooler to the inside of the lid.
8. Ship the samples by a method that will meet the holding time.

### **Polyurethane Foam (PUF) Tube Samples**

1. Disconnect the PUF tube from the air sampling pump and wrap the tube in aluminum foil.
2. Attach a label to the wrapped sample tube that includes the sample number and the date and time of sample collection. Make sure the information on the label matches the chain-of-custody form.
3. Wrap the PUF tube in bubble wrap and place the tube in a glass shipping jar.
4. Complete the chain-of-custody form. In addition to the information normally included, the form should include the following data: sample start and stop dates and times; initial and final air flow rates (or average flow rate); volume of air sampled; and sampling pump identification number.
5. Package the PUF tube jars in a cooler that is filled with double-bagged ice. Use bubble wrap or other cushioning material to separate the samples and prevent breakage.
6. Place the chain-of-custody form within the cooler, seal the cooler, and apply a custody seal if required.
7. If coolers are used for shipping, tape instructions for returning the cooler to the inside of the lid.
8. Ship the samples by a method that will meet the holding time. Samples collected in PUF tubes typically must be extracted within 7 days of collection.

## **2.2 SHIPPING DOCUMENTATION FOR SAMPLES**

Airbills, chain-of-custody forms, and custody seals must be completed for each shipment of nonhazardous environmental samples.

Field staff collecting samples should also review their field work plans to confirm what documentation must be completed during each sampling event, including client-specific requirements. For example, some EPA programs have a specific requirement to use Scribe software, an environmental data management system, to create sample documentation, electronically input information into Traffic Report or chain-of-custody forms, and enter other data.

- The Scribe software can be accessed from the EPA Environmental Response Team (ERT) at the following address: [http://www.ertsupport.org/scribe\\_home.htm](http://www.ertsupport.org/scribe_home.htm)
- The ERT User Manual for Scribe, reference, and training materials can be accessed from the Scribe Support Web site at the following address: <http://www.epaossc.org/scribe>

Note that some laboratories must routinely return sample shipping coolers within 14 calendar days after the shipment has been received. Therefore, the sampler should also include instructions for returning the cooler with each shipment, when possible. The sampler (not the laboratory) is responsible for paying for return of the cooler and should include shipping airbills bearing the sampler's shipping account number, as well as a return address to allow for return of the cooler. Samplers should use the least expensive option possible for returning coolers.

## **2.3 SHIPMENT DELIVERY AND NOTIFICATION**

A member of the field sampling team must contact the laboratory to confirm it accepts deliveries on any given day, especially Saturdays. In addition, samplers should ensure the laboratory has been notified in advance of the pending shipment and notify any additional parties as required. The sampler needs to know the laboratory's contact name, address, and telephone number and be aware of the laboratory's requirements for receiving samples.

In addition, samplers should be aware of the sample holding times, shipping company's hours of operation, shipping schedule, and pick-up and drop-off requirements to avoid delays in analytical testing.

### **Priority Overnight Delivery**

Priority overnight delivery is typically the best method for shipment. Delays caused by longer shipment times may cause the sample temperature to rise above the acceptable range of 4° C ( $\pm 2$  ° C) and technical holding time may expire, which in turn may compromise sample integrity and require recollection of

samples. If sample delivery procedures are to be modified for particular contract- or laboratory-specific requirements, the procedures should be clearly described in site-specific plans such as work plans, FSPs, or QAPPs.

### **Saturday Delivery**

If planning to ship samples for Saturday delivery, the laboratory must be contacted in advance to confirm it will accept deliveries on Saturdays or arrange for them to be accepted. In addition, samplers should ensure the laboratory has been notified in advance of the pending shipment and notify any additional parties as required.

## **2.4 HEALTH AND SAFETY CONSIDERATIONS**

In addition to the procedures outlined in this SOP, all field staff must be aware of and follow the health and safety practices that result from the Activity Hazard Analyses (AHA) for the project. The AHAs include critical safety procedures, required controls, and minimum personal protective equipment necessary to address potential hazards. The hazards specific to project tasks must be identified and controlled to the extent practicable and communicated to all project personnel via the approved, project-specific health and safety plan (HASP).

### 3.0 POTENTIAL PROBLEMS

The following potential problems may occur during sample shipment:

- Leaking package. If a package leaks (either from broken sample containers or melting ice), the carrier may open the package and return the package. Special care should be taken during sample packaging to minimize potential leaks.
- Improper labeling and marking of package. If mistakes are made in labeling and marking the package, the carrier will most likely notice the mistakes and return the package to the shipper, thus delaying sample shipment. A good practice is to have labels, forms, and container markings double checked by a member of the field team.
- Bulk samples and air samples delivered to the analytical laboratory in the same container. If samples are combined in this way, they will be rejected. Always ship bulk samples in separate containers from air samples.
- Issues in packing asbestos samples. When asbestos samples are shipped, avoid using expanded polystyrene because of its static charge potential. Also avoid using particle-based packaging materials with asbestos samples because of possible contamination.
- Improper, misspelled, or missing information on the shipper's declaration. The carrier will most likely notice these errors as well and return the package to the shipper. A good practice is to have another field team member double check this information.
- Missed drop off time or wrong location. Missing the drop off time or having the wrong location identified for drop off will delay delivery to the laboratory and may cause technical holding times to expire. Establish the time requirements in advance of completing the field effort and be sure and provide some contingency time for potential delays such as traffic or checking and redoing paperwork.
- Incorrectly packaging samples for analysis at multiple laboratories. For example, inorganic samples may be shipped to one laboratory for analysis, while organic samples may need to be shipped to another laboratory. All field staff should be aware which samples are to be shipped to which laboratory when they package samples for multiple types of analysis.
- Holidays or weather-related delays. Be aware of holidays and weather forecasts that could cause delays in delivery. Delays caused by longer shipping times may cause technical holding times to expire, which in turn may compromise sample integrity or require recollection of samples.
- Not noting field variances in field logbook. Field variances should be noted in the field logbook and the project manager notified. Common field variances include:
  - Less sample volume collected than planned. Notify appropriate staff and the laboratory to ensure there is an adequate amount for analysis.
  - Sample collected into incorrect jar because of broken or missing bottle-ware. Notify appropriate laboratory staff to ensure there is no confusion regarding the analysis of the sample.

FIGURE 1

EXAMPLE OF A FEDEX US AIRBILL FOR LOW-LEVEL ENVIRONMENTAL SAMPLES

The image shows a FedEx US Airbill form with the following details:

- Section 1: From** (Please print and press hard):
  - Date: 3/1/20
  - Sender's FedEx Account Number: 9999-9999-9
  - Sender's Name: Tyler Hanlon
  - Company: [Blank]
  - Address: 1234 Main Street
  - City: Phoenix, State: AZ, ZIP: 85034
- Section 2: Year Internal Billing Reference**: [Blank]
- Section 3: To** (Recipient's Name):
  - Recipient's Name: Liam Riley
  - Company: Ridgeway Design
  - Address: 2020 Vision Street
  - City: Atlanta, State: GA, ZIP: 30305
- Section 4: Express Package Service**:
  - Service selected:  FedEx Priority Overnight
  - Other services:  FedEx First Overnight,  FedEx 2Day AM,  FedEx 2Day,  FedEx Express Saver
- Section 5: Packaging**:
  - Selected:  Other
  - Other options:  FedEx Envelope,  FedEx Pak,  FedEx Box,  FedEx Tube
- Section 6: Special Handling and Delivery Signature Options**:
  - Signature:  Direct Signature
  - Other options:  No Signature Required,  Indirect Signature
  - Dangerous Goods:  No
- Section 7: Payment**:
  - Bill to:  Sender
  - Total Packages: 1, Total Weight: 1, Total Declared Value: 450

Filling Out the FedEx US Airbill

- The sender *must complete* the following fields on the pre-printed airbill:
  - Section 1: Date
  - Section 1: Sender’s FedEx Account Number (available from your office administrator)
  - Section 1: Sender’s Name, Company, Address, and Phone Number
  - Section 2: Internal Billing Reference (Project Number) (this field may not be present on newer airbills)
  - Section 3: Recipient’s Name, Company, Address, and Phone Number
  - Section 4: Express Package or Freight Services (Priority Overnight)
  - Section 5: Packaging (usually “Other,” your own packaging)
  - Section 6: Special Handling (Saturday delivery if prearranged with receiving laboratory; “No” dangerous goods contained in shipment)
  - Section 7: Payment (“Bill to Sender”)
  - Section 7: Total Number of Packages
  - Section 7: Total Weight (completed by FedEx employee)
  - Section 8: Delivery Signature Options (“No Signature Required”)

Completing a Sample Chain-of-Custody Form (See Also Section 2.2 on SCRIBE for Forms)

After samples have been collected, they will be maintained under chain-of-custody procedures. These procedures are used to document the transfer of custody of the samples from the field to the designated

analytical laboratory. The same chain-of-custody procedures will be used for the transfer of samples from one laboratory to another, if required.

The field sampling personnel will complete a Chain-of-Custody and Request for Analysis (CC/RA) form for each separate container of samples to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. These forms are often triplicate, carbonless forms. Care should be taken when completing the form that all copies are legible—PRESS FIRMLY WHEN WRITING. Information on the form will include:

1. Project identification (ID) (for example, contract and task order number);
2. Project Contract Task Order (CTO) number;
3. Laboratory Project Order (PO) number;
4. Tetra Tech Technical Contact;
5. Tetra Tech Project Manager;
6. Laboratory name;
7. Field sampler names;
8. Field sampler signature;
9. Sample ID;
10. Date and time of sampling;
11. Sample matrix type;
12. Sample preservation method; note “NONE” if no preservatives;
13. Number and types of containers per sample;
14. Sample hazards (if any);
15. Requested analysis;
16. Requested sample turnaround time or any special remarks (for example, possible presence of free product or high screening concentrations);
17. Page \_\_ of \_\_;
18. Method of shipment;
19. Carrier/waybill number (if any);
20. Signature, name, and company of the person relinquishing the samples and the person receiving the samples when custody is transferred;

21. Date and time of sample custody transfer;
22. Condition of samples when they are received by the laboratory.

The sample collector will cross out any blank space on the CC/RA form below the last sample number listed on the part of the form where samples are listed.

The sampling personnel whose signature appears on the CC/RA form is responsible for the custody of a sample from time the sample is collected until the custody of the sample is transferred to a designated laboratory, a courier, or to another Tetra Tech employee for transporting a sample to the designated laboratory. A sample is considered to be in custody when the custodian: (1) has direct possession of it; (2) has plain view of it; or (3) has securely locked it in a restricted access area.

Custody is transferred when both parties to the transfer complete the portion of the CC/RA form under “Relinquished by” and “Received by” or a sample is left at a FedEx facility pending shipment. Signatures, printed names, company names, and date and time of custody transfer are required. When custody is transferred, the Tetra Tech sampling personnel who relinquished the samples will retain the third sheet (pink copy) of the CC/RA form. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the CC/RA form. Receipts of Bills of Lading will be retained as part of the permanent documentation in the Tetra Tech project file.

FIGURE 2

EXAMPLE OF A CHAIN-OF-CUSTODY FORM (WHITE COPY)



**Tetra Tech EM Inc.**  
Oakland Office

1999 Harrison Street, Suite 500  
Oakland, CA 94612  
510.302.6300 Phone  
510.433.0830 Fax

**Chain of Custody Record** No. 9814 13G175 Page 1 of 1

Preservative Added		
NONE	NONE	NONE

Lab PO#: <u>130AK27</u>		Lab: <u>EMAX</u>		No./Container Types		Analysis Required													
Project name: <u>Concord RAPNI</u>		TEMI technical contact: <u>Sara Woolley</u>		Field samplers: <u>Sandy Jack</u> <u>Rebecca Johnson</u>															
Project (CTO) number: <u>1036H5A029</u>		TEMI project manager: <u>Steve DellHonore</u>		Field samplers' signatures: <u>[Signature]</u> <u>[Signature]</u>															
Sample ID	Point ID/Depth	Date	Time	Matrix	MS/MSD	40 ml VOA	1 liter Amber	500 ml Poly	Sieve	Glass Jar	250 ml Poly	Encore	VOA	SVOA	Pest	Metals	TPH Purgeables	TPH Extractables	PCB
1	029SR2SS01	7/22/13	1240	Soil							2		X	X	X	X	X	X	X
2	029SR2SS02	7/22/13	1245								2		X	X	X	X	X	X	X
3	029C3DSS01	7/24/13	1208								1		X	X	X	X	X	X	X
4	029C3DSS02		1215								1		X	X	X	X	X	X	X
5	029C3DSS03		1230								1		X	X	X	X	X	X	X
6	029C3DSS04		1245								1		X	X	X	X	X	X	X

Relinquished by:	Name (print)	Company Name	Date	Time
<u>[Signature]</u>	<u>Rebecca Johnson</u>	<u>Tetra Tech</u>	<u>7/20/13</u>	<u>1630</u>
Received by:	<u>Rebecca Johnson</u>	<u>EMAX</u>	<u>7/30/13</u>	<u>0930</u>
Relinquished by:				
Received by:				
Relinquished by:				
Received by:				

Turnaround time/remarks: Standard TAT Temp - 20°C

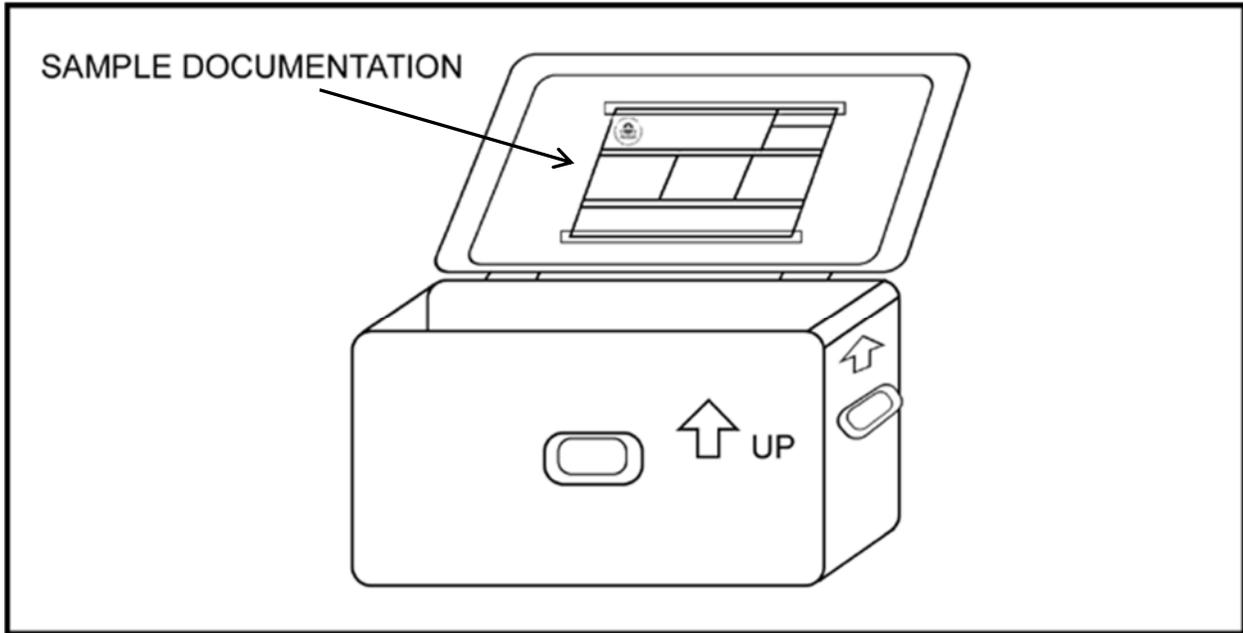
Priority: SVOCs, TPH-e on 029C3DSS01 → BY trace metals

Fed Ex #: 8012 4667 7215

WHITE-Laboratory Copy YELLOW-Sample Tracker PINK-File Copy

**FIGURE 3**

**EXAMPLE OF A SAMPLE COOLER WITH ATTACHED DOCUMENTATION**



Source: U.S. Environmental Protection Agency. 2014.

Place the necessary paperwork (chain-of-custody form, cooler return instructions, and associated paperwork) in the shipping cooler or acceptable container. All paperwork must be placed in a plastic bag or pouch and then secured to the underside of the shipping container lid.

**FIGURE 4**

**EXAMPLE OF A CUSTODY SEAL**

***Custody Seal***

---

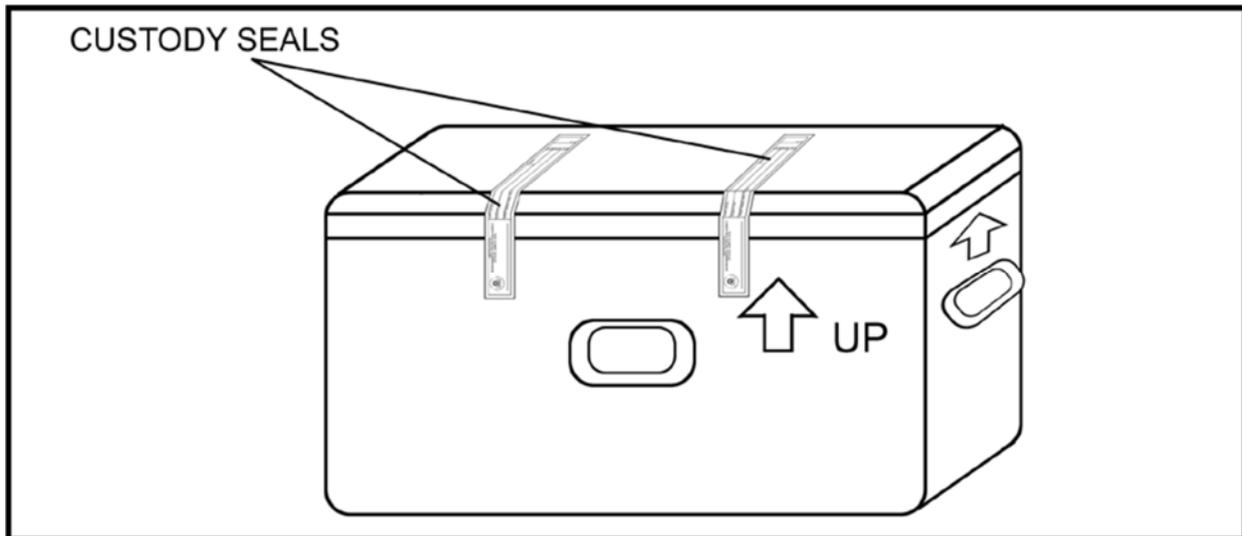
*DATE*

---

*SIGNATURE*

**FIGURE 5**

**EXAMPLE OF SHIPPING COOLER WITH CUSTODY SEALS**



Source: U.S. Environmental Protection Agency. 2014.

Please note that the two seals typically are affixed to opposite sides of the cooler and offset from each other, although the offset is not depicted on the EPA figure above.

**SOP APPROVAL FORM**

TETRA TECH, INC.

EMI OPERATING UNIT

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

**RECORDING NOTES IN FIELD LOGBOOKS**

**SOP NO. 024**

**REVISION NO. 3**

Last Reviewed: July 2020



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Quality Assurance Approved

*July 2, 2020*

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Date

## **1.0 BACKGROUND**

Complete and accurate field documentation is critical to a successful project and the field logbook is an important tool to support field documentation needs. The field logbook should include detailed records of all field activities, document interviews with people, and record observations of conditions at a site. Entries should be described in a level of detail to allow personnel to reconstruct, after the fact, activities and events that occurred during their field assignments. Furthermore, entries should be limited to facts. Avoid speculation related to field events and do not record hearsay or unfounded information that may be presented by other parties during field activities. For example, do not record theories regarding the presence or absence of contamination when you are collecting field screening data or speculation regarding the reasons for a property owner's refusal to grant access for sampling.

Field logbooks are considered accountable documents in enforcement proceedings and may be subject to review. Therefore, the entries in the logbook must be accurate and detailed, but should not contain speculative information that could conflict with information presented in subsequent project deliverables and correspondence. Also be aware that the field logbooks for a site may be a primary source of information for depositions and other legal proceedings that may occur months or years after field work is complete and long after our memories have faded. The accuracy, neatness, and completeness of field logbooks are essential for recreating a meaningful account of events.

Field notes may also be recorded digitally, using a variety of software programs. The requirements and use of digital recording programs is not addressed in this standard operating procedure (SOP) because many items are unique to the selected software system. However, many of the principles discussed in this SOP will apply to the digital recording of field notes.

### **1.1 PURPOSE**

The purpose of this SOP is to provide guidance to ensure that field logbook documentation collected during field activities meets all requirements for its later use. Among other things, field logbooks may be used for:

- Identifying, locating, labeling, and tracking samples
- Recording site activities and the whereabouts of field personnel throughout the day
- Documenting any deviations from the project approach, work plans, quality assurance project plans, health and safety plans, sampling plans, and any changes in project personnel
- Recording arrival and departure times for field personnel each morning and evening and weather conditions each day

- Describing photographs taken during the project.

In addition, the data recorded in the field logbook may later assist in the interpretation of analytical results. A complete and accurate logbook also aids in maintaining quality control, because it can verify adherence to project scope and requirements.

## **1.2 SCOPE**

This SOP establishes the general requirements and procedures for documenting site activities in the field logbook.

## **1.3 DEFINITIONS**

None.

## **1.4 REFERENCES**

Compton, R.R. 1985. *Geology in the Field*. John Wiley and Sons. New York, NY.

## **1.5 REQUIREMENTS AND RESOURCES**

The following items are required for field notation:

- Bound (sewn) notebooks
- Ballpoint pens or Sharpies with permanent waterproof ink
- 6-inch ruler (optional)

Field logbooks should be bound (sewn) with water-resistant and acid-proof covers, and each page should have preprinted lines or grids and numbered pages. They should be approximately 7<sup>1</sup>/<sub>2</sub> by 4<sup>1</sup>/<sub>2</sub> inches or 8<sup>1</sup>/<sub>2</sub> by 11 inches in size. Loose-leaf sheets are not acceptable for use as a field logbook, although logs and field forms used to record field measurements and data are acceptable as loose-leaf sheets maintained in a three-ring binder with numbered pages, as a supplement to the logbook. If notes are written on loose paper, they must be transcribed as soon as possible into a bound field logbook by the same person who recorded the notes originally.

Ideally, distribution of logbooks should be controlled by a designated person in each office. This person assigns a document control number to each logbook, and records the assignment of each logbook distributed (name of person, date distributed, and project number). The purpose of this procedure is to ensure the integrity of the logbook before its use in the field, and to document each logbook assigned to a

project. In the event that more than one logbook is assigned to a project, this process will ensure that all logbooks are accounted for at project closeout.

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## 2.0 PROCEDURES

The following subsections provide general guidelines and formatting requirements for field logbooks, and detailed procedures for completing field logbooks.

### 2.1 GENERAL GUIDELINES

- A separate field logbook must be maintained for each project. If a site consists of multiple subsites (or operable units), designate a separate field logbook for each subsite. Similarly, if multiple activities are occurring simultaneously requiring more than one task leader (for example, well installation, private well sampling, or geophysical survey), each task leader should maintain a separate field logbook to ensure that each activity is documented in sufficient detail.
- At larger sites, a general field log may be kept at the site trailer or designated field office to track site visitors, document daily safety meetings, and record overall site issues or occurrences.
- Data from multiple subsites may be entered into one logbook that contains only one type of information for special tasks, such as periodic well water-level measurements.
- All logbooks must be bound and contain consecutively numbered pages. If the pages are not pre-numbered, the sequential page number should be written at the top of each page.
- No pages can be removed from the logbook for any purpose.
- All information must be entered using permanent, waterproof ink, either a traditional ballpoint pen or a permanent marker. Do not use pens with water-based ink (typically identified as rollerball or gel ink pens) because the ink may wash out if the paper gets wet. Pencils are not permissible for field notes because information can be erased. The entries should be written dark enough so that the logbook can be easily photocopied.
- Be sure that all entries are legible. Use print rather than cursive writing and keep the logbook pages free of dirt and moisture to the extent possible.
- Set apart critical information such as sample numbers by circling or drawing a box around the critical data.
- Do not enter information in the logbook that is not related to the project. The language used in the logbook should be factual and objective. Avoid speculation that could conflict with information presented in subsequent project deliverables and correspondence (see Section 1.0 above).
- Use military time, unless otherwise specified by the client. If a logbook entry is not related to a specific event, set it aside with the identification as a "NOTE."
- Include site sketches, as appropriate.
- Begin a new page for each day's notes.
- Include the date, project number, and location (if the project has multiple locations) at the top of each page.

- At the end of a day, draw a single diagonal line through any unused lines on the page, and sign at the bottom of the page. Note and implement any client-specific requirements (for example, some clients require each logbook page to be signed).
- Write notes on every line of the logbook. Do not skip any pages or parts of pages unless a day's activity ends in the middle of a page.
- If a line is left blank for some reason, cross it out (with a single line) and initial to prevent unauthorized entries.
- Cross out (with a single line) and initial any edits to the logbook entries. Note and implement any client-specific requirements (for example, some clients also require that edits be dated). Edits should only be made if the initial entry is illegible or erroneous. Do not make corrections for grammar or style.

## **2.2 LOGBOOK FORMAT**

The layout and organization of each field logbook should be consistent and generally follow the format guidelines presented below. Some clients or contracts may have specific formatting guidelines that differ somewhat from this SOP; review client requirements at the start of the project to help ensure any client-specific guidelines are integrated.

### **2.2.1 Logbook Cover**

Spaces are usually provided on the inside front cover (or the opening page in some logbooks) for the company name, address, contact names, and telephone numbers. If preprinted spaces for this information are not provided in the logbook, write the information on the first available page. Information to be included on the inside front cover or first page includes:

- Logbook document control number (assigned by issuer)
- "Book # of #" (determined by the project manager if there is more than one logbook for the project)
- Contract and task order numbers
- Name of the site and site location (city and state)
- Name of subsite (or operable unit), if applicable
- Type of activity, if the logbook is for a specific activity, such as well installation or indoor air sampling
- Beginning and ending dates of activities entered into the logbook

### **2.2.2 Inside Cover or First Page**

Spaces are usually provided on the inside front cover (or the opening page in some logbooks) for the company name, address, contact names, and telephone numbers. If preprinted spaces for this information are not provided in the logbook, write the information on the first available page. Information to be included on the inside front cover or first page includes:

- Tetra Tech project manager and site manager names and telephone numbers
- Tetra Tech office address
- Client contact and telephone number
- Site safety officer and telephone number
- Emergency contact telephone number (911, if applicable, or nearest hospital)
- Subcontractor contacts and telephone numbers
- Site property owner or property manager contact information

Note—some clients prohibit the inclusion of personally identifiable information such as personal mobile telephone numbers on official project records.

## **2.3 ENTERING INFORMATION IN THE LOGBOOK**

The following lists provide guidance on the types of information to be included in a typical field logbook. This guidance is general and is not intended to be all-inclusive. Certain projects or clients may specify logbook requirements that are beyond the elements presented in this SOP.

### **2.3.1 General Daily Entries**

- Document what time field personnel depart the Tetra Tech office and arrive at the hotel or site. If permitted by the client to charge travel time for site work, document what time personnel leave and arrive at the hotel each day. (This information may be needed at remote sites where hotel accommodations are not near the site.)
- Indicate when all subcontractors arrive and depart the site.
- Note weather conditions at the time of arrival on site and any changes to the weather that might affect completion of project tasks during the day.
- Include the date and project number at the top of each page.
- Document that a site safety meeting was held and include the basic contents of the meeting.
- List the level of personal protection to be used for health and safety.

- Summarize the day's planned activities.
- Summarize which activities each field team member will be doing.

### **2.3.2 Field Activity Entries**

- Refer to field data collection forms for details about field data collection activities (for example time, date, depth of samples, and field measurements). If separate field sampling sheets are not used, see Section 2.3.3 regarding logbook entries for sampling activities.
- Refer to well purge forms, well construction logs, and other activity-specific forms as applicable rather than including this type of information in the field logbook. These other forms allow the information to be more accessible at a later date.
- List any air monitoring instrumentation used, with readings and locations.
- Refer to instrument field logs for equipment calibration information.
- Summarize pertinent conversations with site visitors (agency representatives, property owners, client contacts, and local citizens).
- Summarize any problems or deviations from the quality assurance project plan (QAPP) or field sampling plan.
- Document the activities and whereabouts of each team member. (As indicated in Section 2.1, multiple logbooks may be required to ensure sufficient detail for contemporaneous activities).
- Indicate when utility clearances are completed, including which companies participated.
- Indicate when verbal access to a property is obtained.
- Include names, addresses, and telephone numbers of any pertinent site contacts, property owners, and any other relevant personnel.
- Document when lunch breaks or other work stoppages occur.
- Include approximate scale for all diagrams. If a scale is not available, write "not to scale" on the diagram. Indicate the north direction on all maps and cross-sections, and label features on each diagram.

### **2.3.3 Sampling Activity Entries**

The following information should typically be on a sample collection log and referenced in the logbook. If the project does not use sample sheets as a result of project-specific requirements, this information should be included in the logbook.

- Location description
- Names of samplers
- Collection time

- Designation of sample as a grab or composite sample
- Identification of blind duplicates or split samples
- Type of sample (water, sediment, soil gas, or other medium)
- On-site measurement data (such as pH, temperature, and specific conductivity)
- Field observations (odors, colors, weather)
- Preliminary sample description
- Type of preservative used
- Instrument readings, if applicable

#### **2.3.4 Closing Daily Entries**

- Describe decontamination procedures (personnel and equipment).
- Describe handling and disposition of any investigation-derived wastes.
- Summarize which planned activities were completed and which ones were not.
- Note the times that personnel depart the site for the day.
- Summarize any activities conducted after departing the site (paperwork, sample packaging, etc.). This may be required to document billable time incurred after field activities were completed for the day.

#### **2.3.5 Photographic Log Entries**

- Before using a digital camera, ensure that the system date and time are correct. Verify whether the timestamp is being recorded on the image, if required.
- Indicate in the text that photographs were taken and the location where the photographs can be found (for example, in the project file) and identify the photographer.
- Begin a new photolog page for each new field day.
- Record the time of photograph so that the image can be generally identified when reviewing the digital files.
- Note the direction in which the photograph was taken, along with any relevant details that might not be understood when looking at the photograph.
- In the event that a film camera is used, the sequential number of the image should also be recorded, and the time from the logbook will be the recorded time for the photograph.

## **2.4 LOGBOOK STORAGE**

Custody of logbooks must be maintained at all times. During field activities, field personnel must keep the logbooks in a secure place (locked car, trailer, or field office) when the logbook is not in personal possession. When the field work is over, the logbook should be included in the project file, which should be in a secured file cabinet; in addition, if directed by the project manager, scan logbook pages for electronic file management upon returning to the office. The logbook may be referenced in preparing subsequent reports and scanned logbook pages may be included as an appendix to a report. However, it is advisable to obtain direction directly from the client before including the logbook as a report appendix, because its inclusion may not be appropriate in all cases.

## **2.5 HEALTH AND SAFETY CONSIDERATIONS**

In addition to the procedures outlined in this SOP, all field staff must be aware of and follow the health and safety practices that result from the Activity Hazard Analyses (AHA) for a project. The AHAs include critical safety procedures, required controls, and minimum personal protective equipment necessary to address potential hazards. The hazards specific to project tasks must be identified and controlled to the extent practicable and communicated to all project personnel via the approved, project-specific health and safety plan.



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## INVESTIGATION-DERIVED WASTE MANAGEMENT

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## INVESTIGATION-DERIVED WASTE MANAGEMENT

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## INVESTIGATION-DERIVED WASTE MANAGEMENT

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### 1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to provide general reference information on the management of investigation-derived waste (IDW) generated during Environmental response Team (ERT) site investigations.

A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The anticipated approach and procedures for IDW management will be detailed in the approved QAPP for the site investigation.

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

### 2.0 APPLICABILITY

This SOP is applicable only if the U.S.EPA On-Scene Coordinator (OSC), Remedial Project Manager (RPM), or other Regional Manager does not have procedures in place for IDW management. Prior to site activities, the ERT contractor's Task Leader (TL) determines if the OSC, RPM, or other Regional Manager has procedures in place for IDW management. This should be done by contacting the ERT Work Assignment Manager (WAM). If it is determined that procedures are not in place, then the contractor's TL should evaluate IDW handling and management options based on:

- Site contaminants and their concentrations, and total projected volume of IDW
- Media potentially affected (e.g., groundwater, soil) by management options
- Location of the nearest population(s) and likelihood and/or degree of site access
- Potential exposure to workers
- Potential environmental impacts

Every effort must be made to ensure the selection of investigation method(s) minimizes the generation of IDW, contact with contaminants, and cost of disposal. It is important that the TL share information about site contaminants and expected IDW with the contractor's Health and Safety Officer (HSO) and Hazardous Waste Coordinator well in advance of site startup. This will better ensure that the upfront work can be done to minimize and dispose of IDW efficiently and in compliance with applicable regulations. Efforts made to characterize IDW will be consistent with the scope and purpose of the site investigation.

### 3.0 DESCRIPTION

#### 3.1 Regulatory Background and Options for Managing IDW

##### 3.1.1 Regulatory References

This SOP provides information that is based on the rules, regulations, and guidance documents summarized in Table 1 of Appendix A.

##### 3.1.2 IDW Management Options

The National Oil and Hazardous Substances Contingency Plan (NCP) requires that management of IDW generated during site investigations complies with all applicable or relevant and appropriate requirements (ARARs) to the extent practicable unless a waiver



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is granted. Potentially applicable provisions for IDW management at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites are listed in the following ARARs: the Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), Clean Air Act (CAA), Toxic Substances Control Act (TSCA), Clean Water Act (CWA), and other state laws.

Typical options for handling IDW include immediate disposal or interim management at the end of which the IDW is either: (1) returned to its source or (2) treated, disposed, or stored elsewhere. The contractor's TL in conjunction with the ERT WAM is required to select options for IDW management that are protective of human health and the environment and comply with or waive the ARARs. The most important general elements of managing IDW are as follows:

- Leaving a site in no worse condition than existed prior to the investigation
- Removing those wastes that pose an immediate threat to human health or the environment
- Leaving on site those wastes that do not require off-site disposal or long-term above-ground containerization
- Complying with federal and state ARARs to the extent practicable (OERR, 1991)
- Planning and coordination for IDW management
- Minimizing the quantity of wastes generated

The specific elements of the approach are as follows:

- Characterizing IDW through the use of existing information (manifests, Safety Data Sheets (SDSs), previous test results, knowledge of the waste generation process, and other relevant records) and best professional judgment.
- Delineating an area of concern (AOC) unit for leaving RCRA hazardous soil cuttings within the unit.
- Containerizing RCRA hazardous groundwater, decontamination fluids, personal protective equipment (PPE), and disposable sampling equipment (if generated in excess of 100 kilograms [kg]/month) and disposing of it at RCRA Subtitle C facilities.
- Leaving on site RCRA nonhazardous soil cuttings, groundwater, and decontamination fluids preferably without containerization and testing.

The U.S. EPA does not recommend the removal of wastes from all sites and, in particular, from those sites where IDW does not pose any immediate threat to human health or the environment.

Based on this information and the guidelines included in the following sections, the ERT contractor's TL should include a plan for handling IDW in the QAPP. Any deviations from or modifications to the plan due to unexpected or unforeseen field conditions must be documented using a field change form and noted in the site logbook.



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## INVESTIGATION-DERIVED WASTE MANAGEMENT

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### 3.2 Characterization of IDW

#### 3.2.1 Types of IDW

IDW can be divided into investigation-derived environmental media, debris, and other materials. The U.S. EPA uses the term environmental media to describe soil, sediment, surface water, and groundwater or a mixture of such materials (61 Federal Register 18780, 18783; April 29, 1996). Environmental media are not inherently waste but contaminated environmental media becomes a waste if it cannot be returned to its source. The definition of environmental debris found in 40 Code of Federal Regulations (CFR) 268.2(g) and includes: solid material, particles that exceed 60 millimeters (mm), and materials intended for disposal. IDW may therefore include, but is not limited to, the following items:

#### Media

- Soil
- Sediment
- Bedrock
- Surface water
- Drill cuttings
- Purge water
- Development water

#### Debris

- Concrete, asphalt, building materials, etc.
- Slag
- Used glassware
- Clean trash
- PPE
- Decontamination equipment (buckets, brushes, clothing, tools, etc.)
- Field analytics waste (immunoassay, chlor-n-oil, chlor-n-soil, HACH kits, sample extracts, etc.)
- Dedicated/expendable equipment (bailers, fitters, hose, buckets, x-ray fluorescence [XRF] cups, etc.)

#### Other Materials

- Sludge
- Drum solids
- Biological tissue
- Drilling fluids
- Fluid and sludge from the dewatering of drilling mud
- Decontamination fluids

#### 3.2.2 Hazardous IDW

To handle IDW properly, the ERT contractor's TL must know whether it contains CERCLA hazardous substances as defined under Section 101(14) and whether those



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substances are RCRA hazardous wastes or contaminants regulated under other statutes such as TSCA, CWA, CAA, and SDWA. The complete list of CERCLA hazardous substances is found at 40 CFR 302.4. To handle IDW in compliance with regulations, reasonable efforts should be made to characterize it. However, these efforts should be consistent with the scope and purpose of the site investigation.

Contaminated environmental media is not solid waste (i.e. because it was in place and not discarded), cannot be considered RCRA hazardous waste (i.e., because it is not solid waste), but is subject to regulation under RCRA Subtitle C when it contains hazardous waste. The “contained-in” policy requires environmental media to be managed as hazardous waste when it is mixed with listed hazardous constituents (F-, K-, P-, or U-codes identified under 40 CFR 261.31 to 261.33) at concentrations above health-based levels or is mixed with enough hazardous constituents that it exhibits one of four hazardous characteristics (ignitability, corrosivity, reactivity, or toxicity) based on comparison of analytical results to limits established in 40 CFR 261.21 to 261.24. Once the characteristic is eliminated (i.e., through treatment), the environmental media is no longer considered to contain hazardous waste and be subject to RCRA regulations. A formal “contained-out determination” is not required because the determination can be easily made through analytical testing. However, in the case of environmental media that are no longer contaminated by high concentrations of a listed hazardous waste, EPA recommends that the Regions or authorized states make the “contained-out determination” using site-specific health-based standards. Environmental media that contained listed hazardous waste when first generated (i.e., removed from the ground) remain subject to Land Disposal Restriction (LDR) regulations known as Universal Treatment Standards (UTS) following an approved “contained out determination”, except under certain circumstances.

The “contained-in” policy also applies to debris contaminated with RCRA-listed hazardous waste (51 Federal Register 37225, August 18, 1992), which must be handled as hazardous material until it no longer contains hazardous waste at concentrations above health-based levels [40 CFR 261.3(f)(2)]. Hazardous contaminated debris are also subject to LDR standards. Hazardous debris treated to comply with those standards would no longer be subject to RCRA regulation if the debris does not exhibit any hazardous waste characteristics. Agency action is not required; a “contained-out determination” is automatic.

A combination of solid IDW, such as sludge or drum solids, and listed or characteristic waste is considered a mixture under the “mixture rule”. Mixtures of solid IDW and listed wastes are RCRA hazardous wastes under 40 CFR 261.3(a)2(iv).

### 3.2.3 Polychlorinated Biphenyl-Containing IDW

Management of IDW contaminated with polychlorinated biphenyls (PCBs) involves compliance with the requirements for PCB remediation waste as specified in the TSCA PCB regulations at 40 CFR 761.50(b)(3) and 761.61. However, PCBs mixed with RCRA hazardous waste become RCRA regulated material. Waste materials containing PCBs as the result of a spill, an intentional or accidental release or uncontrolled discharges of PCBs or other unauthorized disposal of PCBs is called PCB remediation waste which is managed at its “as-found” PCB concentration. Most of the PCB remediation waste encountered during site investigations consists of “bulk PCB remediation waste” (including, but not limited to, existing piles of soil, in-situ soil, sediments, dredged materials, muds, PCB



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sewage sludge, and industrial sludge) or “liquid PCBs” (homogeneous, flowable material containing PCBs and no more than 0.5 percent (%) by weight non-dissolved material).

### 3.2.4 Asbestos-Containing IDW

Asbestos-containing IDW is most likely to be derived from building, landfill, or fill materials during Superfund site investigations. However, soil and rock may also contain naturally-occurring asbestos (NOA) at some sites. Asbestos-containing material (ACM) as defined in the National Emission Standards for Asbestos, found in Subpart M of the National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61, consists of: Category I and Category II nonfriable ACM containing greater than 1% asbestos as analyzed using polarizing light microscopy (PLM). Office of Solid Waste and Emergency Response (OSWER) Directive 9345.4-05 (Clarifying Cleanup Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups, EPA, August 2004) indicated that the 1% definition may not be reliable for assessing potential human health hazards from asbestos-contaminated soils at Superfund sites and that a risk-based, site-specific action level is generally more appropriate. Furthermore, OSWER Directive 9200.0-68 (Framework for Investigating Asbestos-Contaminated Superfund Sites, EPA, September 2008) indicated that accurate quantification is very difficult when the asbestos content of soil is less than 1% PLM and that the results should be interpreted semi-quantitatively.

U.S. EPA does not classify ACM as hazardous waste under RCRA; however, it can be designated a hazardous waste if it is located in a state that regulates asbestos (e.g., California classifies ACM as hazardous waste if it is friable [i.e., can be reduced to powder or dust under hand pressure when dry] and contains 1% or more asbestos). State solid waste regulations generally have asbestos handling and disposal requirements and the states determine which landfills can accept ACM. If the landfills accept regulated ACM (i.e., friable ACM; Category I nonfriable ACM that have become or will become friable or have been subject to grinding, cutting, abrading or burning; or Category II nonfriable ACM that have a high probability of becoming or that have become crumbled, pulverized, or reduced to powder due to work practices used during the course of demolition or renovation), they must comply with Asbestos NESHAP requirements.

### 3.2.5 Non-Hazardous IDW

Non-hazardous IDW is waste that does not meet the EPA’s definition of hazardous waste.

Even if the IDW does not contain RCRA hazardous waste, the ERT contractor’s TL should determine whether the IDW contains other CERCLA hazardous substances. CERCLA hazardous substances include, in addition to RCRA hazardous wastes, substances, elements, compounds, solutions, or mixtures designated as hazardous or toxic under CERCLA itself or under the authority of other laws such as TSCA, CWA, CAA, and SDWA. Therefore, even if RCRA is not applicable, one of these statutes may be.



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### 3.3 Management of IDW

#### 3.3.1 Waste Minimization

The ERT contractor's TL will obtain input from their HSO and Hazardous Waste Coordinator to support selection of site investigation methods that minimize the generation of IDW, particularly TSCA or RCRA hazardous wastes. The site investigation team should limit contact with contaminants and use drilling and decontamination methods (such as steam cleaning) that minimize PPE, disposable equipment, decontamination fluids, and soil cuttings. In particular, the inspection team should minimize the amounts of solvents used for decontamination or eliminate solvents altogether. Minimizing the amount of wastes generated reduces the number of IDW handling problems and costs of disposal.

#### 3.3.2 Types, Hazards, and Quantities of IDW

Extensive testing of the IDW is not warranted in most cases; instead, the nature of the wastes should be assessed by applying professional judgment, using readily available information about the site (such as Safety Data Sheets, manifests, storage reports, process descriptions, preliminary assessments, and results of earlier studies), as well as direct observation of the wastes for discoloration, odor, or other indicators of contamination. Similarly, RCRA procedures for determining whether a waste exhibits RCRA hazardous characteristics do not require testing if the decision can be made by applying knowledge of the characteristic in light of the materials or process used. In most instances, a determination may be made based on available information and professional judgment. This does not mean that IDW can be assumed to be nonhazardous unless clearly proven otherwise. Given the limited information available, the ERT contractor's TL, in conjunction with the ERT WAM, must determine whether it more likely than not that the wastes are hazardous.

To handle IDW properly, the contractor's TL must determine the types (such as soil cuttings, groundwater, decontamination fluids, PPE, or disposable equipment), characteristics (whether RCRA hazardous or containing other CERCLA hazardous substances), and quantities of anticipated wastes. As discussed previously, testing will generally not be required to characterize IDW if available information indicates that it does not likely contain hazardous waste or hazardous constituents.

Upon determining the types of anticipated IDW, the contractor's TL should determine IDW characteristics, in particular whether it is expected to be RCRA hazardous or to contain high concentrations of PCBs. For RCRA hazardous IDW (listed or characteristic), the contractor's TL should determine whether it poses an increased hazard to human health and the environment relative to conditions that existed prior to the site investigation. Field analytical screening results, if available, may be helpful indicators of IDW characteristics. However, the contractor's TL must remember that these are not RCRA tests and that the test results usually do not identify RCRA hazardous wastes. The contractor's TL must also determine the exact properties of RCRA nonhazardous IDW to select an appropriate disposal facility when the off-site disposal is required.

Upon determining the type and characteristics of IDW to be generated, the ERT contractor's TL must assess the anticipated quantities of waste. This should be done based on past experience with site investigations of similar scope.



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### 3.3.3 On-Site IDW Handling Options

In planning the scope of work, the ERT contractor's TL must decide if IDW can be left on site or if it must be disposed off-site. Handling of RCRA hazardous IDW and IDW with high PCB concentrations (greater than 50 parts per million [ppm]) may involve either moving the IDW within an AOC unit, or containerization, storage, testing, treatment, and off-site disposal. It is preferable to leave both RCRA hazardous and nonhazardous IDW on site within an AOC unit whenever it complies with regulations, does not pose any immediate threat to human health and the environment, or there is not a high probability of serious community concerns. The contractor's TL must determine procedures for handling IDW on site in conjunction with the WAM.

#### **RCRA Nonhazardous IDW**

If IDW are RCRA nonhazardous soil or water, they should be left on site unless other circumstances, such as state ARARs or a high probability of serious community concerns, require off-site disposal. RCRA hazardous soil also may be left on site. The on-site handling options available when IDW are RCRA nonhazardous are listed below.

For soil cuttings:

1. Spread around the well.
2. Put back into the boring.
3. Put into a pit within the AOC.
4. Dispose of at the site's operating treatment/disposal unit (TDU).

For groundwater:

1. Pour onto ground next to well to allow infiltration.
2. Dispose of at the site's TDU.

For decontamination fluids:

1. Pour onto ground (from containers) to allow infiltration
2. Dispose of at the site's TDU.

For decontaminated PPE and disposable equipment:

1. Double bag and deposit the bags on the site or in a U.S. EPA dumpster, or in any municipal landfill.
2. Dispose at the site's TDU if available.

#### **RCRA Hazardous IDW**

If IDW are considered RCRA nonhazardous due to lack of information on the waste hazard, the ERT contractor's TL should have an alternate plan for handling IDW if field conditions indicate that these wastes are hazardous. In such a case, there should be an adequate number of containers available for collecting groundwater, decontamination water, soil cuttings, etc.



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If IDW consists of RCRA hazardous soils that pose no immediate threat to human health and the environment, plan on leaving it on site within a delineated AOC unit. However, one must also consider the proximity of residents and workers in the surrounding area and use best professional judgment to make these decisions. Planning for leaving RCRA hazardous waste on site involves:

- Delineating the AOC unit.
- Determining pit locations close to the borings within the AOC unit for waste burial.
- Covering hazardous IDW in the pits with surficial soil.
- Not containerizing and testing wastes designated to be left on site.

Another alternative for handling RCRA hazardous soil is disposal in a TDU located on the same property as the AOC under investigation. If the TDU is outside the AOC, it must comply with the off-site policy. If any decontamination fluids are generated which are RCRA hazardous wastes, they should be disposed off-site in compliance with the off-site policy or in compliance with the conditionally exempt small quantity generator exemption. Small quantities (i.e., no more than 100 kg/month) of decontamination fluids may be containerized prior to delivery to a hazardous waste facility.

### 3.3.4 Options Available for Off-Site Disposal of IDW

IDW should be disposed of off-site in the following situations:

- When identified as RCRA hazardous water
- When identified as RCRA hazardous soil that may pose a substantial risk if left at the site
- When identified as RCRA hazardous PPE and disposable equipment
- If leaving them on site would create increased risks at the site

RCRA nonhazardous wastes could be disposed off-site at appropriate RCRA nonhazardous facilities that are in compliance with CERCLA section 121(d)(3) and off-site policy when it is necessary to comply with legally enforceable requirements such as state ARARs that preclude on-site disposal. IDW designated for off-site disposal must be properly containerized, tested, and stored before pick up and disposal. Decontaminated PPE and disposable equipment should be double-bagged if sent to an off-site dumpster or municipal landfill.

Planning for off-site disposal should include the following guidelines:

- Informing the WAM that containerized IDW may be temporarily stored on site while awaiting pick up for off-site disposal
- Initiating the procurement process for IDW testing, pick up and disposal
- Coordinating IDW testing and pick-up activities
- Preparing adequate numbers and types of containers. Drums should be used for collecting small amounts of IDW. Larger amounts of soil and water can be contained in Baker tanks, poly tanks, and bins. PPE and disposable equipment should be double-bagged for disposal at a municipal landfill or collected in drums for disposal at a hazardous waste facility.
- Designating a storage area (either within the site's existing storage facility, existing



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fenced area, or within a temporary fence constructed for the site investigation). No humans, children in particular, may have access to the storage area.

All IDW shipped off site, whether RCRA hazardous or not, must go to facilities that comply with the RCRA disposal policy, and the ERT contractor's TL, in conjunction with their Purchasing Department, must verify that the facilities operate in accordance with this policy.

### 3.4 Equipment/Apparatus

Equipment, materials, and supplies needed for containerizing IDW are generally selected based on waste characteristics or constituents. Other considerations include the ease of decontaminating or disposing of the equipment. Most equipment and supplies can be easily procured. For example, 5-gallon buckets, plastic bags, etc. can help segregate contaminated materials. Contaminated liquid can be stored temporarily in metal or plastic cans or drums.

#### 3.4.1 Waste Disposal

- Trash bags
- Trash containers
- 55-gallon drums or 5-gallon pails
- Metal/plastic buckets/containers for storage and disposal of decontamination solutions

#### 3.4.2 Decontamination Equipment

- Drop cloths of plastic or other suitable materials
- Large galvanized tubs
- Wash solutions
- Rinse solutions
- Long-handled, soft-bristled brushes
- Paper or cloth towels
- Metal or plastic cans or drums
- Soap or wash solution

## 4.0 RESPONSIBILITIES

### 4.1 ERT Work Assignment Manager

The ERT WAM is responsible for providing technical expertise and technical direction to the contractor, preparing task orders/work assignments, reviewing deliverables, interacting with the Regional customers and monitoring the financial and administrative management of the project.

### 4.2 ERT Contractor's Task Leader

The contractor's TL becomes familiar with the available site history, sampling process and the waste(s) generated before and during field activities. Ensures proper storage/containerization of IDW so it is protected from the elements, covered except for when waste is added, and accessible by equipment needed to remove it. Takes samples of waste(s) for analysis if needed. Provides a physical description of the waste(s) and works closely with the hazardous waste coordinator to



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complete waste profiles. They share site history, known contaminants, information about likely IDWs with their HSO and Hazardous Waste Coordinator well in advance of site mobilization. This would not apply to emergency responses with rapid start-up.

### 4.3 ERT Contractor's Health and Safety Officer

The contractor's HSO works with the contractor's TL and Hazardous Waste Coordinator to ensure that IDW management is compliant with applicable regulations. The HSO works with the TL to convene meetings as necessary to ensure necessary parties participate and that necessary investigation and planning are conducted in advance of field work to determine proper disposition of IDWs.

### 4.4 ERT Contractor's Hazardous Waste Coordinator

Obtains the federal hazardous waste generator identification number from the ERT WAM if needed. Contracts a reputable waste disposal service, completes waste profiles, and schedules waste removal. Requests additional analysis if required. Complies with Off-Site Rule 40 CFR 300.440. Reviews all paperwork for accuracy prior to signature by the ERT WAM. Maintains documentation in an organized file for all IDW removed. Provides ERT WAM with copies of manifests, Off-Site Rule communications and waste profiles.

## 5.0 REFERENCES

U.S. EPA, Management of Investigation-Derived Wastes During Site Inspections, Office of Emergency and Remedial Response Directive 9345.3-02, May 1991.

U.S. EPA, Guide to Management of Investigation Derived Wastes, Office of Solid Waste and Emergency Response Memorandum 9345.3.03FS, January 1992.

Code of Federal Regulations, Title 40, Part 261, Section 23, Section 11 (a) (3), and Section 24 (a) (b).

CFR Proposed Criteria: 51 FR 21685, June 30, 1986 and 51 FR 21450, May 20, 1992.

## 6.0 APPENDICES

This section is not applicable to this SOP.