Ohio Environmental Protection Agency

Division of Environmental Response and Revitalization Site Investigation Field Unit
March 2021

Field Standard Operating Procedures (FSOPs)

Table of Contents

FSOP 1.1 Initial Site Entry

FSOP 1.2 Utility Clearance

FSOP 1.3 Field Documentation

FSOP 1.4 Sample Identification Nomenclature

FSOP 1.5 Sample Custody and Handling

FSOP 1.6 Sampling Equipment Decontamination

FSOP 1.7 Investigation Derived Waste

FSOP 1.8 ODNR Well Logs and Well Sealing Reports

FSOP 1.9 Boring and Monitoring Well Decommissioning

FSOP 2.1.1 Discrete Soil Sampling

FSOP 2.1.2 Composite Soil Sampling

FSOP 2.1.3 Incremental Sampling for Soil and Sediments

FSOP 2.1.4 Sample Headspace Screening

FSOP 2.1.5 Soil Description Classification and Logging

FSOP 2.1.6 VOC Soil Sampling (Bulk Methods)

FSOP 2.1.7 VOC Soil Sampling (5035 Methods)

FSOP 2.2.1 Well Development

FSOP 2.2.2 Ground Water Level Measurement

FSOP 2.2.3 NAPL Detection and Sampling

FSOP 2.2.4 Ground Water Sampling (General Practices)

FSOP 2.2.5 GW Sampling Inertial Lift (Check Valve) Pump

FSOP 2.2.6 Low Flow (Low Stress) GW Sampling

FSOP 2.2.7 GW Sampling Using a Bailer

FSOP 2.2.8 GW Sampling Using a Bladder Pump

FSOP 2.2.9 GW Sampling Using a Peristaltic Pump

FSOP 2.2.10 GW Sampling Using an Electric Submersible Pump

FSOP 2.2.11 Sampling Water Supply Systems

FSOP 2.2.12 Field Filtering of GW Samples

FSOP 2.3.1 Surface Water Sample Collection

FSOP 2.3.2 Sediment Sample Collection

FSOP 2.4.1 Procedures for Active Soil Gas Sampling

FSOP 2.4.2 Install and Decom of Sub-Slab Vapor Ports

FSOP 2.4.3 Procedures for Collection of Indoor Air Samples

- FSOP 2.4.3 Attachment 1 Procedures for Collection of Indoor Air Samples_Indoor Air Bldg and Sampling Form
- FSOP 2.4.3 Attachment 2 Procedures for Collection of Indoor Air Samples_Instructions for Bldg Occupants Prior to IA Sampling
- FSOP 2.4.3 Attachment 3 Procedures for Collection of Indoor Air Samples_Vapor Sampling Data Sheet

FSOP 3.1.1 Photoionization Detector

FSOP 3.1.2 Multiple Gas Detection Meter

FSOP 3.1.3 Interface Meter

FSOP 3.1.4 Electronic Water Level Indicator

FSOP 3.1.5 Water Quality Meter

FSOP 3.1.6 Radiation Detection Meters

FSOP 3.1.7 X-Ray Fluorescence Analyzer

FSOP 4.1 Global Positioning Systems

FSOP 4.2 Down-Hole Well Cameras

FSOP 4.3 Magnetic Locating Instruments

FSOP 4.4 Electromagnetic Geophysical Sensor

Initial Site Entry
FSOP 1.1 (April 29, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

This field standard operating procedure (FSOP) helps ensure the safety of Division of Environmental Response and Revitalization (DERR) and other Ohio EPA personnel during initial entry into uncontrolled hazardous waste sites. While this FSOP is intended to address health and safety concerns generally associated with uncontrolled hazardous waste sites, it does not necessarily address every health and safety concern that may be encountered at a specific site and is not intended to serve as a substitute for a site-specific health and safety plan (HASP). Additional precautions, equipment, and procedures may be needed in addition to those prescribed in this procedure to provide a safe working environment. The FSOP assumes the following circumstances and conditions for initial entry onto suspected waste sites, including initial entry for site reconnaissance:

1.1. Ohio EPA has obtained permission to access the site from the owner and tenant (or operator) as applicable, following DERR's most recent Site Access Legal Protocol.

1.2. An ongoing emergency response situation is not occurring at the site.

1.3. Level D personal protective equipment (PPE) will provide adequate protection for Ohio EPA personnel entering the site, based on the review of available site data related to health and safety concerns (*i.e.,* conditions necessitating Level A, B, or C PPE cannot exist or be reasonably expected to occur during site entry).

1.4. During the initial site visit, Ohio EPA will not be performing any subsurface sampling (see FSOP 1.2 Utility Clearance). In some scenarios, limited sampling (*e.g.,* indoor air, surface water, etc.) may be appropriate.

1.5. If, based on historical knowledge of the site, radioactivity is expected to be present, the initial site entry team will consult with management prior to entry, and with ODH as appropriate. For initial site entry purposes, the team will utilize a radiation detection meter at the site (also see FSOP 3.1.6 Radiation Detection Meters).

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Reference Ohio EPA Standard Safety Operating Procedure Number SP11-19 (Working Alone) and OSHA 1910.120 and talk with management to determine if working alone for an initial site entry is appropriate given the site-specific circumstances and conditions.

3.2 **Never** enter an OSHA-defined confined space for any reason during an initial site entry or during any other field activity event. Contact management and the Agency Safety Coordinator to discuss the site and to identify appropriately trained staff to enter confined spaces for reconnaissance or sampling activities in accordance with Ohio EPA Standard Safety Operating Procedure Number SP14-4 (Confined Space Entry).

4.0 Procedure Cautions

Not applicable

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Field Communication / Field Documentation / Health and Safety References

6.1.1 Camera
6.1.2 Cell phone
6.1.3 Emergency contact information (hospital, police, fire department, etc.)
6.1.4 Field logbook or unbound log sheets
6.1.5 Site access agreement or documentation
6.1.6 Site background information (documenting the conditions expected)
6.1.7 Site contact information
6.1.8 Site Entry Atmospheric Action Levels (Table 1) and other reference guides (*e.g.,* National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards)
6.1.9 Site-specific HASP, if available

6.2 Level D PPE

6.2.1 Clothing appropriate for anticipated field conditions
6.2.2 Eye protection (to be worn when necessary)
6.2.3 First aid kits (including sunscreen, insect repellant, etc.)
6.2.4 Hard hat (to be worn when necessary)

6.2.5 Hearing protection (to be worn when necessary)
6.2.6 Protective gloves appropriate for expected field conditions or potential hazards
6.2.7 Safety boots

6.3 Atmospheric Monitoring Instruments (to evaluate site safety, as necessary, based on conditions anticipated or encountered)

6.3.1 Radiation survey meter
6.3.2 Lower explosive limit (LEL)/oxygen (O_2) meter
6.3.3 Photoionization detector (PID) or flame ionization detector (FID)
6.3.4 Other monitoring instruments appropriate for the expected site conditions, e.g., a carbon monoxide meter, colorimetric (chemical compound-specific) detector tubes, hydrogen sulfide meter, and/or a particulate meter.

7.0 Procedures

7.1 If a site-specific health and safety plan (HASP) has been prepared, review the HASP prior to the initial site entry to understand the hazards associated with the site.

7.2 If a site-specific HASP has not been prepared, review all available site information related to health and safety to evaluate the potential hazards that may be associated with the site.

7.3 If required, ensure that atmospheric monitoring instruments are calibrated and operating properly; refer to instrument-specific equipment manuals and/or FSOPs as necessary.

7.4 Unless otherwise directed (see Section 3.1), include at least two persons on the initial site entry team, preferably both Ohio EPA staff members.

7.5 Systematically search the site for potential physical, chemical, biological, and radiological hazards as necessary and use air monitoring equipment as needed to ensure that atmospheric conditions do not exceed Site Entry Atmospheric Action Levels (Table 1) or any action levels provided in the NIOSH Pocket Guide to Chemical Hazards.

7.6 If Level D PPE is adequate, perform additional tasks as necessary (*e.g.,* marking sampling locations, GPS surveying, photographing site features).

7.7 If the site conditions encountered require a greater degree of protection than that provided by Level D PPE:

7.7.1 Leave the site immediately.

7.7.2 Revise the site-specific HASP (or develop a site-specific HASP) before reentering the site. Only staff cleared to wear respiratory protection can enter or re-enter the site if respiratory protection is required.

7.8 If radioactive materials are encountered, leave the site immediately and contact management first, and ODH as appropriate, to discuss the site before reentry.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

Table 1, Site Entry Atmospheric Action Levels

11.0 References

DERR's Revised Site Access Legal Protocol

FSOP 1.2, Utility Clearance

FSOP 1.3, Field Documentation

Ohio Administrative Code 3701:1-38-13(A)(2)

Ohio EPA Standard Safety Operating Procedure Number SP11-19 (Working Alone)

Ohio EPA Standard Safety Operating Procedure Number SP14-4 (Confined Space Entry)

Ohio Revised Code 3781.25(H)

National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards (available online at http://www.cdc.gov/niosh/npg/)

TABLE 1, SITE ENTRY ATMOSPHERIC ACTION LEVELS

Atmospheric Hazard	Monitoring Equipment	Action Level	Response
Explosive Atmosphere	Lower Explosive Level (LEL) Meter (a.k.a. Combustible Gas Indicator, or CGI)	< 10% LEL	Continue monitoring.
		10%-25% LEL	If outdoors, continue monitoring with caution. If within a structure, explosion hazard. Exit structure.
		> 25% LEL	Explosion hazard, leave site.
O_2 Deficient Atmosphere	Oxygen (O_2) Meter	< 19.5% O_2	Leave site, LEL readings are not valid; toxic vapors or explosive gas may be displacing oxygen.
O_2 Enriched Atmosphere		> 23.5% O_2	Leave site, LEL readings are not valid.
Volatile Organic Compounds (e.g., benzene, methyl-ethyl ketone, vinyl chloride)	Photoionization Detector (PID) or Flame Ionization Detector (FID)	> 1 ppm background in breathing zone	Leave site. (Reenter with appropriate PPE if qualified.)
Hydrogen Sulfide (H_2S)	Hydrogen Sulfide (H_2S) Meter	> 10 ppm	Leave site.
Carbon Monoxide (CO)	Carbon Monoxide (CO) Meter	> 35 ppm	Leave site.
Other Inorganic & Organic Gasses & Vapors	Compound-specific monitoring equipment; consult the NIOSH Pocket Guide to Chemical Hazards for action levels and responses.		
Particulate Matter	Particulate Meter	Compound-specific monitoring equipment and site-specific circumstances; consult the NIOSH Pocket Guide to Chemical Hazards for action levels and responses.	
Radiation	Radiation Survey Meter or Dosimeter	< 2 millirem (mrem)/hr above background	Continue monitoring.
		> 2 millirem (mrem)/hr above background	Leave site and notify ODH.

<u>Utility Clearance</u>
FSOP 1.2 (April 29, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Underground utility clearance must be requested prior to conducting hand or mechanical excavation of soil or sediment per Ohio Revised Code (ORC) 3781.25(I).

1.2 The entity conducting the excavation/drilling work (*e.g.,* the excavator) must coordinate underground utility clearance. Utility clearance for work performed by Division of Environmental Response and Revitalization (DERR) staff may be coordinated by the DERR Site Investigation Field Unit (SIFU) staff or a DERR district office site coordinator or inspector. (See Section 4.1 regarding notification requirements for the Ohio Utilities Protection Service (OUPS) if a contractor is performing the work.)

1.3 SIFU or the DERR district office staff responsible for submitting the utility clearance request will be responsible for retaining documentation of the requests, in electronic format, per Ohio EPA record retention schedules.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Contact with underground or overhead utilities may result in injury or death to personnel or the public, damage to or destruction of equipment or facilities, and/or damage to the environment.

3.2 If the site does not appear to have been cleared (*e.g.,* no evidence of flags or paint markings or notification of clearance), contact the appropriate underground protection service, utility and/or facility as applicable before proceeding with work.

3.3 If a utility line is hit or damaged, walk away immediately and clear the area of personnel and the public. Contact OUPS and the appropriate local utility companies (see Section 4.1). As appropriate and safe, expeditiously notify the property owner and the local government of the situation. Call 9-1-1 if there is any injury or potential threat for injury or if a substance is being released to air, such as natural gas, or if there is a fire, explosion, or a threat of fire or explosion.

4.0 Procedure Cautions

4.1 Ohio currently requires that the excavator notify the OUPS prior to excavation, drilling or other underground activities (See Section 7.1.1). Note that if an LOE or other contractor is performing the work, then that contractor must notify OUPS.

4.2 Many manufacturing plants and other facilities have their own internal underground utilities and infrastructure that are not covered by OUPS (see Section 7.3). Knowledgeable facility staff, such as a plant engineer, maintenance supervisor, or health and safety personnel, should be contacted if possible, to locate and clear any facility-owned underground utilities or infrastructure.

4.3 OUPS member utilities may not mark lateral or service connections from main utility lines to residences and commercial or industrial buildings (see Section 7).

4.4 Do not excavate within the tolerance zone, or "approximate location" of the underground utility without the supervision of the owning utility. The "approximate location" as defined in ORC 3781.25(D), is *"the site of the underground utility facility including the width of the underground utility facility plus eighteen inches on each side of the facility."* Any excavation within the tolerance zone should be performed with hand tools in a careful and prudent manner until the marked utility is exposed.

4.5 Additional utility investigation procedures, such as those described in Section 7.2, may be appropriate as supplemental procedures but may never be used in place of contacting OUPS. In case of a dispute in utility locations between a supplemental procedure and OUPS, or member utilities, contact OUPS or appropriate member utility for verification of utility locations.

4.6 DERR staff members are not authorized to perform underground utility clearance. Do not attempt to use SIFU's geophysical equipment or other DERR equipment to locate underground utilities (or to provide "supplemental" information) for utility clearance.

5.0 Personnel Qualifications

5.1 Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

5.2 It is strongly recommended that Ohio EPA personnel who request utility clearance for investigations attend safety training provided by OUPS so they have a solid understanding of utility clearance procedures.

6.0 Equipment and Supplies

Not applicable

7.0 Procedures

7.1 Contact the following underground protection services to clear utilities prior to excavation:

7.1.1 Contact OUPS at **8-1-1** or **(800) 362-2764** at least 48 hours [two (2) working days] but no more than 10 working days prior to digging. Working days do not include weekends or legal holidays. (As an alternative, OUPS may be contacted online using i-dig Newtin RTE. For more information on i-dig, see **www.oups.org**.)

7.1.1.1 Provide the necessary information as detailed on the attached OUPS Locate Work Order Form to OUPS to accurately locate site and/or work area. Let OUPS know if the sampling locations have been pre-marked (locations should be pre-marked with white paint and/or white flags). Also, let utility locator know if there is a distance around the marked location that should also be cleared (*e.g.,* 20 feet radius around marked location).

7.1.1.2 OUPS will provide notification to full membership utilities to mark or clear utilities.

7.1.1.3 OUPS will provide a ticket number for the location request. Make sure to record the ticket number in the site-specific work plan or other appropriate document accessible to personnel in the field. The entity that will be conducting the excavating/drilling activities may use OUPS Positive Response to check on the status of clearing or marking

7.1.1.4 If work does not begin within 10 working days of the request, another OUPS utility location request must be made.

7.1.1.5 Underground utility lines may be marked by utility companies or their locating services with flags or paint or both. Color codes for marking utilities are shown on the attached OUPS Utility Color Code Guide.

7.1.1.6 Work may continue until markings are no longer visible. If markings are no longer visible, OUPS must be contacted to remark utilities.

7.1.1.7 If the site is vacant, a sign with the street address may need to be posted so that OUPS can locate the site.

7.2 In addition to contacting OUPS, the use of a private utility locator service should be considered. This is especially applicable for large sites where OUPS does not locate facility-owned underground utilities, where site areas are located away from utility main lines, or at sites where the past land uses and industrial or commercial activities are not well known. This may also be applicable for sites involving residential properties.

7.3 If at a manufacturing plant or other facility, contact knowledgeable facility staff such as a plant engineer, maintenance supervisor, or health and safety personnel to locate any facility-owned underground utilities or infrastructure for utility clearance (please refer to paragraph 4.2).

8.0 Data and Records Management

Not applicable

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

Ohio Utility Protection Service Locate Work Order Form

Ohio Utility Protection Service Utility Color Code Guide

American Electric Power Ohio Public Safety Fact Sheet

11.0 References

Ohio Revised Code 3781.25(D) and 3781.25(I)

O.U.P.S. LOCATE WORK ORDER

CALL 48 HOURS BEFORE YOU DIG – 800-362-2764

COLOR CODES: Red = Electric Orange = Phone/Cable TV Yellow = Gas Blue = Water Green = sewer
White = Proposed Excavation

COMPLETING ENTIRE FORM HELPS TO ENSURE A MORE ACCURATE AND TIMELY LOCATE

Contact Phone # ______________________ Caller Name ______________________

Company Name ____________________________________

Fax __________________________ Email ____

County ___________________________ City/Township __________________________

Address/Location of Work____

Extent of Work: Front/Sides/Rear __________________Farthest Distance/Direction back off Road _____

Lot # _________ Subdivision _____________________________Builder Name _______________

Cross / Between Streets ____

Distance & Direction from Cross Street ____

Date of Excavation ______________________ Start Time of Excavation________________________

Type of Work ____

Working for Company ________________________Work Done By Company ___________________

___________Means of Excavation ____ Blasting ____ Pre Markings ____ Meet

____ RR Right of Way ____Highway Mile Marker At/From _________________________

Comments____

OUPS TICKET NUMBER ________________________________

Dig Safely.

COLOR CODES FOR LOCATING UTILITY LINES

RED	Electric Power Lines, Cables, Conduit and Lighting Cables
YELLOW	Gas, Oil, Steam, Petroleum, or Gaseous Materials
ORANGE	Communication, Alarm or Signal Lines, Cables or Conduit
BLUE	Potable Water
PURPLE	Reclaimed Water, Irrigation and Slurry Lines
GREEN	Sewers and Drain Lines
PINK	Temporary Survey Markings
WHITE	Proposed Excavating

Tolerance Zone: Width of Underground Facility Plus 18" on Each Side.

OHIO Utilities Protection SERVICE

Call Before You Dig

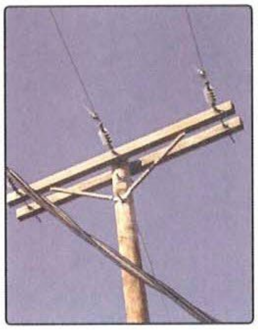
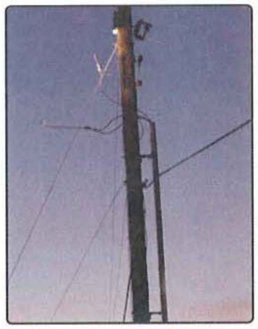
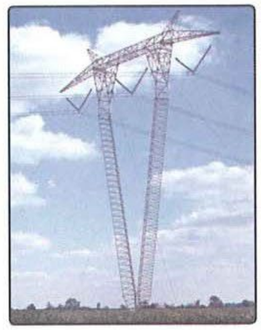
1-800-362-2764

www.oups.org

Public Safety

Look Up for Lines

Keep a Safe Distance from All Overhead Power Lines


Most contact with overhead power lines is accidental, but can result in severe injuries and even death. Fortunately, most, if not all, electrical accidents can be prevented. Before you begin any job, whether it's installing a TV antenna on your roof or constructing a new building, it's important to be aware of power line locations and the necessary safety precautions.

Working Around Electricity

Electricity always attempts to travel to the ground and will follow all paths to get there. If a conductor of electricity becomes available, the electricity will follow that path to ground. Tools and equipment you use, and even your own body, are excellent conductors.

What does this mean? Let's say you're using a ladder to do some work around your house. If that ladder accidentally touches an overhead power line, the ladder (and you) could become the path for the electricity, sending electricity through the ladder and your body, which can cause severe injuries or even death.

Minimum Clearances

Always look up first for overhead power lines. If you see some in the area, there is a MINIMUM clearance of 10 feet which should be maintained. The minimum clearance increases as the voltage increases. Minimum clearances also can be affected by weather conditions, the type of work being performed, the equipment being used and other factors. Additional minimum clearances for various voltages are shown in this chart.

Line Voltage	Minimum Clearances
Up to 50,000 volts	10 feet
50,000 to 200,000 volts	15 feet
200,000 to 350,000 volts	20 feet
350,000 to 500,000 volts	25 feet
500,000 to 750,000 volts	35 feet
750,000 to 1,000,000 volts	45 feet

Equipment and Overhead Lines

- Use a clean, dry wood or fiberglass ladder if electric lines are anywhere in the area. They are less likely to conduct electricity than a metal ladder.
- When installing an antenna, position it at least 1.5 times its total length away from power lines. If it starts to fall, let it go and stay clear.
- Be certain to maintain a safe clearance when the bed of a dump truck is raised.
- Know the minimum distance a crane can operate safely near a power line. Keep all parts of the crane and its load outside this area. If your crane does come in contact with an overhead line, don't leave the cab, call 9-1-1 and the power company immediately.
- Designate a worker responsible for signaling the crane operator when any part of the crane or its load approaches the minimum clearance limit. The worker should never touch the crane.
- Some jobs may require the line be de-energized to complete the task safely. The power company will work with you to determine if this is needed.
- Do not rely on proximity warning devices such as hook insulators or boom guards, because each has its limitations.
- Take time to plan any job and contact your local power company if you have any questions.

AEP OHIO
A unit of American Electric Power

For more public safety information, visit: http://www.AEPOhio.com

Field Documentation
FSOP 1.3 (April 29, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Accurate and complete field documentation of sampling and other field activities is critical for ensuring the technical integrity and legal defensibility of environmental site assessments, remedial investigations/feasibility studies, remedial activity implementations, facility investigations, program field audits, and other field activities.

1.2 Field documentation may include, but is not limited to the following:

1.2.1 Field logbooks or field log sheets (including any LOE field logs)
1.2.2 Activity-specific field forms
1.2.3 Chain-of-Custody (COC) forms
1.2.4 Photographs
1.2.5 Electronic data (*e.g.,* Global Positioning System (GPS)) location coordinates, water level data

1.3 For Contract Laboratory Program (CLP) projects, additional field documentation requirements are applicable. Contact the DERR Site Investigation Field Unit (SIFU) for assistance with CLP project requirements before field activities are initiated.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

Not applicable

4.0 Procedure Cautions

Not applicable

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Appropriate activity-specific field forms (as needed)
6.2 COC forms, sample labels, custody seals (as needed)

6.3 Clipboard
6.4 Digital camera
6.5 Field logbook or field log sheets (waterproof, when necessary)
6.6 Field scale or ruler (as needed)
6.7 GPS and data logging equipment (as needed)
6.8 Maps or site plans for reference and documentation
6.9 Pens and markers (waterproof, when necessary)
6.10 Small dry-erase board with dry-erase markers (for photograph identification)

7.0 Procedures

7.1 Field logbook/field log sheet documentation:

7.1.1 Document the following types of information for site assessment activities in the field logbook or on log sheets, as appropriate for site-specific work plan activities:

7.1.1.1 Site or project name
7.1.1.2 Site location/address
7.1.1.3 People and affiliation present
7.1.1.4 Date(s) and time(s) of field activities
7.1.1.5 Weather conditions
7.1.1.6 Ohio EPA personnel and other persons on-site
7.1.1.7 Health and safety field monitoring data (*e.g.,* LEL/O2 meter or PID readings)
7.1.1.8 General field observations
7.1.1.9 Photograph log
7.1.1.10 Interview notes
7.1.1.11 Problems or unexpected conditions encountered

7.1.2 If activity-specific field forms are not available, use a field logbook to document sampling and other field activities. Record all form-required information, which may include, but is not necessarily limited to the following types of information (generally in the following order):

7.1.2.1 Sampler's name(s)
7.1.2.2 Sample identification number (refer to FSOP 1.4, Sample Identification Nomenclature)
7.1.2.3 Sample collection date and approximate time
7.1.2.4 Sample location (narrative description as needed)
7.1.2.5 Sample matrix type (soil, sediment, groundwater, surface water, soil gas, etc.)
7.1.2.6 Depth intervals for soil samples
7.1.2.7 If required, the classification or description of soil samples
7.1.2.8 Sample type (grab, composite, duplicate, equipment blank, etc.)
7.1.2.9 Field screening data associated with the sample (*e.g.,* PID readings)

7.1.2.10 Laboratory parameters to be performed (*e.g.,* VOCs)

7.1.2.11 Sampling location photograph description/documentation

7.1.2.12 Any other relevant information needed to support the technical integrity or legal defensibility of the sampling process

7.2 The following activity-specific field forms should be used to document specific field activities:

7.2.1 Boring Log and Monitoring Well or Soil Gas Probe Construction Diagram
7.2.2 Ground Water Sampling
7.2.3 Monitoring Well Surveying
7.2.4 Monitoring Well Development
7.2.5 Vapor Intrusion Forms

7.3 Chain of Custody (COC) forms

7.3.1 Always complete a COC form when submitting samples to any laboratory for analyses.

7.3.2 If submitting samples to a DERR contract laboratory, contact the SIFU Laboratory Coordinator, a District Office Laboratory Coordinator, or the contract laboratory for specific instructions for completing COC forms.

7.3.3 If submitting samples to the Ohio EPA Division of Environmental Services (DES) laboratory, use DES COC forms. Contact DES for specific instructions on completing their COC forms.

7.3.4 For federal site assessment projects, use the required U.S. EPA Scribe sample management and reporting software program to create electronic COC forms for the U.S. EPA Contract Laboratory Program (CLP) sampling projects. DERR SIFU has access to the Scribe program.

7.3.5 For federal site assessment projects, vapor samples are to be sent to the U.S. EPA Analytical Services Branch (ASB) for analyses. ASB provides COC forms.

7.4 Photographic documentation

7.4.1 Take photographs to document site features and conditions that are relevant to the environmental site assessment process, including selected sampling locations and samples if necessary.

7.4.2 Log photographs as necessary for project documentation in the field logbook, log sheets, or on other suitable references (*e.g.,* maps or site plans) with respect location/orientation and subject matter.

7.4.3 Use digital cameras capable of embedding the locational, date and time data within the photograph file. It is strongly recommended not to take photographs with personal cell phones.

7.4.4 Site photographs are to be uploaded to the Ohio EPA photograph management system (*i.e.,* LYNX).

7.5 GPS data and other data logging documentation (*e.g.,* water-level or water chemistry dataloggers that may be used for aquifer testing and water quality evaluation). Site-specific file names are to be used for data files.

7.5.1 Create sample location identifications in accordance with FSOP 1.4, Sample Identification Nomenclature.

7.6 Retention of field documentation

7.6.1 Ensure that field documentation is properly filed for future reference. Always provide copies to the appropriate district office personnel.

7.6.2 Scan original copies of written field documentation so that electronic copies are readily available for transmission, review, and reference. Retain all original written field documentation and electronic copies at the appropriate district office.

8.0 Data and Records Management

Ensure that all field documentation records are managed in accordance with the Agency records retention policy. Also ensure that all field documentation records are maintained in compliance with Agency and DERR personally identifiable information (PII) policies.

9.0 Quality Assurance and Quality Control

The Superfund QAPP is to be referenced, primarily for federal site assessment activities.

10.0 Attachments

None

11.0 References

FSOP 1.4, Sample Identification Nomenclature

<u>Sample Identification Nomenclature</u>
FSOP 1.4 (April 29, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This procedure provides a standard nomenclature convention for environmental sample identification. The use of a standard convention facilitates the progress of field sampling activities, reduces the potential for confusion regarding sample identification, and improves the ease of reviewing laboratory analytical results.

1.2 Alternative sample identification conventions may be used for the following circumstances:

1.2.1 When the regulatory program under which the sampling work is being performed requires an alternative sample identification convention

1.2.2 At sites where sampling already has been performed and where use of an existing sample identification convention would promote consistency and help avoid potential confusion

1.2.3 When soil or sediment samples are collected using incremental or other composite sampling methodologies

1.2.4 At sites where unique sampling situations are found to exist.

1.3 If collecting environmental samples from a site with multiple parcels or multiple areas of contamination (*e.g.,* a Voluntary Action Program (VAP) property with multiple identified areas), qualifiers that identify the sample location (*e.g.,* parcel or VAP identified area) may be added to the sample identification nomenclature. Due to the wide variety of sites and circumstances associated with environmental assessments, such nomenclature is best developed and applied on a site-specific basis.

1.4 Anticipated deviations from this procedure should be documented in the site-specific work plan with a brief explanation of the reason(s) for the deviation.

1.5 Ohio EPA's Quality Assurance Project Plan (QAPP) for Targeted Brownfield Assessments (TBAs) requires the use of this procedure.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

Not applicable

4.0 Procedure Cautions

4.1 The geographic location (latitude and longitude) of each sampling location will be determined using Global Positioning System (GPS). Accordingly, sample identification does not typically need to incorporate information regarding geographic direction, e.g., adding “N” to the identification of a soil sample collected from the north side of an excavation.

4.2 Given concerns regarding personally identifiable information (PII), the use of property owner names and addresses in sample nomenclature should be carefully evaluated, particularly for federal site assessment sites.

4.3 Certain regulatory programs (*e.g.,* the U.S. EPA Contract Laboratory Program or CLP) may require the use of sample identification conventions that differ from those prescribed by this procedure.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA’s hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

Not applicable

7.0 Procedures

7.1 The sample identification consists of an abbreviation for the sample matrix type and a consecutive sample number separated by a hyphen, e.g., **SO-1** (soil sample number one) unless otherwise indicated. Environmental sample matrices and association abbreviations (**bold**) include the following:

7.1.1 Soil samples:

7.1.1.1 **SO** for soil samples collected using manual labor (*e.g.,* by scoop or hand auger) or from excavations; the **SO** abbreviation is followed by a consecutive sampling location number, a hyphen, and the approximate sample depth interval (expressed as tenths of feet) in parentheses, e.g., SO-1 (0.5-1.5ft)

7.1.1.2 **SB** for soil samples collected using drilling equipment; the **SB** abbreviation is followed by a consecutive boring location number, a hyphen, and the approximate sample depth interval (expressed as tenths of feet) in parentheses, e.g., SB-1 (0.5-1.5ft)

7.1.2 **SE** for sediment samples

7.1.3 **SW** for surface water samples

7.1.4 Ground water samples:

7.1.4.1 **MW** for monitoring well ground water samples

7.1.4.2 **GW** for ground water samples collected from an open borehole

7.1.4.3 If multiple samples are collected from a monitoring well or open borehole at different depths, add a designation at the end of the identification (*e.g.,* **MW-1(Shallow)**, **MW-1(Deep) or MW-1 (10.0-15.0ft)**, **MW-1 (20.0-25.0ft);** or **GW-1(Shallow)**, **GW-1(Deep)** or **GW-1 (10.0-15.0ft)**, **GW-1 (20.0-25.0ft)**

7.1.4.4 **RW** for ground water samples collected from residential water supply wells

7.1.4.5 **PW** for ground water samples collected from public water supply wells

7.1.4.6 For other types of wells (*e.g.,* remedial extraction wells, non-potable process water wells, irrigation wells) use a sample identification based on the well identification.

7.1.5 **LE** for leachate samples

7.1.6 **IA** for indoor air samples

7.1.7 **AA** for ambient air samples

7.1.8 **SS** for sub-slab vapor samples

7.1.9 **SG** for soil gas samples

7.1.10 **FP** for free product samples

7.1.11 **WA** for solid waste samples

7.1.12 Alternative sample nomenclature may be used for site-specific circumstances (*e.g.,* DRUM, TOTE, etc.).

7.2 Quality assurance/quality control (QA/QC) sample and blank identification consist of an abbreviation for the QA/QC sample or blank type and a consecutive sample/blank number separated by a hyphen, e.g., **FB-01** (field blank number one) unless otherwise noted. QA/QC samples/blanks and association abbreviations (**bold**) include the following:

7.2.1 Duplicate samples

7.2.1.1 **DUP** for duplicate samples, unless blind duplicates are required by the regulatory program (see 7.2.1.2). Duplicates may be numbered consecutively without reference to the sample from which the duplicate was split, e.g., **DUP-1** for a duplicate split from ground water sample MW-1, or identified by adding the suffix “DUP” to the identification of the sample from which the duplicate was split, e.g., **MW-1DUP** for a duplicate split from ground water sample MW-1.

7.2.1.2 Blind duplicates are duplicate samples, preferably split from the same container, which are numbered by the same convention as the other samples so that the laboratory does not know they are duplicates.

7.2.2 **FB** for field blanks

7.2.3 **EB** for equipment blanks

7.2.4 **TB** for trip blanks; if available, the date the trip blank was filled by the laboratory may be written in the “comments” section of the chain-of-custody form

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation

Sample Custody and Handling
FSOP 1.5 (May 6, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This procedure describes standard practices used by the Division of Environmental Response and Revitalization (DERR) for custody and handling of environmental samples (generally water, soil, sediment, soil gas, or air) prior to receipt by a laboratory. See the U.S. EPA Sampler's Guide (October 2014) for additional information, particularly with regard to federal site assessment activities.

1.2 A chain of custody (COC) form documents the exchange of samples from sampling personnel to the laboratory and supports the integrity and legal defensibility of the sampling process. The COC form generally includes the following information:

1.2.1 Project name and location
1.2.2 Sampler's name and contact information
1.2.3 Laboratory name and contact information
1.2.4 Sample number/identification
1.2.5 Date and time of sample collection
1.2.6 Grab or composite designation
1.2.7 Number and types of containers comprising a sample
1.2.8 Analytical methods and preservatives
1.2.9 Requested analytical turnaround time
1.2.10 Notes concerning samples
1.2.11 Sampler's signature
1.2.12 Signatures of individuals involved in the sample transfer (except for commercial shipping personnel)
1.2.13 Air bill or shipping number

1.3 Agency personnel are responsible for the care and custody of samples from the time of collection to the time the samples are relinquished directly to the laboratory or to a commercial shipper for transportation to the laboratory. U.S. EPA Sampler's Guide (October 2014) considers a sample "under custody" under the following conditions:

1.3.1 The sample is in possession.

1.3.2 The sample was in possession and then secured or sealed to prevent tampering.

1.3.3 The sample was in possession when placed in a secured area.

1.4 Proper packaging and prompt shipment of samples is important for the following reasons:

1.4.1 Protecting samples from temperature increases that may cause changes in analyte composition or concentration.

1.4.2 Reducing sample degradation from exposure to ultraviolet rays.

1.4.3 Reducing the chance of leaking or breaking of sample containers and exposure of field sampling or laboratory personnel to toxic substances.

1.4.4 Ensuring compliance with shipping regulations.

1.4.5 Minimizing the potential for sample theft or tampering.

1.4.6 Ensuring that analytical holding times for samples are met.

1.5 This procedure is consistent with certain Contract Laboratory Program (CLP) requirements that are generally accepted practices for sample custody and handling for environmental investigations. However, it does not meet all CLP requirements. It is the responsibility of the DERR Site Investigation Field Unit (SIFU) to meet all CLP project requirements before and after field sampling activities.

1.6 This procedure does not apply to shipping samples that are defined as a hazardous material (also referred to as dangerous goods, see the Dangerous Goods List, Section 4.2 IATA). If shipping a suspected hazardous material always contact appropriate management for assistance. Shipping hazardous waste samples may be excluded from hazardous waste requirements under OAC 3745-51-14 (D).

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Large sample coolers filled with environmental samples and ice typically weigh between 40 and 60 pounds. Always use proper lifting techniques, and if needed request assistance to avoid injuries.

3.2 Glass containers may break during sample handling and packing. Always handle glass containers with care and be aware of the potential for broken glass when packing or rearranging. Broken glass may cause cuts or lacerations. Seek medical attention if needed and/or use first aid kit for cuts or lacerations.

3.3 Strong acids or bases, e.g., HCl, HNO_3, H_2SO_4, and NaOH, are often used to preserve water samples. Skin or eye contact with preservatives or preserved samples may result in injury. Wear appropriate personnel protective equipment (e.g., gloves and eye protection) to avoid chemical burns. Use potable water to flush exposed areas and seek medical attention if needed. (*If directly exposed to a concentrated acid or base, seek medical attention immediately.)*

4.0 Procedure Cautions

4.1 Most environmental samples must be preserved on ice at 4^{o}C (+/-2^{o}C) to prevent sample degradation. Temperature-sensitive samples should be shipped same-day or next-day delivery to the laboratory.

4.2 Do not use “blue ice” packs for temperature preservation of environmental samples. Natural ice is more reliable for maintaining a sample temperature of 4^{o}C (+/-2^{o}C). Additionally, “blue ice” typically contains ingredients (e.g., propylene glycol or styrene) that could contaminate volatile organic compound (VOC) or semi-volatile organic compound (SVOC) samples if the packs leak during transportation.

4.3 Never place loose ice in a sample cooler being prepared for commercial shipment. If the ice melts and water leaks from the cooler during transit, shipment to the laboratory may be delayed or terminated. Always contain ice in sealable plastic bags or within a sealed heavy-duty plastic bag used as a cooler liner.

4.4 In limited circumstances, special handling and shipping requirements will apply to environmental samples containing concentrated preservatives. Some chemical preservatives are regulated as hazardous materials by U.S. Department of Transportation (U.S. DOT). Reference the Hazardous Materials Transportation Act (49 CFR 170-179) which provides detailed guidelines for shipping hazardous materials.

4.5 Each sample cooler should contain a separate COC form documenting only the samples being transported within that cooler. This practice maintains the COC for all samples in case of a lost or misrouted shipment. In addition, this practice helps prevent potential confusion when the samples are received and logged at the laboratory.

4.6 If shipping samples on a Friday for next-day delivery, inform the laboratory that the samples will be arriving on Saturday. Confirm the receiving address for the Saturday delivery, which may be different than the receiving address for sample delivery during weekdays. Note that some commercial shippers may also require a special air bill for Saturday delivery or “Saturday Delivery” labels on the shipping cooler.

4.7 If shipping samples with expedited turnaround times or analytical holding times less than seven days, e.g., unpreserved water samples for VOC analysis, contact the laboratory on the day that the samples are shipped and remind or inform them of the expedited turnaround times. Also, be aware that the holding times for some analytical methods are so short that the samples must be delivered to the laboratory via Ohio EPA staff or courier on the same day. For example, SW- 846 Method 7196A for hexavalent chromium in ground water or surface water has a 24-hour holding time. If in doubt about sample holding time requirements, contact SIFU personnel for assistance.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 COC forms
6.2 Clear tape (for securing and protecting completed labels on sample containers)
6.3 Custody seals
6.4 Custody tape
6.5 Duct tape (for packaging sample containers)
6.6 Environmental samples (in appropriate jars/containers) to be shipped
6.7 Large heavy-duty plastic bags (for use as sample cooler liners)
6.8 Ice
6.9 Knife or scissors
6.10 Packing materials (*e.g.,* bubble wrap, foam molds, laboratory-supplied materials)
6.11 Pens and markers, preferably waterproof
6.12 Sealable plastic bags (pint to two-gallon size for sample containers, COC forms, and/or ice)
6.13 Shipping coolers
6.14 Shipping (mailing) forms for air or ground delivery (unless samples are being delivered directly to the laboratory by an Ohio EPA staff member or courier)
6.15 Shipping labels for package handling (including but not necessarily limited to "Fragile," "This Side Up," and "Do Not Drop")
6.16 Shipping/Packaging tape (for sealing shipping coolers)
6.17 Temperature blanks (if required by the laboratory)
6.18 Trip blanks (if the shipping cooler includes samples for VOC analysis)

7.0 Procedures

7.1 Sample custody and COC forms

7.1.1 To maintain proper custody, keep samples in sight or in a secured location, e.g., a locked vehicle or room. If samples are to be stored overnight prior to shipment to the laboratory, if storage location is not secure then the sample cooler is to be sealed with custody tape/labels to prevent tampering.

7.1.2 District office personnel may leave samples at the Groveport Field Office in the custody of SIFU or other Ohio EPA field staff prior to delivery to a laboratory.

7.1.3 Use only blue or black ink to complete COC forms.

7.1.4 If samples are being shipped to a state contract laboratory, contact SIFU, a District Office Laboratory Coordinator, or the contract laboratory for specific instructions on completing the contract laboratory's COC form.

7.1.5 If submitting samples to the Ohio EPA Division of Environmental Services (DES) laboratory, use DES COC forms. Contact DES for specific instructions on completing their COC forms.

7.1.6 Prior to shipping a sample cooler, review the COC form for accuracy and ensure that each sample being shipped within that cooler is properly documented on the COC form. Never include samples being shipped in other coolers. If required, include the air bill or shipping tracking number on the COC form.

7.1.7 Sign and date each COC form.

7.2 Sample handling (packaging and shipping)

7.2.1 Inspect the sample containers to be shipped for loose or improper fitting lids, damaged lids, and incomplete or illegible sample labels. Document such problems as appropriate and correct if possible. If correction is not possible, inform the District Office Site Coordinator and the SIFU Sampling Team Leader or SIFU Laboratory Coordinator.

7.2.2 Use clear tape to cover and protect the labels on sample containers.

7.2.3 Wrap glass sample containers in bubble wrap and/or use other protective shipping materials such as foam molds to help prevent container breakage.

7.2.4 Place glass sample containers in sealable plastic bags to contain the contents and prevent potential cross contamination of other samples if broken in transit.

7.2.5 Seal any drainage holes in the shipping cooler. Use only clean, dry shipping coolers.

7.2.6 Place two large heavy-duty plastic bags in the shipping cooler as liners, one inside of the other.

7.2.7 Place sample containers upright inside the inner bag. Include a trip blank if samples are being submitted for VOC analysis and a temperature blank if required by the laboratory. Place larger, heavier containers on the bottom of the shipping cooler and smaller, lighter sample containers at the top. Use additional packing material between containers to help prevent breakage. Do not overfill the cooler with sample containers and packing material. Allow at least 25% of the cooler volume for ice.

7.2.8 Twist the inner bag (containing samples) closed while removing excess air volume. Seal the inner bag using duct tape.

7.2.9 Fill the available area between the inner bag and outer bag with fresh ice.

7.2.10 Twist the outer bag closed and seal it using duct tape.

7.2.11 As an alternative to Steps 7.2.6 through 7.2.10 for small-sized or medium-sized shipping coolers, place all sample containers in sealable plastic bags and make ice packs using one-gallon or two-gallon sealable plastic bags. The ice should be double bagged to help prevent leakage into the cooler.

7.2.12 If shipping by common carrier, place the completed COC form in a sealable plastic bag and either tape it to the top of the sample cooler or place it in the cooler on top of the bagged sample containers. Otherwise, give the COC to the laboratory courier or hand deliver it to the laboratory with the samples. (Remember to include the air bill or shipping tracking number on the COC form if required).

7.2.13 Check that the cooler lid closes properly. If it does not, remove some ice and/or reconfigure the sample containers (repeat Steps 7.2.6 through 7.2.11 as necessary).

7.2.14 Affix a signed and dated custody seal to the closed cooler. Protect the custody seal by covering it with clear tape.

7.2.15 Secure the lid by circling the cooler and lid several times with shipping/packing tape. For small to medium coolers, tape the left and right sides. For large coolers, tape the midsection of the cooler in addition to the right and left sides.

7.2.16 Affix “Do Not Drop,” “Fragile,” and “This Side Up” stickers, and any other needed shipping stickers to the sides or top of the cooler.

7.2.17 Complete the air bill and/or other shipping forms. If shipping overnight on a Friday, remember to check the "Saturday Delivery" box on the form. Never check "Shipper Release" or "Signature Release" boxes. Unless otherwise instructed by the SIFU Laboratory Coordinator, do not declare a value for the cooler and always bill the receiver (the laboratory).

7.2.18 If shipping by common carrier, attach the air bill and/or other shipping forms on the top of the cooler and ship same-day or next-day delivery.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Check the completed COC form for errors or omissions by comparing the sample cooler contents to the form prior to sealing the cooler for shipment.

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation

Hazardous Material Transportation Act, U.S. Code of Federal Regulations, 49 CFR 170-179

International Air Transportation Association, Dangerous Goods List, Section 4.2

Ohio Administrative Code OAC 3745-51-04(D)

U.S. EPA, 2014, Sampler's Guide, Contract Laboratory Program Guidance for Field Samplers, OSWER 9200.2-147, EPA 540-R-014-013

Sampling Equipment Decontamination

FSOP 1.6 (May 12, 2020)

Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This procedure describes standard practices used by the Division of Environmental Response and Revitalization (DERR) for the decontamination of sampling equipment. All equipment used to collect environmental samples should be decontaminated prior to use to avoid cross-contamination of samples, sampling personnel, or other environmental media.

1.2 When collecting soil samples, stainless steel pans and spoons should be used. Disposable pans and spoons should be used when heavy contamination is present. Non-disposable sampling equipment must be decontaminated either on site or preferably in a fixed-base facility such as the Ohio EPA Groveport Field Office. Use of a fixed-base facility is logistically easier, especially with regard to the containment and disposal of decontamination fluids.

1.3 Solvents and acids should not be used for equipment decontamination.

1.4 Equipment that cannot be effectively decontaminated using the procedures described in this FSOP must be disposed of properly in accordance with federal, state, and local requirements. Refer to FSOP 1.7, Investigation-Derived Wastes and Materials.

1.5 The procedures described herein are the minimum level of effort that should be expended for equipment decontamination.

1.6 This procedure applies to the decontamination of sampling equipment only. It does not apply to the decontamination of personnel, personal protective equipment (PPE), field monitoring instruments, or vehicles.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

Proper PPE should be worn when performing decontamination procedures to avoid exposure to contaminated media, or decontamination fluids. PPE typically includes but is not limited to protective gloves, safety glasses or goggles, and protective coveralls.

4.0 Procedure Cautions

4.1 Equipment decontamination generates one or more of the following materials:

- Residual soil or sediment
- Wash and rinse water
- Materials used during the decontamination process (*e.g.,* paper towels or plastic sheets)
- Personal protective equipment during the decontamination process (*e.g.,* gloves or coveralls)

Generally, these materials are not hazardous and may be disposed of as non-hazardous wastes; refer to FSOP 1.7, Investigation-Derived Wastes and Materials. However, if hazardous materials or highly elevated concentrations of hazardous substances are encountered during sampling activities, the associated decontamination wastes could be hazardous wastes. To ensure proper disposal, such decontamination wastes need to be characterized in accordance with Ohio Administrative Code (OAC) 3745-51-20 through -24 (Characteristic Hazardous Wastes) or (OAC) 3745-51-30 through -35 (Listed Hazardous Wastes) to determine whether they are hazardous.

4.2 If an equipment blank is needed to evaluate the effectiveness of decontamination procedures, the field team leader should request that the blank be collected at an undisclosed time. This practice helps avoid the introduction of bias into the decontamination procedures based on anticipation of the equipment blank.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA’s hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Appropriate PPE
6.2 ASTM Type II, distilled, or reverse osmosis water
6.3 Detergent (non-phosphate detergent is recommended for field decontamination)
6.4 Clean cloths, paper towels, or disposable wipes
6.5 Brushes
6.6 Spray bottle
6.7 Buckets or pans
6.8 Plastic containers with resealable lids (to contain decontamination fluids in the field)
6.9 Plastic sheets (to cover the ground during field decontamination procedures)
6.10 Aluminum foil or sealable plastic bags (to contain decontaminated equipment)

7.0 Procedures

7.1 Decontamination procedures depend on anticipated field conditions and the nature of the investigation. Equipment may be decontaminated in the field or at a fixed-base facility (*e.g.,* Ohio EPA's Groveport Field Office). Decisions regarding the scope and location of equipment decontamination should be made during the preparation of the project work plan and in consultation with the Site Investigation Field Unit (SIFU).

7.2 <u>Fixed-base facility decontamination procedures</u>:

7.2.1 Remove excess soil or sediment contamination from the equipment while in the field. Remove as much residue as practically possible to minimize investigation derived waste and to keep the wash water as clean as possible.

7.2.2 Disassemble the equipment if necessary, for proper decontamination.

7.2.3 Wash the equipment with tap water and detergent.

7.2.4 Rinse the equipment with tap water.

7.2.5 Rinse the equipment a second time with ASTM Type II, distilled, or reverse osmosis water.

7.2.6 Allow the equipment to air dry or dry it with a clean cloth or paper towel.

7.2.7 If the equipment is not to be used immediately, wrap in aluminum foil or place in sealable plastic bags.

7.3 <u>Field decontamination procedures</u>:

7.3.1 Set up the decontamination area away from potential sources of dust, vapors, or other contaminants. Decontamination supplies should be placed on a clean sheet of plastic to prevent direct contact with the ground or other surfaces that may contain contaminants.

7.3.2 Remove excess soil or sediment contamination from the equipment.

7.3.3 Disassemble the equipment, if necessary, for proper decontamination.

7.3.4 Wash the equipment with ASTM Type II, distilled, or reverse osmosis water and detergent.

7.3.5 Rinse the equipment with ASTM Type II, distilled, or reverse osmosis water.

7.3.6 Dry the equipment with a clean cloth or paper towel.

7.3.7 If the equipment is not to be used immediately, wrap it in aluminum foil or place in a sealable plastic bag

7.4 All waste materials generated during equipment decontamination including rinse water (See Section 4.1) must be containerized and evaluated for proper disposal, regardless of whether the decontaminated equipment was used to sample media known to contain hazardous substances or hazardous wastes.

7.5 Waste materials generated during equipment decontamination are investigation derived waste and should be disposed of in accordance with FSOP 1.7, Investigation Derived Wastes.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Decontamination.

9.0 Quality Assurance and Quality Control

An equipment blank may be required to evaluate the effectiveness of decontamination procedures.

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Decontamination

FSOP 1.7, Investigation Derived Wastes

Ohio Administrative Code 3745-51-20 through -24

Ohio Administrative Code 3745-51-30 through -35

Investigation Derived Waste
FSOP 1.7 (May 21, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Investigation derived waste (IDW) is a generic term used to describe a variety of waste materials generated during sampling and other site assessment activities. IDW typically includes environmental media such as soil boring cores or monitoring well purge water, used disposable sampling equipment, used personal protective equipment (PPE), decontamination fluids and used packaging materials. It may include a variety of waste materials regulated for disposal under federal, state or local regulations, including municipal solid waste (MSW), industrial and residual solid waste, infectious waste, construction and demolition debris, hazardous waste, petroleum waste, coal mine wastes, lime mining wastes, low-level radioactive wastes or wastes regulated by the Toxic Substances Control Act (TSCA) including polychlorinated biphenyls (PCBs) or asbestos-containing materials (ACM).

1.2 Management and disposal of IDW generated during DERR site assessments will be consistent with U.S. EPA guidance (see References below) and meet all applicable regulations. In the event that petroleum, hazardous, TSCA, infectious or low-level radioactive IDW is generated, DERR will comply with the regulations governing the management and disposal of these solid and/or liquid wastes. If IDW is non-petroleum, non-hazardous, non-TSCA, non-infectious and non-radioactive, DERR will manage and dispose of the solid materials as municipal solid waste regardless of whether or not the IDW is an MSW-regulated waste, e.g., unwanted soil cores or coal mine waste. DERR will manage and dispose of non-petroleum, non-hazardous, non-TSCA, non-infectious and non-radioactive fluids as sanitary wastewater.

1.3 When evaluating whether IDW may be petroleum, hazardous, TSCA, infectious or radioactive, DERR field personnel are expected to use the following resources, if available, before or during field work activities:

- Knowledge of site history, industrial processes, material handling and waste releases or disposal practices
- Field evidence (*e.g.,* visual appearance of contamination or waste materials; labeling, or type of discarded containers, etc.)
- Field screening instrument (*e.g.,* photoionization detector) results

These criteria represent the best information that is readily available to DERR management and staff for the evaluation of IDW regulatory status.
Therefore, use of these criteria constitutes both a good faith effort and due diligence on the part of DERR to properly manage (contain, handle, store and/or transport) and/or dispose of IDW.

1.4 This FSOP is applicable to site assessment activities conducted by DERR. It does not apply to the following situations:

- Management or disposal of remediation wastes (*e.g.,* removal of soil or ground water as a site cleanup remedy)
- Management or disposal of IDW generated from site assessment activities performed by Ohio EPA level-of-effort (LOE) contractors
- Management or disposal of IDW generated from emergency response activities
- Management or disposal of ACM - If IDW is known or suspected to include ACM, contact and defer to the Ohio EPA Division of Air Pollution Control for assistance with IDW management and disposal.
- Management or disposal of infectious wastes - If infectious wastes (e.g., medical waste containers with syringes, needles and blood-contaminated waste materials) are encountered during sampling or other site assessment activities, contact and defer to the Ohio EPA Division of Materials and Waste Management (DMWM) for assistance with IDW management and disposal. Attachment A includes a detailed description of the variety of materials that are defined as infectious waste.
- Management or disposal of low-level radioactive wastes - If low-level radioactive IDW is generated during site assessment activities, contact and defer to the Ohio Department of Health (ODH) for assistance with IDW management and disposal.

2.0 Definitions

2.1 For the purposes of the FSOP, **"non-hazardous waste"** means waste which consists of MSW, industrial or residual solid wastes, construction and demolition debris, mining wastes or other unwanted materials that are not defined as regulatory wastes such as soil or sediment, and is not petroleum, hazardous, TSCA-regulated, infectious or radioactive.

2.2 For the purposes of this FSOP, "**hazardous waste**" means any waste that contains or is otherwise contaminated with a listed hazardous waste at any concentration (including previously disposed or spilled hazardous waste) or that exhibits a characteristic of hazardous waste.

2.3 Soil is considered a regulated waste only when contaminated by hazardous waste, petroleum waste or other regulated wastes.

2.4 Refer to Attachment A for regulatory definitions of wastes and associated materials.

3.0 Health and Safety Considerations

3.1 IDW management (handling and storage) and disposal activities must be protective of human health, safety and the environment and must be performed in accordance with all applicable regulations.

3.2 Use appropriate PPE when handling IDW. Refer to the site-specific work plan (SSWP) and health and safety plan (HASP) for required PPE.

3.3 Conduct air monitoring as required when managing IDW. Refer to the SSWP for air monitoring applicability and to Table 1 of FSOP 1.1, Initial Site Entry for air monitoring action levels.

3.4 Exercise extra caution at landfills, construction and demolition debris facilities, or other waste disposal areas that may contain unique hazards such as sharps, medical wastes, chemical containers or ACM.

3.5 Always assume that infectious wastes encountered during site assessment activities are untreated, even within the disposal area of an MSW landfill facility.

4.0 Procedure Cautions

4.1 Every attempt should be made to seek a suitable location for disposal of decontamination water or ground water from monitoring wells. Local publicly owned treatment works (POTW) facilities often will accept purge water but may require analytical results before disposal can occur. On-site treatment facilities may often be a suitable option for disposing of water. If a small quantity (<15 gallons) of water is generated and no other options are available, water may occasionally be transported back to the Ohio EPA's Groveport Field Office or an Ohio EPA district office for disposal.

4.2 If ground water is known or assumed (with reasonable certainty) to be uncontaminated, then it may be suitable to dispose of the water on the ground.

4.3 Never dispose of monitoring well purge water or decontamination fluids on the ground if the contaminants or concentrations are unknown. Waste fluids must be containerized and transported to an appropriate disposal facility unless an alternative disposal option is available at the site or the facility being investigated, or the fluids must be stored on site until appropriate disposal can be arranged.

4.4 IDW containing soil and/or debris must be transported back to the Ohio EPA's Groveport Field Office or an Ohio EPA district office for disposal unless an alternative disposal option is available at the site or facility being investigated.

4.5 Samples may be excluded from hazardous waste regulations during transport to the laboratory and back to the sample collector, during storage in the laboratory before and after analysis, and during storage for evidence in enforcement cases. See OAC rule 3745-51-04

5.0 Equipment and Supplies

5.1 PPE
5.2 Heavy duty plastic bags
5.3 Sealable plastic buckets or other containers suitable for containing fluids
5.4 Department of Transportation (DOT) approved drums
5.5 Tools to open and close drums
5.6 Drum or container labels
5.7 Drum dolly or hoist
5.8 Duct tape
5.9 Plastic sheeting

6.0 Procedures

6.1 General Procedures for IDW Management and Disposal

6.1.1 Before performing field work, review the site history and available field screening, sampling, and analytical data or records of previous waste listing classification to evaluate the types of wastes and contamination likely to be encountered. Include this information in the SSWP, especially if the site is subject to the Resource Conservation and Recovery Act (RCRA) hazardous waste regulations. Use this information to anticipate the types of IDW likely to be generated during sampling and other site assessment activities. Evaluate management and disposal options based on the types and amounts of IDW likely to be generated.

6.1.2 Use sampling and other site assessment procedures that minimize the amount of IDW generated during sampling and investigation activities whenever possible. For example, using low-flow sampling techniques to collect ground water samples typically generates less monitoring well purge water than using bailers to collect ground water samples.

6.1.3 Evaluate if the IDW may be petroleum, hazardous, TSCA-regulated, infectious or radioactive based on the following site and field data:

- Knowledge of site history, industrial processes, material handling and waste releases or disposal practices
- Field evidence (*e.g.,* visual appearance of contamination or waste materials; labeling, or type of discarded containers, etc.)
- Field screening instrument results

These criteria represent the best information that is readily available to DERR management and staff for the evaluation of IDW regulatory status. Therefore, use of these criteria constitutes both a good faith effort and due diligence on the part of DERR to properly manage and/or dispose of IDW.

6.1.4 If IDW is suspected to be hazardous (based on good faith effort and due diligence), containerize, label, date, and retain the waste material until results of more definitive testing and evaluation are available to determine the appropriate disposal procedures.

6.1.5 If IDW is suspected to be hazardous due to mixture with or contamination from a listed hazardous waste, a site-specific contained-in decision may be appropriate for waste management. To make a contained-in decision, a project-specific tasking request will be submitted to the DERR Engineering & Risk Assessment Support Unit (ERAS) supervisor following the Contained-In Request Procedure (Attachment C) and consult with the DERR RCRA manager as necessary.

6.1.6 As a general work practice, manage and dispose of disposable sampling equipment and PPE in the same manner as IDW generated from the media being sampled or otherwise investigated.

6.1.7 If permissible and protective of human health and the environment, use facility equipment and procedures for containerizing and disposing non-hazardous IDW.

6.2 Management and Disposal of Non-Hazardous Wastes

6.2.1 Manage and dispose of IDW solids that are not regulated as petroleum, hazardous, TSCA, infectious, or radioactive waste as MSW. Such non-hazardous IDW may include, but is not limited to the following materials:

- Used PPE, used disposable sampling equipment and used packaging materials
- Soil (soil is not a regulated waste unless contaminated by hazardous waste, petroleum waste or other regulated wastes)
- Construction and demolition debris
- Sediment containing coal mining or lime mining wastes

6.2.2 Manage monitoring well purge water, decontamination fluids and other IDW liquids that are not regulated as petroleum, hazardous, TSCA-regulated, infectious, or radioactive waste as sanitary wastewater that can be disposed of in a POTW.

6.2.3 Containerize non-hazardous IDW solids in heavy duty plastic bags, buckets, other containers or drums.

6.2.4 Containerize non-hazardous IDW liquids in sealable buckets, other sealable containers or drums.

6.2.5 Dispose of non-hazardous IDW solids as MSW in a solid waste dumpster. Dispose of non-hazardous IDW liquids in the POTW as sanitary wastewater with permission from the POTW.

6.2.6 If permissible and protective of human health and the environment, solid or liquid non-hazardous IDW may be disposed of as MSW or sanitary wastewater at the site or facility being investigated.

6.2.7 Stabilize IDW consisting of semi-solid or sludge-like materials (*e.g.,* contaminated sediment) with granular bentonite or other inert absorbent material before disposing of it as solid waste. (Sludge-like materials should not be disposed of as solid waste unless it can pass the Paint Filter Liquids Test, SW-846 Method 9095).

6.3 Management and Disposal of Petroleum Contaminated IDW

6.3.1 If petroleum contaminated IDW solids are not visibly contaminated with free product, dispose of the IDW as MSW unless it is known or suspected to be a characteristic hazardous waste (if so, refer to Sections 6.3.2 and 6.4 below). U.S. EPA 2009 (Hazardous Waste Characteristics, A User-Friendly Reference Document) provides guidance on the RCRA hazardous waste characteristic regulations.

6.3.2 If petroleum contaminated IDW solids are visibly contaminated with free product, consult with the local MSW disposal facility regarding required pre-disposal testing. Required testing may include the Toxicity Characteristic Leaching Procedure (TCLP), SW-846 Method 1311 for benzene and other volatile petroleum constituents, Ignitability and Ignitability of Solids, SW-846 Methods 1010A, 1020B and 1030 or the Paint Filter Liquids Test, SW-846 Method 9095.

6.3.3 If IDW liquid consisting of free-phase petroleum product and water is generated during a site assessment (*e.g.,* monitoring well purge water containing free-phase gasoline), contact and defer to the Office of Emergency Response (OER) Level-of-Effort (LOE) Coordinator for assistance with IDW management and disposal. IDW liquids containing free-phase petroleum products may be characteristic hazardous wastes (refer to Section 6.4)

6.4 Management and Disposal of Hazardous IDW

6.4.1 If IDW is suspected to be hazardous based on the three criteria discussed in Section 6.1.3 or known to contain listed hazardous waste, contact and defer to the OER LOE Coordinator or the DERR RCRA manager for assistance with IDW management and disposal. Hazardous Waste Characteristics, A User-Friendly Reference Document (U.S. EPA 2009) provides guidance on the RCRA hazardous waste characteristic regulations.

6.4.2 When IDW is generated at a site that is not secured, or if potential spills or releases from the IDW containers exist, IDW solids or liquids suspected to be characteristic hazardous wastes based on toxicity, ignitability, or corrosivity may be temporarily stored in a secured location at the Groveport Field Office pending the results of testing (TCLP, SW-846 Method 1311; Ignitability SW-846 Methods 1010A, 1020B and (1030 the test results for this method cannot be used to directly classify a waste as a D001 ignitable hazardous waste); and appropriate corrosivity testing such as SW- 846 Method 9040C or 9041A). Wastes that are suspected or anticipated to exhibit the characteristic of reactivity may be too dangerous for DERR staff to handle, transport or store. Contact and defer to the OER LOE Coordinator for guidance on managing potentially reactive IDW.

6.4.3 If soil samples are managed and disposed as hazardous waste, then any grossly contaminated disposable sampling equipment and PPE used to collect and handle to soil cores will be managed and disposed as hazardous waste.

6.5 Management and Disposal of Toxic Substances Control Act IDW

6.5.1 Wastes regulated under the TSCA include polychlorinated biphenyls (PCBs) and asbestos-containing materials (ACM).

6.5.2 IDW consisting of PCB-containing soil, sediment, or soil-like wastes may be temporarily stored at the Groveport Field Office pending the results of PCB analysis. Contact and defer to the OER LOE Coordinator for assistance with IDW management and disposal.

7.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

8.0 Attachments

Attachment A, Regulatory Definitions for Wastes and Associated Materials

Attachment B, Contained-In Decision Request Procedure

Attachment C, Maximum Concentrations of Contaminants for the Toxicity Characteristic

9.0 References and Regulatory Contact Information

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

OAC 1301:7-9, BUSTR Regulations

OAC 1501:13-1, ODNR Coal Mining Regulations

OAC 1501:14-1, ODNR Lime Mining Regulations

OAC 3701:1-38, ODH General Radiation Protection Standards for Sources of Radiation

OAC 3745-20, Ohio EPA Asbestos Emission Control Regulations

OAC 3745-27, Ohio EPA Solid and Infectious Waste Regulations

OAC 3745-29, Ohio EPA Industrial Waste Regulations

OAC 3745-30, Ohio EPA Residual Waste Regulations

OAC 3745-50 through 52, Ohio EPA Hazardous Waste Management Standards

OAC 3745-400 Ohio EPA Construction and Demolition Debris Regulations

Ohio EPA Division of Air Pollution Control: (614) 644-2270, -2271 or -2272

Ohio EPA Division of Materials and Waste Management: (614) 644-2621

Ohio EPA Groveport Field Office: (614) 836-8800

OER LOE Coordinator: (614) 836-8761

DERR Site Field Investigation Unit: (614) 644-2305

Ohio Department of Health Bureau of Radiation Protection: (614) 644-2727 (main) or (614) 722- 7221 (for emergencies)

SW-846 Methods 1010A, 1020B and 1030, Ignitability of Solids

SW-846 Method 1311, Toxicity Characteristic Leaching Procedure

SW-846 9040C, pH Electrometric Measurement

SW-846 Method 9095, Paint Filter Liquids Test

U.S. EPA, 2009, Hazardous Waste Characteristics, A User-Friendly Reference Document: Materials Recovery and Waste Management Division, Office of Resource Conservation and Recovery

U.S. EPA, January 1992, Guide to Management of Investigation-Derived Wastes: Office of Solid Waste and Emergency Response, 9345.3-03FS

U.S. EPA, July 3, 2014, Management of Investigation-Derived Waste (SESD Operating Procedure): U.S. EPA Region 4, Science and Ecosystem Support Division. SESDPROC-202-R3

Toxic Substances Control Act, 15 U.S.C. §2601 et seq. (1976) (*refer to 40 CFR 761 U.S. EPA PCB Regulations*)

ATTACHMENT A

Regulatory Definitions for Wastes and Associated Materials

Asbestos-Containing Waste Materials [OAC 3745-20-01(B)(4)]

"Asbestos-containing waste materials" means mill tailings or any waste that contains commercial asbestos and is generated by a source subject to the provisions of this chapter. This term includes filters from control devices, friable asbestos-containing material, and bags or other similar packaging contaminated with commercial asbestos. As applied to demolition and renovation operations, this term also includes regulated asbestos-containing material waste and materials contaminated with asbestos including disposable equipment and clothing.

Clean Hard Fill [OAC 3745-400-01(E)]

"Clean hard fill" means construction and demolition debris which consists only of reinforced or nonreinforced concrete, asphalt concrete, brick, block, tile, and/or stone which can be reutilized as construction material. Brick in clean hard fill includes but is not limited to refractory brick and mortar. Clean hard fill does not include materials contaminated with hazardous wastes, solid wastes, or infectious wastes.

Coal Mine Waste [OAC 1501:13-1-02(W)]

“Coal mine waste” means coal processing waste and underground development waste.

Construction and Demolition Debris [OAC 3745-400-01(F)]

"Construction and demolition debris" or "debris" means those materials resulting from the alteration, construction, destruction, rehabilitation, or repair of any manmade physical structure, including, without limitation, houses, buildings, industrial or commercial facilities, or roadways. "Construction and demolition debris" does not include materials identified or listed as solid wastes, infectious wastes, or hazardous wastes pursuant to Chapter 3734 of the Revised Code and rules adopted under it; or materials from mining operations, nontoxic fly ash, spent nontoxic foundry sand, and slag; or reinforced or nonreinforced concrete, asphalt, building or paving brick, or building or paving stone that is stored for a period of less than two years for recycling into a usable construction material.

For the purpose of this definition, "materials resulting from the alteration, construction, destruction, rehabilitation, or repair of any manmade physical structure," are those structural and functional materials comprising the structure and surrounding site improvements, such as brick, concrete and other masonry materials, stone, glass, wall coverings, plaster, drywall, framing and finishing lumber, roofing materials, plumbing fixtures, heating equipment, electrical wiring and components containing no hazardous fluids or refrigerants, insulation, wall-to-wall carpeting, asphaltic substances, metals incidental to any of the above, and weathered railroad ties and utility poles.

"Materials resulting from the alteration, construction, destruction, rehabilitation, or repair" do not include materials whose removal has been required prior to demolition, and materials which are otherwise contained within or exist outside the structure such as solid wastes, yard wastes, furniture, and appliances. Also excluded in all cases are liquids including containerized or bulk liquids, fuel tanks, drums and other closed or filled containers, tires, and batteries.

Hazardous Waste [OAC 3745-50-10(A)(54)]

"Hazardous waste" means a hazardous waste as defined in rule 3745-51-03 of the Administrative Code. (*When attempting to determine whether or not a material is a hazardous waste, please request assistance from the Division of Environmental Response and Revitalization. The regulatory definition of hazardous waste is complex and includes numerous exclusions per OAC 3745-51-04. Accurate characterization of hazardous waste requires specialized knowledge of the hazardous waste rules.*)

Industrial Solid Waste [OAC 3745-29-01(A)]

"Industrial solid waste" or "industrial waste" means a type of solid waste generated by manufacturing or industrial operations and includes, but is not limited to, solid waste resulting from the following manufacturing processes: electric power generation; fertilizer/agricultural chemicals; food and food-related products/by-products; inorganic chemicals; iron and steel manufacturing; leather and leather products; nonferrous metals manufacturing; plastics and resins manufacturing; pulp and paper industry; rubber and miscellaneous plastic products; stone, glass, clay and concrete products; textile manufacturing; and transportation equipment. "Industrial solid waste" does not include solid wastes generated by commercial, agricultural, or community operations. Industrial solid wastes may be disposed in a licensed sanitary landfill facility, a licensed industrial waste landfill facility, or in a licensed residual waste landfill facility, provided that the class number for the residual waste landfill facility is not greater than the class number necessary for that residual waste as determined by the residual waste characterization and landfill classification in accordance with rules 3745-30-03 and 3745-30-04 of the Administrative Code.

Industrial Waste [ORC 6111.01(C)]

“Industrial waste” means any liquid, gaseous, or solid waste substance resulting from any process of industry, manufacture, trade, or business, or from the development, processing, or recovery of any natural resource, together with such sewage as is present.

Infectious Waste [OAC 3745-27-01(I)(6)]

"Infectious wastes" includes all of the following substances or categories of substances:

(a) Cultures and stocks of infectious agents and associated biologicals, including, without limitation, specimen cultures, cultures and stocks of infectious agents, wastes from production of biologicals, and discarded live and attenuated vaccines.

(b) Laboratory wastes that were, or are likely to have been, in contact with infectious agents that may present a substantial threat to public health if improperly managed.

(c) Pathological wastes, including, without limitation, human and animal tissues, organs, and body parts, and body fluids and excreta that are contaminated with or are likely to be contaminated with infectious agents, removed or obtained during surgery or autopsy or for diagnostic evaluation, provided that, with regard to pathological wastes from animals, the animals have or are likely to have been exposed to a zoonotic or infectious agent.

(d) Waste materials from the rooms of humans, or the enclosures of animals, that have been isolated because of diagnosed communicable disease that are likely to transmit infectious agents. Also included are waste materials from the rooms of patients who have been placed on blood and body fluid precautions under the universal precaution system established by the "Centers for Disease Control" in the public health service of the United States department of health and human services, if specific wastes generated under the universal precautions system have been identified as infectious wastes by rules referred to in paragraph (I)(6)(h) of this rule.

(e) Human and animal blood specimens and blood products that are being disposed of, provided that, with regard to blood specimens and blood products from animals, the animals were or are likely to have been exposed to a zoonotic or infectious agent. "Blood products" does not include patient care waste such as bandages or disposable gowns that are lightly soiled with blood or other body fluids, unless such wastes are soiled to the extent that the generator of the wastes determines that they should be managed as infectious waste.

(f) Contaminated carcasses, body parts, and bedding of animals that were intentionally exposed to infectious agents from zoonotic or human diseases during research, production of biologicals, or testing of pharmaceuticals, and carcasses and bedding of animals otherwise infected by zoonotic or infectious agents that may present a substantial threat to public health if improperly managed.

(g) Sharp wastes used in the treatment, diagnosis, or inoculation of human beings or animals or that have, or are likely to have, come in contact with infectious agents in medical, research, or industrial laboratories, including, without limitation, hypodermic needles and syringes, scalpel blades, and glass articles that have been broken. Such wastes are hereinafter in this chapter referred to as "sharp infectious waste" or "sharps."

(h) Any other waste materials generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production of testing of biologicals, that the public health council created in section 3701.33 of the Revised Code, by rules adopted in accordance with Chapter 119. of the Revised Code, identifies as infectious wastes after determining that the wastes present a substantial threat to human health when improperly managed because they are contaminated with, or are likely to be contaminated with, infectious agents.

(i) Any other waste materials the generator designates as infectious waste.

Lime Mining Waste [OAC 1501:14-1-01(FF)]

“Lime Mining Wastes” means residual solid or semisolid materials generated from lime or limestone mining and processing operations, including, without limitation, lime kiln dust, scrubber sludge from kiln operations, lime or limestone materials not meeting product specification, lime hydrating materials, and other lime or limestone mining, processing, or calcining materials associated with lime or limestone mining or processing. “Lime Mining Wastes” does not include materials generated for the manufacture of cement.

Low-Level Radioactive Waste [OAC 3701:1-38-01(A)(175)]

"Waste" means those low-level radioactive wastes containing source, special nuclear, or byproduct material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste means radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in paragraphs (A)(26)(b), (A)(26)(c), and (A)(26)(d) of this rule.

Other Wastes [ORC 6111.01(D)]

"Other wastes" means garbage, refuse, decayed wood, sawdust, shavings, bark, and other wood debris, lime, sand, ashes, offal, night soil, oil, tar, coal dust, dredged or fill material, or silt, other substances that are not sewage, sludge, sludge materials, or industrial waste, and any other "pollutants" or "toxic pollutants" as defined in the Federal Water Pollution Control Act that are not sewage, sludge, sludge materials, or industrial waste.

Petroleum [OAC 1301:7-9-02(B)(44)]

"Petroleum" means petroleum, including crude oil or any fraction thereof that is a liquid at the temperature of sixty degrees Fahrenheit and the pressure of fourteen and seven-tenths pounds per square inch absolute. The term includes, without limitation, motor fuels, jet fuels, distillate fuel oils, residual fuel oils, lubricants, petroleum solvents, and used oils.

Petroleum Contaminated Soil [OAC 1301:7-9-16(B)(8)]

"Petroleum contaminated soil (PCS)" means soil that contains chemical(s) of concern in concentrations that exceed one or more of the re-use action levels in Table 1 found in paragraph (D)(1) of this rule and excludes soil defined as hazardous waste.

Residual Solid Waste [OAC 3745-30-01(B)]

"Residual solid waste" or "residual waste" is a type of solid waste and means:

(1) The following wastes generated by fuel burning operations which are regulated by rule 3745-17-10 of the Administrative Code and which burn as fuel primarily coal: air pollution control wastes, water pollution control wastes, and other wastes with similar characteristics which are approved by the director or his authorized representative.

(2) The following wastes generated from foundry operations: air pollution control dust, wastewater treatment plant sludge, unspent foundry sand, spent foundry sand, and other foundry wastes with similar characteristics which are approved by the director or his authorized representative.

(3) The following wastes generated from pulp and papermaking operations: wastewater treatment plant sludges, lime mud, lime grit, sawdust, wood chips, bark, hydropulper rejects, and other pulp and papermaking wastes with similar characteristics which are approved by the director or his authorized representative.

(4) The following wastes generated from steelmaking operations: air pollution control dust, wastewater treatment plant sludges, dust from steel processing and finishing operations, water softening sludge, flux material, and other steelmaking wastes with similar characteristics which are approved by the director or his authorized representative.

(5) The following wastes generated from gypsum processing plant operations: gypsum wallboard waste, paper surface preparation dust, wastewater treatment plant sludge, and other gypsum processing wastes with similar characteristics which are approved by the director or his authorized representative.

(6) The following wastes generated from lime processing operations: air pollution control dust and/or sludge, and other lime processing wastes with similar characteristics which are approved by the director or his authorized representative.

(7) The following wastes generated from Portland cement operations: air pollution control dust and other processing wastes with similar characteristics which are approved by the director or his authorized representative.

Other Wastes [ORC 6111.01(B)]

"Sewage" means any liquid waste containing sludge, sludge materials, or animal or vegetable matter in suspension or solution, and may include household wastes as commonly discharged from residences and from commercial, institutional, or similar facilities.

Other Wastes [ORC 6111.01(N)]

"Sludge" means sewage sludge and a solid, semi-solid, or liquid residue that is generated from an industrial wastewater treatment process and that is applied to land for agronomic benefit. "Sludge" does not include ash generated during the firing of sludge in a sludge incinerator, grit and screening generated during preliminary treatment of sewage in a treatment works, animal manure, residue generated during treatment of animal manure, or domestic septage.

Other Wastes [ORC 6111.01(O)]

"Sludge materials" means solid, semi-solid, or liquid materials derived from sludge and includes products from a treatment works that result from the treatment, blending, or composting of sludge.

Solid Waste [OAC 3745-27-01(S)(23)]

"Solid waste" means such unwanted residual solid or semisolid material, including but not limited to, garbage, scrap tires, combustible and noncombustible material, street dirt and debris, as results from industrial, commercial, agricultural, and community operations, excluding earth or material from construction, mining, or demolition operations, or other waste materials of the type that normally would be included in demolition debris, nontoxic fly ash and bottom ash, including at least ash that results from combustion of coal, biomass fuels, and ash that results from the combustion of coal in combination with scrap tires where scrap tires comprise not more than fifty percent of heat input in any month, spent nontoxic foundry sand, and slag and other substances that are not harmful or inimical to public health, and includes, but is not limited to, garbage, scrap tires, combustible and noncombustible material, street dirt, and debris. Solid waste does not include any material that is an infectious waste or a hazardous waste.

Toxic Waste [Toxic Substances Control Act, 15 U.S.C. §2601 et seq. (1976)]

The Toxic Substances Control Act (TSCA) addresses the production, importation, use, and disposal of specific chemicals including polychlorinated biphenyls (PCBs), asbestos, radon, and lead-based paint.

ATTACHMENT B

Maximum Concentrations of Contaminants for the Hazardous Waste Toxicity Characteristic (OAC 3745-51-24)			
EPA Hazardous Waste Number	**Contaminant**	**CAS[1] Number**	**Regulatory Level (mg/L)**
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-2	0.5
D006	Cadmium	7440-43-9	1.0
D019	Carbon Tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	o-Cresol	95-48-7	200.0[3]
D024	m-Cresol	108-38-4	200.0[3]
D025	p-Cresol	106-44-5	200.0[3]
D026	Cresol	NA	200.0[3]
D016	2,4-D	94-75-7	10.0
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethylene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.13[2]
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its epoxide)	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	0.13[2]
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0

ATTACHMENT B

Maximum Concentrations of Contaminants for the Hazardous Waste Toxicity Characteristic (OAC 3745-51-24)			
EPA Hazardous Waste Number	**Contaminant**	**CAS[1] Number**	**Regulatory Level (mg/L)**
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10.0
D035	Methyl ethyl ketone	78-93-3	200.0
D036	Nitrobenzene	98-95-3	2.0
D037	Pentachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	5.0[2]
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D039	Tetrachloroethylene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethylene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400.0
D042	2,4,6-Trichlorophenol	88-06-2	2.0
D017	2,4,5-TP (Silvex)	93-72-1	1.0
D043	Vinyl Chloride	75-01-4	0.2

Footnotes:

1. Chemical Abstracts Service number
2. Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.
3. If o-, m- and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level for total cresol is 200.0 mg/L.

ATTACHMENT C

Contained-In Decision Request Procedure

Background:

Listed hazardous waste and materials mixed with or contaminated by listed hazardous waste have special handling and management obligations that must be met by facilities, contractors and government officials, including Ohio EPA. A contained-in decision obtained through Ohio EPA's RCRA program allows media or debris contaminated by a listed hazardous waste to be managed as a non-hazardous waste if certain conditions are met. Contained-in decisions are made by using conservative risk assessment of the contaminated media or debris in a site-specific scenario to determine if the contaminated media or debris no longer requires management as a listed hazardous waste. If the contained-in decision is granted, the media or debris can be managed as non-hazardous waste following Ohio EPA's solid waste rules.

Contained-in decisions are primarily applicable to contaminated media, with media being defined as a naturally occurring material (e.g., soil, sediment, ground water and surface water). If media/contaminated media are mixed with other materials, generally Ohio EPA would describe this mixture as a contaminated media (as opposed to waste or debris) if it is made up of 50% or more of the naturally occurring media.

Hazardous debris includes items such as used personal protective equipment, used disposable sampling equipment, construction and demolition debris and other materials that are mixed or contaminated with listed hazardous waste. OAC rule 3745-270-45 essentially provides a contained-in decision for hazardous debris by allowing the hazardous waste generator to treat the debris using one of the treatment technologies provided in Table 1 of the rule (Alternative Treatment Standards for Hazardous Debris). Generally, the treatment technologies provide physical removal of any listed hazardous waste or media. Treated hazardous debris is no longer considered to be listed hazardous waste and is not required to be managed as hazardous waste unless the treatment was an immobilization technology. Be aware that any residue removed from the debris during treatment is still considered listed hazardous waste and needs to be handled accordingly.

Procedure:

Provide the following supporting information when requesting a contained-in decision for contaminated media. Please be as specific and detailed as possible.

1) Name
2) Division/district
3) Site name and location
4) Site history and information related to listed hazardous waste (listed hazardous waste codes, historical IDW management, etc.)
5) Current project and all potentially listed hazardous waste media or debris to be managed (expected volume of listed hazardous waste media or debris to be managed, planned management of media or debris, etc.)
6) Projected date of project
7) Expected concentrations in potentially listed hazardous waste media or debris to be managed

Forward the request and supporting information and submit the request to DERR ERAS and consult with the DERR RCRA manager as necessary to complete the request.

<u>ODNR Well Construction Logs & Well Sealing Reports</u>
FSOP 1.8 (May 14, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This FSOP is applicable to personnel who install or decommission monitoring wells, piezometers and borings used for ground water characterization. The Ohio Department of Natural Resources (ODNR), Division of Geological Survey requires that a well construction log be filed by anyone who constructs a well, and that a well sealing report be filed by anyone that seals a well.

1.2 Well construction logs ("well log and drilling report" forms) for each well must be completed and filed with the ODNR within 30 days after the installation of the well in accordance with Ohio Revised Code (ORC) 1521.05(B). ODNR well logs must be filed for all permanent or temporary monitoring wells and piezometers. Additionally, well logs must be filed for any boring used to collect a ground water sample when soil/geology is characterized for an aquifer or saturated zone.

1.3 Well casing materials do not have to be installed in the borehole to meet the definition of a well (*e.g.*, a boring used for the collection of a grab ground water sample from the open borehole is considered a well for purposes of filing a well construction log). Well construction logs, however, do not have to be filed for soil borings used solely to characterize soil or obtain soil samples or soil borings less than six feet deep. Refer to the ODNR, Division of Soil and Water Resources Fact Sheet 93-23, *When Does a Well Log Need to be Filed?* (attached).

1.4 Well sealing reports must be completed and filed with the ODNR within 30 days after the completion of the sealing of the well in accordance with ORC 1521.05(C). Well sealing reports must be filed for any well or boring that requires a well construction log to be filed. Refer to the ODNR, Division of Soil and Water Resources Fact Sheet 92-5, *State of Ohio Water Well Sealing Regulations* (attached).

2.0 Definitions

Sealing means to remove a well from service by pulling the pump and associated piping/wiring (if installed) and filling the well with a low-permeability grouting material, typically sodium bentonite granules, chips or slurry. The sealing method used depends on the well construction and the local geologic/hydrogeologic conditions. The well screen (if present) and casing may be removed. **Decommissioning** is sometimes used as a synonym for sealing. Refer to the State of Ohio *Regulations and Technical Guidance for Sealing Unused Water Wells and Boreholes* by the State Coordinating Committee on Ground Water (2015) for additional information.

3.0 Health and Safety Considerations

Not applicable

4.0 Procedure Cautions

Ohio EPA is registered with ODNR to file Well Construction Logs and Well Sealing Reports electronically. Ohio EPA's username and password can be obtained from SIFU or the DERR Ground Water Program. (Please do not create additional ODNR accounts under Ohio EPA's name.)

5.0 Personnel Qualifications

Not Applicable

6.0 Equipment and Supplies

6.1 Ohio EPA boring log (example attached)

6.2 ODNR Well Log and Drilling Report form (example attached; the official electronic version must be filed on-line)

6.3 ODNR Water Well Sealing Report form (example attached; the official electronic version must be filed on-line)

7.0 Procedure

7.1 Prior to the start of field activities, the DERR site coordinator will work with SIFU (and the LOE contractor, as necessary) to determine who is responsible for completing and filing ODNR Well Construction Logs and Well Sealing Reports.

7.2 Ohio EPA is registered with ODNR to file Well Construction Logs and Well Sealing Reports electronically. Ohio EPA's username and password can be obtained from SIFU and the DERR Ground Water Program. (Please do not create additional ODNR accounts under Ohio EPA's name.)

7.3 ODNR Well Construction Log Filing Procedures

7.3.1 Using the example Ohio EPA boring log, attached (or an equivalent form), document the boring and monitoring well installation. Refer to FSOP 2.1.5, Soil Description, Classification and Logging.

7.3.2 Within 30 days of completing the monitoring well or boring, file an electronic well log and drilling report form (example attached) with the ODNR using Ohio EPA's ID and password at the following website: http://apps.ohiodnr.gov/water/maptechs/submitlogs/driller_login.asp

7.3.3 Print out a copy of the completed ODNR well log and drilling report form for inclusion in the Ohio EPA project file.

7.4 ODNR Well Sealing Report Filing Procedures

7.4.1 Follow the procedures provided in FSOP 1.9, Boring and Monitoring Well Decommissioning. Record the relevant information on the ODNR well sealing report form (attached) or in a field log sheet or field book.

7.4.2 Within 30 days of completion of well sealing, file an electronic well sealing report form (example attached) with the ODNR using Ohio EPA's ID and password at the following website:

7.4.3 http://apps.ohiodnr.gov/water/maptechs/submitlogs/driller_login.asp

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

ODNR, Division of Soil and Water Resources Fact Sheet 93-23, *When Does a Well Log Need to be Filed?*

ODNR, Division of Soil and Water Resources Fact Sheet 92-5, *State of Ohio Water Well Sealing Regulations*

Ohio EPA Boring Log Form (example provided)

ODNR Well Log and Drilling Report Form

ODNR Water Well Sealing Report Form

11.0 References

FSOP 1.3, Field Documentation

FSOP 1.9, Boring and Monitoring Well Decommissioning

FSOP 2.1.5, Soil Description, Classification and Logging

Ohio Revised Code (ORC) 1521.05(B) and 1521.05(C)

State of Ohio, Regulations and Technical Guidance for Sealing Unused Water Wells and Boreholes *(*State Coordinating Committee on Ground Water) 2015.

Boring and Monitoring Well Decommissioning
FSOP 1.9 (May 20, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

Borings that are drilled for sampling or subsurface exploratory purposes or monitoring wells that are no longer needed for site assessment purposes must be decommissioned [Ohio Administrative Code (OAC) 3701-28-07, 3745-9-03 and 3745-9-10]. Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring provides appropriate guidance for boring and monitoring well decommissioning (Chapter 9, Sealing Abandoned Monitoring Wells and Boreholes). Also refer to State of Ohio, Regulations and Technical Guidance for Sealing Unused Water Wells and Boreholes *(*State Coordinating Committee on Ground Water) 2015.

1.1 The process of decommissioning a boring or monitoring well includes the following:

- Verifying that the boring or monitoring well is no longer needed for site assessment or remediation purposes. Generally, soil borings not converted to monitoring wells are decommissioned upon completion of the boring.
- Permanently sealing the boring or well with a low-permeability material
- Documenting the decommissioning activities
- For monitoring wells or borings used to characterize or assess ground water, submitting a completed Ohio Division of Natural Resources (ODNR) Geologic Survey "Well Sealing Report" [Ohio Revised Code 1521.05(c), Form DNR 7810.12]. Refer to FSOP 1.8, ODNR Well Construction Log and Well Sealing Report Filing Requirements

1.2 Soil borings greater than six feet deep or that intersect the water table must be sealed with a low permeability sealing material upon completion. Bentonite granules or chips are typically used as a sealing material. Under some circumstances (*e.g.*, a boring that intersects multiple saturated zones), the boring may need to be sealed using positive displacement grouting, *i.e.*, installing bentonite grout slurry using a tremie pipe.

1.3 Soil borings 6 feet deep or less and that do not intersect the water table may be backfilled with the soil cuttings, topsoil, or other clean fill materials (*e.g.,* sand or gravel) rather than bentonite provided that:

- The DERR Site Coordinator or other Ohio EPA division representative approves of using a clean soil or fill material.
- The soil boring does not encounter any hazardous waste, solid waste, or construction and demolition debris (C&DD) materials.
- The soil cuttings or other materials used for backfill are not known to contain contaminants exceeding any federal or state regulatory concentration levels.
- The soil cuttings or other materials used for backfill do not contain any solid waste or C&DD.

1.4 Monitoring wells must be sealed when no longer needed and may be decommissioned by:

1.5.1 Physically removing the well materials (casing and screen) and sealing the boring with a low-permeability material using positive displacement grouting (*i.e.*, installing bentonite grout slurry, typically using a tremie pipe)

1.5.2 Decommissioning the monitoring well in-place by filling the screen and well casing with bentonite or filling the monitoring well with clean sand to approximately two feet above the top of the screen and filling the well casing with bentonite, removing the protective casing, removing the upper 1 to 3 feet of well casing if possible and filling the upper 1 to 3 feet of the borehole with soil or other clean fill materials

1.6 Under some circumstances, DERR's LOE contractor may be needed to decommission borings or monitoring wells. Such situations may include, but are not necessarily limited to, borings or monitoring wells that are greater than 2 inches in diameter, are installed in bedrock, or are installed within the paved area of a highway. These situations may require the use of drilling rigs and other equipment not available to Ohio EPA staff. Decommissioning procedures to be followed by the LOE contractor will vary with site conditions and will be approved through a site-specific work plan (SSWP).

1.7 Monitoring wells that are installed below the base of the uppermost saturated zone (*see Section 2.0, Definitions*) and intersect multiple saturated zones generally should be decommissioned by removing the screen and casing, which will require services of DERR's LOE contractor. Removing the screen and casing may not be possible due to the well location and work/equipment obstructions. Under such circumstances, abandoning the well in place may be acceptable.

2.0 Definitions

2.1 Bentonite Chips (or Coarse Grade Bentonite): crushed sodium bentonite shale particles sized from $^{3}/_{8}$- to ¾-inch diameter that are intended to fall through a water column in a boring or well without bridging (also referred to as crushed or chip bentonite)

2.2 Bridging: the creation of a void within a decommissioned boring or monitoring well when bentonite chips, pellets or granules are either poured into the boring or well too quickly or prematurely hydrate and fail to form a continuous seal

2.3 Granular Bentonite: processed sodium bentonite with a particle size range of 2.4 to 0.8 mm (#8 to #20 mesh), typically used for bentonite grout slurries, but may also be used in dry form to seal borings under certain circumstances

2.4 Neat Cement: a mixture of Portland cement and fresh water (5 to 6 gallons of water per 94-pound sack of cement)

2.5 Tremie Grouting: pumping a grout slurry through a conductor pipe or tube that extends nearly to the bottom of a boring or monitoring well to positively displace (lift) ground water out of the boring or well as the denser grout is emplaced; this method prevents dilution of the grout, which could inhibit formation of a proper grout seal

2.6 Uppermost Saturated Zone: the first (shallowest) zone of saturation present at a given location. The uppermost saturated zone extends from the first ground water encountered to the base of the unit where saturated conditions are not present. For example, the uppermost saturated zone would be from 10 to 20 feet below ground surface (bgs) for a surficial 20-foot thick sand layer saturated from 10 to 20 feet bgs and underlain by low-permeability clay. A monitoring well installed anywhere within 10 to 20-foot bgs would be considered an uppermost saturated zone well. A well installed deeper than that, *i.e.*, below the confining clay layer in lower (second) saturated sand would not be considered an uppermost saturated zone well. Uppermost saturated zones may include perched ground water zones.

3.0 Health and Safety Considerations

3.1 Wear appropriate personal protective equipment (PPE) when working near a drilling rig or grout pump. At a minimum, PPE should include protective eyewear, footwear, and hearing protection.

3.2 Use hand protection to help prevent injuries when performing boring or monitoring well decommissioning activities that require the use of mechanical or manual equipment.

3.3 To avoid direct contact with chemical contaminants and prevent skin irritation, wear chemical-resistant or other protective gloves when handling grouting materials or soil from decommissioning activities. Wash your hands after completing boring or well decommissioning activities.

3.4 Well sealing materials, including but not limited to bentonite, cement and sand may present a silica dust hazard. Appropriate health and safety precautions should be implemented to present exposure to respirable silica, *e.g*., engineering controls and/or respirators with the appropriate filter cartridges.

4.0 Procedure Cautions

4.1 When decommissioning a boring or monitoring well by pouring bentonite granules or chips into it, use a weighted tape or drilling rods to ensure that the bentonite does not bridge above the bottom of the boring.

4.2 Bring the bentonite to within approximately 1 to 3 feet of the ground surface and fill the remainder of the boring with appropriate clean fill materials (*e.g.*, topsoil in a residential lawn area, sand or gravel and asphalt mix in a paved area). If bentonite is brought nearer to the ground surface, it may expand out of the boring onto the ground. Decommissioned borings containing bentonite that has expanded to the ground surface are aesthetically unattractive and present a slip/fall hazard.

4.3 Ground water exhibiting elevated hardness (> 500 ppm) or chloride concentrations (> 1,500 ppm) can suppress the hydration of bentonite grouts. Ground water near solid waste landfill leachate plumes or salt piles may contain high concentrations of chlorides. Under such circumstances use of neat cement grout slurry or an alternative grouting material may be required.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Bentonite chips or granules
6.2 Topsoil, concrete mix, asphalt mix, sand and/or gravel
6.3 Potable water
6.4 Water level indicator
6.5 Weighted measuring tape or drilling rods
6.6 Shovel
6.7 Pry bar
6.8 Sledgehammer
6.9 PVC pipe cutter
6.10 Photoionization detector (PID)
6.11 PPE
6.12 Large heavy-duty trash bags
6.13 Decontamination equipment and supplies
6.14 Field book or decommissioning log form
6.15 Camera

7.0 Procedures

7.1 <u>Decommissioning soil borings 6 feet deep or less that do not intersect the water table:</u>

7.1.1 If the soil boring does not encounter any hazardous waste, solid wastes, or C&DD materials, then decommission the boring by backfilling it with soil cuttings, topsoil, or other clean fill materials (*e.g.*, sand or gravel). The soil cuttings or other materials used for backfilling must be known to not contain contaminants exceeding any federal or state regulatory concentration levels or any hazardous waste, solid waste or C&DD materials. If the soil boring is located within a paved area, complete the decommissioning in a manner that prevents pavement settling and fill the upper 4 to 6 inches (or pavement thickness) of boring space with concrete or asphalt mix, whichever is appropriate.

7.1.2 If the soil boring encounters hazardous waste, solid waste, or C&DD materials, then decommission the boring by backfilling it with bentonite chips or granules unless otherwise directed by the SSWP, DERR Site Coordinator or Ohio EPA client division. Use potable water to hydrate the granules or chips after installation.

7.2 Decommissioning soil borings deeper than 6 feet but less than the depth to the base of the uppermost saturated zone or any boring that intersects the water table:

7.2.1 Depending on the subsurface conditions encountered, decommission soil borings by backfilling with bentonite chips or granules.

7.2.2 Use a weighted tape or drilling rods to ensure that the bentonite does not bridge in the boring and form a void. The dry bentonite should be hydrated by adding potable water as needed.

7.3 Decommissioning monitoring wells installed in the uppermost saturated zone (in-place decommissioning technique)

7.3.1 Before decommissioning the monitoring well, record final static water level and total depth measurements.

7.3.2 Fill the monitoring well screen and casing with granular bentonite or chips. Use a weighted tape or drilling rods to ensure that the bentonite does not bridge in the boring and form a void. Clean sand may be substituted for bentonite from the bottom of the well to approximately two feet above the top of the screen.

7.3.3 The dry bentonite should be hydrated in lifts by adding potable water as needed.

7.3.4 Remove the protective surface casing and concrete seal and cut the well casing between one and three feet below the ground surface.

7.3.5 Fill the remaining void with topsoil or other clean fill materials appropriate for the use of the area in which the boring is located. For example, if the boring is in a lawn area, topsoil may be used. If the boring is in a paved area, use sand or gravel topped with a 4- to 6-inch thick layer of asphalt mix or concrete.

7.4 Decommissioning monitoring wells installed below the base of the uppermost saturated zone

7.4.1 Monitoring wells installed below the base of the uppermost saturated zone generally should not be decommissioned in place, *i.e.*, the casing and screen generally should be removed. However, removing the screen and casing may sometimes not be possible due to the well location and work/equipment obstructions. Under such circumstances, abandoning the well in place may be acceptable.

7.4.2 DERR's LOE contractor should be mobilized to decommission monitoring wells installed below the base of the uppermost saturated zone if the casing and screen are to be removed.

8.0 Data and Records Management

8.1 Document soil boring and well decommissioning procedures, materials and observations on a field decommissioning log form or project field book. Refer to FSOP 1.3, Field Documentation.

8.2 For all wells and soil borings used to assess ground water quality or quantity, an ODNR water well sealing report must be filed. Refer to FSOP 1.8, ODNR Well Construction Log and Well Sealing Report Filing Requirements.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

Not applicable

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.8, ODNR Well Construction Log and Well Sealing Report Filing Requirements

Ohio EPA Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring (February 2009): Chapter 9, Sealing Abandoned Monitoring Wells and Boreholes

Ohio Administrative Code (OAC) 3701-28-07, 3745-9-03 and 3745-9-10 Ohio Revised Code (ORC) 1521.05(c)

State of Ohio, Regulations and Technical Guidance for Sealing Unused Water Wells and Boreholes *(*State Coordinating Committee on Ground Water) 2015.

<u>Discrete Soil Sampling</u>
FSOP 2.1.1 (May 26, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 While there are multiple mechanical drilling methods (*e.g.,* direct-push, hollow stem auger, rotosonic) for sample collection, unless otherwise approved by Division of Environmental Response and Revitalization (DERR) management, the direct-push method will be used on DERR projects.

1.2 Discrete soil sampling is the process of collecting a single soil sample from a specific location and depth interval. Discrete soil sample locations and depths are typically selected based on existing knowledge about site conditions, including:

- Site history and land use
- Type of contaminant and the nature of release
- Visual evidence of releases or source areas, e.g., staining, stressed vegetation, leachate seeps
- Site soil types, geology and hydrogeology
- Field survey data, e.g., geophysical surveys
- Field screening results, e.g., PID or mobile laboratory data
- Analytical results from previous investigations

1.3 The number of discrete soil sample locations needed to characterize site conditions is primarily based on professional judgment, which incorporates knowledge of site information, project goals and data quality objectives (DQOs). Discrete sampling is often used to evaluate the spatial distribution of contaminants or other constituent concentrations within a soil unit (see ITRC reference below). Examples include but not limited to:

- Sampling to define the extent of soil contamination from a surface spill
- Sampling to identify and define the extent of soil contamination associated with a leaking Underground Storage Tank (UST) system
- Sampling to verify that the extent of a contaminated soil excavation meets remedial objectives
- Sampling to determine background concentrations or provide concentration data for geochemical modeling or risk assessment based on statistical evaluation, e.g., calculation of a 95% upper confidence limit on the mean

1.4 The relatively small size of a single discrete sample is generally inadequate to definitively characterize the large volume of un-sampled soil surrounding it, and analytical results should not be extrapolated beyond the immediate vicinity of the sampling location (see ITRC reference below). Discrete sampling may <u>not</u> be preferred when:

- Sampling to determine the average concentrations of constituents in soil underlying a specified area
- Sampling to determine background concentrations or provide concentration data for geochemical modeling or risk assessment based on statistical evaluation when statistical data analysis is not required

For these situations either composite or incremental sampling may be appropriate.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Please refer to FSOP 1.2, Utility Clearance. Underground utility clearance must be requested prior to conducting hand or mechanical excavation of soil or sediment per Ohio Revised Code (ORC) 3781.25(I).

3.2 Wear appropriate personal protective equipment (PPE) when working in the vicinity of drilling or other types of mechanical soil sampling equipment. At a minimum, PPE should include sample gloves, protective eyewear, and protective footwear (OSHA 1910.136). Hearing protection is required in noisy environments. A hard hat (ANSI 289.1-2003 Type II Class E, protection from top and side impact) is required if overhead hazards are present or if required by the facility where work is being performed. Canvas coveralls (or similar protective clothing) are also recommended.

3.3 Use heavy protective gloves to help prevent hand injuries when using hand augers or other manual sampling equipment or handling and opening core barrels, split spoons or core liners.

3.4 Wear chemical-resistant gloves when handling soil samples to avoid direct contact with chemical contaminants. Always thoroughly wash your hands after completing soil sampling activities.

3.5 If free product or splash hazards are a concern during drilling and sampling, use of a chemically resistant suit (*e.g.,* Saranex or coated Tyvek) is recommended.

3.6 If dusty conditions are present, respiratory protection may be necessary to provide protection from dust-inhalation hazards. Work must be stopped to assess site conditions. Work requiring respiratory protection may only be performed by staff certified to wear respiratory protection. Depending on site-specific conditions and chemicals of concern, monitoring with a particulate meter or other air monitoring instruments may be appropriate. To review action levels, refer to the NIOSH Pocket Guide to Chemical Hazards.

3.7 Conduct air monitoring in accordance with the site-specific health and safety plan. For action levels, refer to Table 1 of FSOP 1.1, Initial Site Entry.

3.8 Dress appropriately for anticipated weather conditions, and always have ample drinking water available when working in hot weather. Insect repellant may be needed for protection from ticks, mosquitoes, and other biting insects in heavily wooded areas.

4.0 Procedure Cautions

4.1 Review the site-specific work plan (SSWP) before performing field work to ensure that the discrete sampling method is appropriate for project objectives and the associated DQOs.

4.2 Evaluate access to all borings/soil sampling locations before mobilization of drilling or other sampling equipment to the site

4.3 Hand augers (bucket augers) or triers (probes) may be difficult to advance in dense clayey soils or gravelly soils.

4.4 Loose sandy soils may fall out of hand augers or triers as these samplers are extracted from the subsurface.

4.5 Triers are limited to a relatively small sample volume (*e.g.,* a 5/8-inch by 12-inch soil core) that may not be adequate for analysis of multiple constituents (*e.g.,* semi-volatile organics (SVOCs), pesticide, polychlorinated biphenyls (PCBs), and metals) without collecting multiple co-located samples.

4.6 Complete all activities associated with soil sampling (*e.g.,* soil boring logging or field screening). These activities will be described in the SSWP.

4.7 Use insect repellants and other chemicals in a manner that minimizes the potential for soil sample cross contamination, e.g., apply insect repellent in the morning before drilling and sampling activities begin.

4.8 Avoid excessive handling or manipulation of soil samples collected for laboratory analysis. Portions of a soil sample used for logging or screening purposes should not be used for laboratory analysis. Soil samples collected for laboratory analysis should be placed in laboratory containers and appropriately preserved as soon as possible.

4.9 Soil samples collected for VOC analysis require special sampling and handling techniques. Refer to FSOP 2.1.6, Soil Sample Collection for Volatile Organic Compound Analysis by Bulk Sampling Methods, or FSOP 2.1.7, Soil Sample Collection for Volatile Organic Compound Analysis Compliant with U.S. EPA SW 846 Methods 5035 and 5035A.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Soil sampling equipment, including but not limited to spoons, trowels, triers (probes), hand augers (bucket augers), shovels and/or drilling equipment
6.2 Soil screening equipment (*e.g.,* PID) and supplies, as needed
6.3 PPE
6.4 Stainless steel pans, disposable aluminum pans, stainless steel spoons and/or stainless-steel spatulas for splitting, homogenizing, or otherwise manipulating soil samples
6.5 Plastic sheeting
6.6 Tools for clearing vegetation and surface debris from soil sampling locations (*e.g.,* shovels, brush axes, etc.)
6.7 Laboratory containers and labels
6.8 Sample cooler(s) with ice (if needed)
6.9 Field documentation supplies and equipment, including pens, markers, field log/data sheets, field logbook, chain-of-custody forms, camera
6.10 Decontamination equipment and supplies
6.11 SSWP and HASP

7.0 Procedures

7.1 Before performing soil sampling activities, review the SSWP. The SSWP will provide locations and approximate depths for discrete soil samples, information regarding anticipated subsurface conditions at the site (*e.g.,* soil types, nature of contamination, depth to ground water, etc.), and any required field screening or soil logging activities.

7.2 Refer to FSOP 1.4, Sample Identification Nomenclature, for sample labeling and identification.

7.3 Discrete Soil Sample Collection Using Manual Equipment

7.3.1 Use manual sampling equipment capable of extracting soil samples that will meet both project goals and DQOs.

7.3.2 Place sampling equipment and supplies on a clean plastic sheet adjacent to each sampling location to prevent cross-contamination by direct contact with the ground surface.

7.3.3 Remove surface debris such as vegetation, gravel or other materials or debris prior to sampling.

7.3.4 Wear a new pair of clean sampling gloves when collecting each discrete soil sample.

7.3.5 If required, perform soil field screening or logging activities using a representative portion of the soil sample that is not needed for laboratory analysis. Screening and logging may be performed on a separate split or subsample before or after laboratory containers have been filled. Refer to FSOP 2.1.4, Sample Headspace Screening, and FSOP 2.1.5, Soil Description, Classification and Logging.

7.3.6 Soil samples for VOC analysis should be collected first in accordance with the following FSOPs, depending on project objectives and DQOs identified in the SSWP:

- FSOP 2.1.6, Soil Sample Collection for Volatile Organic Compound Analysis by Bulk Sampling Methods
- FSOP 2.1.7, Soil Sample Collection for Volatile Organic Compound Analysis Compliant with U.S. EPA SW 846 Methods 5035 and 5035A

7.3.7 For non-VOC soil samples, use a disposable aluminum pan or a stainless-steel pan or bowl to contain and homogenize the soil sample prior to filling laboratory container (if applicable).

7.3.8 For non-VOC constituents, fill the laboratory containers with a representative portion of the soil increment sampled in the order of decreasing sensitivity to volatilization (*e.g.,* SVOCs, pesticides, PCBs, metals).

7.3.9 If required for analytical sample preservation, immediately place the labeled and filled laboratory containers in a cooler on ice.

7.3.10 Complete the chain-of-custody form and applicable boring logs, field forms, logbook or log sheets in accordance with FSOP 1.3, Field Documentation.

7.3.11 Decontaminate non-disposable sampling equipment between sampling locations unless the SSWP requires more frequent decontamination (*e.g.,* between depth intervals at each location). Refer to FSOP 1.6, Sampling Equipment Decontamination.

7.4 Soil Sample Collection Using Direct-Push Drilling Equipment

7.4.1 Two types of direct push samplers are typically used for the collection of discrete soil samples:

- The Macro-Core™ Soil Sampling System is used to collect continuous soil cores from an uncased boring (the sampler and rods are removed from the boring after each soil sample is collected and then reinserted to collect the next sample).

- The Dual Tube Soil Sampling System is used to collect continuous as well as discrete depth soil cores from within a sealed casing (the boring remains open while soil samples are collected and extracted). Soil cores are approximately one inch in diameter by 48 inches long.

Disposable acetate core liners are used with both sampler types.
The sampler type(s) selected should produce soil samples that meet both project goals and DQOs. For example, if a large volume of soil sample will be needed for multiple constituents (*e.g.,* SVOCs, pesticides/PCBs and metals) the Macro-Core™ sampling system is likely the best choice.

However, if samples need to be collected below a zone of soil contamination, the Dual Tube sampling system will minimize potential cross contamination between contaminated and uncontaminated soils.

7.4.2 Wear a new pair of clean chemical resistant sampling gloves when collecting each discrete soil sample.

7.4.3 If any of the soil in the sampler appears to be caved or sloughed material from the open boring overlying the sampled interval, remove it from the sampler. Do not submit it for laboratory analysis or log it as part of the sampled interval. If in doubt based on sample appearance, consult with the driller regarding the stability of the borehole (*i.e.,* is it collapsing or heaving between sample intervals?) Treat this material as investigation-derived waste per FSOP 1.7, Investigation Derived Waste.

7.4.4 Record the depth interval and recovery of each soil sample to the nearest one-tenth (0.1) foot. Do not record a recovery that is greater than the length of the soil core. For example, if a core sampler pushed from 8.0 to 10.0 feet recovers only 1.5 ft of soil core, record the recovery as 1.5 ft (or 8.0 to 9.5 ft), not 2.0 ft (or 8.0-10.0 ft).

7.4.5 If required, perform soil field screening or logging activities (*e.g.,* PID screening, soil type identification and description) using a representative portion of the soil sample that is not needed for fixed-base laboratory analysis. Screening and logging activities may be performed before or after laboratory containers have been filled. Refer to FSOP 2.1.4, Sample Headspace Screening, and FSOP 2.1.5, Soil Description, Classification and Logging.

7.4.6 Soil samples for VOC analysis should be collected first in accordance with the following FSOPs depending on project objectives and DQOs identified in the SSWP:

- FSOP 2.1.6, Soil Sample Collection for Volatile Organic Compound Analysis by Bulk Sampling Methods
- FSOP 2.1.7, Soil Sample Collection for Volatile Organic Compound Analysis Compliant with U.S. EPA SW 846 Methods 5035 and 5035A

7.4.7 For non-VOC constituents, fill the laboratory containers with a representative portion of the soil increment sampled in the order of decreasing sensitivity to volatilization (*e.g.,* SVOCs, pesticides/PCBs, metals).

7.4.8 If required for analytical sample preservation, immediately place the labeled and filled laboratory containers in a cooler on ice.

7.4.9 Complete the chain-of-custody form and applicable boring logs, field forms, logbook or log sheets in accordance with FSOP 1.3, Field Documentation.

7.4.10 Direct-push (*e.g.,* Geoprobe™) sampling equipment does not need to be decontaminated between sampling locations because soil cores are collected in disposable acetate liners. However, if gross contamination (*e.g.,* non-aqueous phase liquids) is encountered or if the potential for cross-contamination is a concern, the direct-push Geoprobe™ sampling equipment should be decontaminated in accordance with FSOP 1.6, Sampling Equipment Decontamination.

7.5 Prepare samples for delivery to the laboratory in accordance with FSOP 1.5, Sample Custody and Handling.

7.6 Dispose of unused soil samples, disposable sampling equipment and used supplies in accordance with FSOP 1.7, Investigation Derived Waste.

7.7 After sampling activities are completed, decommission the boring or shallow excavation in accordance with FSOP 1.9, Boring and Monitoring Well Decommissioning

7.8 After sampling activities are completed, file ODNR well logs as necessary in accordance with the requirements of FSOP 1.8, ODNR Well Construction Logs & Well Sealing Reports.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation

9.0 Quality Assurance and Quality Control

Quality assurance/quality control (QA/QC) samples may include equipment blanks, field blanks and/or trip blanks depending on the site-specific chemicals of concern and conditions. Duplicate soil samples are to be collected at a minimum of 1 per 10 soil samples collected. Duplicate samples are required for U.S. EPA Contract Laboratory Program sampling events conducted at Federal CERCLA sites. Duplicate soil samples should not be collected at sites under other regulatory programs unless otherwise directed by DERR management.

10.0 Attachments

None

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.2, Utility Clearance

FSOP 1.3, Field Documentation

FSOP 1.4, Sample Identification Nomenclature

FSOP 1.5, Sample Custody and Handling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Waste

FSOP 1.8, ODNR Well Construction Logs & Well Sealing Reports

FSOP 1.9, Boring and Monitoring Well Decommissioning

FSOP 2.1.4, Sample Headspace Screening

FSOP 2.1.5, Soil Description, Classification and Logging

FSOP 2.1.6, Soil Sample Collection for Volatile Organic Compound Analysis by Bulk Sampling Methods

FSOP 2.1.7, Soil Sample Collection for Volatile Organic Compound Analysis Compliant with U.S. EPA SW 846 Methods 5035 and 5035A

ITRC (Interstate Technology & Regulatory Council), 2012, Incremental Sampling Methodology (ISM-1): Interstate Technology & Regulatory Council, Incremental Sampling Methodology Team, Washington, D.C., www.itrcweb.org. [Note: ISM-2 is scheduled for release in Fall 2020.]

Ohio Revised Code 3781.25(I)

OSHA 1910.136, Personal Protective Equipment (Foot Protection)

Composite Soil Sampling
FSOP 2.1.2 (June 3, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Composite sampling is the process of physically combining and homogenizing several discrete soil increments to form a single sample. Composite sampling is most commonly used for the following:

- Estimating the average concentration of a constituent of concern to meet regulatory sampling requirements (*e.g.,* sampling to characterize the concentrations of inorganics in a predetermined target area)
- Providing a laboratory-defined sample volume for analysis when discrete sample volumes are inadequate
- Reducing the number of discrete analyses as a cost-saving measure

1.2 Composite sampling involves a three-step process:

- Collecting sample increments using a specific sampling design within a defined area or volume of contaminated media (the sampling unit or SU)
- Homogenizing the sample increments
- Collecting subsamples from the homogenized composite for laboratory analysis

The collection of increments for a composite sample may be based on judgmental, simple random, stratified, systematic/grid or other sampling designs (see U.S. EPA 2002 guidance listed below). Homogenization of sample increments should be performed in a laboratory or similar controlled environment. Homogenization and collection of analytical subsamples from the homogenized composite are the most critical steps of the process with respect to obtaining a representative sample.

1.3 This FSOP is applicable to the collection of composite soil samples as well as composite samples from sediment and certain industrial wastes (*e.g.,* fly ash, foundry sand, and cement kiln dust).

1.4 Composite samples differ from discrete samples in that composite samples are used to characterize average contaminant concentrations in a defined area or volume of contaminated media, and are collected in accordance with appropriate sampling design, homogenization and subsampling protocols based on project and data quality objectives (DQOs). Discrete samples are used to characterize the concentration variation and spatial distribution of contaminants at a contaminated site. Therefore, unlike composite sampling, discrete sampling relies more heavily on field observations and professional judgment that incorporate knowledge of site information as well as project objectives and DQOs. Examples of discrete sampling scenarios include:

- Sampling to define the extent of soil contamination from a surface spill of an organic solvent

- Sampling to determine the maximum contaminant concentration present in sediment contained with an industrial wastewater lagoon
- Sampling to verify that the extent of a contaminated soil excavation meets remedial objectives

For projects where variability or spatial distribution or variability of soil or sediment contaminant concentrations is needed, perform soil sampling in accordance with FSOP 2.1.1, Discrete Soil Sampling or sediment sampling in accordance with FSOP 2.3.2, Sediment Sample Collection.

1.5 Composite samples differ from multi-incremental samples in that composite samples are used to estimate average contaminant concentrations based on a defined SU, whereas multi-incremental samples are used to determine representative concentrations in a decision unit (DU).

Multi-incremental samples typically require a higher number of discrete sample increments (at least 30 to 50 increments) than composite samples (typically much less than 30 increments). The higher number of increments provide a greater degree of statistical certainty with respect to average contaminant concentrations within the DU, which in turn provides support for the associate decision. Examples of multi-incremental sampling include:

- Sampling to determine representative (*i.e.,* average) concentrations of inorganic or organic constituents in soil underlying a vacant two-acre parcel located in a former industrial park to determine if the property can be developed as a city park
- Sampling to determine naturally occurring background concentrations of metals in an uncontaminated portion of a soil unit
- Sampling to provide contaminant concentration data for geochemical modeling or risk assessment

If data are needed for project decisions based on a DU, perform incremental soil sampling in accordance with FSOP 2.1.3, Incremental Sampling for Soil and Sediments. Otherwise, use a composite sampling technique in accordance with this FSOP (assuming discrete sampling is not appropriate to meet project objectives).

1.6 Composite sampling may not be an acceptable technique for quantitative assessment of site contamination (*i.e.,* determining representative concentration and extent) due to the limitations identified in section 4.6.

1.7 Composite sampling is not recommended for collecting data to support environmental risk assessments; instead, discrete or multi-incremental sampling techniques should be used. Any site-specific work plans (SSWPs) that include sampling to specifically support risk assessment should be reviewed by Division of Environmental Response and Revitalization’s Engineering & Risk Assessment Support (ERAS) unit.

1.8 Composite sampling is not an acceptable technique for determining background concentrations in soil or sediment. Discrete or multi-incremental sampling techniques should be used to collect background samples.

1.9 Sampling designs for composite sampling may be based on regulatory program requirements (*e.g.,* collecting a composite sample from an underground storage tank excavation soil stockpile for benzene analysis under the Ohio Bureau of Underground Storage Tank Regulations) or technical guidance. Recommended technical guidance includes U.S. EPA (January 2013, December 2002 and August 1995), Patil (2002), Splitstone (2001) and Gilbert (1987).

1.10 Composite samples cannot be used to evaluate RCRA land disposal restrictions (LDRs). The LDR rules require grab (discrete) samples.

1.11 SSWPs that include composite sampling should be reviewed by DERR ERAS staff and/or lead technical staff prior to sample collection to ensure that the composite sampling design and appropriate procedures meet project DQOs.

2.0 Definitions

Decision Unit (DU): the smallest area or volume of soil where a decision is needed regarding the evaluation and/or remediation of contaminated media with respect to the potential environmental hazards posed by existing or anticipated future land use based on Incremental Sampling Methodology (ISM).**Hot Spot**: soil or sediment area/volume with relatively high contaminant concentration(s) that may be present at a site, but whose location and dimensions cannot be anticipated prior to sampling based on existing site information and sampling data

Sampling Unit (SU): an area/volume of soil or sediment from which increments are collected to determine an estimate of the mean concentration for that volume

Source Area: waste disposal units, spills, releases, and areas/volumes of soil or sediment shown by previous sampling to have significant contaminant concentrations relative to the surrounding soil/sediment

3.0 Health and Safety Considerations

3.1 Refer to the site health and safety plan (HASP) for site-specific safety issues.

3.2 Follow all applicable health and safety considerations provided in FSOP 2.1.1, Discrete Soil Sampling and/or FSOP 2.3.2, Sediment Sample Collection.

4.0 Procedure Cautions

4.1 Carefully review the SSWP before performing field work to fully understand the composite sampling procedures that need to be implemented. Composite sampling procedures, including collecting sample increments according to a specific sampling design, homogenizing the sample and sub-sampling the homogenized composite for laboratory analysis, are highly variable site- and project-specific activities. A complete consideration of the scope of composite sampling scenarios is beyond the scope of this FSOP, which is intended to provide general procedures. A detailed discussion of site- and project-specific procedures should be provided in the SSWP. If not, contact DERR-Site Investigation Field Unit staff and/or DERR site coordinator for assistance.

4.2 Integrity of the SU is critical for composite sampling (*i.e.,* the SU should not incorporate different soil, sediment or waste types and should not incorporate both contaminated and uncontaminated media).

4.3 Follow all applicable procedure cautions provided in FSOP 2.1.1, Discrete Soil Sampling and/or FSOP 2.3.2, Sediment Sample Collection.

4.4 Each discrete subsample should contribute an equal amount of material to the composite sample.

4.5 Discrete subsamples must be collected from the same material (*e.g.,* the same soil or fill type).

4.6 Composite sampling for volatile organic compound (VOC) analysis is not recommended (U.S. EPA January 2013). The manipulation of the sample during the compositing/homogenization process raises concerns with potential loss of VOCs. However, if the SSWP requires analysis of a composite sample for VOCs, FSOP 2.1.3 Incremental Sampling for Soils and Sediments should be used.

4.7 To ensure adequate homogenization, the composite subsamples should be homogenized at the Groveport Field Office or by the analytical laboratory. This is because it is more difficult to produce a representative composite sample via field homogenization. If appropriate based on the SSWP and associated DQOs, the sample homogenization procedures in FSOP 2.1.3 Incremental Sampling for Soils and Sediments may be used.

4.8 Subsampling of the homogenized composite sample for laboratory analysis is the most critical part of the composite sampling process. The SSWP should provide detailed procedures for subsampling or reference the subsampling procedures provided in SOP 2.1.3, Incremental Sampling for Soils and Sediments. If clarification is needed regarding the subsampling procedures, contact DERR-SIFU staff and/or the DERR site coordinator.

4.9 Soils or sediments with high clay content may be difficult to composite and require drying and grinding of the sample for adequate homogenization.

4.10 Sample homogenization procedures must not adversely impact the integrity of the target analytes.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

Depending on the SSWP requirements, refer to FSOP 2.1.1, Discrete Soil Sampling, FSOP 2.3.2, Sediment Sample Collection and/or FSOP 2.1.3, Incremental Sampling for Soils and Sediments as applicable for sample collection and homogenization equipment and supplies.

7.0 Procedures

7.1 Before performing sampling activities carefully review the SSWP, which should provide detailed project-specific composite sampling procedures (sampling design and increment collection, sample homogenization, collecting and submitting subsamples for laboratory analysis). If clarification is needed regarding the SSWP procedures, contact the DERR-SIFU staff and/or the DERR site coordinator.

7.2 For the collection of composite sample increments, follow the procedures in the SSWP and/or FSOP 2.1.1, Discrete Soil Sampling, FSOP 2.3.2, Sediment Sample Collection and/or FSOP 2.1.3, Incremental Sampling for Soils and Sediments as applicable based on the SSWP.

7.3 Triplicate samples (one sample and two replicates) should be collected at a rate of 10% of the total number of composite samples. The triplicate increments should be collected in the same manner as the sample increments (same sampling design/grid, depth interval, sampling tool, etc.) but should not be collected from the same exact locations as the sample increments (or other triplicate increments). Efforts should be taken to ensure that all increments for each triplicate sample are collected in different locations to ensure the ability to evaluate sample and SU variability. Triplicate sample results can be used to calculate a 95% upper confidence interval for the mean concentration that helps quantify the uncertainty in the estimate of the mean contaminant concentration(s) for the composite SU.

7.4 For sample homogenization and the selection of subsamples for laboratory analysis, follow the procedures in the SSWP and/or FSOP 2.1.3, Incremental Sampling for Soils and Sediments as applicable based on the SSWP.

7.5 Excess soil or sediment volume left over after homogenization and compositing (*e.g.,* excess sample volume not needed for laboratory sample submission) must be disposed of in accordance with FSOP 1.7, Investigation Derived Waste after the sample results are received and reviewed.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

9.1 A clear record of the discrete sample increments that comprise each composite sample must be maintained.

9.2 Quality assurance/quality control (QA/QC) samples may include equipment blanks, field blank, and/or trip blanks depending on the site-specific chemicals of concern, site conditions and SSWP requirements.

9.3 Triplicate samples should be collected as described in paragraph 7.3 to statistically evaluate the uncertainty in the estimate of the mean contaminant concentration(s) for the composite SU.

10.0 Attachments

Not applicable

11.0 References

FSOP 1.3, Field Documentation

FSOP 1.7, Investigation Derived Waste

FSOP 2.1.1, Discrete Soil Sampling

FSOP 2.1.3, Incremental Sampling for Soils and Sediments

FSOP 2.3.2, Sediment Sample Collection

Gilbert, R.O., 1987, *Statistical Methods for Environmental Pollution Monitoring*: Van Nostrand Reinhold, New York (ISBN 0-442-23050-8)

Patil, G.P., 2002, *Composite Sampling*: Volume I in Encyclopedia of Environmetrics, edited by A.H. El Shaarawi and W.W Piegorsch, John Wiley & Sons Ltd, pp. 387-391

Splitstone, D.E., 2001, *Sample support and related scale issues in composite sampling*: Environmental & Ecological Statistics, Vol. 8, pp. 137-149.

U.S. EPA, January 2013, *Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes – Draft 2*: Solid Waste and Emergency Response, EPA 530-R-12-001

U.S. EPA, December 2002, *Guidance on Choosing a Sample Design for Environmental Data Collection for Use in Developing a Quality Assurance Plan, EPA QA/G-5S*: Office of Environmental Information, EPA/240/R-02/005

U.S. EPA, August 1995, *EPA Observational Economy Series, Volume I: Composite Sampling*: Policy, Planning and Evaluation, EPA-230-R-95-005

<u>Incremental Sampling for Soils</u>
FSOP 2.1.3 (June 9, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol that reduces data variability and increases sample representativeness for a specified area/volume of soil. ISM is a two-part process (sample collection and subsequent laboratory processing with subsampling) that is designed to obtain a single analytical sample having all constituents in the same proportion as an explicitly defined area/volume of soil called the decision unit (DU). A DU is site-specific and represents the smallest volume of soil about which a decision is to be made (ITRC February 2012; update due in 2020). ISM improves the accuracy and precision of COC concentrations for bulk volumes of soil. COCs may include metals, semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), or pesticides. Generally, VOC sampling is not recommended using ISM. The Interstate Technology & Regulatory Council (ITRC) Incremental Sampling Technology (February 2012; update due in 2020) provides detailed ISM guidance and is Ohio EPA's primary reference for ISM. The procedures described in this FSOP are consistent with the ITRC guidance. Example applications of ISM include:

- Determining representative concentrations of inorganic or organic constituents in soil underlying a vacant parcel located in a former industrial park
- Determining representative background concentrations of metals
- Providing representative constituent concentration data to be used for geochemical modeling or risk assessment when statistical evaluation of discrete samples is not required or desired

1.2 ISM procedures are designed to minimize the sources of sampling error associated with soil sampling (Table 1). Discrete soil sampling methodology (*e.g.,* FSOP 2.1.1, Discrete Soil Sampling) typically does not account for these errors, which artificially increase the variability of analytical results. The most significant are fundamental error (FE) caused by variations in particle size and/or composition and grouping and segregation error (SE) caused by variations in particle type distributions. ISM reduces these errors by increasing the mass of the field sample (combining multiple sample increments), reducing particle size (grinding) and homogenizing the field sample, and using unbiased subsampling techniques to select a representative analytical sample.

1.3 A site-specific work plan (SSWP) with incremental sampling should include:

- A description of the nature and extent of contamination
- Site-specific data quality objectives (DQOs)
- DUs based on a conceptual site model (CSM)
- One or more ISM sampling designs
- Volumes and number of ISM sample increments

- Laboratory requirements for sample volumes and subsampling techniques

ISM sampling designs include those typically used for composite sampling, which include simple random, stratified random and systematic random sampling designs. ITRC (February 2012, update due in 2020), U.S. EPA (August 2002), U.S. EPA (December 1995) and Gilbert (1987) provide detailed information on composite sampling designs that are appropriate for ISM. DUs should be selected based on input from the entire project team (*e.g*., SIFU personnel, site coordinators, risk assessors, engineers, management, and laboratory personnel as needed). Appendix A of this SOP provides guidance for selecting DUs.

1.4 Generally, due to feasibility and cost considerations, ISM is often limited to the evaluation of surface soils (less than two feet deep) that can be collected manually. This FSOP assumes that manual sampling equipment (*e.g*., soil probes, hand augers, sampling spoons) will be used to collect ISM samples from surface soils. Related FSOPs include:

- FSOP 2.1.1, Discrete Soil Sampling
- FSOP 2.1.7, Soil Sample Collection for Volatile Organic Compound Analysis Compliant with U.S. EPA SW 846 Methods 5035 and 5035A

In the event that samples are collected using direct push or other mechanical sampling equipment, please consult applicable FSOPs, equipment user manuals, and/or the SSWP and health and safety plan (HASP) for health and safety considerations, procedure cautions, and sample collection procedures. ITRC describes field procedures appropriate for performing ISM on subsurface soil cores (refer to Chapter 5, *Field Implementation, Sample Collection, and Processing*). Figure 1 shows an ISM field sampling implementation flowchart (ITRC, February 2012, update due in 2020).

1.5 DUs normally should not exceed one-quarter acre (approximately 11,000 square feet), unless justified by special sampling scenarios or site-specific circumstances. See Appendix A, Guidance on Determining Decision Units

2.0 Definitions

Decision Unit (DU): the smallest area/volume of soil (or sediment) where a decision is needed regarding the extent and magnitude of contaminants with respect to the potential environmental hazards posed by existing or anticipated future exposures; the smallest volume of soil for which a decision will be made based on ISM sampling

Hot Spot: soil volume with relatively high contaminant concentration(s) that may be present at a site, but whose location and dimensions cannot be anticipated prior to sampling based on existing site information and sampling data

Sampling Unit (SU): a volume of soil from which increments are collected to determine an estimate of the mean concentration for that volume

Source Area: waste disposal units, spills, releases, and volumes of soil shown by previous sampling to have significant contaminant concentrations relative to the surrounding soil

3.0 Health and Safety Considerations

3.1 Prior to conducting hand (or mechanical) excavation of soil, underground utilities must be cleared. Please refer to FSOP 1.2, Utility Clearance.

3.2 Use heavy protective gloves to help prevent hand injuries when using hand augers or other manual sampling equipment, or handling and opening core barrels, split spoons or core liners.

3.3 Wear chemical-resistant gloves when handling soil samples to avoid direct contact with chemical contaminants. Always thoroughly wash your hands after completing soil sampling activities.

3.4 Dress appropriately for anticipated weather conditions, and always have ample drinking water available when working in hot weather. Insect repellant may be needed for protection from ticks, mosquitoes, and other biting insects.

3.5 Refer to the site HASP for site-specific safety issues.

4.0 Procedure Cautions

4.1 The DQO's in the SSWP should document the need for use of the ISM to meet project objectives, provide a detailed description of the DUs, and explain the site-specific sample collection and homogenization procedures.

4.2 Be aware that ISM data may not be acceptable for some regulatory programs.

4.3 ISM sampling equipment should be selected to minimize increment delimitation error (DE) and increment extraction error (EE) (Table 1). In general, sampling tools should have minimum diameter of 16 mm and should equally retain all particles in the sample(s) over the entire depth of interest. Sampling tools that obtain cylindrical or core-shaped increments over a constant depth are preferred over other types of tools (*e.g.,* spoons). For non-cohesive soils, scoops or trowels may be used, but care should be taken to collect a "core-shaped" increment over the entire depth interval of interest.

4.4 Unless required by the SSWP, avoid collecting ISM samples greater than 1 kg, because larger samples require more time and effort to process (sieve, grind and homogenize). The targeted ISM sample size should be specified in the SSWP and should be based in part on the analytical laboratory's requirements.

4.5 In general, ISM samples composed of at least 30 to 50 increments are adequate for most DUs. However, for DUs that are large or are expected to contain heterogeneous soils, 50 to 100 increments may be needed. Alternatively, larger areas or areas with physical, chemical or site screening variability may need to be separated into different DUs. The number of DUs and their spatial configuration and the targeted number of increments per ISM sample should be specified in the SSWP. Note that the number of increments will depend on the total sample mass, contaminant variability, selected sampling design (*e.g.,* gridding), and the volume of each increment. Refer to the ISM guidance on the ITRC website (February 2012, update due in 2020) for information on calculating incremental soil mass.

4.6 ISM sample increments need to be approximately equal in weight/volume. Therefore, calibrating field sampling equipment may be necessary to achieve a constant increment size or volume (*e.g.,* adjusting or marking a soil probe to collect a three-inch core).

4.7 The SSWP should clearly identify whether SIFU or Ohio EPA's contract laboratory will be processing (sieving, grinding, homogenizing and subsampling) ISM samples. Sample processing should occur in a controlled environment (*e.g*., Groveport Field Office or Ohio EPA's contract laboratory) to control sampling error. In addition, the SSWP should briefly describe the processing procedures to be used for each analyte group (*e.g.,* metals, semi-volatiles, pesticides/herbicides, PCBs or volatiles).

4.8 If soil samples collected for mercury, SVOCs, PCBs or pesticides need to be dried before ISM processing, do not heat the sample in an oven or with any other device. Allow the samples to air dry for a period of one to three days. Heating a sample (even at a relatively low temperature) may result in COC loss. If the samples are being analyzed for metals only (excluding mercury), then oven-drying is acceptable.

4.9 Samples collected for COCs that may be easily lost through volatilization (*e.g.,* VOCs, certain SVOCs and mercury) should not be processed by sieving or grinding prior to submission to the laboratory.

4.10 Refer to FSOP 2.1.1, Discrete Soil Sampling, for additional procedure cautions associated with discrete soil sampling.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 SSWP copy for field reference
6.2 Field logbook, chain-of-custody and other field forms
6.3 GPS unit for locating/delineating DUs
6.4 Field screening and soil logging equipment and supplies, if needed
6.5 Disposable and/or decontaminated soil sampling equipment, including but not limited to spoons, scoops, trowels, probes (triers), hand augers (bucket augers), shovels (Note: generally, a 7/8-inch diameter soil probe is preferred for soils)
6.6 Tool(s) to extract soil from sampling device (*e.g.,* a flathead screwdriver for removing clayey soil from a probe)
6.7 Stainless steel pans, disposable aluminum pans, stainless steel spoons and/or spatulas
6.8 Field sampling containers (jars or bags)
6.9 Tape measure
6.10 Marking flags or stakes
6.11 Personal protective equipment
6.12 Decontamination equipment and supplies
6.13 Sample processing supplies and equipment (when performed at GFO)
   6.13.1 Large rectangular pans for drying soil samples and post-size reduction/homogenization subsampling
   6.13.2 #4 (4.75 mm) and/or #10 (2 mm) sieves
   6.13.3 Stainless steel grinders
   6.13.4 Small rectangular scoops (stainless steel or plastic)
6.14 Laboratory containers, preservatives (methanol for VOCs) and labels
6.15 Sample cooler(s) with ice

7.0 Procedures

7.1 <u>Decision Unit Designation</u>

Carefully review the SSWP for DU locations and descriptions, field sampling design and ISM sampling protocol before planning field sampling activities. The targeted sample weight/volume, number of increments, and the sampling depth interval should be specified in the SSWP. If additional information is needed to implement ISM sampling as described in this FSOP, then consult with the DERR District Office Site Coordinator or SIFU Sampling Team Leader. Obtain additional input from a DERR risk assessor/lead technical worker or DERR management as needed. The extent of contamination should be understood prior to selecting DUs.

7.2 <u>ISM Sample Collection for Non-Volatile COC Soil Samples (including metals, SVOCs, PCBs or pesticides)</u>

7.2.1 Locate/delineate each DU using GPS (or manually with a tape measure from site structures/features if necessary).

7.2.2 Using tape measures and marking flags or stakes, set up the sampling design (typically with a grid) in accordance with the SSWP. Document any deviations from the SSWP that may be necessary due to site conditions.

7.2.3 Based on the sample weight/volume and number of soil increments specified in the SSWP, calibrate the sampling tool to collect an appropriate increment weight/volume. For example, if the total sample volume needed is 1 L and 30 increments are specified, a 1-inch diameter soil probe should be marked or adjusted to collect a 2.5-inch soil core at each incremental sampling location (30 – 2.5-inch x 1-inch diameter soil cores fill a volume of approximately 1 L).

7.2.4 Collect the required soil increments as described in the SSWP. Typically, a 1-inch stainless-steel step probe is used to collect each increment. Depths can range up to two feet below ground surface and may vary depending on the SSWP and associated DQOs.

7.2.5 If field screening or logging activities are required, collect a co-located screening/logging sample at each increment sampling point.

7.2.6 Combine all increments into an appropriate sample container. Use two or more containers if necessary and be sure to label each container with the same sample label information.

7.2.7 ITRC (February 2012, update due in 2020) recommends that triplicate samples (one sample and two replicates) be collected. The triplicate increments should be collected in the same manner as the sample increments (*i.e.,* same sampling design/grid, depth interval, sampling tool) but should not be collected from the same locations as the other sample increments. The triplicate samples should be independent sampling events with new locations selected for each set of aliquots based on the sample design. Triplicate sample results are used to calculate a 95% upper confidence interval for the mean concentration that helps quantify the uncertainty in the estimate of the mean for the DU. Variability of the contamination and constancy of the sampling team and laboratory subsampling can also be evaluated based on the results of the triplicate samples.

7.2.8 Decontaminate soil sampling equipment between DUs in accordance with FSOP 1.6, Sampling Equipment Decontamination. Decontaminating sampling equipment between soil increments within the same DU is not necessary.

7.3 <u>ISM Sample Processing for Non-Volatile COC Soil (or Moist/Wet) Samples (including metals, SVOCs, PCBs or pesticides)</u>

7.3.1 The SSWP should indicate whether the sample (and replicates) should be sent directly to the contract laboratory for processing and analysis or processed by SIFU and then submitted to the laboratory for analysis. If SIFU performs the processing, use the following procedures (refer to the

February 2012 ITRC ISM guidance for more detail).

7.3.1.1 Allow the sample (or replicate) to air dry for one to three days if necessary. Refer to paragraph 4.8 for the applicability of drying procedures based on COCs and/or sample matrix.

7.3.1.2 Unless otherwise directed by the SSWP, pass the sample through a #4 (4.75 mm) or #10 (2 mm) sieve to remove gravel and other large particles such as twigs, roots, incidental waste materials, etc.

7.3.1.3 Unless otherwise directed by the SSWP, grind and homogenize the entire sample using a stainless-steel grinder.

7.3.1.4 Spread the sample out on a clean, flat surface to form a layer approximately 0.5 to 1 inch thick. Collect the required increments using a rectangular scoop using a random, stratified random or systematic random sampling design. Place these increments in the analytical container to be submitted to the laboratory. Repeat this step as necessary for multiple COCs (*e.g.,* metals, SVOCs). Sample volume should be only that required by the lab for analysis.

7.3.1.5 Ship the sample to the laboratory for analysis in a cooler preserved with ice (4^o to 6^o C).

7.4 <u>ISM Sample Collection and Processing for VOC Soil Samples</u>

While the ITRC ISM guidance includes procedures for sample collection and processing for VOC soil samples, Ohio EPA DERR does not typically utilize this method. However, procedures are provided below in the event use of the method is desired. Management approval would be required.

7.4.1 Soil samples collected for VOC analyses should be collected and preserved with methanol or collected using zero-headspace vapor tight sampling devices (*e.g.,* EnCore samplers). Ohio EPA's contract laboratory will prepare methanol-preserved sample containers. If zero-headspace sampling devices are used, one device will be needed for each increment (*e.g.,* 30 increments would require 30 EnCore samplers).

7.4.2 Follow the procedures described above in paragraphs 7.2.1 through 7.2.5 as applicable.

7.4.3 To avoid collecting soil than may have lost VOCs due to volatilization, samples should be collected from a depth of at least 6 inches below grade or at least 6 inches within an excavator/backhoe soil scoop. The 6-inch depth limit can be adjusted based on site conditions.

7.4.4 If preserving the sample with methanol, immediately place each sample increment in the laboratory-provided container. Containers should be pre-preserved prior to sampling and should have a volume of methanol equal to the volume of all of the increments to be collected (*e.g.,* 30 sample increments require 30 “units” of methanol, with each unit of methanol being approximately equal in weight to the sample increment weight). Be careful not to spill any methanol preservative while filling the sample container. The container should be closed between the addition of each increment.

7.4.5 If using zero-headspace sampling devices, follow the manufacturer’s instructions to collect each soil increment. Immediately place each filled sampling device in a sample cooler preserved with ice (4^{o} to 6^{o} C).

7.4.6 Follow the procedures described above in paragraphs 7.2.7 through 7.2.8 as applicable.

7.4.7 Ship the sample to the laboratory for analysis in a cooler preserved with ice (4^{o} to 6^{o} C).

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

9.1 Quality assurance/quality control (QA/QC) samples may include equipment blanks, field blank, and/or trip blanks depending on the site-specific chemicals of concern, site conditions and SSWP requirements.

9.2 Triplicate samples should be collected as described in paragraph 7.2.7 to statistically evaluate the uncertainty in the estimate of the mean contaminant concentration(s) for the incremental sampling DU.

10.0 Attachments

Not applicable

11.0 References

FSOP 1.2, Utility Clearance

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

FSOP 2.1.1, Discrete Soil Sampling

FSOP 2.1.7, Soil Sample Collection for Volatile Organic Compound Analysis Compliant with U.S. EPA SW 846 Methods 5035 and 5035A

FSOP 2.3.2, Sediment Sample Collection

Gilbert, R.O., 1987, *Statistical Methods for Environmental Pollution Monitoring*: Van Nostrand Reinhold, New York (ISBN 0-442-23050-8)

The Interstate Technology & Regulatory Council (ITRC), February 2012, *Incremental Sampling Methodology*: Incremental Sampling Methodology Team, ISM-1, Washington, D.C., www.itrcweb.org [update due in 2020]

Ohio Revised Code 3781.25(I)

U.S. EPA, August 2000, *RCRA Waste Sampling Draft Technical Guidance: Planning Implementation and Assessment*: EPA530-D-02-002, Office of Solid Waste, Washington, D.C.

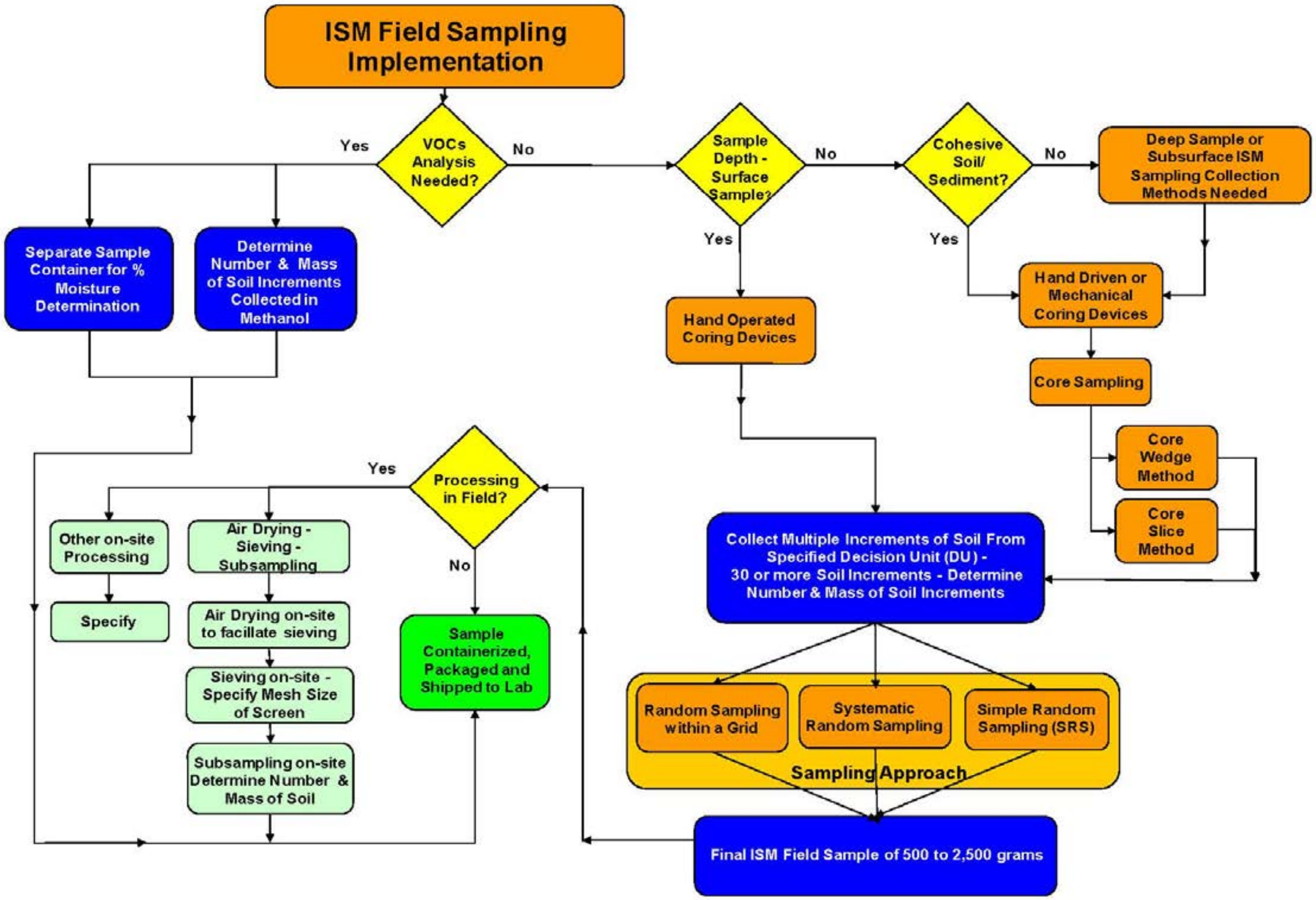
U.S. EPA, December 1995, *Superfund Program Representative Sampling Guidance, Volume 1: Soil (Interim Final)*: EPA 540/R-95/141, Office of Emergency and Remedial Response, Office of Solid Waste and Emergency Response, Washington, D.C.

Table 1
Summary of Soil Sampling Errors and Control Measures[1]

Sampling Error	Cause	Description	Control
Fundamental Error (FE)	Compositional heterogeneity	Error caused by particle size and compositional distribution	Increase sample mass and reduce the size of the largest particles sampled
Grouping and Segregation Error (GE)	Distributional heterogeneity	Error caused by heterogeneous particle distribution	Increase sample mass or number of samples, properly homogenize the sample before selecting a subsample for analysis
Long-Range Heterogeneity Fluctuation Error (CE_2)	Large-scale heterogeneity	Error generated by changes in concentration across space or time	Reduce the spatial interval between samples
Periodic Heterogeneity Fluctuation Error (CE_3)	Periodic heterogeneity	Error generated by periodic changes in concentration over time	Change the spatial or temporal intervals between samples
Increment Delimitation Error (DE)	Sample increment geometry	Error resulting from the shape of the sample increment	Select a sampling plan design and equipment that samples a representative portion of the soil unit of interest
Increment Extraction Error (EE) (ME)?	Sampling device shape	Error resulting from the size and shape of the sampling device	Select sampling equipment that does not exclude certain soil particles based on size or shape, use proper sampling protocols
Preparation Error (PE)	Sample handing	Loss or gain of constituents during sample handling and analytical preparation	Use appropriate sample handling, preservation, transport and preparation protocols

[1] Adapted from the February 2012 ITRC *Incremental Sampling Methodology*, Table 2-2, p. 28

Figure 1
ISM Field Sampling Implementation Flowchart[2]



---

[2] From the February 2012 ITRC *Incremental Sampling Methodology*, Figure 5-1, p. 96

APPENDIX A

Guidance on Determining Decision Units

Decision units (DUs) are carefully selected during the development of the site-specific work plan (SSWP), with input from the SIFU sampling team, DERR site coordinator, DERR risk assessor (or other lead technical staff) and DERR management. This guidance is to assist the team in the selection of appropriate DUs.

ISM requires the designation of a DU from which the sample is collected. A DU is the smallest area/volume of soil where a decision is needed regarding the extent and magnitude of contaminants with respect to the potential environmental hazards posed by existing or anticipated future exposures. DUs should be based on a conceptual site model (CSM) and site-specific data quality objectives (DQOs). Considerations in selecting DUs include:

- COCs and their associated environmental hazards
- Present and future exposure scenarios
- Knowledge of spills, extent of contamination, releases or disposal practices and/or other historical site information
- Site geology and physical characteristics that could influence COC distribution and migration
- Evaluation of existing sampling or field screening data

DUs normally should not exceed one-quarter acre (approximately 11,000 square feet), unless justified by special sampling scenarios or site-specific circumstances. Such circumstances may include:

- Metal contaminants from incinerator or smelting plant emissions that were deposited uniformly in surface soil over an extensive area
- Agricultural pesticide contamination from aircraft application over a large farm field

When used over relatively large areas (greater than one-quarter acre), ISM typically captures the broad effects (*i.e.,* proportional representation and thus higher average concentrations) of hot spots due to the improved spatial coverage within the DU, but it does not provide information on the spatial location of smaller volumes of soil containing hot spots of contaminants within the DU, nor does it indicate the magnitude of these areas of elevated concentration if they exist. To detect and delineate potential hot spots using ISM, DUs must be scaled down to be consistent with the area and depth (or volume) of soil of potential concern for hot spots. In other words, to detect a hot spot of a given size, the spatial dimensions of the DUs have to be that size or smaller. Additionally, the hot-spot DUs need to contiguously cover the area suspected of containing hot spots. While smaller DUs may provide better spatial resolution, as discussed above with discrete sampling approaches, there are practical limits on the number of DUs that can be designated, sampled, and analyzed. Therefore, using ISM to detect relatively small hot spots may also be infeasible in many situations (ITRC, February 2012).

<u>Sample Headspace Screening</u>
FSOP 2.1.4 (June 16, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Headspace is the air space above a sample in a partially filled and sealed sample container. Field headspace screening of soil or other solid or liquid samples with a portable vapor/gas detector such as a photoionization detector (PID), flame ionization detector (FID), or other field screening instrument may be used to determine the relative concentrations of certain gasses or vapors in sample headspace.

1.2 Headspace screening can provide a basis for laboratory sample selection. By comparing relative concentrations of volatile contaminants among sample locations and depths, headspace screening is the preferred screening method for the selection of soil samples for volatile organic compound (VOC) analysis. Depending on project data quality objectives, one or more sample screening methods may be appropriate.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Hazardous vapor or gas may be present in concentrations requiring use of personal protective equipment such as respiratory protection (refer to Table 1, FSOP 1.1, Initial Site Entry). Ambient (breathing zone) air conditions need to be monitored.

3.2 Consult the instrument manual to determine if the instrument is intrinsically safe prior to use in potentially flammable or combustible atmospheres.

4.0 Procedural Cautions

4.1 The user should be familiar with the operation of the instrument being used. Consult the instrument manual for operating and calibration instructions specific to the instrument prior to use. FSOP 3.1.1, Photoionization Detector, provides general instructions for proper use of a PID for environmental site assessment activities.

4.2 PIDs and FIDs do not identify specific compounds and the instrument's response is not a one to one response, i.e., ppm to ppm. The response on the instrument can vary from one compound to another. In cases when the compound detected is known with certainty, the response will likely require a correction factor to estimate the concentration. These instruments are calibrated using a relatively non-toxic gas such as isobutylene and zeroed to background air or a clean air source. Since other compounds have different ionization potentials, the instruments response will be either higher or lower than the response to isobutylene.

4.3 PIDs only detect molecules that can be ionized by the type of lamp installed. PIDs are equipped with ultraviolet lamps of different ionization energies (IE), typically 9.8 electron volt (eV), 10.2 eV, 10.6 eV, and 11.7 eV. The IE of the lamp must be higher than the ionization potential (IP) of the compound(s) being screened.

4.4 PID performance may be adversely affected by temperature fluctuations. PID readings can be significantly affected by high humidity environments due to condensation on the ultraviolet lamp. Methane and other compounds, such as constituents in air, nitrogen, oxygen, and carbon dioxide, have ionization potentials greater than 12 eV and will not be detected by the PID. An FID is generally is preferred in situations where large temperature fluctuations, very moist or humid conditions, or methane is a target compound.

4.5 Excessively dusty environments may overwhelm a PID inlet filter and reduce performance by fouling the ionization chamber or lamp. Regularly inspect and change filters during PID use in excessively dusty environments.

4.6 Never allow the instrument probe to draw in liquid or solid material from the sample container, which may damage the instrument.

4.7 Always use a new clean plastic bag or other container (*e.g.,* glass jar) for each headspace screening sample. Do not submit the portion of sample used for headspace screening to the laboratory for volatile organic compound analysis or any analysis that may be compromised due to cross contamination from the screening container. For example, plastic bags can be a source of phthalate cross contamination.

4.8 When performing U.S. EPA Method SW-846 5035/5035A sampling for soils using EnCore® or similar headspace-free sampling devices (FSOP 2.1.7, Soil Sample Collection for VOC Analysis 5035/5035A), the core may be screened directly to determine the best location for sample collection. However, after collecting the sample, a portion of soil core adjacent to the sample location can be placed in a bag or jar for headspace screening. The headspace screening results (and not the core-screening results) should be used for laboratory sample selection.

4.9 Soil and solid samples for laboratory analysis must be collected immediately from the sampling collection device, placed in the laboratory-supplied container, and preserved on ice. Do not perform headspace screening or sample logging activities or otherwise handle or manipulate soil or other solid materials intended for laboratory analysis prior to placing the sample in a laboratory-supplied container. Delaying sample collection or handling the sample excessively prior to collection will likely result in a significant loss of VOCs and compromise sample integrity. To avoid this problem, soil core samples should be split into a screening subsample and a laboratory subsample when collecting bulk (jar) samples per FSOP 2.1.6, Soil Sample Collection for Volatile Organic Compound Analysis by Bulk Sampling Methods.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Calibration gasses (*e.g.,* isobutylene for PID)
6.2 Clean containers such as sealable plastic bags or jars with foil or film covers
6.3 Hydrogen cylinder (for FID)
6.4 Log book, log sheets, or appropriate field form
6.5 Monitoring instrument with operation manual
6.6 Pens and markers
6.7 Personal protective equipment appropriate for site-specific work activities

7.0 Procedures

7.1 Calibrate the instrument before screening samples, and ensure that the instrument is zeroed, or record background readings before screening.

7.2 Fill the sealable sample container approximately half-full, with the sample to be screened. Disaggregate (*e.g.,* break up) soil or solid samples to the extent possible when placing the sample in the container.

7.3 Seal the container and shake for several seconds.

7.4 Place the container out of direct sunlight and in an area of at least room temperature (65^o-70^o F) for at least ten minutes. In cold weather, the sample container may need to be taken indoors or placed inside a vehicle to warm to approximately room temperature.

7.5 Immediately prior to screening, shake the container for several seconds again. Open the seal slightly or pierce the foil/film cover with a small hole and insert the instrument probe into the headspace. Take care to not allow soil, water or other materials to enter the tip of the probe.

7.6 Observe and record the maximum instrument reading after placing the instrument probe into the container. This usually occurs within a few seconds of placing the probe into the container. All headspace screening data collected to evaluate the presence of VOC analyses must be recorded on a boring log or field logbook.

7.7 After withdrawing the probe, allow sufficient time for the instrument reading to return to zero or background level before screening the next sample.

7.8 In addition to the procedures described above, the instrument may be used to field screen the borehole atmosphere to evaluate the bulk concentration of VOCs (PID or FID) or gases (other meters, refer to FSOP 3.1.2, Multiple Gas Detection

Meters). This field screening data may be used to monitor health and safety concerns, evaluate the potential for soil VOC contamination before opening soil sample liners, or used as real-time screening information to help evaluate the need for additional sampling or other site assessment activities while in the field. However, under no circumstances are borehole atmosphere screening data to be used for the selection of soil samples for VOC or other chemical analysis. Instead, use the procedures described in paragraphs 7.1 through 7.7 to perform soil sample headspace screening as the basis for selecting soil samples for chemical analysis.

7.9 After headspace screening is completed, dispose of the sample material as investigation derived waste (IDW) in accordance with FSOP 1.7, Investigation Derived Waste.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

None

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.7, Investigation Derived Waste

FSOP 2.1.6, Soil Sample Collection for Volatile Organic Compound Analysis by Bulk Sampling Methods

FSOP 2.1.7, Soil Sample Collection for VOC Analysis (5035/5035A)

FSOP 3.1.1, Photoionization Detector

FSOP 3.1.2, Multiple Gas Detection Meters

Soil Description, Classification and Logging
FSOP 2.1.5 (June 30, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This procedure describes standard practices and recommendations used by the Division of Environmental Response and Revitalization (DERR) for field soil description, classification and logging.

1.2 This FSOP is not intended to replace the education or experience of Ohio EPA staff members who have degrees in geology, hydrogeology, soil science, geotechnical engineering, or similar fields. This FSOP should be used in conjunction with professional judgment.

1.3 For the purposes of this FSOP, “soil” includes natural deposits or natural fill materials consisting primarily of granular or cohesive mineral particles derived from sedimentary deposition or the weathering of bedrock. In addition, soil may contain minor amounts of natural organic debris or minor amounts of inorganic or organic waste materials. Soil may be unconsolidated or consolidated but is never cemented or lithified.

1.4 As discussed in this FSOP, soil description is a method of documenting the observed physical properties of soil for scientific or engineering purposes. Soil properties that are important for evaluating the behavior and fate of contaminants at waste sites include, but are not necessarily limited to the following:

- texture (also referred to as grain-size or particle size distribution)
- plasticity characteristics
- color
- moisture content
- sedimentary structures
- anthropogenic influence: the presence of fill materials, waste materials, hazardous substances, or petroleum

The soil properties and soil property criteria described in the FSOP are based on ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). ASTM D2488 is also recommended by the Ohio EPA Division of Drinking and Ground Water (DDAGW) Technical Guidance Manual for Ground Water Investigations (TGM), Chapter 3, Characterization of Site Hydrogeology, for soil description and classification for hydrogeologic investigations.

1.5 Soil classification is a method of systematically categorizing soil into groups with similar physical properties based on field description or laboratory testing. For environmental site assessment and engineering purposes, a soil classification system provides a uniform description of the physical properties of soil. U.S. EPA

(April 1999) recommends the use of the following soil classification systems for environmental investigations at hazardous waste sites:

1.5.1 The Unified Soil Classification System (USCS) as described by ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

1.5.2 The United States Department of Agriculture (USDA) Soil Textural Triangle, USDA Natural Resources Conservation Service Soil Survey Manual, Chapter 3, Examination and Description of Soils (Figure 3-16)

Project data quality objectives (DQOs) should determine whether the USCS or USDA systems (or both) are used.

1.6 Soil description and classification should be performed: 1) during the collection of soil samples for laboratory analysis; 2) during the installation of borings, monitoring wells or soil gas/vapor probes; or 3) whenever characterization of subsurface geologic conditions is needed to meet site assessment project or data quality objectives.

Describing and classifying soil samples in an accurate and consistent manner:

- is critical for understanding site geology and hydrogeology
- helps to ensure proper location and construction of monitoring wells and soil gas probes
- facilitates the selection of samples for laboratory analysis and the subsequent evaluation of contaminant distribution and migration
- may provide an understanding of contaminant migration pathways
- determines the thickness of cover materials or depth of wastes or contaminated soil layers
- provides a means of correlating soil types with geophysical surveys

1.7 Logging the description and classification of soil samples includes the continuous recording of drilling and sampling, field monitoring, and well or probe construction data. A field logging form (example attached) is recommended for logging soils collected with direct-push or rotary drilling rigs or excavating equipment. The form may also be designed to record ground water data and serve as a monitoring well or soil gas probe construction diagram.

2.0 Definitions

Refer to the attached list (Soil Descriptive Terminology).

3.0 Health and Safety Considerations

3.1 Wear appropriate personal protective equipment (PPE) when working in the vicinity of drilling rigs or other types of mechanical equipment used for soil sampling, in accordance with the site-specific health and safety plan. At a minimum, PPE should include protective eyewear, footwear, and hearing protection. In addition, a hard hat is required when working in the vicinity of drilling rigs and the use of canvas coveralls or similar protective clothing is recommended.

3.2 Use heavy protective gloves to help prevent hand injuries when opening and handling split-spoon samplers, core barrels, or plastic soil core liners.

3.3 Wear chemical-resistant gloves when handling soil samples to avoid direct contact with chemical contaminants. Always thoroughly wash your hands after completing soil logging activities.

3.4 If free product or splash hazards are a concern during drilling or sampling, use of a chemically resistant suit (e.g., Saranex® or coated Tyvek®) is recommended.

3.5 If drilling and soil sampling activities cause dusty conditions, respiratory protection may be necessary to provide protection from dust-inhalation hazards. Work should be stopped to assess site conditions. Work requiring respiratory protection may only be performed by staff certified to wear respiratory protection. Depending on site-specific conditions and chemicals of concern, monitoring with a particulate meter and/or other air monitoring instruments as appropriate. For action levels, refer to Table 1 of FSOP 1.1, Initial Site Entry.

3.6 Conduct air monitoring in accordance with the site-specific health and safety plan. For action levels, refer to Table 1 of FSOP 1.1, Initial Site Entry.

3.7 Dress appropriately for anticipated weather conditions, and always have ample drinking water available when working in hot weather. Insect repellant may be needed for protection from ticks, mosquitoes, and other biting insects in heavily wooded areas.

4.0 Procedure Cautions

4.1 For logging soil borings or excavations greater than six feet deep, a field logging form (example attached) is preferred. Logging soil borings using a field logbook or log sheets may be difficult due to the volume of information that typically needs to be recorded.

4.2 Use a level of detail for soil descriptions that is consistent with the site-specific work plan and project DQOs.

4.3 If the driller is collecting soil samples so quickly that logging is difficult, direct the driller to slow down or stop. Soil cores should be processed (*i.e.,* logged, screened, and sampled) as soon as possible after being retrieved from the ground.

4.4 When recording soil descriptions, use a consistent format such as that recommended in paragraph 7.9. Doing so makes logging easier, improves the readability of the field log, and facilitates subsequent data entry in the office.

4.5 Do not indiscriminately apply soil classification systems. Project DQOs will determine whether the USCS, USDA classification system, or both systems should be used for a project. Additionally, DQOs may indicate how soil classification should be applied at a site with respect to boring locations and depth of investigation.

4.6 An accurate location of each boring should be included on the logging form (or field notebook). The location could include a narrative description of the boring location with reference to site features, a schematic and/or GPS coordinates.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard. In addition, personnel who log soil borings should have a background in geology, hydrogeology, soil science or geotechnical engineering, or should have received training in soil classification, description and logging from a qualified individual.

6.0 Equipment and Supplies

6.1 Field logging form (example attached)
6.2 Field logbook or log sheets (*recommended for use as an alternative to a logging form only if soil logging activities are limited to borings or excavations less than six feet deep*).
6.3 Engineering ruler or measuring tape with 0.1 foot increments for measuring soil cores
6.4 Stainless steel spatula or knife for examining and sampling soil core
6.5 Field guide for soil classification/description or soil texturing, a geotechnical (sand) gauge, and/or Munsell Soil Color chart (optional)
6.6 Hand lens (optional, helps identify waste materials)
6.7 Magnet (optional, helps identify waste materials)

7.0 Procedures

7.1 Before drilling begins record project information, boring identification and location, the date, and drilling and sampling method(s) on the soil logging field form.

7.2 Be sure that the driller identifies the top of each core sample.

7.3 If any of the soil in the sampler appears to be caved or sloughed material from the open boring overlying the sampled interval, remove it from the sampler. Do not log it as part of the sampled interval or submit it for laboratory analysis. If in doubt based on sample appearance, consult with the driller regarding the stability of the borehole, i.e., is it collapsing or heaving between sample intervals?

7.4 Using the ruler or tape, measure the length of the soil core recovered from each sampled interval (excluding any caved/sloughed material if present). Record the sampler type and the sampled interval recovery to the nearest 0.1 foot on the soil logging field form. Do not record a recovery that is greater than the length of soil core actually recovered. For example, if a core sampler pushed from 8.0 to 10.0 ft recovers only 1.5 ft of soil core, record the recovery as 1.5 ft (or 8.0 to 9.5 ft) and not 2.0 ft (or 8.0-10.0 ft).

7.5 Discuss possible reasons for core loss with the driller, as well as the driller's insight on likely soil or fill materials encountered based on the behavior of the drilling and sampling equipment.

7.6 Split or scrape any soil core consisting of cohesive soils (silts or clays) using a stainless steel knife or spatula.

7.7 Quickly examine the soil core and evaluate the following properties (preliminary evaluation) to select samples for field screening and/or analytical sampling:

- Soil texture (*i.e.,* is it mostly gravel, sand, silt, or clay?) and changes in texture within the core sample
- Moisture content
- The presence of waste materials, potentially hazardous substances, or petroleum (*the hand lens and/or magnet may be helpful*)

7.8 As required, collect soil samples for field screening and laboratory analysis based on project DQOs and preliminary core examination (paragraph 7.5). Assign each screening or laboratory sample an identification number). Record the sample identification and depth interval to the nearest 0.1 foot on the soil logging form.

7.9 Record a description of the soil core. The soil properties included in the description will depend on project DQOs; however, a soil description should generally include the following information:

7.9.1 **Soil color:** the following colors (with Munsell Soil Color Chart numbers for reference only) are recommended for soil description:

Brown Shades	**Munsell #**	**Gray Shades**	**Munsell #**
Brownish yellow	10YR 6/6	Grayish brown	2.5Y 5/2
Light brown	10YR 7/4	Light gray	2.5Y 7/1
Reddish brown	5YR 5/4	Gray	2.5Y 5/1
Brown	10YR 4/3	Greenish gray	GLEY1 5/1
Dark yellowish brown	10YR 4/6	Olive gray	5Y 4/2
Dark brown	10YR 3/3	Dark gray	2.5Y 4/1

If the soil exhibits a primary color and one or more secondary colors, describe the soil color as “mottled” or “with mottling”, e.g., “gray with brownish yellow mottling” or “mottled light brown, dark yellowish brown, and light gray”.

7.9.2 **Soil classification:** follow the attached Unified Soil Classification System Field Guidance to classify soils according to the USCS or the attached Estimating Soil Texture By Feel (Presley and Thien, September 2008) to classify soils according to the USDA System.

7.9.3 **Moisture content:** ASTM D2488-09a recommends describing soil moisture content as follows:

- **Dry** – absence of moisture, dry and dusty to the touch
- **Moist** – damp but no visible water
- **Wet** – visible free water, usually soil is below the water table

The terms “**slightly moist**” (intermediate between dry and moist) and “**very moist**” (intermediate between moist and wet) may also be used.

7.9.4 **Plasticity characteristics** (for silts and clays only): describe the soil **plasticity**. If possible, also include descriptions for **consistency**, **dilatancy**, and/or **toughness** (refer to Soil Descriptive Terminology, attached). The dry strength test is generally too time-consuming to be performed.

7.9.5 **Sedimentary structures:** describe soil sedimentary structures (refer to Soil Descriptive Terminology)

7.9.6 **Anthropogenic influence:** determine if the soil is native or fill material, and describe the presence of waste materials (construction/demolition debris, solid waste, industrial wastes), hazardous substances, or petroleum (*the hand lens and magnet may be helpful*)

7.10 The following soil properties may also be included in soil descriptions at the discretion of the soil logger:

7.10.1 Secondary grain size percentages as recommended by ASTM D2488-09a:

- Trace – particles are present but estimated to be less than 5%
- Few – 5% to 10%
- Little – 15% to 25 %
- Some – 30% to 45%
- Mostly – 50% to 100%

7.10.2 Depositional environment (*Note: this is a geologic interpretation based on soil texture and sedimentary structures which should be made by a geologist or hydrogeologist.*)

7.10.3 Oxidation, leaching and/or degree of weathering

7.10.4 Other properties described in ASTM D2488-09a

7.11 The following soil description format is suggested: *consistency – color – soil classification: moisture content, plasticity characteristics, sedimentary structures, anthropogenic influence, other*

Examples:

- *firm gray lean clay with dark yellowish brown mottling: moist, medium toughness and plasticity, massive structure, solvent odor*
- *brownish yellow loam: dry to slightly moist, low plasticity, vertical fractures with iron oxide staining, broken glass and demolition debris (concrete, brick and wood fragments)*
- *dark brown sand: wet, stratified, trace fine gravel*
- *soft gray lean clay with silt: moist to very moist, low to medium plasticity, no dilatancy to slow dilatancy, varved, lacustrine (lake) deposit*

Regardless of the specific soil description format, a consistent format should be utilized for borings on the same site/property or installed for the same project.

7.12 In addition to soil descriptions, record field information associated with boring installation, soil sampling or well or probe installation on the soil logging form. Such information may include, but is not limited to the following:

- Field screening data
- Laboratory sample identification numbers for soil and ground water samples
- Ground water levels

- Relevant information recorded by the driller, e.g., changes in penetration resistance
- Monitoring well screen placement and sand pack thickness
- GPS coordinates and/or other boring location data

7.13 Properly dispose of IDW in accordance with FSOP 1.7, Investigation-Derived Wastes.

7.14 In addition to completing a field logging form for each soil boring, an Ohio Department of Natural Resources (ODNR) Well Log and Drilling Report Form may need to be filed with the ODNR Division of Soil and Water Resources. Refer to FSOP 1.8, ODNR Well Construction Logs & Well Sealing Reports.

8.0 Data and Records Management

Please refer to FSOP 1.3, Field Documentation.

9.0 Quality Control and Quality Assurance

Draft soil boring logs should be peer-reviewed by an Ohio EPA staff member with a degree in geology, hydrogeology, soil science, geotechnical engineering, or similar field experience before being finalized.

10.0 Attachments

Logging Field Form (example)

Soil Descriptive Terminology

Unified Soil Classification System Field Guidance

Presley, D. and Thien, S., September 2008, Estimating Soil Texture By Feel, Kansas State University

11.0 References

ASTM D 2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.7, Investigation Derived Waste

FSOP 1.8, ODNR Well Construction Logs & Well Sealing Reports

Ohio EPA Division of Drinking and Ground Waters, April 2015, Technical Guidance Manual for Ground Water Investigations: Chapter 3, Characterization of Site Hydrogeology

Munsell Soil Color Chart

USDA Natural Resources Conservation Service, October 1993, Soil Survey Manual: Chapter 3, Examination and Description of Soils

U.S. EPA (D.S. Burden and J.L. Sims), April 1999, Ground Water Issue, Fundamentals of Soil Science as Applicable to the Management of Hazardous Wastes: EPA/540/S-98/500

Soil Descriptive Terminology

Consistency: the relative ease with which a fine-grained soil (silt or clay) can be deformed. ASTM D2488-09a recommends describing consistency as follows:

- **Very soft** – thumb will penetrate soil more than 1 inch
- **Soft** – thumb will penetrate soil about 1 inch
- **Firm** – thumb will indent soil about ¼ inch
- **Hard** – thumb will not indent soil, thumbnail will indent soil
- **Very hard** – thumbnail will not indent soil

Dilatancy: volume increase under loading, or expansion (and flow) of a saturated fine-grained soil (silt or clay) in response to shaking. ASTM D2488-09a recommends describing dilatancy as follows:

- **None** – no visible change
- **Slow** – water appears slowly on the surface of the soil during shaking (and disappears slowly upon squeezing)
- **Rapid** – water appears quickly on the surface of the soil during shaking (and disappears quickly upon squeezing)

Dry Strength: the relative strength of a dried fine-grained soil (silt or clay) specimen approximately 1/2 inch in diameter. ASTM D2488-09a recommends describing dry strength as follows:

- **None** – the specimen crumbles into powder when handled
- **Low** – the specimen crumbles into powder in response to finger pressure
- **Medium** – the specimen crumbles or breaks into pieces with considerable finger pressure
- **High** – the specimen cannot be broken with finger pressure, but can be broken between the thumb and a hard surface
- **Very High** – the specimen can be broken between the thumb and a hard surface

Plasticity: the ability of a fine-grained soil (silt or clay) to deform continuously under constant stress. ASTM D2488-09a recommends describing plasticity as follows:

- **Nonplastic** – a 1/8 inch diameter thread cannot be rolled at any water content
- **Low Plasticity** – the thread can barely be rolled
- **Medium Plasticity** – the thread is easily rolled and not much time is required to reach the plastic limit (i.e., the water content at which a soil changes from a plastic state to a semisolid state)
- **High plasticity** – the thread is easily rolled and considerable time rolling and kneading is required to reach the plastic limit; the thread can be re-rolled several times after reaching the plastic limit

Soil Descriptive Terminology

Sedimentary Structure: a soil structure formed by sedimentary deposition, e.g., glacial, stream, or lake deposition (primary sedimentary structure) or by processes occurring subsequent to deposition and/or soil formation, e.g., weathering or hydrologic processes (secondary sedimentary structure). Terminology used to describe sedimentary structure includes the following:

- **Massive** – stratification (or layering) is not present; the soil appears to have a homogeneous structure which is the same in all directions
- **Stratified** – distinct near-horizontal layers (or beds) formed primarily by differences in texture (grain-size)
- **Graded** – stratified layers exhibiting grain-sizes that gradually increase or decrease with depth (usually referred to as "graded bedding")
- **Laminated** – horizontal layers less than approximately 0.2 inches thick (laminations)
- **Varved** – alternating light and dark laminations (varves) formed by seasonal sediment deposition in lakes
- **Lensed** – a soil containing small pockets or lenses one or more different soil types, e.g., pockets of sand in a clay
- **Fractured** – vertical or horizontal planes of separation formed by wetting/drying, freezing/thawing, or other physical processes to which the soil is exposed; fractures are generally near-vertical and often contain mineralization distinct from the adjacent soil (iron oxides/hydroxides, carbonates, etc.)
- **Slickenslided** – fracture planes that appear polished or glossy and sometimes slightly curved and/or striated; generally slickenslides are formed by shearing of the soil in response to loading or deformation (e.g., swelling clays)

Toughness: pressure required to roll a fine-grained soil (silt or clay) into a 1/8 inch thread. ASTM D2488-09a recommends describing toughness as follows:

- **Low** – only slight pressure is needed to roll the thread, which is weak and soft
- **Medium** – medium pressure is needed to roll the thread, which is moderately stiff
- **High** – considerable pressure is needed to roll the thread, which is very stiff

Unified Soil Classification System (USCS) Guide[1]

Page 1 of 2 (Silt and Clay)

If the soil consists of >= 50% fines (silt and clay), then the soil is a fine-grained soil. Follow these steps for field classification of silt (M) and clay (C):

1. Using manual field tests, classify the soil as a silt (ML), lean clay (CL), elastic silt (MH) or fat clay (CH) based on its plasticity characteristics:

Soil Type	Group Symbol	Dry Strength	Dilatancy	Toughness & Plasticity
Silt	ML	None to low	Slow to rapid	Nonplastic to low
Lean Clay	CL	Medium to high	None to slow	Medium
Elastic Silt	MH	Low to medium	None to slow	Low to medium
Fat Clay	CH	High to very high	None	High

<u>Tips for classifying fine-grained soils</u>:

- Plasticity and dilatancy may be used to differentiate silt (ML) and lean clay (CL) (*dry strength and toughness data usually aren't critical field tests*).
- Lean clay (CL) is more common than fat clay (CH) in Ohio.
- Elastic silt (MH) is rarely encountered in Ohio.
- Use "lean clay" rather than "silty clay" (CL-ML) for USCS field description of soil. Laboratory testing is necessary to classify a soil as a USCS silty clay due to its narrow plasticity index range (4-7).

2. After identifying the soil as a silt or clay, estimate the percentage of sand and gravel (S&G) ("*plus No. 200 material*" or > 0.075 mm diameter particles) in the sample:

   a. If < 15% S&G, classify the soil as a **silt** (ML), **lean clay** (CL), **elastic silt** (MH), or **fat clay** (CH)

   b. If 15%-25% S&G, add "**with sand**" if the %S >= %G or "**with gravel**" if the %G > %S, *e.g.*, **lean clay with sand** (CL), **silt with gravel** (ML)

   c. If >= 30% S&G and the %S >= %G, add the modifier "**sandy**", and if >= 15% G add "**with gravel**", *e.g.*, **sandy silt** (ML), **sandy lean clay with gravel** (CL)

   d. If >= 30% S&G and the %G > %S, add the modifier "**gravelly**", and if >= 15% S add "**with sand**", *e.g.*, **gravelly fat clay** (CH), **gravelly lean clay with sand** (CL)

3. If the fine-grained soil contains enough organic matter to influence its physical properties, *e.g.*, the soil feels "spongy" during field plasticity testing, classify it as an organic silt or clay (OL or OH). Follow step two (above) to describe the coarse-grained texture characteristics (S&G) of the soil. If the soil is mostly organic matter, classify it as peat (PT).

1 Based on ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual–Manual Procedure)

Unified Soil Classification System (USCS) Guide[1]

Page 2 (Sand and Gravel)

If the soil consists of < 50% fines (silt and clay), then the soil is a coarse-grained soil (sand or gravel). Follow these steps for field classification of sand (S) and gravel (G):

1. Estimate the relative percentages of sand and gravel:
   a. If the % S >= % G, then the soil is a sand
   b. If the % G > % S, then the soil is a gravel

2. Estimate the percentage of fines (silt and clay) present in the soil:
   a. <= 5%
   b. Approximately 10%
   c. >= 15 %

3. Determine if the fines are mostly clay (plastic) or silt (nonplastic)

4. If the soil contains <= 5% fines or approximately 10% fines, then determine if the soil is well-graded (W) (*poorly sorted with a wide range of grain sizes*) or poorly graded (P) (*well-sorted with relatively uniform grain size*)

   a. If the soil contains <= 5% silt or clay, the soil is **well-graded** or **poorly graded sand** (SW or SP) or **well-graded** or **poorly graded gravel** (GW or GP)

   b. If the soil contains approximately 10% silt or clay, the soil is **well-graded** or **poorly graded sand with silt** (SW-SM, SP-SM) or **clay** (SW-SC, SP-SC) or **well-graded** or **poorly graded gravel with silt** (GW-GM, GP-GM) or **clay** (GW-GC, GP-GC)[2]

5. If the soil contains >= 15% silt or clay, then the soil is **silty** or **clayey sand** (SM or SC) or **silty** or **clayey gravel** (GM or GC); the grading modifiers are not used

6. If the soil is sand and contains > 15% gravel, add "**with gravel**" to the classification, *e.g.*, **poorly graded sand with gravel** (SP)

7. If the soil is gravel and contains >= 15% sand, add "**with sand**" to the classification, *e.g.*, **well-graded gravel with silt and sand** (GW-GM)

---

1 Based on ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual–Manual Procedure)

2 Dual symbols (two symbols separated by a hyphen, e.g., SP-SM) must be used when the soil has between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML (silty clay) area of the plasticity chart. Dual symbols are not the same as borderline symbols (two symbols separated by a forward slash, e.g., CL/CH) which should be used to indicate that soil exhibits properties that do not distinctly place it into a specific group (Appendix X3).

Soil Sample Collection for Volatile Organic Compound Analysis by Bulk Sampling Methods
FSOP 2.1.6 (July 9, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

This FSOP describes field procedures used by Division of Environmental Response and Revitalization (DERR) remedial response personnel to collect soil and other solids by bulk sampling methods for volatile organic compound (VOC) analysis (*e.g.,* using a sampling spatula to manually fill unpreserved laboratory supplied containers with soil).

1.1 Bulk sampling procedures are not compliant with U.S. EPA SW 846 Method 5035 or 5035A sampling requirements. Field procedures that are compliant with Methods 5035 and 5035A are described in FSOP 2.1.7, Soil Sample Collection for Volatile Organic Compound Analysis by U.S. EPA Methods 5035 and 5035A. Methods 5035 and 5035A are preferred for collecting soil and solid VOC samples and should be used by DERR personnel whenever possible.

1.2 DERR recognizes, however, that certain regulatory programs or laboratory certification programs may not allow or support the use of the U.S. EPA Method 5035 or 5035A procedures. If Ohio EPA Voluntary Action Program (VAP) laboratory certified data is needed, bulk containers may only be submitted for high concentration samples (>200 ppb) using SW-846 Method 8260B. If bulk containers are submitted for low level analysis (<200 ppb) using Method 8260B, the data will not be certified.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Wear appropriate personal protective equipment as specified in the project health and safety plan (HASP) while conducting sampling activities.

3.2 Conduct air monitoring as specified in the project HASP during sampling activities. Refer to Table 1 of FSOP 1.1, Initial Site Entry.

4.0 Procedure Cautions

4.1 Be familiar with all relevant program requirements, laboratory capabilities or certification requirements and project data quality objectives to ensure that the procedures described in this FSOP are appropriate for the sampling event

4.2 Sample containers should be filled to the top with no headspace.

4.3 Soil and solid samples must be collected immediately from the sampling collection device, placed in the laboratory-supplied container, and preserved on ice. Do not perform headspace screening or sample logging activities or otherwise handle or manipulate soil or other solid materials intended for laboratory analysis prior to placing the sample in a laboratory-supplied container. Sample screening may be performed on a separate portion of sample or co-located sample which is not submitted for laboratory analysis after the laboratory sample is collected and preserved. Delaying sample collection or handling the sample excessively prior to collection will likely result in a significant loss of VOCs and compromise sample integrity.

4.4 Always wear clean sampling gloves before collecting each sample.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

The following is a list of equipment and supplies that are generally required for bulk soil or solid sampling:

6.1 Chain-of-custody form
6.2 Ice
6.3 Laboratory-supplied containers
6.4 Paper towels
6.5 Sample cooler
6.6 Sample labels
6.7 Sampling gloves
6.8 Stainless steel spatula or spoon
6.9 Trip blanks
6.10 Water-proof markers and pens

7.0 Procedures

7.1 Obtain the sample directly from the sampling device (*e.g.,* direct-push core barrel, split barrel sampler, auger bucket, trowel, etc.) with a clean stainless-steel spatula or spoon and immediately place the sample in an appropriate laboratory-supplied container. Do not screen, log, homogenize or unnecessarily handle the sample before placing it into the container.

7.1 Fill the container completely so that there is no headspace visible in the container. Care should be taken not to overfill or underfill the container and to keep the lip and threads of the container free from soil, sand, debris, etc., to provide a good seal with the container lid.

7.2 Wipe any soil or debris from the outside of the container with a clean paper towel and place the lid on the container.

7.3 Immediately place the labeled sample container in a cooler with ice and trip blank samples.

7.4 Decontaminate stainless steel spatulas, spoons, and any other sampling equipment used between samples in accordance with FSOP 1.6, Sampling Equipment Decontamination.

7.5 Follow all applicable criteria in FSOP 1.5, Sample Custody and Handling, when handling or shipping/transporting samples to the laboratory.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Quality assurance/quality control (QA/QC) samples will depend on the site-specific work plan, DQOs, or laboratory requirements. QA/QC requirements need to be determined prior to ordering sample containers or devices. Trip blank samples should be included in each cooler which holds samples to be analyzed for VOCs. Inclusion and analysis of trip blanks imparts information on potential contamination of samples during sample, handling and field conditions by accompanying samples during mobilization, sampling, demobilization and shipment operations.

10.0 Attachments

None

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.5, Sample Custody and Handling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 2.1.7, Soil Sample Collection for Volatile Organic Compound Analysis Compliant with U.S. EPA SW-846 Methods 5035 and 5035A

Soil Sample Collection for Volatile Organic Compound Analysis Compliant with U.S. EPA SW-846 Methods 5035 and 5035A

FSOP 2.1.7 (July 9, 2020)

Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

U.S. EPA SW-846 Methods 5035 and 5035A, *Closed-System Purge and Trap and Extraction for Volatile Organics in Soil and Waste Samples* (U.S. EPA 1996 and 2002), describe a closed system purge and trap process for analyzing volatile organic compounds (VOCs) in solid materials such as soil, sediment, and wastes. These procedures, which include field methods for sample collection, preservation, and handling, may be used in conjunction with any appropriate gas chromatographic procedure such as U.S. EPA SW-846 Methods 8260, 8021 or 8015.

This FSOP describes field procedures used by Division of Environmental Response and Revitalization (DERR) personnel to collect soil and other solids for VOC analysis that conform to the sample collection, preservation and handling procedures acceptable under Methods 5035 and 5035A. Field procedures that are compliant with Methods 5035 and 5035A are preferred to bulk sampling procedures (e.g., using a sampling spatula to manually fill unpreserved laboratory supplied containers with soil) and should be used by DERR personnel whenever possible. DERR recognizes, however, that certain regulatory or laboratory certification programs may not currently allow or support the use of Method 5035 or 5035A procedures. These programs may require bulk sampling of soil or other solids for VOC analysis. For such situations, consult FSOP 2.1.6, Soil Sample Collection for Volatile Organic Compound Analysis by Bulk Sampling Methods.

1.1 Several sample collection and preservation methods are described in Methods 5035 and 5035A. The methods specify field or laboratory preservation of samples in one or more solvents including methanol, sodium bisulfate, and organic-free reagent-grade water or laboratory preservation of the sample by freezing. Two general methods are described in this FSOP. One involves collection of the sample followed by immediate field preservation, and the other method describes collection of the sample in a headspace-free sample device and delivery to the analytical laboratory for preservation or analysis within 48 hours of sample collection. Other collection and preservation methods detailed in Methods 5035 and 5035A may also be acceptable on a case-by-case basis depending on project data quality objectives (DQOs) (U.S. EPA 1999), the site - specific work plan or laboratory or regulatory requirements.

1.2 Some of the procedures described in this FSOP may not be appropriate for Bureau of Underground Storage Tank Regulations investigations or Targeted Brownfield Assessments. Check program and laboratory certification requirements as well as laboratory capabilities prior to sampling.

1.3 The procedures listed in this FSOP are not acceptable for Toxicity Characteristic Leaching Procedure (TCLP) sampling.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Handle flammable or toxic solvent preservatives such as methanol or sodium bisulfate carefully. Refer to the appropriate safety data sheet for the preservative.

3.2 Wear appropriate personal protective equipment as specified in the project health and safety plan (HASP) while conducting sampling activities. Wear appropriate eye protection, gloves and other splash protection as appropriate when handling solvent preservatives.

3.3 Conduct air monitoring as specified in the project HASP during sampling activities. Refer to Table 1 of FSOP 1.1, Initial Site Entry.

4.0 Procedure Cautions

4.1 Be familiar with all relevant program requirements, laboratory capabilities or certification requirements and project DQOs to determine that the procedures described in this FSOP are appropriate for the sampling event.

4.2 Consult with the laboratory prior to sample collection to determine appropriate sample collection, preservation, shipping and handling and holding time requirements as these requirements may vary between laboratories. Consult the laboratory in advance to determine if the laboratory detection limits will meet project DQOs.

4.3 If a headspace-free sampling device such as the En Core® Sampler is used, then the sample must be preserved within 48 hours of collection by the laboratory. Samples need to be delivered to the laboratory as soon as possible, and the laboratory needs to receive advance notice of sample arrival. This is especially critical for Saturday delivery.

4.4 Preserve and containerize laboratory samples as soon as possible. Steps should be taken to minimize headspace screening, handling, or other manipulation of samples collected for laboratory analysis prior to sample preservation or containerization. For example, don’t submit material from headspace screening for laboratory analysis, and don’t allow soil cores to sit for an extended period prior to containerizing the sample. (Sample screening may be performed on a separate portion of sample or co-located sample which is not submitted for laboratory analysis after the laboratory sample is collected an preserved.)

4.5 If a field or laboratory solvent preservation method is used, an additional unpreserved portion of the sample must also be submitted to determine the percent moisture to calculate VOC concentration on a dry weight basis.

4.6 Soil samples from multiple sampling locations should not be collected with the same device. However, multiple aliquots of sample from the same location may be collected (into separate vials) using a device such as the Terra Core® sampler or EasyDraw Syringe®.

4.7 Samples collected using the Terra Core® sampler, EasyDraw Syringe® or similar coring device should be calibrated to ensure that the proper amount of sample material is collected. This may be achieved by adjusting the sampler to the soil density, per location, necessary to achieve 5.0 (+/- 0.5) grams of sample. Some samplers have calibrations on the cylinder of the sampler (*e.g.,* EasyDraw Syringe®, etc.). Alternatively, collect several trial samples with a clean plastic syringe. Weigh each trial sample and note the length of the soil column in the syringe. Use these data to determine the length that corresponds to 5.0+/- 0.5 g. Discard each trial sample.

4.8 Methods 5035 / 5035A state that when practical, pre-prepared vials containing methanol should be weighed on the day of sampling to ensure that no solvent has been lost since the time of container preparation. Vials with > 0.01 g less methanol than noted on the vial should be returned to the laboratory for disposal and not used for sampling.

4.9 Use a portable analytical balance for confirming the weight of sample aliquots and pre-preserved sample vials. Limitations of using portable balances may include imprecise readings due to lack of a stable and sheltered location for the balance (*e.g.,* a mobile laboratory, fixed building, etc.) and variability in instrument precision or calibration standard weights between the laboratory's and Ohio EPA's instruments or standards. Balances should be calibrated in the field on a daily basis using an appropriate standard weight.

4.10 Always wear clean sampling gloves before collecting each sample.

4.11 Non-cohesive sample material (*e.g.,* dry sand, sediments/sludges with a high moisture content, etc.) sampled using En Core®, Terra Core® or similar devices should be collected differently than cohesive or consolidated materials, refer to Section 7.2.3. Alternate collection methods should be considered based on work plan and DQOs.

4.12 Aggregate, cemented material or material larger than the diameter of the sampler cannot be effectively collected using En Core®, Terra Core® or similar sampling devices. These materials should be collected using an alternate sampling technique.

4.13 If samples containing methanol preservative are to be shipped by common courier (*e.g.,* UPS, FedEx), air or ground, ensure that applicable U.S. DOT and/or IATA regulations are followed. The shipping of methanol is regulated by U.S. DOT, Title 49 of the Code of Federal Regulations (Parts 171 through 180).

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

The following is a list of equipment and supplies that may be required depending on the selected sampling method:

6.1 Appropriate sample handle for En Core® (T-Handle) or EasyDraw Syringe® (PowerStop Handle®)
6.2 Chain-of-custody form
6.3 Dry weight containers
6.4 En Core® samplers or similar headspace-free sample collection devices
6.5 Terra Core® or EasyDraw Syringe® samplers or similar sample collection devices
6.6 Ice
6.7 Paper towels
6.8 Preservative
6.9 Sample cooler
6.10 Sample labels
6.11 Sampling gloves
6.12 Sealable plastic bags
6.13 Trip blanks
6.14 Water-proof markers and pens
6.15 Analytical field balance and calibration weights
6.16 Pre-preserved/pre-tared sample containers, including stir bar (as applicable)

7.0 Procedures

7.1 Collection and solvent field preservation of samples followed by laboratory analysis:

7.1.1 Obtain a new unused sampler and remove the end cap. Seat the plunger on the Terra Core® or place the EasyDraw Syringe® into the PowerStop Handle® per the manufacturer's directions (Recommended Use of Terra Core®, Recommended Use of the EasyDraw Syringe® and The PowerStop Handle®, attached)

7.1.2 Expose the soil to be sampled by scraping the surface with a clean spatula or spoon. Push the device into the soil until the sample chamber is full and then extract the device.

7.1.3 Wipe any soil or debris from the outside of the sampler with a clean paper towel. Rotate the plunger 90 degrees to align with the slots in the body of the sampler.

7.1.4 Place the mouth of the sampler into a laboratory-supplied vial containing the appropriate solvent preservative and extrude the sample into the vial by pushing the plunger down. Replace the cap on the vial immediately and gently swirl (do not shake) the vial to saturate the entire sample.

7.1.5 Complete a sample label on the vial. (Note: labels should be affixed to the vials prior to weighing/reweighing the vials. Labels affixed after filling and weighing of the vials may introduce a sample weight error).

7.1.6 Place the vial with the preserved sample in a locking plastic bag and place in a cooler with ice.

7.1.7 Repeat Steps 7.1.1 through 7.1.5 to collect as many vials per sample as directed by the laboratory for VOC analysis.

7.1.8 Collect a portion of the soil sample in the same manner as above (Steps 7.1.1 through 7.1.3) and extrude the sample into an unpreserved vial or container (*e.g.,* 40mL or 60mL VOA vial) for laboratory determination of percent moisture. This data is needed for the laboratory to determine VOC concentrations on a dry weight basis.

7.1.9 Immediately place filled sample containers into a sample cooler with ice or chilled to 4°C and including trip blank samples. Samples collected by Methods 5035 / 5035A should be segregated from samples with gross contamination or free product and packed in separate coolers.

7.2 Collection of samples followed by laboratory preservation and analysis with an En Core® Sampler or similar headspace-free sample device:

7.2.1 Obtain a new sampler and place the sampler in the T-Handle per the manufacturer's directions (Disposable En Core® Sampler Sampling Procedures, attached).

7.2.2 For cohesive material, use the handle to push the sampler into the soil until the body is completely full and the O-ring rests against the tabs. Remove the sampler and wipe any excess soil from the sampler's exterior with a clean paper towel or wipe.

7.2.3 The En Core® Sampler is not recommended for non-cohesive sample material (*e.g.,* dry sand, sediments/sludge with a high moisture content). Other sampling methods should first be considering when establishing the project's data quality objectives.

7.2.4 If the En Core® Sampler is chosen as the sampling method for non-cohesive material, push the sampler plunger down into the O-ring until it rests against the tabs. Depress the locking lever on the handle and place the sampler, plunger end first, into the handle, aligning the slots on the device body with locking pins in the handle. Turn the sample upside down and fill with a clean spatula or other device.

7.2.5 Cap the sampler body while it is still in the handle. Push the cap flat and twist to lock.

7.2.6 Remove the sampler from the handle by depressing the locking lever on the handle while twisting and pulling the sampler from the handle.

7.2.7 Lock the plunger by rotating the plunger rod counterclockwise until the wings are firmly resting against the tabs.

7.2.8 Attach a sample label to the sample device and place the sampler(s) in a locking plastic bag. Place the bag in a cooler with ice.

7.2.9 Repeat the above steps to collect as many sampling devices per sample as directed by the laboratory.

7.2.10 Collect at least one portion of sample in a sample device or container (*e.g.,* 2oz jar, 40mL or 60mL VOA vial) for laboratory dry weight determination of the sample.

7.2.11 Immediately place filled sample containers into a sample cooler with ice (4°+/-2° C). Samples collected for high-level VOC analysis should be segregated from samples collected by Methods 5035 / 5035A.

7.2.12 Deliver the samples to the laboratory within 48 hours of collection. Ensure that there is sufficient ice in the cooler for preservation during sample shipment.

7.3 Follow all applicable criteria in FSOP 1.5, Sample Custody and Handling, when handling or shipping/transporting soil samples to the analytical laboratory.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Quality assurance / quality control (QA/QC) samples) will depend on the site-specific work plan, DQOs, or laboratory requirements. QA/QC requirements need to be determined prior to ordering sample containers or devices. Trip blank samples should be included in each cooler which holds samples to be analyzed for VOCs. Inclusion and analysis of trip blanks imparts information on potential contamination of samples during sample, handling and field conditions by accompanying samples during mobilization, sampling, demobilization and shipment operations.

10.0 Attachments

En Novative Technologies, Inc., Recommended Use of Terra Core®

Chemisphere, Inc., Recommended Use of the EasyDraw Syringe® and The PowerStop Handle®

En Novative Technologies, Inc., Disposable En Core® Sampler Sampling Procedures

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.5, Sample Custody and Handling

FSOP 2.1.6, Soil Sample Collection for Volatile Organic Compound Analysis by Bulk Sampling Methods

U.S. DOT, Title 49 CFR, Parts 171 through 180

U.S. EPA, July 2002, SW-846 Method 5035A: Closed System Purge-and-Trap and Extraction for Volatile Organics In Soil And Waste Samples

U.S. EPA, December 1996, SW-846 Method 5035: Closed System Purge-and-Trap and Extraction for Volatile Organics In Soil And Waste Samples

Well Development
FSOP 2.2.1 (July 14, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This field standard operating procedure (FSOP) describes standard monitoring well development practices used by the Ohio EPA Division of Environmental Response and Revitalization (DERR) for both newly installed wells and redevelopment of existing wells. Monitoring wells installed and/or developed by DERR are typically 0.5-inch to 2.0-inch inside-diameter wells. The practices and equipment discussed in this procedure focus on effective development of small-diameter wells used for ground water sampling.

1.2 The practices and equipment described herein may or may not be appropriate for the development of larger (> 2.0-inch inside diameter) wells used for aquifer testing, ground water remediation, gradient control, or water supply purposes (ASTM, 2018). For such situations this FSOP may serve as only a general guidance. Development of larger diameter wells may require techniques or equipment that are not discussed in this FSOP. Additional reference materials may need to be reviewed, and the site-specific work plan may need to specify additional well development procedures.

1.3 Monitoring well development is performed to (1) remove fluids that may have been added during drilling or during the well construction process, (2) remove fine sediment from the vicinity of the well screen, and (3) ensure good hydraulic interconnection between the sand filter pack and the adjacent geologic materials (formation) in which the well screen is installed. Proper development is especially critical for wells used to evaluate turbidity-sensitive ground water constituents such as metals, and for wells used to evaluate hydraulic conductivity or ground water yield (Ohio EPA TGM, February 2009).

1.4 The terms “well development” and “well purging” (the removal of water from a well) are not synonymous. While purging is an integral part of the overall well development effort, simply purging a monitoring well generally does not provide adequate development of the filter pack and surrounding formation.

1.5 For the purposes of this FSOP, development techniques include (1) surging and pumping, (2) purging with an inertial lift pump, (3) over-pumping, and (4) bailing:

1.5.1 Surging and pumping may be performed using an electric submersible pump or a bladder pump with or without a surge block. The surge block may be a separate assembly or attached to the pump assembly. If a surge block is not available, then the pump must be of sufficient diameter and weight to effectively surge the well. “Surging” means forcing the flow of water back and forth through the filter pack. This action optimizes the hydraulic interconnection between the well and surrounding formation by (1) removing fine sediments and (2) grading (sorting) and stabilizing the filter pack and adjacent (unconsolidated) formation. Pumping may be performed during or after surging. Surging and pumping is the preferred technique for wells installed in bedrock, gravel, or sand. This technique should not be used for wells installed in silt or clay.

1.5.2 Purging with a manually operated inertial lift pump (*e.g.,* a Waterra Pump™) may be used to develop monitoring wells installed in bedrock, gravel, sand, silt, or clay. This method is very effective and may be applied over a wider range of formation materials.

1.5.3 A surge block attachment may be used in wells with screens set mostly in bedrock, gravel, or sand. The attachment may also be used in wells with screens set mostly in silt if surging is performed gently for a short duration (*e.g.,* three one-minute intervals). The surge block attachment should not be used when developing wells that screen mostly clay.

1.5.4 Over-pumping is the process of repeatedly pumping the monitoring well at a relatively high rate (as compared to the well yield) to rapidly draw down the water level as far as possible, and then turning off the pump and allowing the well to recharge. Over-pumping may be performed with a submersible pump or peristaltic pump (depending on the well yield). This technique will remove fine sediments from the well casing and filter pack but does not grade (sort) the filter pack, and therefore develops the well less effectively than surging and pumping or an inertial lift pump with a surge block. In addition, it is generally less effective than an inertial lift pump at removing sediment that has accumulated at the bottom of the well screen. Over-pumping is an acceptable alternative for wells that screen mostly silt or clay.

1.6 Bailing can be used to develop monitoring wells installed in bedrock, gravel, sand, silt, and clay. However, bailing is not a very effective well development technique and should generally be avoided. Surging and pumping or purging with an inertial lift pump are much more effective techniques for wells that screen mostly bedrock, gravel, or sand. For wells that screen mostly silt or clay, purging with an inertial lift pump or over-pumping are likely to produce better results.

1.7 Development techniques and documentation should support the project data quality objectives and work plan. Requirements for well development are in part project-specific, and therefore the specific technique, level of effort, and associated data will vary between projects and sites. Not all information on the DERR Monitoring Well Development Form will be applicable to every project or site.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) before performing well development activities. The HASP should address any site-specific hazardous that may be associated with well development activities.

3.2 Due to likelihood of direct contact with ground water during well development, eye and dermal protection are strongly recommended.

3.3 If concerns exist regarding potentially toxic or explosive atmospheres within the well casings, open each monitoring well and screen the atmosphere (1) within the breathing zone above the open well casing and (2) within the well casing with a PID and/or LEL/O_2 meter.

3.4 If a portable generator is being used to operate a development pump, ensure that the generator is properly grounded to avoid electric shock.

4.0 Procedure Cautions

4.1 If a monitoring well has been installed using liquid grout to seal the annular space above the filter pack, well development activities should not be performed until the grout has set for at least 24 hours. Otherwise, development activities could damage the well by drawing uncured grout into the filter pack and well screen.

4.2 Monitoring wells that contain nonaqueous phase liquids (NAPL) should not be developed. Typically, the presence of NAPL is confirmed if an immiscible fluid layer at least 0.01 inches thick can be detected with an interface probe or clear bailer. Often, NAPL occurs in a discrete layer within the screened formation. Well development will distribute the NAPL throughout the filter pack and surrounding formation and generate purge water that is time-consuming and costly to dispose. In addition, development will likely cause subsequent NAPL recovery efforts to be more difficult and compromise any attempt to collect a representative ground water sample from the well.

4.3 Excessively or vigorously surging a monitoring well can permanently damage the filter pack. As a general rule, small-diameter wells should not be surged for a time interval longer than three minutes before pumping or manually purging sediment-laden water from the well and should not be surged for more than 15 minutes in total. Surging always should be performed slowly and gently.

4.4 As a general rule, monitoring wells that screen mostly clayey silt or clay should not be surged, because an excessive amount of fine sediment could be drawn into the filter pack and significantly reduce the hydraulic interconnection between the well and surrounding formation. Removing such sediment from the filter pack is very difficult, if not impossible. If surging is deemed necessary based on well performance concerns, it should be performed very slowly and gently and for short time intervals (*e.g.,* no more than three one-minute intervals), each followed by evacuation of at least one well volume to remove sediment from the well.

4.5 Stainless-steel, weighted non-disposable PVC or Polyethylene bailers should be used for well development. Disposable Teflon or PVC bailers designed for ground water sampling should not be used for well development.

4.6 If the measured total depth of a monitoring well indicates that more than 10 percent of the screen has filled with sediment, excess sediment should be

removed by using a bailer or inertial lift pump before lowering an electric submersible pump or bladder pump into the well. Operation of an electric submersible pump or bladder pump in a well with significant sediment accumulation may result in the pump becoming lodged ("sand locked") within the well screen or casing. Additionally, an excessive sediment load can damage the internal components of some electric submersible pumps.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard. In addition, field staff assigned to perform monitoring well development should be DERR or Division of Drinking and Ground Water personnel who have a background in hydrogeology and/or well development experience.

6.0 Equipment and Supplies

6.1 Equipment and supplies needed for every well development event regardless of technique or site-specific criteria:

6.1.1 Boring logs and well construction diagrams
6.1.2 Decontamination equipment and supplies (refer to FSOP 1.6, Sampling Equipment Decontamination)
6.1.3 Graduated bucket or other container to estimate purge volumes
6.1.4 Personal protective equipment (protective eyewear, gloves, and footwear at a minimum)
6.1.5 Plastic sheeting
6.1.6 Purge water containers
6.1.7 Watch or cell phone
6.1.8 Water level meter
6.1.9 DERR Monitoring Well Development Form

6.2 Equipment and supplies needed for well development depending on the technique or site-specific criteria:

6.2.1 Bladder pump system
6.2.2 Electric submersible pump system
6.2.3 Inertial lift pump system
6.2.4 Peristaltic pump system
6.2.5 Pump-specific tubing
6.2.6 Monitoring instruments required to evaluate the following purge water

stabilization parameters: temperature, pH, specific conductance (conductivity), oxidation/reduction potential, turbidity, or dissolved oxygen

6.2.7 Photoionization Detector (PID) and/or Lower Explosive Limit/Oxygen (LEL/O_2) meter for health and safety monitoring

6.2.8 Stainless steel or PVC bailer (and bailer rope)

6.2.9 Surge block

7.0 Procedures

7.1 Review the boring log(s) and well construction diagram(s) to determine the most appropriate well development technique.

7.2 Well development data should be recorded using the DERR Monitoring Well Development Form (attached).

7.3 Deviations from this procedure should be documented with a brief explanation of the reason(s) for the deviation.

7.4 Initial field activities:

7.4.1 If concerns exist regarding potentially toxic or explosive atmospheres within the well casings, open each monitoring well and screen the atmosphere (1) within the breathing zone above the open well casing and (2) within the well casing with a PID and/or LEL/O_2 meter.

7.4.1.1 If volatile organic compound (VOC) concentrations or the percentage LEL *in the breathing zone* exceed the health and safety action levels provided in Table 1 of FSOP 1.1, Initial Site Entry or site-specific action levels, close and secure the monitoring well. Development of the well will need to be delayed until appropriate health and safety measures can be implemented.

7.4.1.2 If VOC concentrations or the percentage LEL *in the well casing* exceed the health and safety action levels provided in Table 1 of FSOP 1.1 or site-specific action levels but VOC concentrations or the percentage LEL in the breathing zone do not, allow the well to vent. Continue monitoring the breathing zone as necessary while performing well development activities.

7.4.1.3 Record health and safety monitoring data using the DERR Monitoring Well Development Form or a field logbook or field log sheets (*e.g.,* ranges of PID and LEL measurement values).

7.4.2 Measure the static water level and total depth of each well scheduled to be developed that day. Record these data using the DERR Monitoring Well Development Form.

7.4.3 Calculate the volume of the static water column in each well scheduled to be developed. At least three well volumes must be removed from every well for development efforts to be considered complete (refer to Step

7.3.5). Further, stabilization parameters should be monitored based on well volumes (rather than arbitrary time intervals) to avoid purging too little water between successive stabilization parameter measurements and prematurely concluding that purge water stabilization has been attained (refer to Step 7.4.2).

One Well Volume (gal) = (Total Depth, ft **–** Static Water Level, ft) **x** 3.14 **x** (Well Radius, ft)^2 **x** 7.48 gal/ft^3

One Well Volume (L) = (Total Depth, ft **–** Static Water Level, ft) **x** 3.14 **x** (Well Radius, ft)^2 **x** 28.32 L/ft^3

The following table summarizes volume (gallons and liters) per foot (of casing/screen length) for 0.5- to 4-inch inside diameters wells:

Well Inside Diameter (inches)	Volume per Foot (gallons)	Volume per Foot (liters)
0.5	0.01	0.04
0.75	0.02	0.09
1.0	0.04	0.15
1.5	0.09	0.35
2.0	0.16	0.62
3.0	0.37	1.39
4.0	0.65	2.47

Ideally, one "well volume" should include the water contained in the filter pack surrounding the screen. However, the filter pack contribution is typically less than 25 percent of the total well volume, and therefore is not a critical consideration for well development in most situations. Either well volume calculation (with or without the filter pack contribution) may be used at the discretion of the District Office Site Coordinator (based on the recommendation of the DDAGW Geologist assigned to the site.) If the District Office Site Coordinator does not indicate a preference, SIFU staff will decide based on their best professional judgment. Calculating the well volume with filter pack contribution requires the saturated length of the filter pack interval (which is usually longer than the screen), the boring diameter, and an estimation of the filter pack porosity (typically 25 to 30 percent):

One Well Volume Including Filter Pack (gal) = [(Total Depth, ft **–** Static Water Level, ft) **x** 3.14 **x** (Well Radius, ft)^2] **x** 7.48 gal/ft^3 **+** [Filter Pack Length, ft x 3.14 **x** ((Boring Radius, ft)^2 **–** (Well Radius, ft)^2) **x** 0.25 or 0.30] **x** 7.48 gal/ft^3

7.4.4 Calibrate all field monitoring equipment that will be used for well development.

7.4.5 At each well location, set up the well development equipment on a plastic sheet to avoid possible cross contamination through direct contact with the ground. Clean 5-gallon buckets may be used to hold pump hoses, air lines, bailer rope, etc.

7.4.6 Compare the total depth measurement to the total depth shown on the well construction diagram. If the measured total depth indicates that more than 10 percent of the screen has filled with sediment, remove the excess sediment by using a bailer or an inertial lift pump before lowering an electric submersible pump into the well.

7.5 Specific procedures for development techniques:

7.5.1 Surging and pumping: start at the top of the well screen and gradually work downwards in 2 to 3 foot intervals to the bottom of the well, surging slowly with a surge block, a pump equipped with a surge block, or the pump itself. Surge for two to three minutes and then pump the well to remove at least one well volume of sediment-laden water. After repeating this process three to five times, continue to pump the well at a sustainable rate.

7.5.2 Inertial lift pump:

7.5.2.1 If using an inertial lift pump with a surge block attachment, start at the top of the well screen and gradually work downwards in 2 to 3-foot intervals to the bottom of the well, surging slowly. Surge and purge for two to three minutes to remove at least one well volume of sediment-laden water. After repeating this process three to five times, continue to purge the well at a sustainable rate. The pump foot valve should be within 2 inches of the bottom of the well during purging to remove sediment.

7.5.2.2 If using an inertial lift pump without a surge block attachment, purge the well at a sustainable rate. The pump foot valve should be within 2 inches of the bottom of the well during purging to remove sediment.

7.5.3 Over-pumping: lower the pump intake to the top of the well screen. Purge the well at a pumping rate high enough to drawdown the water level to the pump intake. Turn off the pump, allowing the water level in the well to recover to at least two feet above the pump intake. Lower the pump approximately two feet deeper into the well screen and repeat the process. After repeating this process three to five times, continue to purge the well at a sustainable rate.

7.5.4 Bailing:

7.5.4.1 If using a bailer to develop a monitoring well installed in bedrock, gravel, sand, sandy silt, or silt, surge the screened interval with the bailer, using the same method as described in paragraph 7.3.1 above. While surging, *gently* tap the bailer on the bottom of the well to remove sediment. Remove at least one well volume of water after each period of surging. Continue to bail the well at a sustainable rate; bail from the top of the water column (do not lower the bailer into the screened interval) to avoid resurging the filter pack and re-elevating the turbidity.

7.5.4.2 If using a bailer to develop a monitoring well installed in silty clay or clay, initially purge the well by lowering the bailer to the bottom of the well for each withdrawal so that it is lowered and raised through the entire length of the well screen (*do not surge as described in Step 7.3.1 above*). *Gently* tap the bailer on the bottom of the well to remove sediment. After three well volumes have been removed, continue to bail the well at a sustainable rate. Bail from the top of the water column (do not lower the bailer into the screened interval) to avoid resurging the filter pack and re-elevating the turbidity.

7.5.5 Continue well development using one or more of the procedures described above until (1) the sediment thickness remaining in the wells is less than 1 percent of the screen length or 0.1 ft (whichever is larger), (2) required purge-water stabilization parameters have stabilized, and (3) at least three well volumes of purge water have been removed.

7.5.6 Record well development procedures and the volume of water removed from the well using the DERR Monitoring Well Development Form.

7.6 Stabilization parameter monitoring:

7.6.1 The use of temperature, pH, and specific conductance as purge water stabilization parameters for well development is strongly recommended. Depending on the project data quality objectives and associated work plan requirements, stabilization parameters may include temperature, pH, conductivity, oxidation-reduction potential, turbidity, or dissolved oxygen. If the work plan does not include well development stabilization parameters, the District Office Site Coordinator will decide which, if any, stabilization parameters will be monitored (based on the recommendation of the DDAGW Geologist assigned to the site.) If the District Office Site Coordinator does not indicate a preference, stabilization parameters will be monitored at the discretion of SIFU staff.

7.6.2 Once the parameters have stabilized, collect at least three successive measurements for each parameter to evaluate stabilization criteria. At least one well volume should be purged from the monitoring well prior to each successive measurement.

The following table summarizes purge water stabilization criteria:

Purge Water Parameters	**Stabilization Criteria**
Temperature	0.5º C
pH	+/- 0.2 Standard Units (S.U.)
Specific Conductance	+/- 3%
Oxidation-Reduction Potential (ORP)	+/- 20 millivolts (mV)
Purge Water Parameters	**Stabilization Criteria**
Turbidity	< 10 Nephelometric Turbidity Units (NTUs) or +/- 10% for turbidity > or = 10 NTUs
Dissolved Oxygen (DO)	+/- 10% or 0.2 mg/l, whichever is greater

7.7 Water level and pumping/purging rate monitoring:

7.7.1 Monitoring the water level in the well is recommended during well development activities if possible. Record water level data using the DERR Monitoring Well Development Form.

7.7.2 Monitoring the pumping or purging rate is recommended during well development activities if possible. Record data for calculating pumping or purging rates (water volumes withdrawn over time) using the DERR Monitoring Well Development Form.

7.7.3 Water level data and pumping or purging rates can provide general information about the formation hydraulic conductivity and the well yield, which in turn may be helpful for selecting appropriate ground water sampling techniques or for locating additional monitoring wells during future assessment activities.

7.8 Upon completion of well development activities, ensure that each well is properly closed and secured.

7.9 Purge water and other waste disposal:

7.9.1 Refer to FSOP 1.7, Investigation Derived Wastes.

7.9.2 Well development water with concentrations of petroleum or hazardous substances exceeding Voluntary Action Program generic potable use standards [OAC 3745-300-08(D)(3)] must be containerized and properly disposed.

7.9.3 If well development water is suspected to be a hazardous waste, contact SIFU for assistance.

7.10 Monitoring well redevelopment is needed if more than 10 percent of the screened interval has filled with sediment. In addition, redevelopment may be needed if:

7.10.1 The well produces excessively turbid water as compared to the turbidity typically observed or measured during prior sampling events.

7.10.2 The well exhibits anomalously high or low water levels as compared to its range of historic water levels, or significantly slower recharge rates than expected.

7.10.3 The well casing or surface seal is damaged and subsequently repaired. Surface water, soil, or other foreign materials may have entered the well after it was damaged and/or during its repair. Use of a downhole camera may be used to evaluate whether a well has been damaged.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

DERR Monitoring Well Development Form

11.0 References

ASTM, D5521 / D5521M-18, Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers, ASTM International, 2018, www.astm.org http://www.astm.org/cgi-bin/resolver.cgi?D5521D5521M

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

FSOP 3.1.2, Multiple Gas Detection Meter

Ohio EPA Division of Drinking and Ground Waters, 2009, Technical Guidance Manual for Ground Water Investigations (Chapter 8: Well Development, Maintenance, and Redevelopment)

Ground Water Level Measurement
FSOP 2.2.2 (July 20, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Measurement of ground water levels from wells or piezometers is generally required to:

- Provide static water level data to prepare a potentiometric surface map and evaluate ground water flow direction
- Determine the depth to set a ground water sampling pump
- Estimate the volume of water to be purged from the well prior to sampling
- Monitor water level drawdown while purging and sampling or during aquifer testing

1.2 This FSOP is applicable to the measurement of ground water levels with an electronic water level indicator (refer to FSOP 3.1.4, Electronic Water Level Indicator) in monitoring wells, piezometers, water supply wells, soil gas probes and soil borings that intersect the water table.

1.3 Measuring water levels may be difficult in some situations, including small-diameter (< 1 inch) monitoring wells, piezometers or soil gas probes. In addition, water supply wells may not provide access for water level measurements and often contain a dedicated pump with plumbing and electrical wiring that can obstruct or entangle a water level probe or pressure transducer.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Consult the instrument’s operation manual to determine if it is intrinsically safe when working in an area where there is a potential fire or explosion hazard.

3.2 Always review the site-specific health and safety plan (HASP) for site-specific sampling hazards before beginning work.

4.0 Procedure Cautions

4.1 The user should be familiar with the instrument operation. Consult the instrument manual for operating instructions prior to use.

4.2 Inspect the instrument tape for cuts or abrasions.

4.3 If concerns exist regarding potentially toxic or explosive atmospheres within the well casings, open each monitoring well and screen the atmosphere (1) within the breathing zone above the open well casing and (2) within the well casing with a PID and/or LEL/O_2 meter. (Refer to FSOP 3.1.1, Photoionization Detector and FSOP 3.1.2, and FSOP 3.1.2, Multiple Gas Detection Meter.)

4.3.1 If volatile organic compound (VOC) concentrations or the percentage LEL *in the breathing zone* exceed the health and safety action levels provided in Table 1 of FSOP 1.1, Initial Site Entry or site-specific action levels, close and secure the monitoring well. Development of the well will need to be delayed until appropriate health and safety measures can be implemented.

4.3.2 If VOC concentrations or the percentage LEL *in the well casing* exceed the health and safety action levels provided in Table 1 of FSOP 1.1 or site-specific action levels but VOC concentrations or the percentage LEL in the breathing zone do not, allow the well to vent for a few minutes and then measure the LEL again. If the LEL is less than the action level, proceed with the measurement.

4.3.3 Record health and safety monitoring data using the DERR Monitoring Well Development Form or a field logbook or field log sheets (*e.g.,* ranges of PID and LEL measurement values).

4.4 The use of electronic water level indicators to measure the depth to water in residential or other wells with pumps and associated plumbing is discouraged, because the tape may become entangled in the downhole plumbing or centralizing disks. If water level measurements must be obtained from such wells, the pump and plumbing may need to be temporarily removed first, which usually requires the services of a registered water well drilling contractor. Additional disinfection of the well and/or downhole equipment may be required by the county or local health department that has jurisdiction over the well.

4.5 Use caution when lowering and raising the tape within a well. A sharp casing edge or burr may damage the tape if it is pulled against the edge of the casing.

4.6 Do not use electronic water level indicators in wells known or suspected to contain nonaqueous phase liquids (NAPL). Use an interface meter instead (refer to FSOP 3.1.3, Interface Meter).

4.7 If using the water level indicator to measure the total depth of the well, add the length of any probe extension beyond the sensor pin (*e.g.*, 0.3 ft) to obtain an accurate measurement of the total well depth.

4.8 Be sure the instrument has charged batteries. Bring spare batteries.

4.9 Remove the batteries if the instrument is not going to be used for an extended period of time.

4.10 When reeling the tape in, be careful that the tape does not twist, kink or fold. The tape protection device (attached to the reel) should be used to prevent abrasion while the probe is in the well.

4.11 Always transport the instrument in a protective case or secure the instrument during transport.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Water level indicator with battery and operation manual
6.2 Protective case for instrument transport
6.3 Data forms or field book and pen
6.4 Well keys and tools needed to open well(s)
6.5 Decontamination equipment and supplies
6.6 Personal protective equipment appropriate for site-specific work activities

7.0 Procedure

7.1 Make sure the electronic water level indicator is functioning properly and the battery is charged. When testing the instrument, use tap water and not distilled water. Distilled water contains no dissolved solids to act as electrolytes and the alarms will not be activated.

7.2 Open the well. Allow sufficient time for the water level to equilibrate, especially if the well is installed in a confined aquifer or if air pressure is released (a "pop" is heard) when the well casing cap is removed.

7.3 Locate the designated measuring point mark on the casing. For monitoring wells this is generally marked on the highest point or north side of the top of the inner casing. If a mark is not present, use the highest visible point of the inner casing as the measuring point. If the inner casing is level (no discernible high point), use the north side of the casing. In either case mark a new measuring point.

7.4 Turn the water level indicator's switch on to the highest sensitivity position. Press the test button to ensure battery and alarm function.

7.5 Slowly lower the tape down the well, taking caution not to twist the tape or allow the tape to scrape the edge of the casing as it is being lowered. When the probe contacts water, the instrument's audible and visual alarms will be activated.

7.6 Raise the tape slightly to lift the probe out of the water. The alarm should stop. A mild shake of the tape may be necessary to remove water from the probe's sensor pin. Lower the tape slightly until the alarms activate and hold the tape firmly against the side of the casing so that the probe does not move up or down.

7.7 Carefully read the tape measurement at the well's measuring point to the nearest hundredth of a foot (0.01 ft) and verify.

7.8 Record the water level reading.

7.9 If using the water level indicator to measure the total depth of the well, turn off the instrument. Next, lower the tape to the bottom of the well and record the tape reading at the measuring point. Remember to add the length of any probe extension to the total depth measurement.

7.10 Decontaminate the probe and the length of tape lowered into the well in accordance with the decontamination procedures specified in FSOP 1.6, Sampling Equipment Decontamination or the site specific work plan. Use deionized water and a paper towel to wipe the tape as you reel it up from the well.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

None

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

FSOP 3.1.1, Photoionization Detector

FSOP 3.1.2, Multiple Gas Detection Meter

FSOP 3.1.3, Interface Meter

FSOP 3.1.4, Electronic Water Level Indicator

Detection and Sampling of Nonaqueous Phase Liquids in Monitoring Wells
FSOP 2.2.3 (July 28, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This procedure describes standard practices used by the Division of Environmental Response and Revitalization (DERR) for the detection, sampling and handling of nonaqueous phase liquid (NAPL), including light nonaqueous phase liquid (LNAPL) and dense nonaqueous phase liquid (DNAPL) that may be present in ground water monitoring wells at contaminated sites.

1.2 NAPLs are organic liquids that exist as a separate, relatively immiscible phase when in contact with water. NAPLs are divided into the general categories of LNAPL and DNAPL based on density relative to that of water:

1.2.1 LNAPL floats on the water column and accumulates on the ground water surface because its density is less than that of water (< 1.0 g/cc). Petroleum products such as gasoline, diesel fuel and motor oil are typical sources of LNAPL (U.S. EPA 1995).

1.2.2 DNAPL sinks through the water column and accumulates at the bottom of the well because its density is greater than that of water (> 1.0 g/cc). DNAPL sources include chlorinated solvents, coal tar, wood preservative wastes and pesticides (U.S. EPA 1991).

1.3 NAPL may be analyzed to determine its physical properties and chemical composition. Knowledge of physical properties such as density or viscosity is important for evaluating NAPL mobility and distribution in the subsurface and for remediation system design. Knowledge of chemical composition may be used for computing the effective solubility of NAPL components, identifying potential NAPL sources and evaluating the applicability of remedial technologies.

1.4 Refer to the Ohio EPA Technical Guidance Manual for Ground Water Investigations (Chapter 10) for additional guidance on collecting ground water samples from monitoring wells containing NAPL.

2.0 Definitions

Free Product: term sometimes used as a synonym for NAPL

3.0 Health and Safety Considerations

3.1 LNAPL typically consists of a flammable petroleum product (*e.g.,* gasoline) that releases vapors of volatile organic compounds (VOCs) known to be toxic and/or carcinogenic (*e.g.,* benzene).

3.2 DNAPL typically consists of nonflammable, volatile chlorinated solvents (*e.g.,* perchloroethylene) that are known to be toxic and/or carcinogenic.

3.3 Personal protective equipment (PPE) should be chemically resistant to organic solvents.

3.4 If NAPL (especially LNAPL) is present in a monitoring well, vapors migrating from the well casing may contaminate the work area breathing zone with VOC concentrations and/or flammable vapors that exceed health and safety action levels (Table 1, FSOP 1.1, Initial Site Entry). The work zone should be monitored using a photoionization detector (PID) for VOC concentrations and a four-gas meter for lower explosive limit (LEL) and percent oxygen (O_2). Monitoring, sampling or LNAPL recovery efforts may need to be performed using respiratory protection by qualified DERR staff.

3.5 All equipment used to monitor or sample NAPL (or ground water from wells containing NAPL) must be intrinsically safe.

3.6 NAPL samples that are flammable fluids cannot be shipped via air and must be delivered to the laboratory by an Ohio EPA staff member, a courier, or via ground shipment. Always assume that NAPL from an unknown source is flammable fluid for the purpose of sample shipment.

4.0 Procedure Cautions

4.1 Monitoring or sampling equipment that directly contacts NAPL must be resistant to organic solvents.

4.2 Excessive agitation of a monitoring well water column containing NAPL will distribute the NAPL throughout the filter pack and surrounding formation. This will cause subsequent NAPL recovery efforts to be more difficult and will compromise any attempt to collect a representative ground water sample from the well. Monitoring wells that contain NAPL generally should not be developed, purged using a bailer or pumped at a high flow rate relative to the well yield.

4.3 Measurement of NAPL layers in monitoring wells should always be performed prior to sampling or otherwise extracting ground water from the well.

4.4 Regardless of the measuring method used, the measured thickness of LNAPL or in a monitoring well rarely corresponds to that in the adjacent saturated formation, and typically exceeds the LNAPL-saturated formation thickness by approximately 2 to 10 times. This discrepancy can be caused by several factors, including but not limited to soil or bedrock capillary forces, the volume and rate of the NAPL release, fluctuation in ground water elevations or the presence of low-permeability layers above the water table. Therefore, a measured LNAPL thickness in a monitoring well should be qualified as an apparent thickness.

4.5 The measured thickness of DNAPL in a monitoring well may not correspond to that in the adjacent saturated formation depending on the placement of the well screen with respect to the DNAPL layer and the underlying impermeable layer. Therefore, a measured DNAPL thickness in a monitoring well generally should be qualified as an apparent thickness, unless well construction records indicate that the screen intercepts the DNAPL interface and the bottom elevation of the screen closely approximates the elevation of the underlying impermeable layer.

4.6 If measuring NAPL thickness using a transparent bailer, the apparent NAPL thickness in the bailer may be greater than the NAPL thickness in the well casing due to positive fluid displacement by the bailer.

4.7 DNAPL layers should be measured and sampled using double check-valve bailers rather than single check valve bailers. The second (upper) check valve on a double-check valve bailer isolates the sample as the bailer is lifted through the well water column, thereby maintaining the integrity of a DNAPL sample.

4.8 Ground water elevations in monitoring wells containing LNAPL should be corrected for the depression of the LNAPL/water interface to obtain total hydraulic head. The depression is caused by the weight of the LNAPL. The correction is performed by multiplying the measured LNAPL thickness by an estimate of the LNAPL specific gravity, and then adding the result to the elevation of the LNAPL/water interface. Approximate specific gravities at 20^{o} C (68^{o} F) for common petroleum product sources include the following:

- Gasoline, 0.74 g/cc
- Jet fuel or kerosene, 0.80 g/cc
- Diesel fuel, 0.85 g/cc
- Motor oil, 0.90 g/cc

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Detecting and measuring NAPL in monitoring wells:

6.1.1 Decontamination equipment and supplies (refer to FSOP 1.6, Sampling Equipment Decontamination)
6.1.2 Field logbook or field log sheets and appropriate field log forms
6.1.3 Multiple gas detection meter (aka four-gas meter), to include lower explosive limit/ oxygen LEL/O_2 sensors)
6.1.4 Oil-absorbent pads or mats
6.1.5 Interface meter (oil/water interface probe) or transparent bailers, single check valve (for LNAPL) and double check valve (for LNAPL or DNAPL)

6.1.6 Personal protective equipment (protective gloves at a minimum)
6.1.7 Photoionization detector (PID)
6.1.8 Site map with monitoring or recovery well locations
6.1.9 Water-proof pens and markers

6.2 Collecting NAPL samples from monitoring wells for laboratory analysis:

6.2.1 All equipment and supplies listed above in Section 6.1
6.2.2 Chain-of-custody forms
6.2.3 Protective eyewear and coveralls
6.2.4 Sample containers and labels as specified by the laboratory
6.2.5 Sample coolers
6.2.6 Sampling device(s), including single-check valve bailers (for LNAPL), double-check valve bailers (for LNAPL or DNAPL), or an intrinsically safe peristaltic pump

7.0 Procedures

7.1 Detecting and measuring NAPL in monitoring wells:

7.1.1 Always inspect purge water and development/monitoring/sampling equipment removed from any well for the presence of NAPL, which typically forms sheens, layers, or droplets of black, brown, yellow or clear immiscible fluid having a petroleum or solvent odor.

7.1.2 If NAPL is present or potentially present in a monitoring well, screen the atmospheres within **(a) the breathing zone above the open well casing** and **(b) within the well casing** with a PID and multiple gas detection meter with LEL and O_2 sensors. Refer to FSOP 3.1.1 for PID and 3.1.2 for multiple gas detection meter use.

7.1.2.1 If VOC concentrations or the percentage LEL **in the breathing zone** exceed the health and safety action levels provided in Table 1 of FSOP 1.1, Initial Site Entry or site-specific action levels, close and secure the monitoring well. Work will need to be delayed until appropriate health and safety measures can be implemented.

7.1.2.2 If VOC concentrations **in the well casing** exceed the health and safety action levels provided in Table 1 of FSOP 1.1 or site-specific action levels, but VOC concentrations in the breathing zone do not, work activities may continue. If LEL concentrations in the well casing exceed action levels, leave the well open and to ventilate. If LEL concentrations fall below action levels in the well casing, then continue work. Monitor the breathing zone continuously for VOC concentrations and percentage LEL. Do not work if LEL concentrations in the well casing continue to exceed action levels.

7.1.2.3 Use a logbook or field log sheets to record health and safety monitoring data (*e.g.,* ranges of PID and LEL measurement values).

7.1.3 Measure the apparent thickness of the NAPL layer in the well (the difference between the air/LNAPL and the LNAPL/water interface depths, or the difference between the water/DNAPL and well bottom depths) using one of the following techniques:

7.1.3.1 Interface meter: slowly lower the probe through the fluid column to detect and measure NAPL interfaces. Refer to FSOP 3.1.3 for interface meter use.

7.1.3.2 Transparent bailer: slowly lower the bailer through the fluid column to span the NAPL layer, slowly withdraw the bailer, and measure the NAPL thickness within it. Use double check-valve bailers to retrieve DNAPL samples. Use single-check valve or double check-valve bailers to retrieve LNAPL samples. Handle bailers over oil-absorbent pads or mats to contain NAPL that may be inadvertently spilled on the ground.

7.1.4 Measure NAPL thickness to an accuracy of +/- 0.01 ft. If the thickness is less than 0.01 ft, describe the thickness as a "sheen."

7.2 Collecting NAPL samples from monitoring wells for laboratory analysis:

7.2.1 Collecting samples using a bailer:

7.2.1.1 To collect an LNAPL sample, slowly lower a single-check valve or double check-valve bailer through the LNAPL layer and into the underlying water column, taking care to allow as little water as possible to enter the bailer. Upon retrieval of the bailer, decant water from it by carefully opening the check valve at the bottom of the bailer. Then fill the sample containers with LNAPL by pouring from the top of the bailer. Repeat this process until all sample containers are filled or until no more LNAPL can be recovered from the well.

7.2.1.2 To collect a DNAPL sample, slowly lower a double check valve bailer to the bottom of the well. Carefully retrieve the bailer, and upon retrieval, decant water from it by pouring from the top of the bailer. Then fill the sample containers with DNAPL by opening the check valve at the bottom of the bailer. Repeat this process until all sample containers are filled or until no more DNAPL can be recovered from the well.

7.2.2 Collecting samples using a peristaltic pump:

7.2.2.1 An intrinsically safe peristaltic pump may be used to collect LNAPL or DNAPL samples provided that the NAPL is within the suction limit of the pump (generally within the upper 20 feet of the well water column).

7.2.2.2 Set the pump intake within the LNAPL or DNAPL and fill the sample containers from the pump discharge, taking care to minimize the amount of water in the sample. Repeat this process until all sample containers are filled or until no more NAPL can be recovered from the well.

7.2.3 Perform sampling activities over oil-absorbent pads or mats to contain NAPL that may be inadvertently spilled on the ground.

7.3 Decontaminate equipment in accordance with FSOP 1.6, Sampling Equipment Decontamination.

7.4 Properly containerize all wastes in accordance with FSOP 1.7, Investigation Derived Wastes. Pour waste NAPL and fluids containing NAPL into a DOT-approved container for flammable fluids and tightly seal the container. Segregate NAPL-contaminated disposable sampling equipment and personal protective equipment by double-bagging with heavy duty trash can liners. Contact the Site Investigation Field Unit (SIFU) for additional guidance on the containerization, transportation, and disposal of NAPL and media or disposal sampling equipment or personal protective equipment contaminated with NAPL.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

None

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

FSOP 3.1.1, Photoionization Detector

FSOP 3.1.2, Multiple Gas Detection Meter

FSOP 3.1.3, Interface Meter

Ohio EPA Division of Drinking and Ground Waters, May 2012, Technical Guidance Manual for Ground Water Investigations (Chapter 10: Ground Water Sampling)

U.S. EPA, 1995, Ground Water Issue: Light Nonaqueous Phase Liquids, EPA/540/S-95/500

U.S. EPA, 1991, Ground Water Issue: Dense Nonaqueous Phase Liquids, EPA/540/4-91-002

Ground Water Sampling (General Practices)
FSOP 2.2.4 (August 4, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This procedure describes general standard practices that should be used by the Division of Environmental Response and Revitalization (DERR) for collecting ground water samples from monitoring wells and soil borings, regardless of the technique or sampling equipment used. These procedures may be used for collecting ground water samples for screening, compliance or other objectives. Applicable ground water sampling techniques include the following:

- FSOP 2.2.5, Ground Water Sampling Using an Inertial Lift (Check Valve) Pump
- FSOP 2.2.6, Low-Flow (Low-Stress) Ground Water Sampling
- FSOP 2.2.7, Ground Water Sampling Using a Bailer
- FSOP 2.2.8, Ground Water Sampling Using a Bladder Pump
- FSOP 2.2.9, Ground Water Sampling Using a Peristaltic Pump
- FSOP 2.2.10, Ground Water Sampling Using an Electric Submersible Pump
- FSOP 2.2.11, Sampling Water Supply Systems

1.2 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring, specifically Chapter 10, Ground Water Sampling. In addition, U.S. EPA 2002 (Yeskis and Zavala) provides ground water sampling guidance for RCRA and CERCLA sites. The site-specific work plan (SSWP) will provide project objectives and data quality objectives (DQOs). In the event there appears to be inconsistency between the TGM and project objectives or DQOs, please contact the DERR SIFU manager and DERR site coordinator for clarification.

2.0 Definitions

2.1 Ground Water Screening Sample: a ground water sample used for site assessment decision-making purposes, as opposed to a ground water compliance sample collected for modeling, risk assessment or to evaluate regulatory compliance. Ground water screening samples may be used for optimizing the location and construction of monitoring wells, selecting ground water samples for fixed-base laboratory analysis, installing additional investigatory soil borings, or as the basis for sampling other environmental media such as soil vapor. Ground water screening samples may be collected from monitoring wells, piezometers, soil borings, sumps or excavations, and do not necessarily need to meet the strict ground water purging and stabilization requirements for ground water compliance samples as described below in paragraph 2.2.

2.2 Ground Water Compliance Sample: a representative ground water sample intended to support regulatory compliance, risk assessment or modeling. Ideally, this type of sample is collected in a manner that minimizes disturbance to ambient ground water chemical and physical properties and is representative of in-situ ground water quality within the saturated zone or aquifer of interest. These samples are collected from properly constructed and developed monitoring wells and must meet strict ground water purging and stabilization requirements. Unless otherwise indicated in this FSOP, the terms “ground water sample” or “sample” refer to this type of ground water compliance sample.

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) for sampling hazards before beginning work.

3.2 If required by the SSWP or HASP, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector (PID), multiple gas detection meter, *i.e.,* a meter with lower explosive limit (LEL) and oxygen (O_2) measurement capabilities or other required instrument. Breathing zone action levels are provided in Table 1 of FSOP 1.1, Initial Site Entry.

3.3 Wear appropriate personal protective equipment (PPE) when performing ground water sampling activities, including but not limited to chemical-resistant gloves compatible with the contaminants of concern, and eye/face protection and coveralls for splash protection.

3.4 Use caution when handling glass sample containers and chemical preservatives.

3.5 Use caution and wear work gloves when assembling or disassembling equipment and cutting discharge tubing.

4.0 Procedure Cautions

4.1 If non-aqueous phase liquid (NAPL) is present in the well, notify the DERR site coordinator and refer to FSOP 2.2.3, Detection and Sampling of Nonaqueous Phase Liquids in Monitoring Wells.

4.2 At minimum, wells should be redeveloped when 20% of a well screen is occluded by sediments, or records indicate a change in yield and turbidity. Wells should be redeveloped per FSOP 2.2.1, Well Development to obtain a representative sample.

4.3 Use the low-flow sampling technique (FSOP 2.2.6) to sample low-yielding (100 ml/min to 500 ml/min) wells whenever possible.

4.4 For very low-yielding wells (< 100 ml/min), sample collection options include no purge sampling, purging the well dry and allowing it to recover or using a passive ground water sampling device. The SSWP should provide specific procedures for sampling very low yielding wells. If it does not and very low-yielding wells need to be sampled, contact the DERR SIFU manager and DERR site coordinator to provide sampling procedures appropriate for project objectives and DQOs.

4.5 Avoid collecting ground water samples with bailers (FSOP 2.2.7) whenever possible to prevent elevated sample turbidity and sample volatilization.

4.6 Be aware that peristaltic pumps (FSOP 2.2.9) create a vacuum to pull ground water from a well. Based on site-specific data quality objectives (DQOs), use of a peristaltic pump may or may not be appropriate for collecting ground water compliance samples for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), dissolved metals or dissolved gases.

4.7 Prolonged purging at a rate that exceeds a well's yield will result in ground water cascading within the screened interval, causing volatilization and oxidation of contaminants and inhibiting the ability to collect a representative ground water sample.

4.8 When filling pre-preserved ground water sample containers, be careful not to flush out chemical preservatives.

4.9 When collecting samples for volatile organic compound (VOC) analysis, the 40-ml sample container should be filled slowly and gently (at rate of 100 ml/min or less) to minimize sample agitation and aeration and associated loss of VOCs, regardless of the specific sampling technique used.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

- Sample containers and preservatives
- Sample coolers and ice
- Sample labels
- PPE including at a minimum, chemical-resistant gloves
- Paper towels
- Decontamination equipment and supplies
- Purge water containers
- Field forms and/or logbook
- Chain-of-custody (COC) forms
- Pens and markers

- Calculator
- Water quality meter(s) to measure pH, temperature, specific conductance, oxidation-reduction potential (ORP), dissolved oxygen, turbidity and/or other water quality parameters
- Purging and sampling equipment (pumps, or bailers)
- Tubing (if needed)
- Electrical power source (car batteries or generator, if needed)

7.0 Procedures

7.1 Pre-sampling inspection and field monitoring

7.1.1 Document weather and other field conditions that could affect ground water sample activities and sample representativeness.

7.1.2 Inspect each monitoring well to evaluate and document the following conditions:

- Is the well secured (locked)?
- Is the well labeled?
- Are there insects (*e.g.,* wasps) or rodents (*e.g.,* mice) living inside the protective casing?
- Is the well damaged, or does it appear to have been tampered with?

7.1.3 If required by the SSWP or HASP, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector (PID), multiple gas detection meter (with LEL/O^2 capabilities) or other required instrument. Breathing zone action levels are provided in Table 1 of FSOP 1.1, Initial Site Entry. Monitoring may need to continue during purging and sampling activities. Additionally, if the LEL is exceeded inside the well casing, allow the open well to ventilate and measure the LEL again. Allow the LEL concentration to drop to below the LEL before placing instrumentation or sampling devices inside the well. Refer to FSOP 3.1.1, Photoionization Detector and FSOP 3.1.2, Multiple Gas Detection Meter for use and operation of these instruments.

7.2 Static water level and total depth measurements

7.2.1 Allow sufficient time for the water level to equilibrate (at least 10 to 15 minutes) if the well is installed in a confined saturated zone, or if air pressure is released (a popping sound is heard) when the well cap is removed.

7.2.2 Measure the static water level and total depth in accordance with FSOP 2.2.2, Ground Water Level Measurement. The static water level should be measured to an accuracy of +/- 0.01 ft, and the total depth should be measured to an accuracy of +/- 0.1 ft.

7.2.3 If NAPL is present in the well, following the monitoring procedures provided by FSOP 2.2.3, Detection and Sampling of Nonaqueous Phase Liquids in Monitoring Wells. In addition, immediately notify the DERR SIFU manager and DERR site coordinator.

7.3 Purging

7.3.1 Set up ground water purging and sampling equipment ensuring that:

- The work area is organized to maximize efficiency and minimize the potential for cross contamination.
- Non-disposable down-well equipment has been decontaminated.
- Monitoring equipment is properly calibrated.
- Preserved sample containers are ready for use.
- Field forms and sample labels are ready for use.

7.3.2 Purging for volumetric sampling techniques (*e.g.* bailing or high-flow pumping) is based on well volumes, i.e., the volume of water present in the screen and well casing under static water level conditions. At a minimum, three well volumes should be purged before sampling unless the well goes dry. However, the SSWP may require collecting:

- More than three well volumes
- A specified number of well volumes (three or more) with selected water quality parameters (refer to paragraph 7.3.4)
- A variable number of well volumes (three or more) based on selected water quality parameter stabilization (refer to paragraph 7.3.4)

One well volume can be calculated based on the well depth, well diameter and ground water depth using the following equation:

One Well Volume (gallons) = $\mathbf{D}^2/4 \times 3.14 \times (\mathbf{Hd} - \mathbf{Hw}) \times 7.48\ \text{gal/ft}^3$, where

D = well diameter, ft
Hd = well depth, ft top-of-casing (TOC)
Hw = static water depth, ft TOC

Alternatively, the following well diameter-based conversion factors (see quick reference guide in table below) can be multiplied by the static water column length (**Hd** - **Hw**) to determine the well volume in gallons or milliliters (1 gallon = 3,784.41 milliliters):

Well Diameter (Inches)	Gallons Per Foot	Milliliters Per Foot
0.5	0.01	39
0.75	0.02	87
1.0	0.04	154
1.5	0.09	347
2.0	0.16	617
3.0	0.37	1,389
4.0	0.65	2,470
5.0	1.02	3,859
6.0	1.47	5,557
8.0	2.61	9,879

7.3.3 Purging for the low-flow (low-stress) ground water sampling technique is based on the stabilization of water quality parameters to determine when to begin sampling. The SSWP will indicate at least three specific stabilization parameters to be monitored. In addition, water level drawdown in the well should be minimized, with the pumping level stabilized above the screened interval (unless the static water level is within the screened interval). At least one equipment volume (pump and discharge line volume) should be evacuated between stabilization parameter measurements unless a greater volume is required by the SSWP Refer to FSOP 2.2.6, Low-Flow (Low-Stress) Ground Water Sampling.

7.3.4 The SSWP will indicate the water quality stabilization parameters that need to be monitored prior to sample collection. Ground water stabilization parameters and criteria include the following:

Stabilization Parameters	Criteria (for at least three consecutive measurements)
Temperature	+/- 0.5^{o} C
pH	+/- 0.2 standard units (S.U.)
Specific Conductance	+/- 3%
Oxidation-Reduction Potential	+/- 20 millivolts (mV)

Stabilization Parameters	**Criteria (<u>for at least three consecutive measurements</u>)**
Dissolved Oxygen	+/- 0.3 mg/L
Turbidity	< 10 nephelometric turbidity units (NTUs) is possible, or +/- 10% if > 10 NTUs

Turbidity is more susceptible to influence from poor well construction or inadequate well development than the other parameters. Therefore, if turbidity is difficult to stabilize or exceeds 100 NTUs, the well may need to be redeveloped or may be improperly constructed. A pH value exceeding 8, along with high turbidity, typically indicate that grout contamination is present in the water column/screened interval.

7.3.5 Purge the monitoring well following the SSWP-specific procedures to meet the criteria for ground water sample collection.

7.3.6 When collecting ground water screening samples using a direct push drilling unit, the ground water sampling device should be purged to lower sample turbidity and help ensure that the ground water screening sampling is representative of the depth from which it is collected. Purging requirements will vary based on site conditions and project DQOs (refer to the SSWP).

7.3.7 If the well goes dry before purging criteria are met, allow the well to recover sufficiently to collect the ground water sample as soon as possible but within 24 hours.

7.4 Ground Water Sample Collection

7.4.1 Use the purging device to collect the ground water sample, i.e., don't remove the purging equipment (*e.g.,* a bladder pump) from the well and sample with another device (*e.g.,* a bailer) unless it is absolutely necessary in order to collect the sample.

7.4.2 Fill ground water sample containers slowly and carefully. Overfilling will dilute chemical preservatives. Fill VOC samples at a rate of 100 ml/min or less to minimize volatilization.

7.4.3 If using a volumetric sampling technique, purging to dryness or no-purge sampling, collect chemical constituents in the flowing order: VOCs, SVOCs, other extractable organics (pesticides/herbicides/PCBs), total metals, dissolved metals, and other inorganic constituents.

7.4.4 If using the low-flow technique, sample containers for constituents other than VOCs may be filled first (in no particular order) at a flow rate of 500 ml/min or less, followed by filtered samples and VOCs (last). Reduce the flow rate to 100 ml/min or less for VOCs.

7.5 Decontaminate ground water purging and sampling equipment after each use in accordance with FSOP 1.6, Sampling Equipment Decontamination.

7.6 Dispose of investigation-derived waste (purge water and used PPE, disposable sampling equipment and supplies) in accordance with FSOP 1.7, Investigation Derived Wastes.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation. At a minimum, document monitoring and purging data on field ground water sampling forms or in a field logbook, and document sample collection data on a chain-of-custody (COC) form. Calibration records for water quality monitoring equipment should also be retained with site-specific purging data and COC forms.

9.0 Quality Assurance and Quality Control

9.1 Ground water quality assurance/quality control (QA\QC) samples should include duplicate samples and equipment blanks (if using non-dedicated, non-disposable equipment) at a minimum rate of 1 per 10 ground water samples. A trip blank should be included in every sample cooler with VOC samples. Field blanks should be collected as needed or as specified by the SSWP. Refer to the SSWP for site-specific QA/QC sample requirements.

9.2 Water quality monitoring instruments used to evaluate ground water stabilization parameters should be properly maintained and calibrated before each ground water sampling event per the manufacturer’s instructions. During multiple-day sampling events water quality monitoring equipment should be calibrated at the beginning of each day.

10.0 Attachments

DERR Monitoring Well Sampling Log Sheet

DERR Residential Water Supply Well Sampling Log Sheet

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

FSOP 2.2.1, Well Development

FSOP 2.2.2, Ground Water Level Measurement

FSOP 2.2.3, Detection and Sampling of Nonaqueous Phase Liquids in Monitoring Wells

FSOP 2.2.5, Ground Water Sampling with an Inertial Lift (Check Valve) Pump

FSOP 2.2.6, Low-Flow (Low-Stress) Ground Water Sampling

FSOP 2.2.7, Ground Water Sampling Using a Bailer

FSOP 2.2.8, Ground Water Sampling Using a Bladder Pump

FSOP 2.2.9, Ground Water Sampling Using a Peristaltic Pump

FSOP 2.2.10, Ground Water Sampling Using an Electric Submersible Pump

FSOP 2.2.11, Sampling Water Supply Systems

FSOP 3.1.1., Photoionization Detector

FSOP 3.1.2, Multiple Gas Detection Meter

Ohio EPA Division of Drinking and Ground Waters, 2009, Technical Guidance Manual for Ground Water Investigations (Chapter 8: Well Development, Maintenance, and Redevelopment)

Ohio EPA Division of Drinking and Ground Waters, 2020, Technical Guidance Manual for Ground Water Investigations (Chapter 10: Ground Water Sampling)

U.S. EPA (D. Yeskis and B. Zavala), May 2002, Ground Water Sampling Guidelines for Superfund and RCRA Project Managers (Ground Water Forum Issue Paper): Office of Solid Waste and Emergency Response, EPA 542-S-02-001

Ground Water Sampling Using an Inertial Lift (Check Valve) Pump
FSOP 2.2.5, August 11, 2020
Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Inertial lift pumps, commonly referred to as check valve samplers, are portable purging and sampling devices which do not require a power source. Inertial lift pumps consist of a ball valve connected to flexible tubing. Water is purged from the well by lifting and dropping the pump in a continuous up-and-down manner (manually or automatically). These tools can quickly move water and are an efficient means of purging a well.

1.2 The check valve sampler device typically used by Ohio EPA is constructed of stainless steel (Geoprobe® MN#:214061) and is most commonly used for ground water sample collection with a Screen Point Sampler. The check valve is 2.25" long and is used with 3/8" OD tubing (Teflon™ lined or LDPE tubing can be used).

1.3 Check valve samplers are used for screening purposes during the assessment phase of site investigations. The water quality results from samples collected using a check valve device are very helpful for evaluating and optimizing monitoring well locations and construction. Due to the way these devices are operated, check valve samplers should not be used to collect ground water samples for compliance, risk assessment or modeling.

1.4 A mechanical Waterra Pump™ can also be used to develop and sample monitoring wells or screen points. This method requires much less manual labor and is more efficient in deeper wells or screen points.

1.5 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring, specifically Chapter 10, Ground Water Sampling and Chapter 15, Use of Direct Push Technologies for Soil and Ground water Sampling. In addition, U.S. EPA 2002 (Yeskis and Zavala) provides ground water sampling guidance for RCRA and CERCLA sites. The site-specific work plan (SSWP) will provide project objectives and data quality objectives (DQOs). In the event there appears to be inconsistency between the TGM and project objectives or DQOs, please contact the DERR SIFU manager and DERR site coordinator for clarification.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) for site-specific hazards before beginning work.

3.2 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling health and safety considerations.

3.3 The manual method in this sampling procedure requires physical exertion for lifting and lowering the tubing and check valve through the water column. Sampling many wells in one day using this technique can be physically challenging.

4.0 Procedure Cautions

4.1 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling procedure cautions.

4.2 The up-and-down motion of the check valve and tubing within the water column may cause excessive sample turbidity, especially when sampling wells or well points in fine-grained geologic materials. Excessive turbidity may result in artificially elevated metals concentrations in a ground water sample.

4.3 The up-and-down motion of the check valve and tubing within the water column may cause off-gassing of volatile organic compounds (VOCs), resulting in sample VOC concentrations that are not representative of in-situ ground water quality.

4.4 Fine-grained sediments may get caught between the check valve wall and ball and decrease the lift capability (efficiency) of the check valve. The tubing and check valve may need to be periodically removed and cleaned.

4.5 Check valves can be used at multiple locations if properly cleaned and decontaminated in accordance with FSOP 1.6, Sampling Equipment Decontamination. However, excessive reuse of the sampler can result in oxidation (rusting) of the check valve ball and can result in the ball getting jammed or not providing sufficient seal to ensure the lift needed. Replace check valves that appear to have their seal compromised from oxidation.

4.6 Always carry extra check valve samplers and tubing to the field.

4.7 Decontaminate the check valve assembly and replace the tubing between sample locations.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Check valve sampler
6.2 Appropriately sized tubing (LDPE, Teflon™ lined tubing, etc.)
6.3 Tubing cutters
6.4 Waterra Pump™ and generator, as needed
6.5 Sample collection supplies as outlined in FSOP 2.2.4, Ground Water Sampling (General Practices)
6.6 Water quality meter(s)

7.0 Procedures

7.1 If required by the SSWP or HASP, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector, multiple gas detection meter (with lower explosive limit/oxygen detection capabilities) or other required instrument and follow the breathing zone and well casing monitoring procedures included in FSOP 2.2.4.

7.2 Measure the water level in the well or well point, calculate the well or well point volume and determine purge volume per FSOP 2.2.4, Ground Water Sampling (General Practices).

7.3 Attach tubing to the check valve by screwing the check valve clockwise onto the tubing so that approximately ½" of tubing is inserted into the valve casing. Ensure that the connection is very snug.

7.4 Insert the check valve and tubing into the well or well point to the bottom of the screen. After ensuring the check valve is at the bottom of the screen, cut the tubing to the proper length to allow the purged ground water to easily discharge into a container.

7.5 Raise the tubing about one foot out of the well point and then lower the tubing back down (manually or using the Waterra Pump™). Continue this up-and-down motion to lift ground water to the surface.

7.6 Ensure that the open (discharge) end of the tubing remains in the purge water collection container to avoid spilling potentially contaminated water on the ground and to obtain an accurate purge volume estimate.

7.7 Begin measuring the field parameters per FSOP 2.2.4, Ground Water Sampling (General Practices) when the purge water container begins to fill with ground water.

7.8 Purging activities should be performed as required by the SSWP to meet project objectives and DQOs, and in accordance with FSOP 2.2.4, Ground Water Sampling (General Practices). General purging practices for collecting ground water screening samples from Geoprobe® wells and screen point borings as follows:

7.8.1 GEOPROBE® WELLS: purge at least 3 well volumes or purge until the field parameters have stabilized. If collecting samples for metals or other turbidity-sensitive constituents, continue to purge until ground water turbidity is less than 10 NTUs or has stabilized to within +/- 10 percent over three consecutive measurements. In some instances, it may be appropriate to use a ground water filter to decrease turbidity if collecting samples for metals analysis.

7.8.2 GEOPROBE® SCREEN POINT BORINGS: purge the temporary point until the water clarity visually stabilizes; a turbidity meter should be used to monitor sample turbidity if required by the SSWP.

7.9 Ground water samples should not be filtered unless filtering is included in the SSWP. DERR's Remedial Response Program and Voluntary Action Program both discourage the use of filtered ground water samples for site assessment purposes.

7.10 After purging is completed, collect and handle samples following the procedures outlined in FSOP 2.2.4, Ground Water Sampling (General Practices) and FSOP 1.5, Sample Custody and Sampling.

7.11 Decontaminate the check valve between each sampling location per FSOP 1.6, Sampling Equipment Decontamination unless using a new (dedicated) check valve at each sample location. Discharge tubing should not be reused between sampling locations.

7.12 Dispose of discharge tubing and other investigation derived waste in accordance with FSOP 1.7 Investigation Derived Wastes.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Refer to the SSWP and FSOP 2.2.4, Ground Water Sampling (General Practices)

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation.

FSOP 1.5, Sample Custody and Sampling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

FSOP 2.2.4, Ground Water Sampling (General Practices)

FSOP 3.1.7, Geoprobe® Operation and Sampling

Ohio EPA Division of Drinking and Ground Waters, 2020, Technical Guidance Manual for Ground Water Investigations (Chapter 10: Ground Water Sampling)

U.S. EPA (D. Yeskis and B. Zavala), May 2002, Ground Water Sampling Guidelines for Superfund and RCRA Project Managers (Ground Water Forum Issue Paper): Office of Solid Waste and Emergency Response, EPA 542-S-02-001

Low-Flow Ground Water Sampling
FSOP 2.2.6, August 19, 2020
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Low-flow ground water sampling is designed to collect ground water samples under minimal drawdown (low-stress) conditions. This technique minimizes vertical gradients and turbulence within the well and surrounding formation, thereby reducing undesired sampling-related changes to in-situ ground water quality.

1.2 Low-flow sampling assumes that under low-flow purging conditions, ground water passes continuously through a well's screened interval and does not mix with the water above the screen. The well is pumped at a rate much lower than the saturated zone yield so that drawdown is minimized and stagnant water in the casing above the screened interval remains relatively undisturbed. Fresh ground water enters the pump intake at a low velocity that minimizes turbulence in the screened interval.

1.3 In addition to effectively facilitating the collection of a representative ground water sample, low-flow sampling significantly reduces the volume of purge water generated compared to other ground water sampling techniques.

1.4 Because low-flow sampling minimizes sample volatilization and turbidity compared to other ground water sampling techniques, it is recommended for collecting ground water samples for regulatory compliance, risk assessment or modeling, especially volatile organic compound (VOC) and metal samples.

1.5 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring, specifically Chapter 10, Ground Water Sampling. In addition, U.S. EPA 2002 (Yeskis and Zavala) provides ground water sampling guidance for RCRA and CERCLA sites. The site-specific work plan (SSWP) will provide project objectives and data quality objectives (DQOs). In the event there appears to be inconsistency between the TGM and project objectives or DQOs, please contact the DERR SIFU manager and DERR site coordinator for clarification.

1.6 Ohio EPA's TGM recommends that low-flow sampling be performed using a bladder pump or variable-speed electric submersible pump. Depending on SSWP project objectives and DQOs, a peristaltic pump may also be used for low-flow sampling.

1.7 Low-flow sampling purging rates typically vary between 100 and 500 ml/min.

2.0 Definitions

Low-flow purging is also referred to as low-stress purging, low-impact purging, minimal drawdown purging, or Micropurging®.

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) for site-specific hazards before performing work.

3.2 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling and health and safety considerations.

3.3 When sampling with a bladder pump and using compressed nitrogen or carbon dioxide gas, properly secure compressed gas cylinders when transporting, using or storing them.

3.4 When carrying a 12-volt battery, lift the battery properly. Bend your hips and knees to squat down, grasp the battery, and while keeping it close to your body, straighten your legs to lift it. Do not lift the battery by bending forward, which may cause back injury.

4.0 Procedure Cautions

4.1 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling procedure cautions.

4.2 If NAPL is encountered in a monitoring well, do not perform ground water sampling. Immediately notify the DERR-SIFU manager and DERR site coordinator.

4.3 Low-flow sampling should not be performed using single-speed pumps. Use of a ball or gate valve with a single-speed pump to lower the flow rate is not acceptable, because the valve will cause turbulence in the sample discharge line.

4.4 Low-flow sampling cannot be performed using bailers.

4.5 Accurately measuring the static water level before beginning the low-flow sampling process is critical for evaluating water level drawdown during sampling.

4.6 Avoid drawing the water level into the screened interval during low-flow purging and sampling (if the static water level is above the screened interval). If this happens, the ground water sample will need to be collected using the volumetric (well volume) technique.

4.7 Low flow ground water samples should not be collected until drawdown has stabilized and water quality indicator parameters have stabilized.

4.8 VOC sample vials should never be filled at flow rates exceeding 100 ml/min.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Low-flow pump assembly, including control box and power supply or compressed nitrogen or carbon dioxide
6.2 Water quality meters and/or flow-through cell with data sonde to measure water quality stabilization parameters including pH, specific conductivity, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP) and turbidity
6.3 Water level indicator
6.4 Stopwatch or timer (for measuring flow rate)
6.5 Graduated cylinder (for measuring flow rate)
6.6 Disposable tubing
6.7 Well construction information (total depth of well, depth to screened interval)
6.8 Other ground water sampling equipment and supplies as needed per FSOP 2.2.4, Ground Water Sampling (General Practices)

7.0 Procedures

7.1 If required by the SSWP or HASP, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector, multiple gas detection meter (with lower explosive limit/oxygen detection capabilities) or other required instrument and follow the breathing zone and well casing monitoring procedures included in FSOP 2.2.4, Ground Water Sampling (General Practices).

7.2 Before installing the pump, measure the static water level in accordance with FSOP 2.2.2, Ground Water Level Measurement.

7.3 Slowly and carefully install the pump in a manner that minimizes disturbance to the water column in the well. The pump should be installed in the approximate center of the screened interval. Avoid placing the pump at the bottom of the well to avoid increasing turbidity.

7.4 Ensure that the flow-through cell and/or water quality meters have been calibrated and are set up and ready for use.

7.5 Start the pump at the lowest flow rate possible and measure the flow rate in a graduated cylinder (or similar device). The purge rate will depend on the well size (diameter) and yield. Typically, the purge rate will be between 100 and 500 ml/min for a two-inch inside diameter (ID) monitoring well. The purge rate for a smaller diameter well (*e.g.,* 0.75-inch ID) may be lower and the purge rate for a larger diameter well (*e.g.,* 4-inch ID) may be higher.

7.6 Monitor the water level drawdown in the well. If continuous drawdown is occurring, reduce the pumping rate until equilibrium is achieved, i.e., the water level stabilizes with the least amount of drawdown (as compared to pre-pumping static water level).

7.7 If the static water level *was initially above the screened interval* and drawdown into the screened interval cannot be avoided (despite efforts to lower the pumping rate), perform volumetric sampling by purging at least three well volumes before collecting the sample. Do not exceed a purge rate of 500 ml/min. Measure stabilization parameters as required by the SSWP.

7.8 While monitoring the water level drawdown as described above, measure and record stabilization (water quality) parameters using the flow-through cell and/or water quality meters. The SSWP will provide specific stabilization parameters, however, at least three stabilization parameters should be measured, and two of the parameters should always include specific conductance and either DO or ORP.

7.9 The time interval between successive stabilization parameter measurements should always be long enough to allow one equipment volume (pump + discharge line + flow through cell) to completely be purged from the well. Generally, a time three to five minutes is acceptable. If the pumping rate is very low (*e.g.,* 80 ml/min), the time needed between stabilization parameter measurements may need to be longer (*e.g.,* 5 to 12 minutes).

7.10 Continue low-flow purging until the water level drawdown and associated parameters have stabilized. Stabilization parameters are considered stable upon meeting the following criteria for at least three consecutive measurements:

Stabilization Parameters	**Criteria (<u>for at least three consecutive measurements</u>)**
Temperature	+/- 0.5^{o} C
pH	+/- 0.2 standard units (S.U.)
Specific Conductance	+/- 3%
Oxidation-Reduction Potential	+/- 20 millivolts (mV)
Dissolved Oxygen	+/- 0.3 mg/L
Turbidity	< 10 nephelometric turbidity units (NTUs) is possible, or +/- 10% if > 10 NTUs

If stabilization cannot be achieved through low-flow sampling based on SSWP DQOs and other criteria, perform volumetric sampling by purging at least three well volumes before collecting the sample. Avoid drawing the water level into the screen if possible, and do not exceed a purge rate of 500 ml/min.

7.11 After purging is completed, collect and handle samples following the procedures outlined in FSOP 2.2.4, Ground Water Sampling (General Practices) and FSOP 1.5, Sample Custody and Sampling. Disconnect the sample tubing from the flow-through cell prior to sample collection (*i.e.,* do not collect samples directly from the flow-through cell).

7.12 Collect the ground water sample by filling containers for constituents other than VOCs first (in no particular order) at a flow rate of 500 ml/min or less, followed by filtered samples (if specified by the SSWP) and VOCs (last). Reduce the flow rate to 100 ml/min or less for VOCs. If elevated turbidity is an issue, samples for metals may be collected last in an effort to minimize sample turbidity.

7.13 Decontaminate sampling equipment between each sampling location in accordance with FSOP 1.6, Sampling Equipment Decontamination. Do not reuse disposable tubing between sampling locations.

7.14 Dispose of discharge tubing and other investigation derived waste in accordance with FSOP 1.7 Investigation Derived Wastes.

8.0 Data Records and Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Refer to the SSWP and FSOP 2.2.4, Ground Water Sampling (General Practices)

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation.

FSOP 1.5, Sample Custody and Sampling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

FSOP 2.2.2, Ground Water Level Measurement

FSOP 2.2.4, Ground Water Sampling (General Practices)

Ohio EPA Division of Drinking and Ground Waters, 2020, Technical Guidance Manual for Ground Water Investigations (Chapter 10: Ground Water Sampling)

U.S. EPA (D. Yeskis and B. Zavala), May 2002, Ground Water Sampling Guidelines for Superfund and RCRA Project Managers (Ground Water Forum Issue Paper): Office of Solid Waste and Emergency Response, EPA 542-S-02-001

Ground Water Sampling Using a Bailer
FSOP 2.2.7, August 25, 2020
Ohio EPA Division of Environmental Protection and Revitalization

1.0 Scope and Applicability

1.1 Bailers are portable, manually operated ground water sampling devices that consist of a tube with one or more check valves and an attached cord. The cord is used to lower and raise the bailer to purge water from a well. As a bailer is lowered into a well water column, the check valve(s) opens and allows the tube to fill with water. As the bailer is raised from a well water column, the check valve(s) closes and seals the ground water-filled tube that is being retrieved from the well for ground water purging or sampling.

1.2 Bailers can be constructed of virtually any rigid or flexible material. For ground water sampling purposes, Ohio EPA uses bailers constructed of materials that are inert (*i.e.,* they are neither sources of chemical contaminants nor adversely affected by chemical contaminants). Preferred materials for ground water sampling include, but are not limited to PVC, stainless steel, Teflon®, polyethylene and polypropylene. Bailers are available in a variety of diameters, volumes and lengths.

1.3 Bailer cords should be composed of contaminant-inert materials. Preferred cord materials include, but are not limited to nylon, polypropylene or Teflon®-coated wire or cord.

1.4 Given the range of material types and sizes, bailers can be used for sampling a wide variety of wells and ground water constituents. However, Ohio EPA does not consider bailers a best available technology for sampling ground water because when used, they surge the well and cause turbulence that increases turbidity and the potential for volatilization. The use of bailers to collect ground water samples for contaminants sensitive to turbidity and volatilization (especially VOCs and metals) should be avoided.

1.5 Bailers may be the only practicable option for sampling monitoring wells under the following conditions:

- The well is located in a remote area or in an area that is difficult to access
- The well is very low yielding (*i.e.,* < 100 ml/min)
- The depth to ground water is very deep (*i.e.,* > 100 ft)
- The water column is very small (*i.e.,* < 1 ft)
- NAPL is present or contaminant concentrations are very high

1.6 Use of bailers to sample contaminated ground water may require an increased level of personal protective equipment (PPE) as compared to other ground water sampling techniques, because there is a higher likelihood of purge water contact.

1.7 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring, specifically Chapter 10, Ground Water Sampling. In addition, U.S. EPA 2002 (Yeskis and Zavala) provides ground water sampling guidance for RCRA and CERCLA sites. The site-specific work plan (SSWP) will provide project objectives and data quality objectives (DQOs). In the event there appears to be inconsistency between the TGM and project objectives or DQOs, please contact the DERR SIFU manager and DERR site coordinator for clarification.

1.8 If the use of bailers for collecting ground water samples is not included in the site-specific work plan (SSWP), contact the DERR-SIFU manager and DERR site coordinator before using bailers to collect ground water samples to ensure that the use of bailers will meet project objectives and data quality objectives (DQOs).

2.0 Definitions

2.1 **Top-filling bailer:** a bailer designed such that water can enter and exit only through its top. Due to sample agitation and aeration, top-filling bailers are only appropriate for collecting light non-aqueous phase liquids (LNAPLs).

2.2 **Bottom-filling (or single-check valve) bailer:** a bailer that is open at the top with a check valve at the bottom that seals the bailer when it is withdrawn from the well water column. Ohio EPA prefers disposable bottom-filling bailers with discharge tubes when using bailers for most ground water sampling projects.

2.3 **Discharge tube:** a short section of rigid tubing with tapered cuts at both ends that is used to collect a sample from the bottom of a bottom-filling valve bailer.

2.4 **Double-check valve (or point source) bailer:** a bailer with check valves at the top and bottom that is designed to collect water samples from discrete locations within a well water column. Water flows through both ends when the bailer is lowered into the water column. When the bailer reaches the desired depth and is retrieved, both valves close and the water from the sampled interval is retained with the bailer. Double-check valve bailers can be used to collect dense non-aqueous phase liquids (DNAPLs). The SSWP should include sample collection procedures when using double-check valve bailers.

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) for site-specific hazards before performing work.

3.2 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling and health and safety considerations

3.3 Using a bailer to purge and sample is labor intensive. Two or more staff may be needed to collect ground water samples using bailers under (but not necessarily limited to) the following conditions:

- More than 8 wells need to be sampled within one day or less
- Wells that need to be sampled are large diameter (*i.e.,* > 2 inches) or very deep (> 50 ft)
- Well water columns are very large (*i.e.* > 20 ft)
- The temperature is very warm (*i.e.,* > 80^o F) or very cold (*i.e.,* < 32^o F)

3.4 Avoid splashing yourself with purge water when bailing a well. Use appropriate personal protective equipment (PPE), including chemical-resistant gloves, chemical resistant coveralls and safety glasses or goggles.

3.5 Avoid leaning over the well when purging or sampling to prevent back injuries and to prevent inhalation of organic vapors associated with VOC ground water contamination from the well casing.

4.0 Procedure Cautions

4.1 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling procedure cautions.

4.2 If NAPL is encountered in a monitoring well, do not perform ground water sampling unless otherwise directed. Immediately notify the DERR-SIFU manager and DERR site coordinator.

4.3 A non-slip knot such as a bowline is recommended for tying the rope to the bailer. Other knots may slip, resulting in the loss of the bailer in the well. Refer to the attached instructions on how to tie a bowline knot.

4.4 When using a bailer, do not purge quickly or allow the bailer to free fall into the well water column or "bounce" the bailer on the bottom of the well. These actions will aerate the well water column and/or cause significantly increased sample turbidity, and in some cases may damage the well,

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Bailer
6.2 Cord
6.3 Knife or cord cutter
6.4 Graduated bucket or similar container
6.5 Other ground water sampling equipment and supplies as needed per FSOP 2.2.4, Ground Water Sampling (General Practices)

7.0 Procedures

7.1 If required by the SSWP or HASP, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector, multiple gas detection meter (with lower explosive limit/oxygen detection capabilities) or other required instrument and follow the breathing zone and well casing monitoring procedures included in FSOP 2.2.4, Ground Water Sampling (General Practices).

7.2 Before purging or sampling, measure the static water level and total depth in accordance with FSOP 2.2.2, Ground Water Level Measurement.

7.3 Calculate the well volume and determine purge volume in accordance with FSOP 2.2.4, Ground Water Sampling (General Practices).

7.4 Don a clean pair of chemically resistant sampling gloves.

7.5 Place clean plastic sheeting adjacent to the well to prevent contamination of the bailer cord in the event it should touch the ground. Alternatively, a clean five-gallon bucket can be used to contain the bailer cord as it is removed from the well. Ideally, the cord should not touch the ground or any other potentially contaminated objects when purging or sampling.

7.6 If the well is deep (> 50 ft), the well volume is large (> 5 gallons) or the bailer is large (> 2 inches in diameter), a tripod and pulley assembly may be used to operate the bailer.

7.7 Attach the cord to the bailer using a non-slip knot such as a bowline (see attached instructions).

7.8 Slowly lower the bailer down the well to the water column. Do not allow the bailer to free-fall into the water column or touch the bottom of the well. If possible, avoid lowering the bailer into the wells screened interval to minimize sample turbidity.

7.9 Slowly withdraw the bailer and empty the purge water into the graduated container.

7.10 Lower the bailer to the same approximate depth in the well each time. Raise the bailer slowly. If the bailer is not filled with water upon retrieval, you may be purging the well dry, or you may not be lowering the bailer far enough into the water column. Continue until you meet SSWP purging and stabilization criteria (generally least three well volumes removed) or until the well purges dry.

7.11 Upon completion of purging, lower the bailer into the well to collect the ground water sample as follows:

7.11.1 If using a bottom-filling bailer with a discharge tube, hold the bailer vertically and carefully insert the discharge tube into the bottom of the bailer to displace the check valve ball. Collect the sample from the bottom of the bailer through the discharge tube, controlling the flow while adjusting the insertion depth of the discharge tube.

7.11.2 If using a bottom-filling bailer without a discharge tube, carefully and slowly decant the sample from the top of the bailer.

7.12 If using a non-disposable bailer, decontaminate the bailer between each sample location in accordance with FSOP 1.6, Sample Equipment Decontamination.

7.13 Manage ground water samples in accordance with FSOP 1.5, Sample Custody and Handling.

7.14 Dispose of used disposable bailers, cord and PPE in accordance with FSOP 1.7, Investigation Derived Waste.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Refer to the SSWP and FSOP 2.2.4, Ground Water Sampling (General Practices).

10.0 Attachments

Step-by-step guide on how to tie a non-slip (bowline) knot

11.0 References

FSOP 1.3, Field Documentation.

FSOP 1.5, Sample Custody and Sampling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

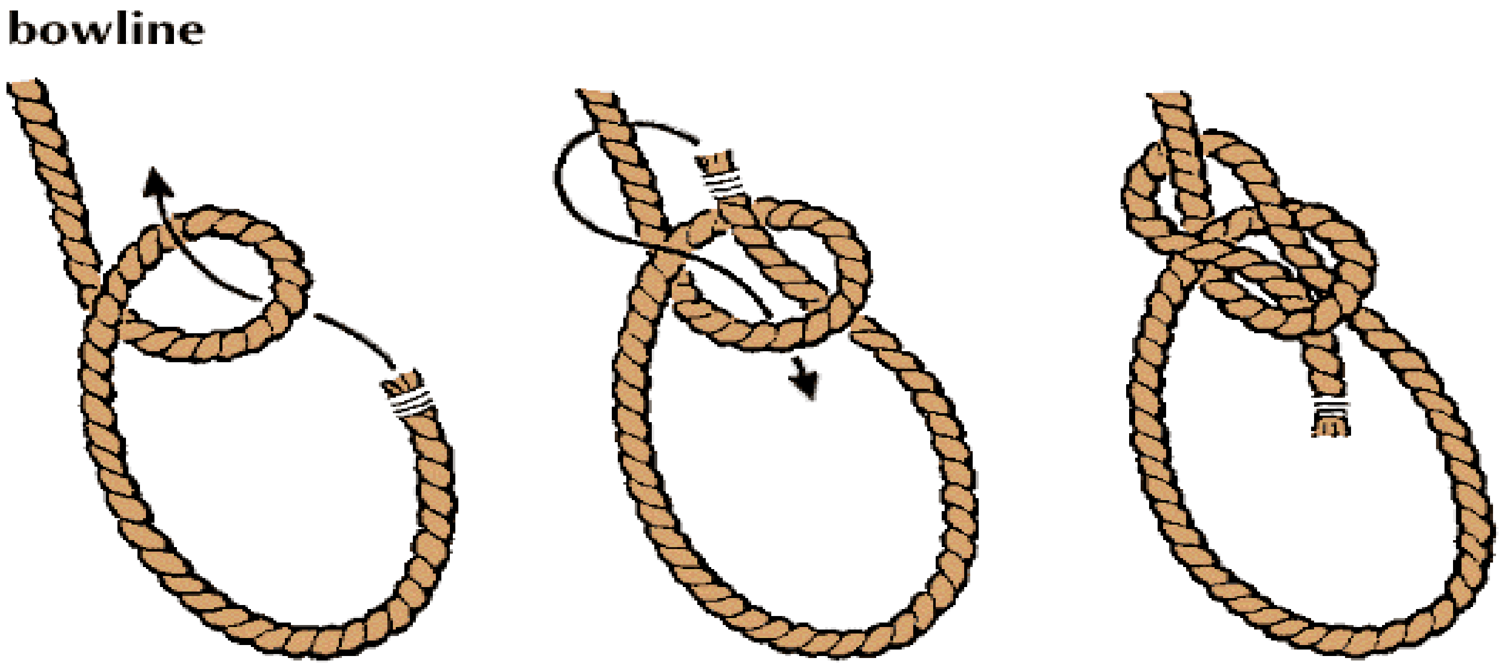
FSOP 2.2.2, Ground Water Level Measurement

FSOP 2.2.4, Ground Water Sampling (General Practices)

Ohio EPA Division of Drinking and Ground Waters, 2020, Technical Guidance Manual for Ground Water Investigations (Chapter 10: Ground Water Sampling)

U.S. EPA (D. Yeskis and B. Zavala), May 2002, Ground Water Sampling Guidelines for Superfund and RCRA Project Managers (Ground Water Forum Issue Paper): Office of Solid Waste and Emergency Response, EPA 542-S-02-001

How to Tie a Bowline (Non-slip) Knot



Ground Water Sampling Using a Bladder Pump
FSOP 2.2.8 (December 3, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 A bladder pump consists of a flexible bladder inside a rigid housing with check valves at the top and bottom. Water enters the bladder through a check valve and is lifted (squeezed) to the surface through a discharge line when air or inert gas (*e.g.,* carbon dioxide) pressure is applied through an air line to the space between the inside of the housing and the outside of the bladder. An air compressor or compressed air/gas tank and regulator cycle the pressure on and off, allowing water to continuously enter the bladder and be pumped to the ground surface. The bladder chamber does not allow the ground water sample to contact the compressed air or gas. The check valves prevent backwashing from the discharge line and bladder. Flow can be readily controlled and low flow rates of 100 ml/min or less are easy to maintain.

1.2 Depending on project data quality objectives (DQOs), Ohio EPA recommends the use of polyethylene or Teflon® bladders and Teflon®/stainless steel bladder housings. Pump discharge line tubing should be composed of polyethylene or Teflon®. Both bladders and discharge line tubing are disposable.

1.3 Bladder pumps minimize ground water sample agitation, aeration and turbidity, and are generally recognized as the best overall sampling device for both organic and inorganic constituents (U.S. EPA 1992). Bladder pumps are Ohio EPA's preferred ground water sampling device, especially for the low-flow sampling technique (FSOP 2.2.6, Low-Flow Ground Water Sampling).

1.4 Ohio EPA's bladder pump can be used to sample wells up to 200 feet deep and wells with inside diameters as small as 0.75 inches.

1.5 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring, specifically Chapter 10, Ground Water Sampling. In addition, U.S. EPA 2002 (Yeskis and Zavala) provides ground water sampling guidance for RCRA and CERCLA sites. The site-specific work plan (SSWP) will provide project objectives and DQOs. In the event there appears to be inconsistency between the TGM and project objectives or DQOs, please contact the DERR SIFU supervisor and DERR site coordinator for clarification.

2.0 Definitions

2.1 Cycles Per Minute (CPM): the number of times the process of filling and discharging the bladder occurs (cycles) over one minute

2.2 Discharge: the process of the bladder closing and discharging water when pressure is applied

2.3 Refill: the process of the bladder opening and refilling with water after the pressure is released

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) for site-specific hazards before performing work.

3.2 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling and health and safety considerations.

3.3 When sampling with a bladder pump and using compressed nitrogen gas or carbon dioxide, properly secure compressed gas cylinders when transporting, using or storing them.

3.4 When carrying a 12-volt battery, lift the battery with proper form. Bend your hips and knees to squat down, grasp the battery, and while keeping it close to your body, straighten your legs to lift it. Do not lift the battery by bending forward, which may cause back injury.

3.5 Be careful when operating a 12-volt power supply under wet conditions, and if using a generator for power supply ensure that it is grounded to avoid electrical shock.

3.6 If using a generator for power supply, handle gasoline carefully. Always wear protective gloves when handling gasoline, and store gasoline containers outside of the work area.

4.0 Procedure Cautions

4.1 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling procedure cautions.

4.2 If NAPL is encountered in a monitoring well, do not perform ground water sampling. Immediately notify the DERR-SIFU supervisor and DERR site coordinator.

4.3 If sampling for PFAS, ensure that the bladder pump does not contain any parts containing Teflon, including includes O-rings, bladders, and tubing.

4.4 Do not lower or lift the bladder pump inside a well using the discharge tubing. Instead, use a safety cord for lowering and lifting the pump. The cord should be composed of an inert material (*e.g.,* polypropylene) that will not affect ground water quality and should be tied to the pump using a non-slip knot such as a bowline.

4.5 When using a bladder pump in a well containing high levels of turbidity or suspended solids, fine sediment may damage the bladder or cause the check valves to fail.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Stainless steel bladder pump
6.2 Dual tubing (connected air line and discharge tubing)
6.3 Disposable bladders
6.4 Aluminum lock discs
6.5 Safety cord
6.6 Knife or tubing/cord cutters
6.5 Control box and regulator
6.6 Air compressor powered by 12-volt power supply and generator or compressed air/gas tanks
6.8 Other ground water sampling equipment and supplies as needed per FSOP 2.2.4, Ground Water Sampling (General Practices)

7.0 Procedures

7.1 If required by the SSWP or HASP, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector, multiple gas detection meter (with lower explosive limit/oxygen detection capabilities) or other required instrument and follow the breathing zone and well casing monitoring procedures included in FSOP 2.2.4, Ground Water Sampling (General Practices).

7.2 Measure the well's static water level and total depth in accordance with FSOP 2.2.2, Ground Water Level Measurement.

7.3 Assemble the pump per the manufacturer's instruction, taking care to prevent potential cross-contamination (*e.g.,* assembling the pump over a clean sheet of plastic to prevent direct contact with the ground).

7.4 Calculate the well volume, even if low-flow sampling. If the well yield is too low to stabilize the water level for low flow sampling, the volumetric sampling technique (*i.e.,* removal of three well volumes) will need to be used.

7.5 Using the safety cord, slowly and carefully install the pump in a manner that minimizes disturbance to the water column in the well. The pump should be installed in the approximate center of the screened interval. Avoid placing the pump at the bottom of the well to avoid increasing turbidity.

7.6 When low flow sampling, measure the static water level with the pump in the well. Monitor the static water level during sampling to ensure that drawdown is minimized. Follow other low-flow sampling procedures as described in FSOP 2.2.6, Low-Flow Ground Water Sampling.

7.7 Bladder pumps operate by alternating between refill and discharge cycles, which are measured in cycles per minute (CPM). Each round of refill and discharge is one cycle. Adjust the CPM control to increase or decrease the pumping or discharge rate. One CPM pressurizes for a longer time and should be used on deeper or lower yielding wells, while 4 to 6 CPM may be used on shallow or higher yielding wells.

7.8 The discharge rate may be optimized by adjusting the refill and discharge cycle lengths (measured in seconds on the control box readout).

7.9 The volume of water purged in one discharge cycle multiplied by the CPM equals the pumping rate (*e.g.,* 75 ml/cycle x 4 CPM = 300 ml/min). Measure the volume being discharged per cycle at the start of purging and periodically afterwards.

7.10 Increase the refill time or reduce the pressure to reduce the pumping rate.

7.11 Refer to the pump's manual as needed for operating instructions.

7.12 After purging criteria have been met, collect ground water samples in accordance with FSOP 2.2.4, Ground Water Sampling (General Practices). Handle ground water samples in accordance with FSOP 1.5, Sample Custody and Handling.

7.13 Decontaminate pump between sampling locations as appropriate in accordance with FSOP 1.6, Sampling Equipment Decontamination. If using a disposable bladder replace after each use.

7.14 Dispose of investigation derived waste in accordance with FSOP 1.7, Investigation Derived Wastes.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Refer to the SSWP and FSOP 2.2.4, Ground Water Sampling (General Practices).

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation.

FSOP 1.5, Sample Custody and Sampling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

FSOP 2.2.2, Ground Water Level Measurement

FSOP 2.2.4, Ground Water Sampling (General Practices)

FSOP 2.2.6, Low-Flow Ground Water Sampling

Ohio EPA, 2020, Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring, Chapter 10, Ground Water Sampling: Ohio EPA Division of Drinking and Ground Waters

U.S. EPA (D. Yeskis and B. Zavala), May 2002, Ground Water Sampling Guidelines for Superfund and RCRA Project Managers (Ground Water Forum Issue Paper): Office of Solid Waste and Emergency Response, EPA 542-S-02-001

U.S. EPA, November 1992, RCRA Ground -Water Monitoring: Draft Technical Guidance: Office of Solid Waste

Ground Water Sampling Using a Peristaltic Pump
FSOP 2.2.9 (December 10, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Peristaltic pumps operate by creating a vacuum in the pump discharge line which draws ground water upwards to the ground surface. The vacuum is created by a series of rotating cams or rollers that compress and relax a flexible discharge line. Air or ground water in front of the rollers is pushed forward through the discharge line, and the portion of the discharge line behind the rollers rebounds to create a vacuum that continuously purges ground water from the well. Typically, these pumps are powered using an internal rechargeable 12-volt battery.

1.2 Limitations of peristaltic pumps for ground water sampling include the following:

1.2.1 Because the peristaltic pumps operate by creating a vacuum, these devices can only be used to purge ground water from depths of approximately 25 feet or less below ground surface (bgs) (the vacuum limit).

1.2.2 The application of a vacuum (negative pressure) to groundwater may promote an unacceptable amount of degassing and associated changes in ground water chemistry (see TGM Chapter 10). However, peristaltic pumps may be used for the collection of ground water compliance samples [FSOP 2.2.4, Ground Water Sampling (General Practices)] for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pH, oxidation-reduction potential, dissolved metals, dissolved gasses or other vacuum-sensitive constituents depending on the site-specific work plan (SSWP) project objectives and data quality objectives (DQOs). If use of the peristaltic pump is not supported by the SSWP objectives or DQOs, then another pump (e.g., a bladder pump) should be considered. Peristaltic pumps -are also suitable for collecting ground water screening samples or compliance samples for constituents that are not vacuum sensitive (*e.g.,* pesticides/herbicides, PCBs, nitrate, chloride, sulfate etc.)

1.2.3 Peristaltic pumps are small and are not recommended for purging large volumes of ground water.

1.3 Peristatic pumps offer the following advantages:

1.3.1 Peristaltic pumps are easily portable and relatively simple to operate compared to other ground water sampling devices.

1.3.2 The only pump components that contact ground water are the disposable discharge line and pump-head tubing, so minimal equipment decontamination is needed. No moving pump parts need to be decontaminated.

1.3.3 Sampler exposure to contaminated ground water is reduced compared to other ground water sampling techniques.

1.3.4 Peristatic pumps may be used to sample wells with inside diameters as small as 0.5 inches.

1.3.5 Peristaltic pumps may be used to perform low-flow ground water sampling at very low rates, *i.e.,* < 100 ml/min (FSOP 2.2.6, Low-Flow Ground Water Sampling).

1.4 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring, specifically Chapter 10, Ground Water Sampling. In addition, U.S. EPA 2002 (Yeskis and Zavala) provides ground water sampling guidance for RCRA and CERCLA sites. The SSWP will provide project objectives and DQOs. In the event there appears to be inconsistency between the TGM and project objectives or DQOs, please contact the DERR SIFU manager and DERR site coordinator for clarification.

2.0 Definitions

None

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) for site-specific hazards before performing work.

3.2 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling and health and safety considerations.

3.3 If the pump does not include an internal rechargeable 12-volt battery or additional battery charge is needed, an external 12-volt battery may be needed as a power source. In that case, be aware of the following health and safety considerations:

3.3.1 When carrying a 12-volt battery, lift the battery properly. Bend your hips and knees to squat down, grasp the battery, and while keeping it close to your body, straighten your legs to lift it. Do not lift the battery by bending forward, which may cause back injury.

3.3.2 Be careful when operating a 12-volt power supply under wet conditions.

3.3.3 If using a generator for power supply with a 12-volt adaptor, ensure that it is grounded to avoid electrical shock. Handle gasoline carefully. Always wear protective gloves when handling gasoline, and store gasoline containers outside of the work area.

4.0 Procedure Cautions

4.1 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling procedure cautions.

4.2 If NAPL is encountered in a monitoring well, do not perform ground water sampling. Immediately notify the DERR-SIFU manager and DERR site coordinator.

4.3 If the pump does not have an internal rechargeable battery, a portable 12-volt battery or 12-volt power adapters will be needed to power the pump.

4.4 Discharge line and pump-head tubing used with the peristaltic pump should not adversely affect ground water quality. For discharge line, Ohio EPA recommends the use of fluorocarbon polymer (Teflon®), polyethylene or similarly inert materials.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Peristaltic pump
6.2 12-volt battery or another power source (will need a 12-volt adaptor)
6.3 Appropriate diameter flexible tubing for pump head (cams/rollers)
6.4 Discharge line tubing (must connect to flexible pump head tubing)
6.5 Knife or tubing cutters
6.6 Other ground water sampling equipment and supplies as needed per FSOP 2.2.4, Ground Water Sampling (General Practices).

7.0 Procedures

7.1 If required by the SSWP or HASP, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector, multiple gas detection meter (with lower explosive limit/oxygen detection capabilities) or other required instrument and follow the breathing zone and well casing monitoring procedures included in FSOP 2.2.4, Ground Water Sampling (General Practices).

7.2 Measure the well's static water level and total depth in accordance with FSOP 2.2.2, Ground Water Level Measurement.

7.3 Place the pump near the well, connect the power source (if external) and install the flexible tubing and discharge line. The end of the discharge line should extend to the approximate center of the well's screened interval. Take care to prevent potential cross contamination of the discharge tubing. Avoid lowering the discharge tubing to the bottom of the well if possible, to avoid increased sample turbidity.

7.4 Calculate the well volume, even if low-flow sampling. if the well yield is too low to stabilize the water level for low flow sampling, the volumetric sampling technique will need to be used.

7.5 When low flow sampling, measure the static water level with the pump in the well. Monitor the static water level during sampling to ensure that drawdown is minimized If low flow sampling. Follow other low-flow sampling procedures as described in FSOP 2.2.6, Low-Flow Ground Water Sampling.

7.6 Adjust the pump speed control to increase or reduce the pumping rate to stabilize the water column drawdown. Refer to the pump's manual as needed for operating instructions.

7.7 Peristaltic pumps may be used in certain scenarios (*i.e.,* see the TGM (Chapter 10, Ground Water Sampling) and site-specific work plans) for the collection of VOC ground water samples for regulatory compliance, risk assessment or modeling.

7.8 After purging criteria have been met, collect ground water samples in accordance with FSOP 2.2.4, Ground Water Sampling (General Practices). Handle ground water samples in accordance with FSOP 1.5, Sample Custody and Handling.

7.9 Replace the disposable discharge line and flexible pump-head tubing between each sampling location. No decontamination is necessary.

7.10 Dispose of investigation derived waste in accordance with FSOP 1.7, Investigation Derived Wastes.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Refer to the SSWP and FSOP 2.2.4, Ground Water Sampling (General Practices).

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation.

FSOP 1.5, Sample Custody and Sampling

FSOP 1.7, Investigation Derived Wastes

FSOP 2.2.2, Ground Water Level Measurement

FSOP 2.2.4, Ground Water Sampling (General Practices)

FSOP 2.2.6, Low-Flow Ground Water Sampling

Ohio EPA, October 2020, Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring, Chapter 10, Ground Water Sampling: Ohio EPA Division of Drinking and Ground Waters

U.S. EPA (D. Yeskis and B. Zavala), May 2002, Ground Water Sampling Guidelines for Superfund and RCRA Project Managers (Ground Water Forum Issue Paper): Office of Solid Waste and Emergency Response, EPA 542-S-02-001

Ground Water Sampling Using an Electric Submersible Pump
FSOP 2.2.10 (December 10, 2020)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Electric submersible pumps used for ground water sampling include centrifugal submersible pumps and progressive cavity (helical rotor) pumps. Centrifugal submersible pumps are the more common and operate by using an electric motor to rotate an impeller (or series of impellers) that push ground water upward through a discharge line by centrifugal force. Ohio EPA uses variable speed centrifugal submersible pumps specifically designed for collecting ground water samples.

1.2 Electric submersible pumps are very versatile for ground water sampling. These devices can be used for low-flow sampling (< 500 ml/min or < 0.1 gpm) and quickly purging large volumes of ground water at higher pumping rates (> 5 gpm). These pumps are effective for purging deep wells (> 100 feet), larger diameter wells (> 2 inches) or wells with large water columns (> 30 feet). The use of an electrical submersible pump to sample a deep well is limited by the length of the electric cord and the amount of hydraulic head the pump is capable of lifting.

1.3 The variable speed electrical submersible pumps used by Ohio EPA for ground water sampling are constructed of stainless steel, Teflon® (fluorocarbon polymer) or other inert, non-sorptive materials. These pumps are also equipped with water-cooled motors, i.e., the electric motor is cooled by ground water flow around and through the pump. Either a portable generator or a 12-volt deep-cycle battery is used for power supply. Ohio EPA also uses disposable discharge line composed of Teflon®, polyethylene or similar materials depending on data quality objectives (DQOs).

1.4 When operated at low-flow rates (< 500 ml/min), variable-speed electric submersible centrifugal pumps may perform similarly to bladder pumps with respect to maintaining sample integrity.

1.5 Limitations of electrical submersible pumps include the following:

1.5.1 When operated at flow rates greater than 1 gpm, electrical submersible pumps may cause increased turbulence and pressure changes, which could adversely affect ground water sample quality, e.g., increased turbidity or loss of volatile constituents.

1.5.2 The heat generated by the electric motor may cause increased ground water sample temperature and loss of dissolved gasses and volatile constituents. However, this concern can be evaluated by monitoring the ground water temperature, and special devices are available (pump shrouds), depending on the well diameter, to prevent the pump motor from generating excessive heat.

1.5.3 Electric submersible pumps include intricate parts and typically result in an increase in decontamination and maintenance time compared to other ground water sampling devices.

1.5.4 Electric submersible pumps are susceptible to locking up when pumping water with excessive silt and fine sand. Caution should be exercised when purging or sampling excessively turbid wells. In some instances, an inertial lift pump and check valve should be used to remove the excessive silts and collect a sample.

1.6 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring, specifically Chapter 10, Ground Water Sampling. In addition, U.S. EPA 2002 (Yeskis and Zavala) provides ground water sampling guidance for RCRA and CERCLA sites. The site-specific work plan (SSWP) will provide project objectives and DQOs. In the event there appears to be inconsistency between the TGM and project objectives or DQOs, please contact the DERR SIFU manager and DERR site coordinator for clarification.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) for site-specific hazards before performing work.

3.2 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling and health and safety considerations.

3.3 Be careful when working with electricity under wet conditions.

3.4 If using a generator for power supply, ensure that it is grounded to avoid electrical shock. Handle gasoline carefully. Always wear protective gloves when handling gasoline, and store gasoline containers outside of the work area.

3.5 When carrying a 12-volt battery, lift the battery properly. Bend your hips and knees to squat down, grasp the battery, and while keeping it close to your body, straighten your legs to lift it. Do not lift the battery by bending forward, which may cause back injury.

4.0 Procedure Cautions

4.1 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for general ground water sampling procedure cautions.

4.2 If NAPL is encountered in a monitoring well, do not perform ground water sampling. Immediately notify the DERR-SIFU manager and DERR site coordinator.

4.3 If ground water is being sampled for per- and polyfluoroalkyl substances (PFAS), the pump will need to be checked to ensure that the pump components do not contain Teflon® or other PFAS (see TGM Chapter 10).

4.4 Never lower or lift the pump inside a well using the electrical power cord, especially while operating. This could result in electrocution.

4.5 The pump may be lowered or lifted using the discharge line if it is securely attached to the pump with a hose clamp. When using a hose clamp, do not overtighten the hose clamp screw if the pump is plastic. A safety cord may also be used for lowering and lifting the pump on some pumps. The cord should be composed of an inert material that will not affect ground water quality and should be tied to the pump using a non-slip knot such as a bowline. When removing the pump from the well, be sure to pull the safety line, tubing, and electrical line at the same rate. Otherwise, the lines can coil, bind, and obstruct the pump removal.

4.6 Operating an electrical submersible pump in a well with high amounts of suspended solids or turbidity may “sand lock” (seize) or damage the impellers. Carrying one or more impeller replacement kits during ground water sampling is recommended.

4.7 When operating the pump, do not allow the water level to fall below the pump intake. Otherwise, the pump will overheat.

4.8 If possible, do not operate the pump within the screened interval when purging at rates greater than 1 gpm. This may cause increased sample turbidity.

4.9 Never operate the pump at the bottom of a well. Doing so will likely cause increased sample turbidity and may sand lock the pump in the well.

4.10 Check the pump periodically to ensure the electrical wires have not loosened from the pump head or become abraded or otherwise damaged.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Electric submersible pump and controller box
6.2 Generator or 12-volt deep cycle battery
6.3 Disposable discharge tubing
6.4 Safety cord
6.5 Knife or tubing/cord cutter
6.6 Other ground water sampling equipment and supplies as needed per FSOP 2.2.4, Ground Water Sampling (General Practices)

7.0 Procedures

7.1 If required by the SSWP or HASP, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector, multiple gas detection meter (with lower explosive limit/oxygen detection capabilities) or other required instrument and follow the breathing zone and well casing monitoring procedures included in FSOP 2.2.4, Ground Water Sampling (General Practices).

7.2 Measure the well's static water level and total depth in accordance with FSOP 2.2.2, Ground Water Level Measurement.

7.3 Connect the discharge tubing (and safety cord if applicable) to the pump, taking care to prevent potential cross-contamination (*e.g.,* working over a clean sheet of plastic to prevent direct contact with the ground or other potentially contaminated surfaces).

7.4 Calculate the well volume, even if low-flow sampling. (If the well yield is too low to stabilize the water level for low flow sampling, the volumetric sampling technique will need to be used.)

7.5 Using the discharge line tubing (or safety cord), slowly and carefully install the pump in a manner that minimizes disturbance to the water column in the well. The pump should be installed in the approximate center of the screened interval for low-flow sampling, and if possible, above the screened interval for volumetric sampling. Never place the pump at the bottom of the well.

7.6 When low-flow sampling, measure the static water level with the pump in the well. Monitor the static water level during sampling to ensure that drawdown is minimized. Follow other low-flow sampling procedures as described in FSOP 2.2.6, Low-Flow Ground Water Sampling.

7.7 If using a generator for power supply, the exhaust should be directed away from (downwind of) the wellhead work area where the ground water samples will be collected to avoid cross contaminating the samples.

7.8 Connect the power source to the pump controller box and the controller box to the pump.

7.9 Start the pump and adjust the flow rate using the pump speed control on the controller box. Refer to the pump's manual as needed for operating instructions.

7.10 Monitor the drawdown in the well while purging to avoid drawing the water level below the top of the well screen or to the pump intake. If this situation occurs, immediately reduce the flow rate to allow the water level to rise above the top of the well screen or the pump intake.

7.11 Monitor the purge water temperature to evaluate if the pump motor may be heating the ground water. If this situation occurs, the well will likely need to be sampled using a different device. Consult the SSWP or contact the DERR SIFU manager and DERR site coordinator for direction regarding alternative sampling procedures.

7.12 After purging criteria have been met, collect ground water samples in accordance with FSOP 2.2.4, Ground Water Sampling (General Practices). Handle ground water samples in accordance with FSOP 1.5, Sample Custody and Handling.

7.13 Replace the discharge line between each sampling location and decontaminant the pump and electrical cord in accordance with the manufacturer's instructions and FSOP 1.6, Sample Equipment Decontamination.

7.14 Dispose of investigation derived waste in accordance with FSOP 1.7, Investigation Derived Wastes.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Refer to the SSWP and FSOP 2.2.4, Ground Water Sampling (General Practices).

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation.

FSOP 1.5, Sample Custody and Sampling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

FSOP 2.2.2, Ground Water Level Measurement

FSOP 2.2.4, Ground Water Sampling (General Practices)

FSOP 2.2.6, Low-Flow Ground Water Sampling

Ohio EPA, 2020, Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring, Chapter 10, Ground Water Sampling: Ohio EPA Division of Drinking and Ground Waters

U.S. EPA (D. Yeskis and B. Zavala), May 2002, Ground Water Sampling Guidelines for Superfund and RCRA Project Managers (Ground Water Forum Issue Paper): Office of Solid Waste and Emergency Response, EPA 542-S-02-001

Sampling Water Supply Systems
FSOP 2.2.11 (January 5, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This FSOP provides general procedures for collecting a representative water sample from a water supply system tap (valve or faucet). The water source for the system may be ground water or surface water.

1.2 Ensuring that the public has a safe source of potable water is the primary concern for sampling water supply systems. Other reasons may include, but are not limited to the following:

- Investigating water quality concerns when directly sampling the water source is not practicable
- Characterizing the extent of a ground water contamination plume
- Evaluating the water quality at the point of use, including potential contaminants that may originate from the water distribution system components.

1.3 This FSOP does not apply when sampling directly from a water supply well using the ground water sampling techniques described in the following FSOPs:

- FSOP 2.2.7, Ground Water Sampling Using a Bailer
- FSOP 2.2.8, Ground water Sampling Using a Bladder Pump
- FSOP 2.2.10, Ground Water Sampling Using an Electric Submersible Pump

1.4 Water supply system samples may be subject to contamination from the system components including piping (*e.g.,* iron, copper, lead, plastics and solvent glues) and greases or oils from valves and pumps.

1.5 For water supply systems with ground water sources, information such as aquifer type and well depth, yield and construction may be obtained from The Ohio Department of Natural Resources (ODNR) Division of Geologic Survey water well log report (online search tools) or the local health department.

1.6 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring, specifically Chapter 10, Ground Water Sampling. For this FSOP, refer to Appendix A, Additional Information for Sampling Water Supply Wells. The site-specific work plan (SSWP) will provide project objectives and data quality objectives (DQOs). In the event there appears to be inconsistency between the TGM and project objectives or DQOs, please contact the DERR SIFU manager and DERR site coordinator for clarification. The procedures described in the FSOP may vary based on site-specific work plan (SSWP) project objectives or data quality objectives (DQOs).

1.7 The procedures provided by the FSOP pertain to ground water samples collected to investigate the presence of CERCLA hazardous substances and petroleum. If sampling for bacterial content, please refer to Chapter 10, Appendix A of Ohio EPA's TGM or contact the local health department or the Ohio Department of Health (ODH) for appropriate sampling procedures. If sampling for other types of constituents (*e.g.,* radionuclides), following the sampling procedures provided in the SSWP.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) for site-specific hazards before performing work.

3.2 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) as applicable for general ground water sampling and health and safety considerations.

3.3 Be aware of health and safety hazards associated with residential properties including but not limited to pets, clutter, fuels, household hazardous materials, staircases, low basement ceilings, work areas with limited space, etc.

3.4 **Never** enter an OSHA-defined confined space for any reason for sampling a water supply system or during any other field activity. Only appropriately trained Agency staff are qualified to enter confined spaces for reconnaissance or sampling activities and will perform such work as necessary in accordance with Ohio EPA's Confined Space Entry Policy (OEPA-SM-10-002). The Agency Safety Program Manager is to be contacted for guidance in such situations.

3.5 Wear sample gloves and eye protection when collecting samples in pre-preserved containers or when adding sample preservatives to containers.

4.0 Procedure Cautions

4.1 Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) as applicable for general ground water sampling procedure cautions.

4.2 If NAPL (*i.e.,* sheen) is identified in purge water and/or in a water supply sample, immediately notify the DERR SIFU manager and DERR site coordinator.

4.3 Evaluate the design, age and construction of the water system before selecting a sampling location to ensure that a representative water sample is obtained and to avoid damaging the system.

4.4 Collect samples from cold water taps only.

4.5 Avoid sampling leaking taps that allow discharge from around the valve-stem handle and down the outside of the faucet or taps where water tends to flow up along the outside of the faucet lip. Samples from these taps may be contaminated with greases or oils from the valve stem, or contamination located on the outside surface of the tap.

4.6 Avoid sampling taps where the water flow is not constant.

4.7 Hoses, strainers, filters or aerators attached to the tap may be potential sources of contamination and should be removed before sampling, if possible.

4.8 Water supply samples should never be filtered.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

Refer to FSOP 2.2.4, Ground Water Sampling (General Practices) for the ground water sampling equipment and supplies needed, which will vary based on SSWP project objectives and DQOs.

7.0 Procedures

7.1 The DERR site coordinator will obtain written permission to access the property and perform water supply system sampling from the property owner and tenant (if applicable) prior to mobilizing for sampling activities.

7.2 After access permission has been granted in writing, contact the property owner and/or tenant (if applicable) to arrange a date and time to perform the sampling. Also contact the local health department or ODH for scheduling if they will be observing or participating in the sampling activities.

7.3 Before selecting a sampling point, inspect the water supply system to fully understand the location of all components and evaluate all potential sampling locations. Ideally, the tap selected for sample collection should be the closest to the water line entering the property and located upstream of any water treatment system components.

7.4 After obtaining permission from the property owner or tenant, remove any hoses, strainers, filters or aerators from the selected tap (if possible).

7.5 Open the sampling point valve (cold water only) and purge the water supply system as follows:

7.5.1 If sampling an actively used system, purge for at least 5 minutes.

7.5.2 If the system has not been actively used, purge for at least 15 minutes.

7.5.3 If the sampling location is located upstream of a pressurization or storage tank, taps inside the building (downstream of the tank) should be opened to prevent backflow from the tank to the tap being sampled.

7.5.4 In the event the water sample must be collected from a tap downstream of a pressurization or storage tank, purge enough water for a complete exchange of fresh water into the tank and at the sampling location.

7.5.5 If the sample is collected from a faucet (e.g., kitchen faucet) with an aerator, remove the aerator if possible, prior to collecting the sample.

7.6 If required by the SSWP, monitor ground water stabilization parameters.

7.7 When SSWP purging criteria have been met, collect the water sample by adjusting the flow to a moderately slow rate (*e.g.,* 0.2 to 0.5 gpm) and filling the sampling containers. Do not touch the inside of lip of the sampling containers to any part of the tap, and when filling the sample containers be careful not to flush out chemical preservatives. Do not adjust the flow rate during sampling. Chemical-resistant (*e.g.,* nitrile) gloves should be worn when sampling. Follow the sampling procedures in FSOP 2.2.4, Ground Water Sampling (General Practices) as applicable.

7.8 Handle water samples in accordance with FSOP 1.5, Sample Custody and Handling.

7.9 Dispose of any investigation derived waste in accordance with FSOP 1.7, Investigation Derived Wastes.

8.0 Data and Records Management

8.1 Document the water supply system components, configuration and condition. Take photographs as needed.

8.2 Follow FSOP 1.3, Field Documentation.

8.3 Please be aware of Personally Identifiable Information (PII) considerations when conducting residential sampling and reporting activities under federal grants.

9.0 Quality Assurance and Quality Control

QA/QC samples may include duplicate samples, trip and equipment blanks and matrix spike/matrix duplicate samples depending upon the project DQOs. In general, water supply samples should include 1 duplicate sample per 10 water supply samples collected. If VOC samples are being collected for analysis, at least one trip blank should be submitted per sample shipment.

10.0 Attachments

DERR Water Supply Well Sampling Logsheet

11.0 References

FSOP 1.3, Field Documentation.

FSOP 1.5, Sample Custody and Sampling

FSOP 1.7, Investigation Derived Wastes

FSOP 2.2.4, Ground Water Sampling (General Practices)

Ohio EPA, 2020, Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring, Chapter 10, Ground Water Sampling, Appendix A, Additional Information for Sampling Water Supply Wells: Ohio EPA Division of Drinking and Ground Waters

DERR Water Supply Sampling Log Sheet

Site Name: ______________________________ **Date:** ______________________________

Sample ID: ______________________________ **Time:** ______________________________

Duplicate Sample ID #: ____________________________ **Time:** ______________________________

Sampled by: ______________________________

Sample Type: **FIELD** **DUP** **BKG** **MS/MSD**

Parameters	**VOCs**	**SVOCs**	**Metals**	**Pest**	**Cyanide**			
# Containers								
Preservative (circle)	HCL	Ice	HNO3	Ice	NaOH			

Owner's Name:	**Phone:**
Owner's Address:	
Number Served by Water Source (if available):	
Sample Collection Point:	
Water Supply System Notes (if available):	
Depth of Well:	
Date Well Installed:	
Type of Filter or Well Treatment System:	
Is the Home on Septic or Sewer?	
Other:	

<u>Field Filtering of Ground Water Samples</u>
FSOP 2.2.12, January 5, 2021
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Field filtration of ground water samples is performed to remove the immobile sediment fraction associated with sample turbidity, which is an important concern for samples to be analyzed for total metals and other turbidity-sensitive constituents. The presence of sediment in samples preserved by field acidification may result in total metal analyses that overestimate the true concentration of mobile (dissolved plus colloidal fraction) metals species. Therefore, field filtering of ground water samples may be appropriate under certain conditions if consistent with site-specific work plan (SSWP) project and data quality objectives (DQOs), and if permitted under the regulatory program for which the samples are being collected and analyzed.

1.2 There are two types of field filtration techniques: “open system” and “in-line” (or “closed”) system. The primary difference between the two is that ground water samples filtered using the open system technique are exposed to the atmosphere and pressurized, whereas ground water samples filtered using the in-line system are not exposed. Accordingly, Ohio EPA utilizes the in-line filtering technique, which provides more representative and reliable results. The open system technique should not be used.

1.3 Ground water samples should be filtered only when <u>all</u> of the following conditions are present:

1.3.1 Samples are collected from monitoring wells that have been properly designed, installed and developed.

1.3.2 Samples are collected using the low-flow purging and sampling technique that is designed to minimize sample disturbance. Refer to FSOP 2.2.6, Low-Flow Ground Water Sampling.

1.3.3 Indicator parameters have been measured and stabilized before sample collection.

1.3.4 Turbidity stabilizes above 10 Nephelometric Turbidity Units (NTU), and based on professional judgment, the formation/saturated zone being sampled exhibits a high degree of sediment mobility, i.e., the turbidity is a function of natural formation conditions (e.g., clay- or silt-rich glacial deposits, karst aquifers with high flow rates).

1.4 Ground water samples collected at municipal solid waste landfills (MSW) should never be filtered. Federal regulations [40 CFR 258.53(b)] specify that metals analyses for ground water samples collected at MSW landfills be performed on unfiltered ground water samples only.

1.5 All ground water sampling techniques and associated procedures should be consistent with Ohio EPA's Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Ground Water Monitoring, specifically Chapter 10, Ground Water Sampling. In addition, U.S. EPA 2002 (Yeskis and Zavala) provides ground water sampling guidance for RCRA and CERCLA sites. For Ohio EPA Voluntary Action Program (VAP) sites, field filtration procedures should be consistent with Ohio EPA VAP Technical Guidance Compendium VA30007.19.010, Ground Water Sample Filtration. The site-specific work plan (SSWP) will provide project objectives and data quality objectives (DQOs). In the event there appears to be inconsistency between the referenced guidance documents and project objectives or DQOs, please contact the DERR SIFU manager and DERR site coordinator for clarification.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Review the site-specific health and safety plan (HASP) for sampling hazards before beginning work.

3.2 Wear appropriate personal protective equipment (PPE) when performing ground water sampling activities, including but not limited to chemical-resistant gloves compatible with the contaminants of concern and eye/face protection and coveralls for splash protection, which may be more likely to occur when field filtering ground water samples.

3.3 Use caution and wear work gloves when assembling or disassembling equipment and cutting discharge tubing.

4.0 Procedure Cautions

4.1 Field filtering should only be performed for metals and other turbidity-sensitive parameters. Ground water samples for volatile organic compounds, semivolatile organic compounds, pesticides/herbicides or polychlorinated biphenyls should never be field filtered.

4.2 The appropriate filter size should be determined during the development of the SSWP. Filters with pore sizes ranging from 10 microns to 0.1 microns may be used as warranted based on project objectives, DQOs and site hydrogeologic conditions. SIFU typically uses 0.45-micron filters for non-VAP ground water sampling and 5-micron filters for VAP ground water sampling. If estimates of dissolved metals concentrations are desired, Ohio EPA recommends 0.1-micron filters.

4.3 If using filters with smaller pore sizes (*i.e.,* 0.45-micron to 0.1-micron field filters), carry at least two filters per sample in the field. These filters tend to clog quickly, and additional filters may be needed to collect the required sample volumes.

4.4 If using a flow-through cell to measure ground water stabilization parameters, an in-line field filter should never be installed directly before (directly upgradient of) the flow through cell. A “t” fitting with a stopcock valve may be installed in the discharge line before (upgradient) of the flow-through cell to provide a separate discharge line for sample filtering.

4.5 Never attempt to decontaminate or re-use a field filter.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA’s hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 In-line 5-micron to 0.45-micron (or other filter pore size in accordance with SSWP) polycarbonate or cellulose acetate filters

6.2 In-line filter apparatus

6.3 Ground water sampling supplies required by FSOP 2.2.4, Ground Water Sampling (General Practices)

7.0 Procedure (In-Line Filtering Method with Low-Flow Sampling Only)

7.1 After ground water stabilization has been achieved (including turbidity stabilization), assemble the filter and install it in the sampling discharge line as recommended by the filter manufacturer. If using a flow-through cell to measure ground water stabilization parameters, the flow through cell should be disconnected and removed before installing the in-line filter. Alternatively, a “t” fitting with a stopcock valve may be installed in the discharge line before (upgradient) of the flow-through cell to provide a separate discharge line for sample filtering.

7.2 Allow at least 500 ml of ground water to pass through the filter before sample collection to help ensure that the filter has equilibrated with the ground water sample (Ohio EPA 2020 and U.S. EPA 2002). The filter manufacturer’s recommendations regarding sample equilibration should also be consulted.

7.3 Collect filtered samples for metals or and/or other turbidity-sensitive parameters as described in the SSWP and in accordance with FSOP 2.2.4, Ground Water Sampling (General Practices).

7.4 When sampling is completed, dispose of the used filters and any associated disposable apparatus in accordance with FSOP 1.7, Investigation Derived Wastes.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Control and Quality Assurance

None

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation

FSOP 1.7, Investigation Derived Wastes

FSOP 2.2.4, Ground Water Sampling (General Practices)

FSOP 2.2.6, Low-Flow (Low-Stress) Ground Water Sampling

Ohio EPA, 2020, Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring, Chapter 10, Ground Water Sampling: Ohio EPA Division of Drinking and Ground Waters

Ohio EPA, January 2003 (rev. 2018), VAP Technical Guidance Compendium VA30007.19.010, Ground Water Sample Filtration

U.S. EPA (D. Yeskis and B. Zavala), May 2002, Ground Water Sampling Guidelines for Superfund and RCRA Project Managers (Ground Water Forum Issue Paper): Office of Solid Waste and Emergency Response, EPA 542-S-02-001

<u>Surface Water Sample Collection</u>
FSOP 2.3.1 (January 11, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This FSOP provides general procedures for surface water sample collection. The methods, procedures, and sampling equipment selected for a sampling event should always meet the site or project-specific data quality objectives (DQOs).

1.2 Surface waters include rivers, streams, lakes, ponds, wetlands, springs, and seeps. In addition, surface water may be sampled from drainage ditches, man-made lagoons or impoundments, discharge pipes/outfalls, storm sewers and associated manholes or vaults, or areas of transient ponding.

1.3 This FSOP is not necessarily applicable to field activities conducted by Emergency Response, the Office of Special Investigations, the Radiation Assessment Team, or other specialized teams.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Always be conscious of hazards associated with the water body during surface water sampling, especially if sampling a lake, pond, wetland, lagoon, impoundment, river, or large stream.

3.2 Never enter a river or stream under high-flow conditions.

3.3 Be aware of trip or fall hazards along riverbanks and lagoon or impoundment slopes.

3.4 Be aware of the dangers of working near low-head dams (*e.g.,* rapid flow and undercurrents) as well as hazards that may be posed by other man-made structures such as manholes, vaults, weirs, pump houses, and associated electrical or mechanical equipment.

3.5 If sampling in swift water, near low head dams, through ice over water of unknown depth, or in other potentially dangerous situations, always wear a personal flotation device (PFD).

3.6 Never walk on a surface crust, or partially submerged debris in a lagoon or impoundment.

3.7 Do not walk on a frozen river, lake, pond, lagoon, or impoundment.

3.8 When collecting surface water samples, use the “buddy system,” with at least two persons present at all times.

3.9 Be aware of biological hazards, e.g., snakes, ticks, mosquitoes, and poison ivy, in areas around water bodies.

3.10 Never enter a permit required confined space for any reason during surface water sampling activities. Only Ohio EPA Office of Special Investigation Unit staff or other appropriately trained staff are qualified to enter confined spaces for reconnaissance or sampling activities, and will perform such work as necessary in accordance with Ohio EPA’s Confined Space Entry Policy (OEPA-SP-14-4).

3.11 Always review the site-specific health and safety plan (HASP) for site-specific sampling hazards before beginning work.

3.12 When sampling in cold weather, be aware of the potential for hypothermia due to falling in or immersion in cold water. Be sure the sampling vehicle is nearby so staff can enter and turn on the vehicle heater and change clothes as necessary.

4.0 Procedure Cautions

4.1 Sample surface water before sampling sediment whenever possible.

4.2 Avoid agitating and splashing surface water during sampling. Aeration of the sampled water may cause loss of volatile organic compounds or other undesirable changes in sample quality.

4.3 Avoid disturbing sediments during surface water sampling. Incorporating excessive sediment into (increasing the turbidity of) a surface water sample often artificially elevates the concentrations of certain constituents, particularly metals and polynuclear aromatic hydrocarbons. If sediments are disturbed, allow sufficient time for the sediment to settle and the water to clear before sampling.

4.4 Avoid introducing foreign materials into surface water samples. “Foreign materials” may include vegetative debris (leaves, tree bark, plant stems, etc.) or fragments of solid waste or debris materials (paper, plastics, wood fragments, etc.)

4.5 Samples may be collected at the surface water (air/water) interface or below the water surface dependent on project DQOs.

4.6 If collecting multiple samples from flowing surface water, begin at the downstream location and work upstream to avoid compromising sample quality (*e.g.,* increasing sample turbidity or disturbing contaminated sediments).

4.7 If using pre-preserved sample containers, take care not to flush the preservative from the container during the sampling process.

4.8 Use a glass sample jar or stainless-steel dipper to collect samples for organic chemical analyses. Plastic dippers or sample containers may serve as a source of cross contamination for certain organic chemicals.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Equipment and supplies needed regardless of sampling method:

6.1.1 Chain-of-custody forms
6.1.2 Clear tape
6.1.3 Decontamination equipment and supplies (FSOP 1.6, Sampling Equipment Decontamination)
6.1.4 Field logbook, field log sheets, or activity-specific field forms
6.1.5 Method-specific analytical sample containers with waterproof labels
6.1.6 Paper towels
6.1.7 Pens and markers (preferably waterproof)
6.1.8 Personal protective equipment per the HASP including PFD
6.1.9 Sample coolers
6.1.10 Sampling gloves
6.1.11 Sample preservatives, (*e.g.,* ice, HCl, HNO_3, NaOH, H_2SO_4)
6.1.12 Stainless steel dippers or clean sample jars for sample collection
6.1.13 Water quality monitoring instruments (*e.g.,* pH/temperature/specific conductance meter, dissolved oxygen meter, turbidity meter)

6.2 Other equipment and supplies that may be needed for unique circumstances such as seep sampling and/or surface waters that are difficult to access:

6.2.1 Composite Liquid Waste Sampler (Coliwasa)
6.2.2 Disposable bailers
6.2.3 Extension rod (for stainless steel dipper or glass sample jar)
6.2.4 Hand auger, sampling spoon, or shovel
6.2.5 Inertial lift pump
6.2.6 Peristaltic pump and sampling tubing
6.2.7 Small diameter PVC well screen to construct seep sampling point

7.0 Procedures

7.1 General surface water sampling procedures (regardless of sampling method)

7.1.1 If possible, conduct site reconnaissance to identify potential sampling locations.

7.1.2 If using pre-labeled sample containers, complete each label and cover with clear tape before sampling.

7.1.3 Use decontaminated or disposable equipment to collect each sample.

7.1.4 Wear a pair of clean sampling gloves when collecting each sample.

7.1.5 Samples should be collected in the following order of sensitivity to volatility and turbidity: (1) volatile organic compounds (VOCs); (2) metals; (3) semi-volatile organic compounds (SVOC)s; (4) pesticides, herbicides and PCBs; and (5) general water quality parameters, e.g., ammonia, chloride, alkalinity, etc.

7.1.6 After filling, preserving, and labeling sample containers, place each sample container in a cooler on ice for shipment or delivery to the laboratory. Complete the chain-of-custody form.

7.1.7 Collect water quality measurements (*i.e.,* stabilization parameters) such as pH, temperature, specific conductance, dissolved oxygen, or turbidity, as required.

7.1.8 A field logbook or field log sheet may also be used to record the pertinent information if the field data form is not used (refer to FSOP 1.3, Field Documentation).

7.1.9 Decontaminate stainless steel dippers and any other sampling equipment used between samples in accordance with FSOP 1.6, Sampling Equipment Decontamination.

7.1.10 Dispose of investigation derived waste (IDW) in accordance with FSOP 1.7, Investigation Derived Wastes.

7.1.11 Follow all applicable criteria in FSOP 1.5, Sample Custody and Handling, when handling or shipping/transporting samples to the laboratory.

7.1.12 Mark the sampling locations clearly for Global Positioning System (GPS) surveying.

7.2 Sampling using a sample jar or stainless-steel dipper

7.2.1 For samples collected at the surface water interface, use a clean sample jar or a decontaminated stainless-steel dipper to fill the sample containers. Avoid overfilling pre-preserved sample containers and diluting the preservative.

7.2.2 For samples collected below the surface water interface, collect the samples as follows:

7.2.2.1 Close, invert, and completely submerge unpreserved sample containers. Pre-preserved sample containers cannot be used.

7.2.2.2 If the surface water is flowing, position the sample container opening in the upstream direction.

7.2.2.3 Fill each container by opening it under water, slowly turning it right side up, and allowing it to fill completely without breaking the water surface.

7.2.2.4 Close each filled container while still submerged.

7.2.2.5 Add preservatives to the sample container <u>after</u> the sample has been collected.

7.2.2.6 Alternatively, collect the sample from below the surface water interface using a peristaltic pump and disposable tubing. One sampler holds the tubing in the water while the other operates the pump and fills the sample containers from the bank or shore of the surface water body. This technique allows the use of pre-preserved sample containers.

7.3 Sampling from springs or seeps

7.3.1 If possible, avoid sampling springs or seeps during periods of significant rainfall.

7.3.2 Developed springs generally consist of a trench filled with buried gravel, which may include a discharge pipe and/or a concrete basin. If the spring has a flowing discharge pipe, simply fill the sample containers at the outflow (just as if collecting a water sample from an outdoor tap). If the spring consists only of a concrete basin with no discharge pipe, collect the sample directly from the basin using the techniques described in Section 7.2.

7.3.3 Collect surface water samples from seeps or undeveloped springs using the techniques described in Section 7.2 if a sufficient depth of ponded water is present. Otherwise, use any of the following techniques to provide adequate water volume for sampling:

7.3.3.1 Excavate a small area of the seep or undeveloped spring to a depth of approximately six inches using a clean sampling spoon or shovel. After allowing the excavation to fill with water (and allowing time for sediment to settle out and turbidity to drop), use the techniques described in Section 7.2 to collect a sample.

7.3.3.2 Use a sampler specifically designed to collect seep samples such as a stainless-steel scoop that has been modified to capture and contain water as it slowly discharges from a seep. Such samplers may help to reduce sample turbidity.

7.3.3.3 To collect low turbidity samples, easily purge prior to sampling, or collect multiple samples over time, install a small-diameter well screen in the seep or undeveloped spring to construct a fixed sampling sump:

7.3.3.3.1 Use a hand auger to excavate a shallow boring approximately two feet deep.

7.3.3.3.2 Install approximately 2.5 feet of PVC well screen with a sand pack. Use a PVC cap or J-plug to close the top of the screen when the sump is not being used.

7.3.3.3.3 Allow sufficient time for the sump to fill completely and for disturbed sediment to settle before sampling. If necessary, sediment-laden water may be purged from the sump after installation and prior to sampling to obtain lower turbidity samples.

7.3.3.3.4 Use a disposable bailer, peristaltic pump, or inertial lift pump to collect a sample from the sump (screen) after it fills with water.

7.4 Some surface waters may be difficult to sample due to site characteristics or health and safety concerns, such as an impoundment with steep banks or a deep storm sewer or outfalls with extremely high flows. Consider using the following equipment for these circumstances:

7.4.1 Extension rod for a stainless-steel dipper or glass sampling jar

7.4.2 Disposable bailer

7.4.3 Peristaltic pump with extended tubing

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

9.1 Quality assurance/quality control (QA/QC) sample requirements are to be specified in the site-specific work plan. QA/QC samples may include duplicate samples, trip and equipment blanks and matrix spike/matrix duplicate samples depending upon the project DQOs. In general, surface water sampling events should include 1 duplicate sample per 10 surface water samples collected. If VOC samples are being collected for analysis, at least one trip blank should be submitted per sample shipment.

9.2 If possible, collect duplicate samples at locations where contamination (or chemical(s)s of concern) is known or likely to be present at detectable concentrations.

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation

FSOP 1.5, Sample Custody and Handling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

Ohio EPA, Office of Safety and Labor, Standard Operating Procedure (OEPA-SP-14-4), Confined Space Entry Policy. Revised 08.07.2020

Sediment Sample Collection
FSOP 2.3.2 (January 11, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 This FSOP provides general procedures for sediment sample collection from shallow surface waters less than approximately two feet deep, areas of exposed sediment deposition adjacent to surface water bodies (*e.g.,* exposed mud flats during low water conditions), and seeps. The methods, procedures, and sampling equipment selected for a sampling event should always meet the site- or project-specific data quality objectives (DQOs). Surface waters include rivers, streams, lakes, ponds, wetlands, springs, and seeps. In addition, sediment may be sampled from storm sewers, drainage ditches, man-made lagoons or impoundments, or areas of transient ponding.

1.2 This FSOP is not applicable for the collection of sediment samples from surface waters deeper than approximately two feet or if sampling with specialized sampling equipment. For sediment sampling in deeper water or sediment sampling using specialized equipment (*e.g.,* dredges, coring devices, etc.), consult with SIFU and/or the Division of Surface Water for appropriate methodology and procedures.

1.3 For the purpose of this FSOP, sediments are unconsolidated organic or inorganic materials deposited by or beneath a surface water body. The physical and chemical nature of sediments is strongly influenced by particle size. Relatively fine-grained materials such as silts or clays with particle sizes less than 0.06 millimeters (60 microns) are preferred for chemical analysis. Larger sediment sizes may not retain chemical analytes of concern. Therefore, for the purpose of chemical analysis and the evaluation of chemical data, a representative sediment sample should contain a minimum of 30 percent silt and clay by volume. For a more detailed discussion of the definition of sediment and selection of sediment sampling locations and methods, consult the Ohio EPA Division of Surface Water Sediment Sampling Guide and Methodologies (3rd Edition, 2012).

1.4 Depending on project DQOs, either discrete sediment sampling or incremental sampling may be appropriate. Incremental sampling methodology is a structured composite sampling and processing protocol that reduces data variability and provides a reasonable estimate of a chemical's average concentrations for the area and volume of sediment being sampled. Please refer to FSOP 2.6.1, Multi-Incremental Sampling for Soils and Sediments, for DERR's incremental sampling procedures. If incremental sediment sampling is performed, then FSOP 2.6.1 should be used in conjunction with this FSOP.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Always be conscious of water hazards during sediment sampling, especially if sampling a lake, pond, lagoon, impoundment, river, or large stream.

3.2 Never enter a river or stream under high-flow conditions.

3.3 Be aware of trip or fall hazards along riverbanks and lagoon or impoundment slopes.

3.4 Be aware of the dangers of working near low-head dams (i.e., rapid flow and undercurrents) as well as hazards that may be posed by other man-made structures such as manholes, vaults, weirs, pump houses and associated electrical or mechanical equipment.

3.5 Always wear a personal flotation device (PFD) if in the immediate vicinity of deep or swift water, near low head dams, though ice over water of unknown depth, or in other potentially dangerous situations.

3.6 Never walk on exposed sediment of unknown thickness, surface crust or partially submerged debris in a lagoon or impoundment.

3.7 Do not walk on a frozen river, lake, pond, lagoon, or impoundment.

3.8 When collecting sediment samples, use the “buddy system,” with at least two persons present at all times.

3.9 Be aware of biological hazards (*e.g.,* snakes, ticks, mosquitoes, and poison ivy areas), around water bodies.

3.10 Never enter a permit required confined space for any reason during surface water sampling activities. Only Ohio EPA Office of Special Investigation staff or other appropriately trained staff are qualified to enter confined spaces for reconnaissance or sampling activities, and will perform such work as necessary in accordance with Ohio EPA’s Confined Space Entry Policy (OEPA-SP-14-4).

3.11 Always review the site-specific health and safety plan (HASP) for site-specific sampling hazards before beginning work.

3.12 When sampling in cold weather, be aware of the potential for hypothermia due to falling in or immersion in cold water. Be sure the sampling vehicle is nearby so staff can enter and turn on the vehicle heater and change clothes as necessary.

4.0 Procedure Cautions

4.1 If surface water sampling is being performed with sediment sampling, collect the surface water samples first to avoid entraining sediment into surface water samples.

4.2 If collecting multiple samples from flowing surface water, begin the sampling in a downstream direction and work upstream to avoid compromising sample quality.

4.3 Use a stainless-steel spoon or trowel to collect sediment samples for organic chemical analyses rather than plastic implements that may serve as a source of cross contamination for certain organic chemicals.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Chain-of-custody forms
6.2 Clear tape
6.3 Decontamination equipment and supplies (FSOP 1.6, Sampling Equipment Decontamination)
6.4 Field logbook, field log sheets, or activity-specific field forms
6.5 Method-specific analytical sample containers with labels (preferably waterproof)
6.6 Paper towels
6.7 Pens and markers (preferably waterproof)
6.8 Personal protective equipment per the HASP and PFD when working near water
6.9 Plastic sheeting
6.10 Sample coolers
6.11 Sampling gloves
6.12 Shovel with long handle (to reach sediments in deeper water)
6.13 Stainless steel dippers or trowels for sample collection
6.14 Stainless steel pans or bowls
6.15 Waders or rubber boots
6.16 Water quality monitoring instruments (*e.g.,* pH/temperature/specific conductance meter, dissolved oxygen meter, turbidity meter), as needed to achieve project DQOs

7.0 Procedures

7.1 If possible, conduct site reconnaissance to identify potential sampling locations. Investigate and probe for areas of adequate sediment accumulation, which are typically located in the quieter backwater or slack water areas in streams and rivers. In some areas of faster flowing water, “discrete” samples may have to be composited from several adjacent locations to obtain an adequate sample volume.

7.2 Set up a staging area on the water body bank or other dry area adjacent to each sample collection location. Place sample containers and equipment on plastic sheeting to avoid cross contamination.

7.3 If using pre-labeled containers, complete each label and seal with clear tape before sampling.

7.4 Use decontaminated or disposable equipment to collect each discrete or incremental sample.

7.5 Wear a pair of clean sampling gloves when collecting each discrete or incremental sample.

7.6 If surface water samples are also being collected for analysis at the same locations as sediment samples, collect the surface water samples first, then perform any required surface water field monitoring, and collect sediment samples last.

7.7 For the collection of discrete sediment samples:

7.7.1 For analytes other than volatile organic compounds (VOCs), collect sediment with a stainless-steel spoon, trowel, hand auger, or shovel and place it into a stainless-steel or disposable foil pan or bowl. (If sufficient fine-grained sediments (silt and clay) are not available at the selected location, then sediment samples may need to be collected from several adjacent locations to obtain adequate sample volume.) Slowly decant excess water from the pan or bowl. Remove large rocks, twigs, leaves, and other debris from the pan or bowl. Gently homogenize the sample with a stainless-steel spoon or trowel. Place the sample in an appropriate laboratory-supplied sample container(s) and preserve it as required (*i.e.,* in cooler with ice).

7.7.2 For VOC analysis, place sediment directly into the laboratory-supplied sample container and close the container. If additional sample volume is needed from adjacent location(s), reopen the container at each additional location, add additional sediment as necessary, and close the container. Preserve the sample as required (*i.e.,* in cooler with ice).

7.8 For collection of incremental samples, follow the procedures provided by FSOP 2.6.1, Multi-Incremental Sampling for Soils and Sediments.

7.9 After filling and labeling all sample containers, ensure that the chain-of-custody form has been properly completed and place each sample container in a sample cooler on ice for shipment or delivery to the laboratory.

7.10 Record all sample information on the attached Sediment Sample Collection Data Form (preferred). A field logbook or other field log sheet may also be used to record the pertinent sampling information if the attached field data form is not used (refer to FSOP 1.3, Field Documentation).

7.11 Decontaminate stainless-steel spoons, trowels, and shovels and any other sampling equipment used between samples in accordance with FSOP 1.6, Sampling Equipment Decontamination.

7.12 Dispose of investigation derived waste (IDW) in accordance with FSOP 1.7, Investigation Derived Wastes.

7.13 Follow all applicable criteria in FSOP 1.5, Sample Custody and Handling, when handling or shipping/transporting samples to the laboratory.

7.14 Mark the discrete sampling locations or incremental sampling decision unit areas clearly for global positioning system (GPS) surveying. If a sediment sample is being collected in conjunction with a corresponding surface water sample, mark the surface water location. If a discrete sediment sample is composited from several adjacent subset locations, mark the approximate center of the sample subset area.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation

9.0 Quality Assurance and Quality Control

Quality assurance/quality control (QA/QC) sample requirements are to be specified in the site-specific work plan. QA/QC samples may include duplicate samples, trip and equipment blanks and matrix spike/matrix duplicate samples depending upon the project DQOs. Sediment sampling events will include 1 duplicate sample per 10 sediment samples collected.

10.0 Attachments

None

11.0 References

FSOP 1.3, Field Documentation

FSOP 1.5, Sample Custody and Handling

FSOP 1.6, Sampling Equipment Decontamination

FSOP 1.7, Investigation Derived Wastes

FSOP 2.6.1, Multi-Incremental Sampling for Soils and Sediments

Ohio EPA, Division of Surface Water, Sediment Sampling Guide and Methodologies (3rd Edition), March 2012.

Ohio EPA, Office of Safety and Labor, Standard Operating Procedure (OEPA-SP-14-4), Confined Space Entry Policy. Revised 08.07.2020

Procedures for Active Soil Gas Sampling Using Direct-Push Systems
FSOP 2.4.1 (January 25, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Vapor intrusion is defined as vapor phase migration of volatile organic compounds (VOCs) into occupied buildings from underlying contaminated ground water and/or soil. Soil gas surveys provide information on the soil atmosphere in the vadose zone that can aid in assessing the presence, composition, source, and distribution of contaminants. The purpose of this document is to provide guidance for conducting soil gas sampling, and shall pertain to active soil gas surveys, whereby a volume of soil gas is pumped out of the vadose zone into a sample collection device for analysis.

1.2 Detection of individual constituents by active soil gas sampling is limited by the physical and chemical properties of individual contaminants of concern* and the soil characteristics of the site. In general, chemical parameters or criteria to be considered prior to selecting soil gas sampling activities are as follows:

- Vapor Pressure > 0.1 mm Hg
- Henry's Law Constant > 0.1
- Degree of soil saturation (chemical and/or water) < 80%
- Sampling zone is permeable and permits vapor migration

*Please refer to Sample Collection and Evaluation of Vapor Intrusion to Indoor Air (Ohio EPA DERR, March 2020).

1.3 Results from soil gas surveys are used in both qualitative and quantitative evaluations. The quality and application of the data is dependent upon many factors, including but not limited to: the DQO's used to develop the sampling plan, the number of sample locations and data points, the selection of the sample locations, the soil characteristics of the site, the distribution of the contaminants in both the vadose and saturated zones, the equipment and personnel used to gather the data, etc. The work plan should be finalized before any sampling is conducted. The work plan will provide specific information on the type and quality of data gathered during the soil gas sampling event. Any questions regarding data needs and usage should be resolved prior to sampling.

1.4 The evaluation of the indoor inhalation pathway at contaminated sites is a significant concern at sites/properties where contamination is known or expected to exist. As a result, procedures and technology related to evaluating the pathway continue to evolve.

NOTE: This procedure pertains to the active collection of soil gas using direct-push techniques (*i.e.,* driven probe rods/tooling). With respect to the use of other appropriate methods, procedures, and equipment for measuring concentrations of chemicals of concern in soil gas, please refer to the Vapor Intrusion Guidance: A Practical Guide (ITRC, January 2007). Please note that the ITRC web page includes a warning that this guidance has not been updated and as such it may include information that is out of date and which no longer may be applicable.

2.0 Definitions

Terms specific to soil gas sampling using direct-push systems are defined throughout this FSOP.

3.0 Health and Safety Considerations

3.1 Follow the site specific health and safety plan (HASP). If a site-specific HASP is not available, follow the health and safety procedures in FSOP 1.1, Initial Site Entry.

3.2 The use of direct push systems on a site within the vicinity of electrical power lines and other utilities requires that special precautions be taken by the operators. Underground electrical utilities are as dangerous as overhead electricity. Be aware and always suspect the existence of underground utilities (water, natural gas, cable and phone lines, fiber optic cables, storm water and sewer lines, etc.). Contacting the Ohio Utilities Protection Service (OUPS) and private utility location services will be necessary prior to initiating a field sampling plan. The LOE contractor (or in limited instances Ohio EPA) must contact OUPS prior to drilling with a direct-push drilling rig or if the LOE contractor is using another method.

REMEMBER Call 811:
Ohio Utilities Protection Service (OUPS): 800-362-2764

4.0 Procedure Cautions

4.1 A soil gas survey is only applicable to volatile contaminants. Geological barriers may exist that interfere with vapor migration such as perched water, clay or man-made structures. Interference from these geological barriers can lead to non-representative sampling with low or false negative readings or may produce localized areas of high concentrations. In addition, heavy precipitation, 24 to 48 hours prior to sampling can result in a significant reduction in volatile concentrations. Please refer to project specific DQO's for additional procedural cautions.

4.2 Soil gas implants should generally be installed to a minimum depth of 5 feet below ground surface to prevent short circuiting to the atmosphere unless there are extenuating circumstances (*e.g.,* collecting samples along shallow utilities).

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

Personal Protective Equipment (PPE):

6.1 Hearing protection
6.2 Safety glasses
6.3 Nitrile (or similar) disposable gloves
6.4 Steel-toed boots
6.4 Hard hat

Soil Gas Sampling:

6.7 1L Evacuated canisters (i.e., Summa®), with grab flow regulators
6.8 9/16" wrench
6.9 Tubing cutter
6.10 Polycarbonate 2- & 3-way valves
6.11 Silicon connector tubing
6.12 Disposable 60cc Syringe
6.13 Photoionization detector (FSOP 3.1.1, Photoionization Detector), ppb capable
6.14 Multi-gas meter (FSOP 3.1.2, Multiple Gas Detection Meters)
6.15 Field documentation equipment and supplies, including pens, markers, field logbook and Soil Gas Data Sheets, chain-of-custody forms, camera, etc.
6.16 Hand Auger
6.17 Miscellaneous tools

7.0 Procedures: Summary of Probe Installation Methods

7.1 Using the Post-Run Tubing System for Grab Sample Collection

[This section is for informational purposes only, for Ohio EPA staff and Level of Effort (LOE) contractors.]

This is a temporary, single use application for collecting a soil gas grab sample. Using the post-run tubing system (PRT), probe rods are driven to the desired depth, and then internal tubing, with PRT fitting attached, is inserted and seated for soil gas sampling. Using the inner tubing for soil gas collection has many advantages: potential for leakage is reduced, dead air volume that must be purged is reduced, and decontamination problems are reduced as the sample does not contact the rod bore.

7.1.1 Clean all parts prior to use. Inspect all probe rods and clear them of obstructions. Install O-ring on the PRT expendable point holder and the PRT adapter.

7.1.2 Test fit the adapter with the PRT fitting on the expendable point holder to assure that the threads are compatible and fit together smoothly. Ensure the threads are clean of debris.

NOTE: PRT fittings are left-hand threaded and must be rotated counter-clockwise to engage the point holder threads.

7.1.3 Push the PRT adapter into the end of the selected tubing. Tape may be used on the outside of the adapter and tubing to prevent the tubing from spinning freely around the adapter during connection - especially when using Teflon™ tubing.

NOTE: The sample will not come into contact with the outside of the tubing or adapter.

7.1.4 Attach the PRT expendable point holder (with O-ring) to the female end of the leading probe rod.

7.1.5 Attach an O-ring to an expendable soil vapor drive point and insert into the expendable point holder. Attach the drive cap to the male end of the drive rod and position rod under probe.

7.1.6 Drive the PRT rod configuration into the ground, connecting probe rods as necessary to reach the desired depth.

7.1.7 After desired depth has been achieved, disengage the expendable drive point. Using the inner extension rods, insert the expendable point popper to the bottom of the rod string and then slowly pull up on the probe rods using the rod grip pull system. Retract the rods approximately 4"- 6" up to create a void from which to sample the soil gas. Position the probe unit to allow room to work around the sample location.

7.1.8 Insert the PRT adapter end of the tubing down the inside diameter of the probe rods.

7.1.9 Feed the tubing down the rod bore until it hits bottom on the expendable point holder. Allow approximately 4-6 ft. of tubing to extend out of the hole before cutting it. Grasp the excess tubing end and lightly apply downward pressure while turning it in a counter-clockwise motion to engage the adapter threads with the expendable point holder. Continue turning until the PRT adapter O-ring bottoms out in the expendable point holder.

7.1.10 Pull up lightly on the tubing to test the engagement of the threads. Failure of the PRT adapter to thread could mean that intrusion of soil may have occurred during driving of the rods or disengagement of the expendable drive point. Once tubing has been connected, finish the surface end with a 2-way valve in the closed position.

7.1.11 Sampling at the location can commence following an equilibrium period (minimum of 15 minutes). Connect the sampling tubing and follow appropriate purging and sampling procedures. Refer to “Procedures for Collection of Indoor Air, FSOP 2.4.3” for reference for use of evacuated canisters for sample collection; and refer to Section 7.3.1 below, for sampling procedures using the bag sampler (e.g., Lung Box).

7.1.12 Prior to sample collection and screening, ensure that the implant is in a porous soil zone that will freely give up soil gas. Connect a 60-cc syringe to the implant tubing, open the 2-way tubing valve, and gently pull the plunger out to fill the syringe with gas. Let go of the plunger and observe whether it holds position where released, or if it can be observed moving back due to an induced vacuum. Should a vacuum be present, the soil zone at the end of the probe rods may be too tight to get a representative soil gas sample. Should this occur, the probe rods can be pulled up 1 to 2 feet at a time, retesting each interval until soil gas can be freely obtained. If not, abandon the location, seal the borehole with bentonite, and reposition the probe; or relocate to another position.

7.2 Installation of Soil Gas Implants

[This section is for informational purposes only, for Ohio EPA staff and Level of Effort (LOE) contractors.]

For long-term soil gas monitoring applications (multiple sampling events from the same location), a stainless steel, aluminum, polycarbonate or ceramic implant can be installed at any depth by direct push. Implants are inserted down inside the probe rods when the appropriate sampling depth has been achieved. When installing soil gas implants, knowledge of the local geology and soil types is paramount to the success of any soil gas survey. For sites where geology or soil characteristic information is not available, the collection of soil borings to target depth may be helpful in identifying zones or soil horizons in which to set soil gas implants.

7.2.1 Drive probe rods to the desired depth using the implant expendable point holder and an expendable drive point. Disengage the drive point using the point popper. Using the inner extension rods, insert the expendable point popper to the bottom of the rod string and then slowly pull up on the probe rods using the rod grip pull system. Retract the rods approximately 1”- 2” to push the expendable point out with the point popper. Remove all extension rods and point popper. Check end of last inner rod or point popper for evidence of moisture. Implants should not be installed in moist zones as these can inhibit vapor migration as well as, given enough time for water to accumulate, may result in water being drawn up and into sample containers (evacuated canister or Tedlar® bag).

7.2.2 Attach implant to one end of appropriate sample tubing (Teflon™, or nylon). Depending on implant type and diameter of sample tubing, a very short length of silicone tubing of appropriate size may be used to securely connect the implant to the sample tubing.

7.2.3 Lower the implant and tubing down the inside of the probe rods until the implant hits the top of the anchor/drive point. Note the length of the tubing to assure that proper depth has been reached. Cut the tubing flush with the top of the probe rod.

7.2.4 Using an inner extension rod, place one end of the rod on top of the fresh cut tubing. While holding the rod in place, slowly retract the rods, 4 feet at a time, and remove the drive rod. Continue this action of using the extension rod to hold the tubing in place until all the drive rods have been removed from the borehole.

7.2.5 Slowly pour sand (20/40 grade or #5) down the borehole around the outside of the tubing so that the sand extends several inches above the implant. Use the tubing to “stir” the sands into place around the implant. Do not lift up on the tubing. It should take less than 250 mL of sand to fill the space around the implant. The sand therefore will act as a grout barrier, inhibiting the grout from impacting the implant. Slowly pouring sand and bentonite will lessen the chance for the materials to bridge in the borehole.

NOTE: Implants come in various sizes and the drive rods can vary in diameter, so it is best to calculate the necessary volume of sand for each implant installation. Placement of the grout barrier by backfilling the borehole can only be performed in the vadose zone, not below the water table.

7.2.6 Once the sand is in place, slowly add the bentonite granules on top of the sand. After approximately 0.5 L of bentonite has been added, hydrate the bentonite in the hole. Hydration can be accomplished using a pump sprayer, or by using a section of tubing connected to the 60 cc syringe filled with water. Depending on borehole depth, the bentonite should be hydrated at a minimum of 3-5 intervals. Allow bentonite to come to ground surface, saturate the bentonite with water to create a bentonite “mud” and, using a finger, push this mix around the tube and back down the hole to enhance the closure. This results in a tight seal preventing gas migration down the column.

NOTE: Use caution not to over hydrate, as the water may flow out into the soil formation and travel down to the implant, causing it to become wet and potentially loose diffusivity

7.2.7 After sealing the borehole, cut the tubing to a manageable length (~12” - 18”), attach a 2-way valve connector (in the OFF position) or airtight (e.g., Swagelok®) plug, and mark the location with a pin flag or stake. Attach a label or tag to the tubing indicating the sample location identifier and depth at which the implant was set for future reference when sampling. Example: SG-3-18, meaning a soil gas point at location #3 with an implant set at 18 feet bgs.

7.2.8 Check the viability of the sample point just installed following the procedures outlined in section 7.1.12 using a 60-cc syringe. A multi-gas meter with a PID is also a very good way to purge and check the sample point’s viability and usefulness. Stable field screening measurements for VOC’s, oxygen, and hydrogen sulfide can be good indicators on a well-sealed and sampling-ready implant. Should the meter’s pump motor labor, or if the syringe plunger recedes back into syringe after pulling, a vacuum has been induced and the point is not viable for sample collection. The induced vacuum would be too much to overcome to obtain a gas sample using either an evacuated canister or a bag sampler.

7.2.9 A minimum equilibrium time should be established prior to sampling the implant (preferably stated in the work plan). While a 24-hour equilibrium period will ensure adequate equilibration, four to eight hours is generally sufficient. After equilibration, the implant is ready for sampling. Refer to Section 7.3 for sampling procedures using a vacuum canister (*e.g.,* Summa® or Silco).

7.2.10 To provide long term security to the sampling port, the installation of a flush mount or above ground protective casing with a cap can be installed and finished with a concrete pad. For temporary, short-term finishing of a sampling port, 4-6" (ID) PVC pipe sections with associated caps can be installed.

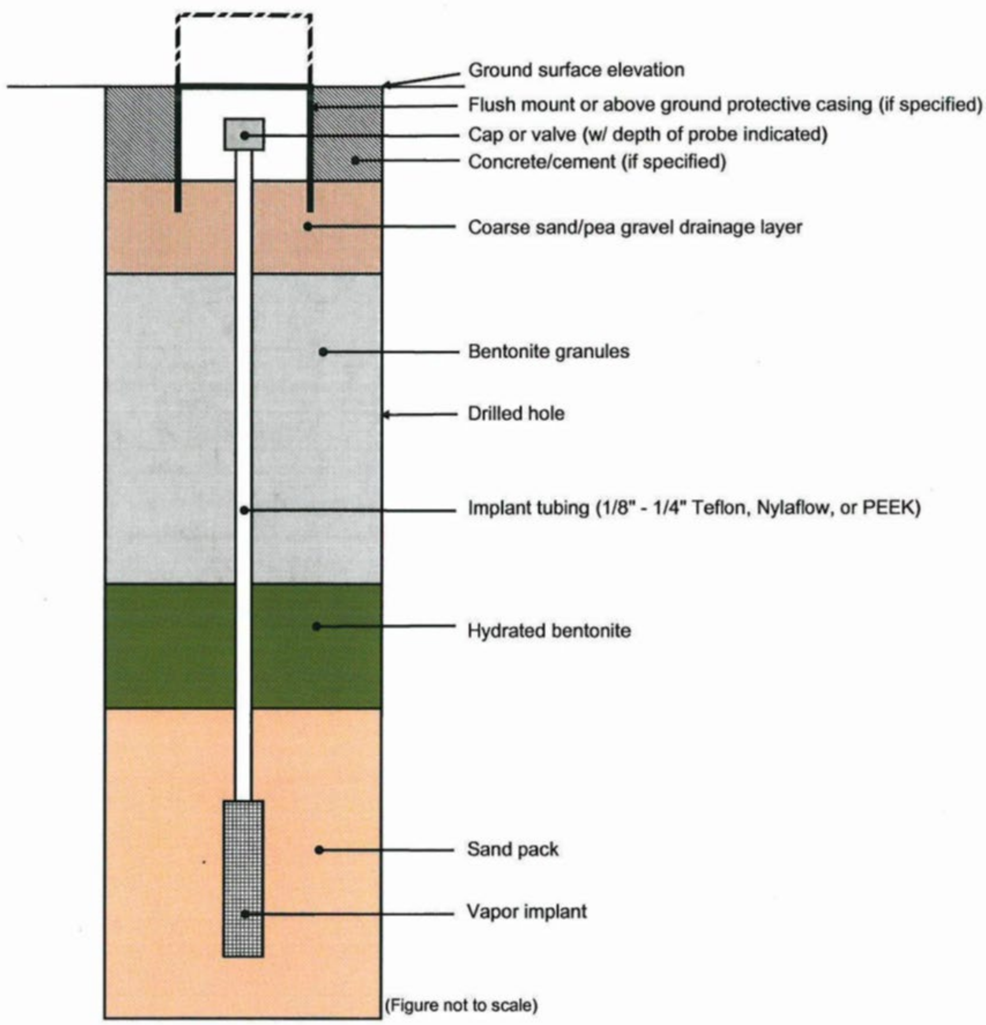


Figure 3: Permanent Soil Gas Probe Schematic

7.3 Sample Collection Methods

Three common methods of sample collection for vapor intrusion contaminants of concern (COCs) are discussed in this FSOP: 1) the lung box sampler uses Tedlar® bags as sample containers; 2) collection of samples on adsorbents is performed by using a small external pump to pull air through adsorbent media cartridges and/or tubes; and 3) collection of samples directly to stainless-steel evacuated canisters (*e.g.,* Summa®). Data Quality Objectives (DQOs) for the project will determine which sample collection method to use. Field data should be recorded on the Soil Gas Sampling Data Sheet (attached) or in a field notebook.

7.3.1 The Lung Box Sampler (Bag Samplers)

The Lung Box allows direct filling of a Tedlar® air sample bag using negative pressure without passing gas through the pump. This eliminates the risk of contaminating the pump or the sample. The Lung Box, pictured below, includes an in-line pump. Other types of bag samplers may require the use of a separate air pump or hand pump.

The recommended holding time for samples collected into Tedlar® bags is 24 to 48 hours. Therefore, soil gas samples collected in Tedlar® bags should be analyzed as quickly as practical or samples can be transferred to another container with longer holding times (i.e., Summa canister). If this method of sampling is performed, ensure that the laboratory can accept Tedlar® bags, and can meet the holding time requirements.

Semi-permanent soil gas probe location with multi-depth implants. The lung box sampler is used to collect soil gas samples using 1-liter Tedlar® bags. Note that each tube is labeled with the sampling depth; the PVC pipe is used to protect the soil gas tubing.

7.3.1.1 Prior to sampling, and after an appropriate equilibrium period (typically 8 – 24 hrs. depending on DQOs), ambient air needs to be removed from the sample train by purging. Purging of the filter pack is required if sampling occurs within 24 hours of installation. At least three volumes should be removed. For example, the sample tubing can be purged using a 60 cc syringe with an attached 3-way valve (~4 cc/ft for ¼" ID tubing/volume). Other methods may be used as long as a minimum of 3 volumes are purged from the tubing. Once purging is complete, the sample may be collected. Field screening may be performed using a direct reading instrument after sample collection.

7.3.1.2 Install new tubing in the bag sampler before collecting each sample. Place a new Tedlar® sample bag (already labeled) inside the bag sampler. Attach the inside portion of the tubing to the inlet valve on the sample bag. Open the sample valve on the sample bag following the manufacturer's instructions. Close sampler lid and secure. (DO NOT use any type of permanent marker, i.e., "*Sharpie"* pens)

7.3.1.3 Attach external part of the inlet tubing to the sample tubing. Make sure that the purge valve on the side of the box is closed (closed for fastest fill rate, open for slower fill rate).

7.3.1.4 Turn on the sample pump or initiate hand pumping. While filling, watch through the observation window of the Bag sampler as the Tedlar® bag fills with gas. Avoid filling bag more than 80% of its maximum volume. Turn the pump off when the bag has filled to the desired volume. Do not over fill sample bags. The vacuum pump may be strong enough to break a sample bag.

NOTE: Be sure to watch the sample line for the first sign of water coming up the line. Pulling water up the line is not uncommon, especially in cases where the position of the water table is unknown. This is a good reason why ample lengths of tubing should be used for the sample line. If water is drawn up the tubing, the tubing can be cut before the water reaches the sampling equipment.

NOTE: Exercise extreme caution if filling sample bags with explosive gases.

7.3.1.5 Once filling of the sample bag is complete, turn off the pump, open the purge valve to equalize the pressures, unlatch the bag sampler lid and open. Close the sample bag inlet valve by holding the side stem and turning the entire upper portion of the fitting clockwise until snug. Remove the filled sample bag from the internal inlet tubing.

NOTE: In an effort avoid any photochemical reactions, keep filled Tedlar® bags out of sunlight. Store and ship bag samples in a protective box at room temperature. Do not chill to avoid condensation.

7.3.1.6 If measurements with a portable meter are to be made (*e.g.,* oxygen), conduct measurements after collecting the soil gas sample(s).

7.3.2 Collection of Samples on Adsorbents

7.3.2.1 An alternative approach to collecting soil gas in a sample container is to concentrate the soil gas on an adsorbent media. This type of method is required for SVOCs and is often used for mercury (generally compounds heavier than naphthalene). Typically, a pump is used to draw soil gas through the adsorbent matrix, and the adsorbent is then analyzed by a laboratory.

7.3.2.2 A variety of adsorbent cartridges and pumping systems are available from commercial vendors. In addition, it is essential that the soil gas be drawn through the adsorbent by the pump, not pumped through the adsorbent to eliminate the chance for cross-contamination by the pump. It is often recommended that two tubes be used in series to avoid breakthrough losses in areas of suspected higher concentrations. The adsorbent, purge rate, and sample volume must be determined by discussion with the analytical laboratory.

7.3.3 Collection of Samples Directly to Evacuated Canisters

7.3.3.1 "Summa® Canister", a generalized trademark that refers to electropolished, passivated stainless steel vacuum sampling devices (*e.g.,* evacuated canisters). Sizes of canisters will vary with the most commonly used sizes being 6L and 1L. Canister size will depend on the predetermined time frame for sampling (*e.g.,* 24-hour v. "grab" sampling). A "Silco" canister is another name for a summa canister.

The Summa® Canister (canister) allows direct filling of soil gas into a 1-liter (or 6-liter) laboratory-supplied evacuated canister. This style of soil gas sample collection is the preferred method. Soil gas samples collected by this method are typically "grab" samples and use a supplied regulator to achieve a flow rate of approximately 200 to 250 ml/min. Sample collection time will be approximately 7 to 10 minutes to fill the 1L canister.

7.3.3.2 Prior to sampling, and after an appropriate equilibrium period (typically 15 – 30 min. depending on DQOs), ambient air needs to be removed from the sample train by purging. Purging of the tubing and filter pack is required if sampling occurs within 24 hours of installation. At least three volumes should be removed.

For example, the sample tubing can be purged using a 60-cc syringe with an attached 3-way valve (~4 cc/ft for ¼" ID tubing/volume). Other methods may be used as long as a minimum of 3 volumes are purged from the tubing. Once purging is complete, the sample may be collected. Field screening may be performed using a direct reading instrument (ppb multi-RAE) after sample collection.

7.3.3.3 Attaching/removing the flow regulator. The flow regulator/quick-connect regulator must be correctly connected to the sample canister to eliminate the potential for leaks.

- Remove the brass plug from the canister and connect the flow regulator to the canister.
- Gently tighten the connection between the flow regulator and the canister using the open-end 9/16" wrenches. Do not over-tighten this connection. Before continuing, record the canister number and the associated flow regulator number on the "Vapor Sampling Data Sheet". The canister number can be used for sample identification on the COC form.
- Attach the canister to the sample line with a slightly larger piece of silicon tubing (one that can snugly fit around the tip of the flow regulator). Open the canister/regulator valve. Record the sample start time and the canister pressure. Once the sample collection is completed, close the valve on the regulator or disconnect the quick-connect regulator from the canister. This stops the collection of any additional vapor into the canister.
- Remove the flow regulator from the canister using the 9/16" open-end wrenches. Re-install the brass plug on the canister fitting and tighten with an open-ended wrench.
- Package the canister and the flow regulator into the shipping container provided by the lab. **Note**: the canister does not require preservation.
- Complete the Soil Gas Sampling Data Sheet, and other appropriate forms and sample labels as directed by the laboratory. Use the sample start time when completing the laboratory chain of custody and double check canister identification numbers for accuracy.
- Ship the canisters to the laboratory for analysis.

7.4 Soil Gas Sample Field Screening

7.4.1 Following sample collection, field-screen the borehole or soil gas probe atmosphere with a PID in accordance with FSOP 3.1.1, Photoionization Detector, to estimate the bulk concentration of VOCs present in the soil gas sample. The PID field screening data should be recorded with the sample information on the soil gas sampling data sheet (see attached). The analytical laboratory needs to be aware of any samples potentially containing high concentrations of VOCs that may need to be diluted prior to analysis.

7.4.2 If desired, to perform the field-screening, attach an appropriate length of tubing to the PID sampling tip with a small piece of silicon tubing and extend it at least halfway into the boring or attach PID directly to tubing on a soil gas probe to obtain readings.

7.4.3 The PID field screening data may also be collected for sampler health and safety concerns or to use as real-time screening information to help evaluate the need for additional sampling or other site assessment activities while in the field.

7.4.4 In addition to a PID, a multi-gas meter (FSOP 3.1.2, Multiple Gas Detection Meters) may be used to field screen the borehole or soil gas probe atmosphere to collect gas concentration field screening data. This information may be provided to the analytical laboratory, used to monitor health and safety concerns, or used as real-time screening information to help evaluate the need for additional sampling or other site assessment activities while in the field. Parameters often include VOCs (ppb), Oxygen (% O_2), Lower Explosive Level (% LEL), Carbon monoxide (ppm CO), and Hydrogen sulfide (ppm H_2S)

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation

Soil Gas Sampling Data Sheet

9.0 Quality Assurance and Quality Control

Refer to the data quality objectives (DQOs) provided in the work plan.

10.0 Attachments

Soil Gas Sampling Data Sheet

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 3.1.1, Photoionization Detector

FSOP 3.1.2, Multiple Gas Detection Meters

Interstate Technology & Regulatory Council (ITRC) Vapor Intrusion Team, January 2007, Vapor Intrusion Pathway: A Practical Guideline

SOIL GAS SAMPLING DATA SHEET

GENERAL INFORMATION

Site Name:____________________________________	**Sampling Address:**_____________________________ *(if other than site address)*
Site Address:_________________________________	**Grab Sample:**________ **Canister Sample:**_________
City:____	**Sample ID #:** __________________________________
County/District_______________________________	**If canister used, complete info below:**
Contact Name:_________________________________	**Canister ID #:**_________________________________
Phone #:______________________________________	**Regulator ID #:**________________________________

SAMPLING INFORMATION

(mm/dd/yy) *(military)*	**Canister Info:**	**Field Screening Info:**
Soil Gas port installed: Date:_______Time:_______ **Depth :_______**	**Initial canister vacuum:** ______ **"Hg or mm Hg**	**PID (ppm):__________**
If canister used for sample collection, complete following info:	**Final canister vacuum:** _______**"Hg or mm Hg**	**% O_2 :_______________**
Sample Collection Start: Date:_______Time:_______	**Temperature:** __________ **°F**	**CH_4 (%LEL):_________**
Sample Collection End: Date:________ Time:_______		**CO_2:________________**
Regulator Calibrated for:		**CO:_________________**
_____ **8-hr** _____ **12-hr** _____ **24-hr** _____ **grab (no regulator)**		**H_2S:________________**
Laboratory & Analytical Method: _________________		**List instrument (and ID#) used to collect parameters:** ______________________
Sample Delivered: Date_________ **Time:**__________		
Method of Delivery: _____________________________ *(ex. Lab courier, UPS, delivered by sampler, etc.)*		

NOTES: (include any information on the installation of the soil gas port, or problems with sampling/canister etc.)

Signature of Sampler: ____ **Date:**________________

Note: If a diagram of the sample location(s) is sketched on the back of this data sheet, check here ☐

Installation, Sampling and Decommissioning of Sub-Slab Vapor Ports
FSOP 2.4.2 (January 28, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

Sub-slab vapor ports are used to sample the vapor contained in the interstitial spaces beneath the floor slab of dwellings and other structures for volatile organic compounds (VOCs) and other volatile chemicals. Sub-Slab vapor ports may be constructed using a custom fit stainless steel implant with Swagelok® fittings or a custom pre-manufactured Vapor Pin™ (see Section 9.0 Cox-Colvin Standard Operating Procedure, Installation and Extraction of the Vapor Pin™).

2.0 Definitions

Summa® Canister: Genericized trademark that refers to electro-polished, passivated stainless steel vacuum sampling devices (*i.e.,* evacuated canister). Sizes of canisters will vary with the most commonly used sizes being 6L and 1L. Canister size will depend on the pre-determined time frame for sampling (*e.g.*, 24-hour vs. "grab"). A "Silco" canister is another name for a summa canister.

3.0 Health and Safety Considerations

3.1 This activity involves accessing private residences and spaces in commercial buildings. Follow Ohio EPA Standard Safety Operating Procedure Number SP11-19 (Working Alone) to determine if working alone is appropriate given the site conditions and circumstances.

3.2 Never enter an OSHA-defined confined space for any reason. Only Ohio EPA Office of Special Investigation (OSI) staff or other appropriately trained staff are qualified to enter confined spaces for reconnaissance or sampling activities and will perform such work as necessary in accordance with Ohio EPA Standard Safety Operating Procedure Number SP14-4 (Confined Space Entry).

3.3 Follow the site-specific health and safety plan (HASP), which should identify the potential presence of asbestos-containing materials and other building-specific health and safety concerns. If a site-specific HASP is not available, follow the health and safety procedures in FSOP 1.1, Initial Site Entry.

3.4 This activity may result in the creation of silica dust when drilling through concrete. To prevent exposure to silica, a HEPA vacuum with an associated dust containment system must be used when drilling through concrete. Staff must be trained in the proper use of the silica dust collection equipment before installing sub-slab vapor probes.

3.5 When using electricity, be cautious of wet areas or areas with standing water, (*e.g.,* wet basement floors, sump pumps, etc.).

3.6 Be aware of potential vermin (fleas, rats, etc.)

3.7 Hearing protection should be worn while using a hammer drill.

3.8 A dust mask is to be worn in addition to using the HEPA vacuum during drilling.

3.9 Use a photoionization detector (PID) to evaluate VOC concentrations during vapor port installation in accordance with FSOP 3.1.1, Photoionization Detector.

3.10 Review available plans or documents before selecting sampling locations. Ensure that all sub-slab utilities (public and private or building specific) have been located and marked prior to installation. Contact the Ohio Utilities Protection Service (OUPS) at 811 or (800) 362-2764 to mark locations of public utilities leading to the building. For commercial buildings, it is recommended that a utility locating service be contacted to scan for and mark indoor utilities.

3.11 Do not attempt to drill through steel-reinforcement (*e.g.,* rebar) within a concrete slab without first contacting a private utility locating service.

4.0 Procedure Cautions

4.1 Review the site-specific work plan (SSWP), which should include a description of the building's size and use. In certain emergency circumstances a SSWP may not be available, and all necessary information for sub-slab vapor port installation and sampling will need to be obtained during the pre-sampling visit as described below. If a pre-sampling meeting cannot be held due to time constraints, please collect as much of the information as possible as listed below. This information can be obtained during a telephone call or in person.

4.2 A pre-sampling site visit should be conducted to meet with the building's owner and/or tenant and inspect the proposed vapor port sampling locations. During the pre-sampling visit, discuss sample location access and associated logistical concerns, including, but not limited to, lighting and electrical power, the need to temporarily move furnishings, the need to remove floor coverings (e.g., carpet or tile), the location of floor drains and/or other sub-slab utilities, and whether or not the sampling areas are occupied or unoccupied spaces.

4.3 The thickness of concrete slabs varies from structure to structure. A single structure may also have a slab with variable thickness. Drill bits of various sizes and cutting ability may be required to penetrate slabs of variable thicknesses. If a slab contains steel reinforcement (*e.g.,* rebar), a sub-slab vapor port can only be installed if SIFU can find a location where steel reinforcement can be located or is not present. SIFU cannot drill through the steel reinforcement within a concrete slab.

4.4 There is a potential for high concentrations of VOC vapors to exist under the slab. Perform work quickly to ensure minimal exposure to VOCs.

4.5 When installing sub-slab vapor ports in commercial or industrial buildings, there is the potential to encounter sub-slab utility conduits (*e.g.,* floor drains or electric, gas or water lines). Follow the procedures provided in section 7.1 for sub-slab utility clearance before installing vapor ports.

4.6 Unless approved by Ohio EPA management and the building owner, sub-slab vapor ports should never be installed in the floor of a building with an existing sub-slab vapor barrier that is a component of a vapor mitigation system because vapor port installation could penetrate the barrier. However, sub-slab vapor ports may be installed through sub-slab moisture barriers that are typically not components of vapor mitigation systems, providing that the vapor port is decommissioned in accordance with section 7.7 when it is no longer needed for sampling purposes.

4.7 When using the drill and HEPA vacuum, you will collectively exceed 15 amps which is the standard for most household outlets. Therefore, be prepared to connect the drill and the HEPA vacuum to separate outlets (*i.e.,* different circuits).

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard. Prior knowledge, training and experience with this sampling technique is strongly recommended before collecting samples.

6.0 Equipment and Supplies

General

6.1 Hammer drill or rotary hammer drill
6.2 Alternating current (AC) extension cord
6.3 AC generator, if AC power is not available on site
6.4 Hammer or rotary hammer drill bit, ⅜" diameter
6.5 Hammer or rotary hammer drill bit, 1" diameter
6.6 1 – ¾" open end wrench or 1 – medium adjustable wrench
6.7 2 – $^{9}/_{16}$" open end wrench or 2 – small adjustable wrenches
6.8 Disposable cups, 5 ounces (oz.)
6.9 Disposable mixing implement (*e.g.,* tongue depressor, etc.)
6.10 Vapor Sampling Data Sheet, Sub-Slab and Indoor Air (attached) or logbook
6.11 Pens and markers
6.12 Flashlight or equivalent head lamp
6.13 Utility knife
6.14 Disposable syringe (60 cc)
6.15 PPE appropriate for site-specific work activities (*i.e.,* mask, etc.)
6.16 Disposable mixing implement (*e.g.,* tongue depressor, etc.)
6.17 Tap water, for mixing anchoring cement/grout
6.18 Hand broom and dust pan
6.19 Small bottle brush to remove loose debris clean side walls of borehole
6.20 Portable HEPA vacuum
6.21 Dust collector
6.22 Traffic cones (to place over locations in high-traffic floor areas)

Swagelok® Equipment and Supplies

6.23 Hex head wrench, ¼”
6.24 Tubing cutter and pipe cutter
6.25 Swagelok® SS-400-7-4 female connector, ¼” national pipe thread (NPT) to ¼” Swagelok® connector
6.26 Swagelok® SS-400-1-4 male connector, ¼” NPT to ¼” Swagelok® connector
6.27 Hose barb adapter, brass, 3/16” barb x ¼” male iron pipe (MIP)
6.28 ¼” NPT flush mount hex socket plug
6.29 ¼” outer diameter (OD) stainless steel tubing, pre-cleaned, instrument grade
6.30 ¼” OD Teflon™ or nylon tubing
6.31 Teflon™ or nylon washer ID ¼”, OD ¾”
6.32 ¼” OD stainless welded tubing, 12” to 24” length
6.33 Swagelok® tee, optional (SS-400-3-4TMT or SS-400-3-4TTM)
6.34 Appropriate size tubing

Vapor Pin™ Equipment and Supplies

6.35 Cox-Colvin Vapor Pin™ Kit
6.35 Dead blow hammer
6.36 Appropriate silicon tubing
6.37 Vapor Pin™ protective cap to prevent vapor loss prior to sampling
6.38 Standard Operating Procedure Installation and Extraction of the Vapor Pin™ http://vaporpin.coxcolvin.com/wp-content/uploads/2015/02/Vapor-Pin-SOP-02-27-15-Web.pdf

7.0 Procedures

7.1 Review the SSWP, which should include a description of the building’s size and use. In certain emergency circumstances a SSWP may not be available, and all necessary information for sub-slab vapor port installation and sampling will need to be obtained during the pre-sampling visit as described below. If a pre-sampling visit is not feasible, call the owner and/or tenant prior to sampling to obtain the information.

7.2 A pre-sampling site visit should be conducted to meet with the building’s owner and/or tenant and inspect the proposed vapor port sampling locations. During the pre-sampling visit, discuss sample location access and associated logistical concerns, including but not limited to lighting and electrical power, the need to temporarily move furnishings, the need to remove floor coverings (*e.g.,* carpet or tile), the location of floor drains and/or other sub-slab utilities and whether or not the sampling areas are occupied or unoccupied spaces.

7.3 Before installing sub-slab vapor ports in a commercial or industrial building, use the following procedures for sub-slab utility clearance:

7.3.1 Perform a visual inspection of the area(s) of the building where vapor ports are to be located for potential sub-slab utility lines.

7.3.2 Discuss the presence and location(s) of sub-slab utility lines with the building owner and/or operator and review any available building construction plans that may show the location of sub-slab utility lines.

7.3.3 If the presence or location(s) of sub-slab utility lines cannot be verified following the procedures in sections 7. 1 and 7. 2, contract a private utility locating company to locate potential sub-slab utility lines before installing vapor ports.

7.4 Preparation and Drilling of the Vapor Port

7.4.1 Connect the dust collector to the HEPA vacuum. Ensure that all connections are tight.

7.4.2 Plug the HEPA vacuum into the outlet and place the dust collector on the floor. Turn on the HEPA vacuum and ensure that the dust collector has created a tight seal with the floor. If a tight seal is not present, turn off the vacuum and check to ensure that all of the connections between the vacuum and the dust collector are tight. If the connections are tight, check the filter. It may be full, and need replaced. Also make sure the rubber gasket on the dust collector is in good condition. Finally, reposition the dust collector to a smoother floor surface. Retest the seal between the dust collector and the floor.

7.4.3 After ensuring that there is a good seal between the floor and the dust collector, set-up the drill and make sure the dust collector is positioned over the location selected for the vapor port. Turn on the vacuum and then the drill.

7.5 Swagelok® Probe Assembly and Installation for Multiple Sampling Events

7.5.1 Drill a ⅜” diameter pilot hole to a depth of approximately 2” (Figure 1).

7.5.2 Using the ⅜” pilot hole as your center, drill a 1” diameter outer hole to a depth of approximately 1 ⅜” (Figure 1). Vacuum cuttings out of the hole.

Figure 1: Assembled sub-slab port ready for installation

7.5.3 Continue drilling the ⅜" inner or pilot hole through the slab and a few inches into the sub-slab material.

7.5.4 Determine the length of stainless-steel tubing required to reach from the bottom of the outer hole, through the slab and into the open cavity below the slab. To avoid obstruction of the probe tube, ensure that it does not contact the sub-slab material. Using a tube cutter, cut the tubing to the desired length.

7.5.5 Attach a measured length (typically 3"-4") of ¼" OD stainless tubing to the female connector (SS-400-7-4) with the Swagelok® nut. Make sure that the tubing rests firmly in the fitting body and that the nut is finger tight. While holding the fitting body firmly, tighten the nut 1¼ turns.

7.5.6 Insert the ¼" hex socket plug into the female connector. If using a stainless-steel socket plug, wrap one layer of Teflon™ thread tape around the threads to prevent binding. If using a brass socket plug, Teflon™ tape is not needed. Tighten the plug slightly. Do not over tighten. If excessive force is required to remove the plug during the sample set up phase, the probe may break loose from the anchoring cement.

7.5.7 Place the completed probe into the outer hole to check fit and to ensure that stainless steel tubing is not in contact with the sub-slab material. Make necessary adjustments to the hole or probe assembly.

7.5.8 In a disposable cup or other container, mix a small amount of the anchoring cement or grout. Add water sparingly to create a mixture that is fairly stiff and moldable. Place a spoonful or two of the cement/grout around the stainless-steel tubing adjacent to the female connector nut. Mold the cement/grout into a mass around the connector nut and up around the main body of the probe assembly. Slide the Teflon™ washer onto the stainless-steel tube so that it rests next to the cement/grout mixture. The washer will prevent any anchoring cement/grout from flowing into the inner hole during the final step of probe installation.

7.5.9 Carefully place the probe assembly into the drilled hole, applying light pressure to seat the assembly. While inserting the probe assembly, work the concrete/grout mixture to fill voids. Clean up cement/grout that discharged out of the hole during placement; avoid getting any of the concrete/grout into fittings or on fitting threads. Allow the cement/grout to cure according to manufacturer's instructions before sampling (typically 24 hours). This elapsed time also allows for subsurface conditions to equilibrate prior to sampling.

7.6 Swagelok® Sample Set-Up and Collection

7.6.1 Conduct a leak test prior to sampling. Follow project-specific DQO's and/or the SSWP to determine which of the following method(s) are appropriate:

7.6.1.1 The water dam that is included in the Cox-Colvin Vapor Pin™ kit is a simple means of determining if there are any leaks (see Cox-Colvin instructions, Figure 6). To use the water dam, simply attach the water dam to the floor using putty ensuring that there are no holes between the putty and the floor. Then add water to the dam and observe whether there are any air bubbles. If there are no air bubbles, the seal is tight. If there are air bubbles, refer to Section 7.7.

7.6.1.2 Another option is to evaluate the oxygen concentration by attaching an oxygen sensor (Multi-RAE Pro meter) to the vapor pin. If the percent oxygen drops, it can be inferred that there is a tight seal. However, since this method draws in sub-slab vapor, a longer waiting period may be required before collecting the sample to allow for the sub-slab air to re-equilibrate.

7.6.1.3 A tracer gas can be used during sample collection to evaluate whether the connections between the vapor pin and the sample container have any leaks. A tracer gas is very lightly sprayed on a paper towel and the paper towel is briefly laid around the fittings. As an alternative, the tracer gas can be lightly sprayed into the atmosphere near the sample train. Do NOT spray directly on the fittings. **Note**: you will not know if there were any leaks until after the sample has been analyzed. The recommended tracer gas is 1,1-Difluoroethane, which is present in some brands of dust cleaner for electronics.

7.6.2 Wrap one layer of Teflon™ thread tape onto the NPT end of the male connector OR wrap one layer of Teflon™ tape onto the threaded end of the hose barb adapter (3/16" barb x ¼" MIP).

7.6.3 Carefully remove the ¼” hex socket plug from the female connector. Refer to Section 7.7 if the probe breaks loose from the anchoring cement/grout during this step.

7.6.4 To ensure that the sub-slab port has not been blocked by the collapse of the inner hole below the end of the stainless-steel tubing, a stainless-steel rod, ⅛” diameter, may be passed through the female connector and the stainless-steel tubing. The rod should pass freely to a depth greater than the length of the stainless-steel tubing, indicating an open space or loosely packed soil below the end of the stainless-steel tubing. Either condition should allow a soil gas sample to be collected. If the port appears blocked, the stainless-steel rod may be used as a ramrod to open the port. If the port cannot be cleared, the probe should be reinstalled, or a new probe installed in an alternate location.

7.6.5 Screw and tighten the Teflon™ taped male connector into the female connector, <u>or</u> screw and tighten the hose barb adapter (3/16” barb x ¼” MIP) into the female connector. Do not over tighten. This may cause the probe assembly to break loose from the anchoring cement/grout during this step or when the male connector/hose barb adapter is removed upon completion of the sampling event. Refer to Section 7.7 if the probe breaks loose from the anchoring compound during this step.

7.6.6 If a co-located sub-slab sample or split sample is desired, a stainless-steel Swagelok® T, may be used in place of the male connector.

7.6.7 Using a short piece of silicon tubing, attach a length of ¼” tubing (Teflon™ or nylon) to the sampling container (*e.g.,* SUMMA® canister) or system (*e.g.,* lung box for Tedlar® bag) to be used for sample collection. Connect the other end of the tubing to the male connector with a Swagelok® nut or connect directly to the barbed hose adapter.

7.6.8 Refer to site specific work plan for canister size and type of sample required (*e.g.,* 6-liter canister with regulator for either 8-hour or 24-hour sample collection or a 1-liter evacuated canister for a grab sample). After sampling, use a PID to measure the VOC concentrations to provide the laboratory with an indication of how concentrated the VOCs may be in the sample. Provide this information to the laboratory. **Note**: PID readings are not contaminant-specific quantifications. Do not assume that the PID reading equates (or approximates) the concentration of the contaminant of concern.

7.6.9 After sample collection, remove the male connector or barbed hose adapter from the probe assembly and reinstall the ¼” hex socket plug. Make sure the plug threads are wrapped with Teflon tape. Do not over tighten the hex socket plug. If excessive force is required to remove the plug during the next sampling event, the probe may break loose from the anchoring compound. Refer to Section 7.7 if the probe breaks loose from the anchoring compound during this step.

7.7 Repairing a Loose Swagelok® Probe Assembly

7.7.1 If the probe assembly breaks loose from the anchoring compound while removing or installing the hex socket plug, the Swagelok® male connector, or the barbed hose adapter, lift the probe assembly slightly above the surface of the concrete slab.

7.7.2 Hold the female connector with the ¾" open-ended wrench.

7.7.3 Complete the step being taken during which the probe broke loose, following the instructions contained in this FSOP (*i.e.,* do not over tighten the hex socket plug, the male connector, or the barbed hose adapter).

7.7.4 Push the probe assembly back down into place and reapply the anchoring cement/grout.

Figure 2: Swagelok® port connected to canister and ready for sampling

7.8 Vapor Pin™ Probe Installation

7.8.1 Refer to attached Cox-Colvin Vapor Pin™ Standard Operating Procedure for proper vapor pin installation and removal.

7.8.2 After installing a Vapor Pin™ place the small rubber cap over the barbed inlet to prevent and gas from escaping.

7.8.3 Conduct a leak test. The project specific DQO's or SSWP may dictate which of the following method(s) may be followed. **Note**: There are other techniques beyond those listed that may be used.

7.8.3.1 The water dam that is included in the Cox-Colvin Vapor Pin™ kit is a simple means of determining if there are any leaks (see Cox-Colvin instructions, Fig 6). To use the water dam, attach the water dam to the floor using putty ensuring that there are no holes between the putty and the floor. Then add water to the dam and observe whether there are any air bubbles. If there are no bubbles, the seal is tight. If there are air bubbles, remove the water and reset the vapor point. Test with the water dam again to see if the seal is now tight. Remove the water and dam once test is complete.

7.8.3.2 Another option is to attach an oxygen sensor (Multi-RAE Pro meter) to the vapor pin and evaluate the oxygen concentration. If the percent oxygen drops, it can be inferred that there is a tight seal. However, since this method draws in sub-slab vapor, a longer waiting period may be required before collecting the sample to allow for the sub-slab air to re-equilibrate.

7.8.3.3 A tracer gas can be used during sample collection to evaluate whether the connections between the vapor pin and the sample container have any leaks. A tracer gas is very lightly sprayed on a paper towel and the paper towel is briefly laid around the fittings. As an alternative, the tracer gas can be lightly sprayed into the atmosphere near the sample train. Do NOT spray directly on the fittings. **Note**: you will not know if there were any leaks until after the sample has been analyzed. The recommended tracer gas is 1,1-Difluoroethane, which is present in some brands of dust cleaner for electronics.

7.8.3.4 Allow a minimum of 2 hours for the sub-slab soil gas conditions to re-equilibrate prior to sample collection unless site-specific work plan requires a different equilibration time. Place traffic cone over non-recessed pins in high floor traffic areas until pin can be removed.

Figure 3: Vapor Pin™ installed and ready for sampling

7.9 Vapor Pin™ Sample Collection

7.9.1 Remove the rubber cap and attach a piece of ¼" tubing (Teflon™ or nylon) to the barbed hose adapter. The tubing must be long enough to span from the sample port to the sample container (*e.g.,* SUMMA® canister) or system (*e.g.,* lung box for Tedlar® bag).

7.9.2 Refer to site specific work plan for canister size and type of sample required (*e.g.,* 6-liter canister with regulator for either 8-hour or 24-hour sample collection or a 1-liter evacuated canister for a grab sample). After sampling, use a PID to measure the VOC concentrations to provide the laboratory with an indication of how concentrated the VOCs may be in the sample. Provide this information to the laboratory. **Note:** this number is not contaminant specific. Do not assume that your contaminant of concern equates to the reading from the PID.

7.10 Vapor Port Decommissioning

Remove the vapor pin according to the attached Cox-Colvin Vapor Pin™ Standard Operating Procedure for proper vapor pin installation and removal.

7.10.1 Prior to filling the vapor port hole, measure the slab thickness. One method is to use a "hole hook", a section of rigid wire (such as a stiff-wire coat hanger) with a small (0.25-inch) 90-degree crimp at one end. Insert the hole hook inside the drilled hole and catch the hooked end on the underside of the concrete slab. Mark the wire where it meets the top of the slab, remove the hole hook, and measure the distance between the hooked end and marked end of the wire to determine the slab thickness. Record the measured slab thickness on the log sheet or in a field notebook. This information is necessary if a sub-slab treatment system is ever installed.

7.10.2 Gently pour dry granular bentonite into the hole to fill any void space in the gravel or soil below the underside of the slab that may have been created during the drilling of the slab or installation of the vapor port. Continue adding bentonite until the level is approximately one inch below the top of the slab.

7.10.3 Slowly add a small amount of water to hydrate the bentonite without creating a column of standing water in the hole. Use of a flashlight when adding water helps to visually determine when the bentonite stops absorbing water. If too much water is added, use a syringe or absorbent material (*e.g.,* paper towels) to remove the standing water. While adding water, try to wet the hole side walls to help create good contact with the floor tile grout that will be used to fill and seal the hole as described below.

7.10.4 Mix approximately ¼ cup of floor tile grout with a small amount of water using a disposable spoon. Add water until the consistency of the grout mixture is a little stiffer than drywall or spackling compound.

7.10.5 Use a plastic knife, putty knife, tongue depressor or similar tool to add the tile grout mixture to the hole until it is completely full. Use a concrete trowel or similar tool to remove any excess grout and finish the top of the seal so that it is smooth and even with the surrounding floor.

7.10.6 Clean up the area around the sealed hole and complete any needed field documentation, including photographs if required. Ensure all relevant information is entered in the Vapor Sampling Data Sheet.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation

Vapor Sampling Data Sheet

9.0 Quality Assurance and Quality Control

9.1 Clean Vapor Pins™ and sampling ports prior to installation by washing in warm water with laboratory-grade detergent, followed by rinsing with hot water and then rinsing with deionized water. Always inspect equipment before use.

9.2 Leak testing should be conducted to document the quality of the sample.

9.3 Photographs of the sampling location and equipment may be required for project documentation.

9.4 Refer to the data quality objectives (DQOs) provided in the work plan.

10.0 Attachments

Cox-Colvin Standard Operating Procedure, Installation and Extraction of the Vapor Pin™

Vapor Sampling Data Sheet, Sub-Slab and Indoor Air (revised May 2018)

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 3.1.1, Photoionization Detector

Ohio EPA Standard Safety Operating Procedure SP11-19 (Working Alone)

Ohio EPA Standard Safety Operating Procedure SP14-4 (Confined Space Entry)

Procedures for Collection of Indoor Air Samples
FSOP 2.4.3 (January 28, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

The collection of indoor air samples assists in the investigation of air quality within buildings for possible vapor intrusion of volatile organic compounds (VOCs) and other volatile chemicals from environmental media (*e.g.,* soil, ground water). Samples are collected from locations within buildings and structures that are occupied on a regular basis to evaluate potential exposure to VOCs. Analysis of the air samples are typically performed using U.S. EPA Method TO-15.

2.0 Definitions

"Summa® Canister", a genericized trademark that refers to electropolished, passivated stainless steel vacuum sampling devices (*i.e.,* evacuated canister). Sizes of canisters will vary with the most commonly used sizes being 6L and 1L. Canister size will depend on the predetermined time frame for sampling (*e.g.,* 24-hour v. "grab" sampling). A "Silco" canister is another name for a summa canister.

3.0 Health and Safety Considerations

3.1 This activity involves accessing private residences and spaces in commercial buildings. Follow Ohio EPA Standard Safety Operating Procedure Number SP11-19 (Working Alone) to determine if working alone is appropriate given the site conditions and circumstances.

3.2 Never enter an OSHA-defined confined space for any reason. Only Ohio EPA Office of Special Investigation (OSI) staff or other appropriately trained staff are qualified to enter confined spaces for reconnaissance or sampling activities and will perform such work as necessary in accordance with Ohio EPA Standard Safety Operating Procedure Number SP14-4 (Confined Space Entry).

3.3 Follow the site-specific health and safety plan (HASP), which should identify the potential presence of asbestos-containing materials and other building-specific health and safety concerns. If a site-specific HASP is not available, follow the health and safety procedures in FSOP 1.1, Initial Site Entry.

3.4 Be aware of potential vermin (fleas, rats, etc.)

3.5 Review available plans or documents before selecting sampling locations.

4.0 Procedure Cautions

4.1 Review the site-specific work plan (SSWP), which should include a description of the building's size and use. In certain emergency circumstances a SSWP may not be available, and all necessary information for indoor air sampling will need to be obtained during the pre-sampling visit as described below.

4.2 A pre-sampling site visit is to be conducted to meet with the building's owner and/or tenant and inspect the proposed indoor air sampling locations. Completion of the Indoor Air Building Survey and Sampling Form (attached) is recommended to ensure a comprehensive evaluation. During the pre-sampling visit, address arrangements for sampling location access and associated logistical concerns. Also, determine if the sampling areas are occupied or unoccupied spaces. Obtain a property access agreement prior to sampling.

4.3 Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke before and/or during the sampling event.

4.4 Care should be taken to ensure that the flow regulator is pre-calibrated to the appropriate sample collection time (8 hours, 24 hours, etc.). Eight (8) hour sample collection is utilized for commercial/industrial settings. Twenty-four (24) hour sample collection is used for residential and/or sensitive receptor settings (*e.g.,* day care facilities).

4.5 The flow regulator must be correctly connected to the sample canister to eliminate the potential for leaks.

4.6 The regulator should be closed shortly before the actual sampling time is completed so that a small amount of vacuum remains. If it isn't closed and no vacuum remains in the canister, extracting a sample for analysis may be very difficult. In addition, sample integrity may be compromised if the canister reaches atmospheric pressure.

4.7 An interview of the building occupants should be conducted before sampling to determine if there are any potential chemicals present that could cause interferences during sample collection. For example, paints, woodworking products, household solvents and various chemicals used in hobbies may all contain VOCs that could be detected. If possible, the building occupants should remove such products several days before sampling takes place. A copy of Instructions for Building Occupants Prior to Indoor Air Sampling Form (attached) should be provided to the resident during the interview.

4.8 If sub-slab samples are to be collected from the same building that indoor air samples are being collected, it is preferable to complete the indoor air sampling prior to installing a sub-slab vapor port (FSOP 2.4.2, Construction, Installation and Decommissioning of Sub-Slab Vapor Ports). However, if site specific reasons (*e.g.,* access or emergency conditions, etc.) dictate the need to collect both samples at the same time, care needs to be taken to install the sub-slab vapor port before beginning the indoor air sampling. In addition, the indoor air sample should be taken as far as possible from the location where the sub-slab vapor point is installed.

4.9 Indoor air samples should only be collected from the first floor/ground-level floor of the structure, unless otherwise directed in the site-specific work plan.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard. Prior knowledge, training and experience with this sampling technique is strongly recommended before collecting samples.

6.0 Equipment and Supplies

6.1 Stainless steel canister(s) (request at least one additional canister as a backup). A 6L canister will be required for this sampling activity. A 1L "grab sample" canister will not provide enough volume to sample for a timed (8 hr. or 24 hr.) sample period, refer to Section 2.0 (Definitions).

6.2 Flow regulator(s) properly calibrated for the specific sample collection duration – 8 hr. or 24 hr. (request at least one extra regulator as a back-up)

6.3 In-line filters, if needed (*e.g.,* for semi-volatile organic compounds (SVOCs)

6.4 Open-end wrenches, typically 9/16" (two wrenches are recommended to tighten the fitting in two directions at the same time)

6.5 PID (refer to FSOP 3.1.1, Photoionization Detector)

6.6 Indoor Air Building Survey and Sampling Form (attached)

6.7 Instructions for Building Occupants Prior to Indoor Air Sampling Form (attached)

6.8 Vapor Sampling Data Sheet (attached)

6.9 Field documentation supplies and equipment, including pens, markers, field logbook and additional data sheets, chain-of-custody forms, camera

7.0 Procedures

7.1 Sample Location Determination

7.1.1 Conduct a building/structure survey using the Indoor Air Building Survey and Sampling Form (attached) to determine potential target receptors and identify potential interferences to sample collection. PID screening may also help to identify VOC sampling interferences. In addition, provide the Instructions for Building Occupants Prior to Indoor Air Sampling Form to the building residents or worker for completion at this time. Potential sampling interferences need to be recognized and eliminated before sample collection begins. This should be completed at least 48 to 72 hours prior to sample collection.

7.1.2 Select indoor air sampling locations that are in inhabited or frequently used.

7.1.3 Do not place sample canisters in locations near primary-use doors or open windows.

7.1.4 Do not place sample canisters in the pathway of indoor fans.

7.1.5 If ceiling fans are in use, request that they be turned off for the duration of the sample period.

7.1.6 Note any obvious odors from scented candles, mothballs, cleaning products, gas or oils.

7.1.7 If the building has a dirt basement or dirt crawl space, an indoor air canister should be placed in this area.

7.2 Sample Set-up

7.2.1 Place the sampling canisters at breathing-zone height.

7.2.2 Remove the brass plug from the canister and connect the flow regulator (with in-line particulate filter and vacuum gauge, if needed) to the canister.

7.2.3 Gently tighten the connection between the flow regulator and the canister using the open-end 9/16” wrenches. Do not over-tighten this connection. Before continuing, record the canister number and the associated flow regulator number on the Vapor Sampling Data Sheet. The canister number can be used for sample identification on the COC form.

7.2.4 Open the canister/regulator valve. Record the sample start time and the canister pressure.

7.2.5 Photograph each canister and the surrounding areas.

Example of a canister with a regulator attached and placed in the breathing zone.

7.3 Termination of Sample Collection

7.3.1 Return to the sample collection site a minimum of 15 minutes before the end of the sample collection interval. Examine the canister to ensure it has not been moved or damaged. Document any alterations to the canister or location.

7.3.2 Examine the flow regulator to ensure that some vacuum is left on the gauge (preferably 2" to 10" of mercury on the regulator flow dial).

7.3.3 Record the vacuum pressure and stop sample collection by closing the flow regulator.

7.3.4 Remove the flow regulator from the canister using the 9/16" open-end wrenches. Re-install the brass plug on the canister fitting and tighten it with an open-ended wrench.

7.3.5 Package the canister and the flow regulator into the shipping container provided by the lab. **Note**: the canister does not require preservation.

7.3.6 Complete the Vapor Sampling Data Sheet, and other appropriate forms and sample labels as directed by the laboratory. Use the sample start time when completing the laboratory chain of custody and double check canister identification numbers for accuracy.

7.3.7 Ship the canisters to the laboratory for analysis.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

Indoor Air Building Survey and Sampling Form

Instructions for Building Occupants Prior to Indoor Air Sampling

Vapor Sampling Data Sheet

9.0 Quality Assurance and Quality Control

An ambient air sample is collected outside of the building where the indoor air is being sampled. The ambient air sample is collected at the same time as the indoor air sample and provides quality assurance/quality control (QA/QC) to help evaluate outdoor air quality. Refer to the data quality objectives (DQOs) provided in the work plan.

10.0 Attachments

Indoor Air Building Survey and Sampling Form

Instructions for Building Occupants Prior to Indoor Air Sampling

Vapor Sampling Data Sheet

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 2.4.2, Construction, Installation and Decommissioning of Sub-Slab Vapor Ports

FSOP 3.1.1, Photoionization Detector

Ohio EPA Standard Safety Operating Procedure SP11-19 (Working Alone)

Ohio EPA Standard Safety Operating Procedure SP14-4 (Confined Space Entry)

Ohio Environmental Protection Agency

INDOOR AIR BUILDING SURVEY and SAMPLING FORM

Preparer's name: ______________________________ Date:______________________

Preparer's affiliation: ___________________________ Phone #: ____________________

Site Name: _________________________________ Case #: _____________________

Part I - Occupants

Building Address: ____

Property Contact:_____________________Owner / Renter / other: ____________________

Contact's Phone: home ( )__________ work ( )____________ cell ( )___________

# of Building occupants: Children under age 13 ______ Children age 13-18 _______ Adults ______

Part II – Building Characteristics

Building type: residential / multi-family residential / office / strip mall / commercial / industrial

Describe building:____________________________________ Year constructed: __________

Sensitive population: day care / nursing home / hospital / school / other (specify): ______________

Number of floors below grade:_______(full basement / crawl space / slab on grade)

Number of floors at or above grade: _______

Depth of basement below grade surface:________ft. Basement size:________ft^2

Basement floor construction: concrete / dirt / floating / stone / other (specify): _______________

Foundation walls: poured concrete / cinder blocks / stone / other (specify) _______________

Basement sump present? *Yes / No* Sump pump? *Yes / No* Water in sump? *Yes / No*

Type of heating system (circle all that apply):

hot air circulation	hot air radiation	wood	steam radiation
heat pump	hot water radiation	kerosene heater	electric baseboard
other (specify): ____________________			

Type of ventilation system (circle all that apply):

central air conditioning mechanical fans bathroom ventilation fans individual air conditioning units kitchen range hood fan outside air intake
other (specify): ___________________

Type of fuel utilized (circle all that apply):
Natural gas / electric / fuel oil / wood / coal / solar / kerosene

Are the basement walls or floor sealed with waterproof paint or epoxy coatings? *Yes / No*

Is there a whole house fan? *Yes / No*

Septic system? *Yes / Yes (but not used) / No*

Irrigation/private well? *Yes / Yes (but not used) / No*

Type of ground cover outside of building: grass / concrete / asphalt / other (specify) _______________

Existing subsurface depressurization (radon) system in place? *Yes / No* *active / passive*

Sub-slab vapor/moisture barrier in place? *Yes / No*
Type of barrier: ______________________________

Part III - Outside Contaminant Sources

Potential contaminated site (1000-ft. radius): ____

Other stationary sources nearby (gas stations, emission stacks, etc.): ________________________________

Heavy vehicular traffic nearby (or other mobile sources): ____

Part IV – Indoor Contaminant Sources

Identify all potential indoor sources found in the building (including attached garages), the location of the source (floor and room), and whether the item was removed from the building 48 hours prior to indoor air sampling event. Any ventilation implemented after removal of the items should be completed at least 24 hours prior to the commencement of the indoor air sampling event.

Potential Sources	**Location(s)**	**Removed** **(Yes / No / NA)**
Gasoline storage cans		
Gas-powered equipment		
Kerosene storage cans		
Paints / thinners / strippers		
Cleaning solvents		
Oven cleaners		
Carpet / upholstery cleaners		
Other house cleaning products		
Moth balls		
Polishes / waxes		
Insecticides		
Furniture / floor polish		
Nail polish / polish remover		
Hairspray		
Cologne / perfume		

Potential Sources	Location(s)	Removed (Yes / No / NA)
Air fresheners		
Fuel tank (inside building)		NA
Wood stove or fireplace		NA
New furniture / upholstery		
New carpeting / flooring		NA
Hobbies - glues, paints, etc.		

Part V – Miscellaneous Items

Do any occupants of the building smoke? *Yes / No* How often? _______________

Last time someone smoked in the building? _____________ hours */ days ago*

Does the building have an attached garage directly connected to living space? *Yes / No*

If so, is a car usually parked in the garage? *Yes / No*

Are gas-powered equipment or cans of gasoline/fuels stored in the garage? *Yes / No*

Do the occupants of the building have their clothes dry cleaned? *Yes / No*

If yes, how often? weekly / monthly / 3-4 times a year

Do any of the occupants use solvents in work? *Yes / No*

If yes, what types of solvents are used? ______________________________

If yes, are their clothes washed at work? *Yes / No*

Have any pesticides/herbicides been applied around the building or in the yard? *Yes /* No

If so, when and which chemicals? _____________________________________

Has there ever been a fire in the building? *Yes / No* If yes, when? ______________

Has painting or staining been done in the building in the last 6 months? *Yes / No*

If yes, when____________________ and where? ______________________________

Has there been any remodeling done (flooring/carpeting) in the building in the last 6 months? *Yes / No*

If yes, when ___________________ and where? ______________________________

Part VI – Sampling Information

Sample Technician:_______________________________Phone number: ( )________- ___________

Sample Source: Indoor Air / Sub-Slab / Near Slab Soil Gas / Exterior Soil Gas

Sampler Type: Tedlar bag / Sorbent / Stainless Steel Canister / Other (specify): __________________

Analytical Method: TO-15 / TO-17 / other:___________ Cert. Laboratory: __________________

Field ID #______-____________________________ Field ID #_____- _____

Were “Instructions for Occupants” followed? Y*es / No*

If not, describe modifications: ____

Additional Comments:

Provide Drawing of Sample Location(s) in Building

Part VII - Meteorological Conditions

Was there significant precipitation within 12 hours prior to (or during) the sampling event? *Yes / No*

Describe the general weather conditions: ____

____

Part VIII – General Observations

Provide any information that may be pertinent to the sampling event and may assist in the data interpretation process.

____

____

____

Ohio Environmental Protection Agency

Instructions for Building Occupants Prior to Indoor Air Sampling

Representatives from the Ohio EPA – Division of Environmental Response and Revitalization (DERR) - will be collecting one or more indoor air samples from your building on__________- beginning @__________and ending @________. Your assistance is requested during the sampling program in order to collect an indoor air sample that is both representative of indoor conditions and avoids the common background indoor air sources associated with occupant activities and consumer products.

Please follow the instructions below starting at least 48 hours (2 days) prior to and during the indoor air sampling event:

- ❑ Do operate your furnace and whole house air conditioner as appropriate for the current weather conditions
- ❑ Do not use wood stoves, fireplaces or auxiliary heating equipment
- ❑ Do not use window air conditioners, fans or vents
- ❑ Do not use paints or varnishes (up to a week in advance, if possible)
- ❑ Do not use cleaning products (e.g., bathroom cleaners, furniture polish, appliance cleaners, all-purpose cleaners, floor cleaners)
- ❑ Do not use hair spray, nail polish remover, perfume, etc.
- ❑ Do not store containers of gasoline, oil or solvents within an attached garage.
- ❑ Do not operate or store automobiles within an attached garage
- ❑ Do not open windows or keep doors open
- ❑ Do not smoke in the building
- ❑ Do not apply pesticides
- ❑ Do not use air fresheners or odor eliminators
- ❑ Do not engage in indoor hobbies that use solvents (e.g. gun cleaning)
- ❑ Do not operate gasoline powered equipment within the building, attached garage or around the immediate perimeter of the building
- ❑ Do not bring freshly dry cleaned clothes into the building

You will be asked a series of questions about the structure, consumer products you store in your building, and occupant activities typically occurring in the building. These questions are designed to identify "background" sources of indoor air contamination. While this investigation is looking for a select number of chemicals related to the known or suspected subsurface contamination, the laboratory will be analyzing the indoor air samples for a wide variety of chemicals. As a result, chemicals such as tetrachloroethene that is commonly used in dry cleaning or acetone, which is found in nail polish remover might be detected in your sample results.

Your cooperation is greatly appreciated. If you have any questions about these instructions, please feel free to

contact____at___________________________________.

VAPOR SAMPLING DATA SHEET
SUB-SLAB AND INDOOR AIR

General Information

Site Name / Address: ____

Sampling Location / Address: ____
(if other than site address)

Contact Name: ______________________ **Phone:** ______________________

Laboratory & Analytical Method: __________________ **Method of Delivery:** __________
(Courier, UPS, delivered by sampler, etc.)

Sampling Team Members: ____

Met with resident/business on (date) ____________ **to provide information on VOC inventory and sampling cross-contamination concerns. If not, explain why:**____

____

____

Indoor Air Samples

Sample ID #: __________________ **Canister ID #:**__________________ **Regulator ID #**__________________

Start: Date: __________________ **Time:** __________ **Initial canister vacuum:** ________ **mm Hg**

End: Date: __________________ **Time:** __________ **Final canister vacuum:** _________ **mm Hg**

Regulator Calibrated for: 8 hr _____ **24 hr** _____ **grab (no regulator)**______

Canister/ Regulator Leak Checked: Yes ______ **No**______

Sub-Slab Samples

Sample ID #: _________________ **Canister ID #:**________________ **Regulator ID #**________________

Size of canister: __________ **Thickness of sub-slab (inches)** _________ **Port install time:** __________

Sampling Start: Date: ________________ **Time:** __________ **Initial canister vacuum:** ________ **mm Hg**

Sampling End: Date: ________________ **Time:** __________ **Final canister vacuum:** _________ **mm Hg**

Regulator Calibrated for: 8 hr _____ **24 hr** _____ **grab (no regulator)** ______

Canister/ Regulator Leak Checked: Yes No **Sub-Slab Port Leak Checked: Yes No**

Type of sub-slab port: Swagelok __________ **Vapor Pin:** __________

Sub-Slab Port Installed by: _________________________ **Sub-Slab Port Sealed: Yes No**

PID Reading: VOC ppb___________ **% 02**_____________ **PID ID#:** __________________

NOTES: (sampler/canister problems, other significant sampling details, or FSOP deviations)

Note: If a diagram of the sample location(s) is sketched on the back of this data sheet, check here ☐

Revised: 05.2018

Photoionization Detector
FSOP 3.1.1 (January 27, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

The photoionization detector (PID) is a portable instrument used to detect the real-time presence and relative concentration of certain ionizable compounds in gaseous or vapor states. This instrument is typically used for both health and safety monitoring of the work area breathing zone and for the screening of environmental samples. Other uses may include screening of soil gas probes or leak detection (*e.g.,* tanks, vessels, process lines). Consult FSOP 1.1, Initial Site Entry and FSOP 2.1.4, Sample Headspace Screening prior to using a PID for health and safety monitoring or sample headspace screening procedures, respectively.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Hazardous vapors or explosive gases may be present in concentrations requiring use of personal protective equipment (PPE) such as respiratory protection (Table 1, FSOP 1.1, Initial Site Entry) when work area breathing zone air conditions need to be monitored. Only personnel cleared to wear respiratory protection can enter the work area breathing zone if respiratory protection is required.

3.2 Prior to use in potentially flammable atmospheres, consult the instrument manual to determine if the PID is intrinsically safe.

3.3 PIDs only measure the relative concentration of molecules in gases or vapors that are ionizable (*i.e.,* those with an ionization potential (IP) less than that of the ionization energy (IE) of the instrument's ultraviolet lamp). Refer to paragraph 3.3 below for additional information. PIDs may not detect the presence of toxic or explosive gases or vapors with relatively high IPs, including carbon monoxide, chlorine, hydrogen, hydrogen cyanide, hydrogen sulfide or methane. PIDs do not detect or measure the concentration of atmospheric oxygen or the presence of explosive atmospheres. Be sure to use the correct instrument(s) for health and safety monitoring. (Refer to FSOP 1.1, Initial Site Entry.)

3.4 Many instruments are equipped with audio and visual alarms that may be set at threshold limits for the gas or condition of concern. Default alarm levels are generally set by the manufacturer but should be set in accordance with the specified limits in the site-specific health and safety plan.

4.0 Procedure Cautions

4.1 The user should be familiar with the operation of the instrument being used. Consult the instrument manual for operating and calibration instructions specific to the instrument prior to use.

4.2 PID readings are not compound-specific. The instrument must be calibrated using a relatively non-toxic gas such as isobutylene and zeroed to a known clean or background air source. Readings are relative to the calibrant gas, and although the instruments display “ppm” or parts per million readings, the readings are actually ppm-calibration gas equivalents. The PID’s display concentration may be lower or higher than the actual concentration. There are correction factors that can be applied if the compound detected is known and the calibration gas is known.

4.3 PIDs only detect molecules that can be ionized. PIDs are equipped with ultraviolet lamps of different IEs, typically 9.8 electron volts (eV), 10.2 eV, 10.6 eV, and 11.7 eV. The IE of the lamp must be higher than the ionization potential (IP) of the compound(s) being screened. Consult the instrument manual or other reference for the ionization potential of the constituent(s) to be monitored to determine the proper lamp (or if a PID is appropriate for the proposed monitoring task).

4.4 PID performance may be adversely affected by temperature fluctuations, and PID readings are significantly affected by the presence of water vapor and methane due to their high IEs (> 12 eV). If using a PID in extremely wet or cold conditions, store the instrument in a relatively warm, dry location such as the front seat of a field vehicle with the heater running. A flame ionization detector may be better suited for use in these conditions and generally is preferred in situations where large temperature fluctuations, very moist or humid conditions or high methane concentrations are anticipated. Elevated methane concentrations may be encountered in subsurface areas at or adjacent to solid waste landfill disposal units.

4.5 Excessively dusty environments may overwhelm a PID inlet filter and reduce performance by fouling the ionization chamber or lamp. Filters should be inspected and changed after use in excessively dusty environments, and the lamp or ionization chamber should be cleaned if the instrument begins exhibiting a weak response to calibration gas.

4.6 If used for sample headspace screening, never allow the instrument probe to draw in liquid or solid material from a sample container, which may damage the instrument.

4.7 PIDs should be calibrated before each use and at any time the proper performance of the instrument appears to be questionable.

4.8 Always use a regulator with an appropriate flow rate to calibrate a PID. Information on calibration and regulator flow rate should be included in the operator’s manual.

4.9 Never use a source of highly concentrated organic vapors to check whether a PID is responding properly (*e.g.,* never insert a PID probe into the fill port of a vehicle fuel tank, as doing so could damage the instrument).

4.10 Take care when using a PID to screen atmospheres with highly concentrated organic vapors (*e.g.,* opening of a drum containing solvent- or petroleum-contaminated soil). Screening in this manner may contaminate the instrument's lamp or filter to the point that the PID must be serviced or removed from the area of elevated vapor concentrations until it can equilibrate or may otherwise damage the instrument.

4.11 PIDs should be cleaned, inspected, and internally calibrated annually by a service center authorized by the instrument manufacturer.

4.12 Always transport the instrument in a protective case or secure the instrument during transport.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Calibrant gas (*e.g.,* isobutylene)
6.2 Regulator for calibrant gas cylinder
6.3 Clean containers such as sealable plastic bags or jars with foil or film covers (if using for headspace screening)
6.4 Field logbook, field log sheets, or appropriate field form
6.5 Pens or markers
6.6 PPE appropriate for site-specific work activities
6.7 Inert tubing with "tee" connector
6.8 Instrument with operation manual
6.9 Protective case for instrument transport
6.10 Tedlar® bag
6.11 Calibration log sheet

7.0 Procedures

7.1 Consult the instrument manual for both general procedures and instrument-specific operating functions prior to using the instrument.

7.2 Make sure instrument is fully charged before use. Bring a backup battery if necessary.

7.3 Turn the instrument on and allow it to warm up. Some instruments will give a "ready" prompt in the instrument display when ready for use. Make sure pump is running and lamp is on. Check for warnings on instrument display during warm up. Check alarm levels to be sure they are consistent with site specific health and safety plan.

7.4 Calibrate the instrument according to the manufacturer's instructions with a relatively non-toxic span gas (*e.g.,* isobutylene) before each use.

7.4.1 Calibrate the instrument directly from the cylinder using a flow regulator of appropriate flow rate (equal to or slightly higher than the pump capacity) or a pressure demand regulator. Use a piece of tubing to connect the regulator to the instrument probe. If the regulator flow rate is significantly higher than the pump flow, then install a "tee" fitting in the tubing to bleed of excess calibrant gas.

7.4.2 For an alternate calibration method, fill a clean Tedlar® bag with the calibrant gas by first connecting the cylinder to the bag with the regulator and tubing and allowing the bag to inflate after opening the valve on the bag. Next, close the valve on the bag, attach the instrument probe to the bag with a length of tubing and open the bag valve when ready to calibrate.

7.4.3 Record calibration data, including operator name, location, instrument make and model, date, time, calibration gas type, and result on the calibration log sheet.

7.5 Zero the instrument with a clean air source such as a cylinder of certified clean air, or to ambient (background or off-site) air, and ensure that the instrument is zeroed or recording background readings before use.

7.6 Use the instrument for health and safety monitoring or headspace screening in accordance with the site-specific health and safety plan and FSOP 1.1, Initial Site Entry and/or site-specific work plan and FSOP 2.1.4, Sample Headspace Screening as appropriate.

7.7 Observe and record the instrument readings as appropriate.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

None

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 2.1.4, Sample Headspace Screening

Multiple Gas Detection Meters
FSOP 3.1.2 (January 27, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Multiple gas detection meters are a class of portable instruments used to monitor the presence or absence of several classes of atmospheric gases or conditions in real time. These instruments are typically used for initial site entry and health and safety monitoring at a site (FSOP 1.1, Initial Site Entry). Other uses may include screening of soil gas probes or leak detection (*e.g.,* tanks, vessels, process lines).

1.2 Although there is a wide range and combination of detection sensors available, instruments owned or used by the agency are typically equipped with sensors for the detection of oxygen, explosive atmospheres (*e.g.*, LEL) and two other gases, generally carbon monoxide and hydrogen sulfide. These instruments are commonly referred to as “four gas meters” because they typically have four detection sensors, however, the number of sensors may vary. For example, several multiple gas meters are available with a built-in photoionization detector for the detection of ionizable molecules in addition to the four sensors listed above (FSOP 3.1.1, Photoionization Detector). In addition, some instruments may be designed to measure the temperature and pressures from solid waste landfill gas monitoring or extraction wells.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Hazardous vapor or explosive gases may be present in concentrations requiring use of personal protective equipment (PPE) such as respiratory protection (Table 1, FSOP 1.1, Initial Site Entry) when work area breathing zone air conditions need to be monitored. Only personnel cleared to wear respiratory protection can enter the work area breathing zone if respiratory protection is required.

3.2 Consult the instrument manual to determine if the instrument is intrinsically safe prior to use in potentially flammable atmospheres.

3.3 Combustible gas indicator (CGI) or lower explosive limit (LEL) sensors are designed to operate under normal atmospheric oxygen concentrations (20.9% v/v) and will not function properly in oxygen-deficient or oxygen-enriched environments. When using a CGI/LEL sensor, the user should concurrently monitor the ambient percentage of oxygen. If oxygen monitoring data are not available, the CGI/LEL readings cannot be considered reliable.

3.4 Many instruments are equipped with audio and visual alarms that may be set at threshold limits for the gas or condition of concern. Default alarm levels are generally set by the manufacturer but should be checked and re-set as needed, in accordance with the specified limits in the site-specific health and safety plan.

3.5 If a CGI/LEL sensor indicates potentially explosive atmospheric conditions, or other sensors indicate the presence of oxygen-deficient, oxygen-enriched or toxic atmospheres, evacuate the area immediately. (Refer to Table 1 of FSOP 1.1, Initial Site Entry, and to the site health and safety plan for action levels and responses.)

4.0 Procedure Cautions

4.1 The user should be familiar with the operation of the instrument being used. Consult the instrument manual for operating and calibration instructions specific to the instrument prior to use.

4.2 Instrument should be serviced and/or cleaned and calibrated annually by a service center authorized by the instrument manufacturer.

4.3 Do not use calibrant gas (“mixed gas”) for “zero” calibration as the oxygen content of the calibrant gas may be less than normal atmospheric oxygen content (20.9%).

4.4 Always transport the instrument in a protective case or secure the instrument during transport. Multiple gas meter performance may be adversely affected by temperature fluctuations, and readings are significantly affected by the presence of water vapor and methane. If using a multiple gas meter in extremely wet or cold conditions, store the instrument in a relatively warm, dry location such as the front seat of a field vehicle with the heater running.

4.5 Excessively dusty environments may overwhelm a multiple gas meter inlet filter and reduce performance by fouling the instrument. Filters should be inspected and changed after use in excessively dusty environments if the instrument begins exhibiting a weak response during calibration.

4.6 If used for sample headspace screening, never allow the instrument probe to draw in liquid or solid material from a sample container, which may damage the instrument.

4.7 Multiple gas meters should be calibrated before each use and at any time the proper performance of the instrument appears to be questionable.

4.8 Always use a regulator with an appropriate flow rate to calibrate a multiple gas meter. Information on calibration and regulator flow rate should be included in the operator’s manual.

4.9 Never use a source of highly concentrated organic vapors to check whether a multiple gas meter is responding properly (*e.g.,* never insert a probe into the fill port of a vehicle fuel tank, as doing so could damage the instrument).

4.10 Take care when using a multiple gas meter to screen atmospheres with highly concentrated organic vapors (*e.g.,* opening of a drum containing solvent- or petroleum-contaminated soil). Screening in this manner may contaminate the instrument's sensors, filters, or lamp (when meter contains PID) to the point that the multiple gas meter must be serviced or removed from the area of elevated vapor concentrations until it can equilibrate or may otherwise damage the instrument.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Calibrant gas (*e.g.,* mixed gas consisting of known concentrations that instrument sensors may detect)
6.2 Regulator for cylinder
6.3 Logbook, log sheets, or appropriate field form
6.4 Pens or markers
6.5 PPE appropriate for site-specific work activities
6.6 Instrument with operation manual
6.7 Protective case for instrument transport
6.8 Inert tubing with "tee" connector
6.9 Tedlar® bag
6.10 Calibration log sheet

7.0 Procedures

7.1 Consult the instrument manual for both general procedures and instrument-specific operating functions prior to using the instrument.

7.2 Make sure instrument is fully charged before use. Bring a spare battery if necessary.

7.3 Turn the instrument on and allow it to warm up. Some instruments will indicate a "ready" prompt in the instrument display when ready for use. Make sure the pump is running. Check for warnings on instrument display during warm up. Check the alarm levels to be sure they are consistent with site specific health and safety plan.

7.4 Calibrate the instrument according to manufacturer's instructions before use:

7.4.1 The instrument may be calibrated directly from the cylinder using a flow regulator of appropriate flow rate (equal to or slightly higher than the pump capacity) or a pressure demand regulator. Use a piece of tubing to connect the regulator to the instrument probe. If the regulator flow rate is significantly higher than the pump flow, then a "tee" may be inserted in the tubing to bleed of excess calibrant gas.

7.4.2 An alternate calibration method is to fill a clean Tedlar® bag with the calibrant gas by first connecting the cylinder to the bag with the regulator and tubing and allowing the bag to inflate after opening the valve on the bag. Next, close the valve on the bag, attach the instrument probe to the bag with a length of tubing and open the bag valve when ready to calibrate.

7.5 Zero the instrument with a clean air source or to ambient or background air and ensure that the instrument is zeroed or record background readings before use. If using a cylinder of clean air for zeroing, make sure cylinder contains 20.9% oxygen. Calibrate the instrument with cylinder of mixed gas of known concentration. When calibrating with a cylinder of mixed gas, an oxygen content of less than atmospheric percentage (e.g., 18.0 – 19.5 %) is recommended to verify that the instrument is accurately detecting oxygen-deficient conditions.

7.6 Record calibration data, including operator name, location, instrument make and model, date, time, calibration gas type, and result on the calibration log sheet.

7.7 Use the instrument for monitoring in accordance with the site-specific health and safety plan and FSOP 1.1, Initial Site Entry or site-specific work plan.

7.8 Observe and record the instrument readings as appropriate.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

None

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 3.1.1, Photoionization Detector

<u>Interface Meter</u>
FSOP 3.1.3 (February 16, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

Interface meters (also referred to as oil/water interface probes) are used to measure the depth and thickness of light and dense non-aqueous phase liquid (LNAPL and DNAPL) and depth to ground water in wells. [Use FSOP 2.2.3, NAPL Detection and Sampling, in conjunction with this FSOP.] Typically, interface meters consist of a reel, graduated tape and sensor. The reel has an alarm, control switches and a battery pack. The tape has a wire or series of wires encased within it. The sensing probe is connected to the end of the tape which is lowered into the well. When the probe contacts water or NAPL, audible and/or visual alarms will be activated. The probe utilizes an infrared beam and detector. When the probe is lowered into a liquid, the infrared light is refracted triggering audible (buzzer) and visual (light) alarms. In general, if the liquid is relatively non-conductive, such as oil, a steady audible alarm tone will sound, and a steady alarm light will be displayed. If the liquid is conductive, such as water, then an intermittent (beeping) alarm will sound, and a flashing light will be displayed.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Consult the instrument's operation manual to determine if it is intrinsically safe when working in an area where there is a potential fire or explosion hazard.

3.2 Always review the site-specific health and safety plan (HASP) for site-specific sampling hazards before beginning work.

3.3 If NAPL or high concentrations of VOCs are suspected to be present in the well, use a photoionization detector (PID) or a flame ionization detector (FID) to screen the breathing space above the well casing before taking measurements. Monitoring, sampling or LNAPL recovery efforts may need to be performed using respiratory protection by qualified DERR staff.

3.4 If NAPL is suspected to be present in the well, monitor the well for lower explosive limit (LEL) and percent oxygen (O_2) for a potentially explosive atmosphere with a multiple gas detection meter. If the LEL is exceeded inside the well casing, allow the open well to ventilate and measure the LEL again. Allow the LEL concentration to drop to below the LEL before placing instrumentation or sampling devices inside the well.

4.0 Procedure Cautions

4.1 The user should be familiar with the operation of the instrument being used. Consult the instrument manual for operating instructions specific to the instrument prior to use.

4.2 Inspect the instrument tape to make sure there are no cuts or abrasions that may impair the function of the tape.

4.3 The use of an interface meter to measure the depth to water or NAPL in residential or other wells with pumps and associated plumbing is generally discouraged because the tape may become entangled in the downhole plumbing or centralizing disks. If water level measurements must be obtained from such wells, the pump and plumbing may need to be temporarily removed first, which generally requires the services of a registered water well drilling contractor. Additionally, for residential or other water supply wells, there may be additional sanitary requirements for disinfection of the well and/or downhole equipment required by the county or local health department that has jurisdiction over the well.

4.4 Use caution when lowering and raising the tape within a well. A sharp casing edge or burr may damage the tape if the tape is allowed to rub against the edge of the casing.

4.5 Be sure the instrument has new or charged batteries. Replace old or weak batteries as necessary.

4.6 Remove instrument batteries if the instrument is not going to be used for an extended period of time.

4.7 Always transport the instrument in a protective case or secure the instrument during transport.

4.8 When reeling the tape back in, be careful that the tape does not twist, kink or fold.

4.9 If NAPL is encountered, follow the decontamination procedures in FSOP 1.6, Equipment Decontamination before reusing the instrument.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Interface meter with battery and operation manual
6.2 Protective case for instrument transport
6.3 Field log sheet (attached) or field book and pen
6.4 Well keys or tools to open well
6.5 Decontamination equipment and supplies
6.6 Personal protective equipment appropriate for site-specific work activities

6.7 Photoionization Detector (PID)
6.8 Multi Gas detection meter, as necessary
6.9 Spare replaceable battery

7.0 Procedures

7.1 Make sure the interface meter is functioning properly and the battery is charged. (**Note:** when testing the instrument, use tap water and not distilled water. Distilled water contains no dissolved solids to act as electrolytes and the alarm may not activate.)

7.2 Open the well by removing the lock and cap.

7.3 If required by the SSWP or HASP, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector (PID), multi gas detection meter (with LEL/O2 capabilities) or other required instrument. Breathing zone action levels are provided in Table 1 of FSOP 1.1, Initial Site Entry. Monitoring may need to continue during purging and sampling activities. Additionally, if the LEL is exceeded inside the well casing, allow the open well to ventilate and measure the LEL again. Allow the LEL concentration to drop to below the LEL before placing instrumentation or sampling devices inside the well. Refer to FSOP 3.1.1, Photoionization Detector and FSOP 3.1.2, Multiple Gas Detection Meter for use and operation of these instruments.

7.4 Locate the measuring point elevation mark on the casing. A surveyed measuring point will need to be established if not already present. For monitoring wells, this is generally marked on the highest point or north side of the top of the inner casing. If a mark is not present, then use the highest visible point of the inner casing as the measuring point.

7.5 Turn the instrument's switch on to the highest sensitivity position. Adjust the sensitivity as necessary.

7.6 Slowly lower the tape down the well taking care not to twist the tape or allow the tape to scrape the edge of the casing as it is being lowered. If LNAPL is present in a measurable thickness (generally 0.01 foot), the instrument's audible alarm (buzzer) will emit a steady tone and visual (light) alarm will display a steady light. When the instrument's probe contacts water, the audible alarm will emit a beeping tone and the visual alarm will flash. If the instrument is lowered through the water column and encounters DNAPL, then the instrument will sound a continuous alarm similar to when it encounters LNAPL.

7.7 Raise the tape slightly so that the probe is out of the water or LNAPL/DNAPL. The alarm signals should stop or change. A mild shake of the tape may also be necessary to remove water from the probe sensor pin. Lower the tape slightly until the alarms activate and hold the tape firmly against the side of the casing so that the probe does not move up or down.

7.8 Carefully read the tape measurement at the well's measuring point to the nearest 0.01 foot.

7.9 Record the water level reading, NAPL reading(s) and supporting information (site, date, time, notes) on the attached field log sheet or in a field logbook.

7.10 For apparent LNAPL thickness, subtract the LNAPL reading from the water level reading. For apparent DNAPL thickness, subtract the DNAPL reading from the total depth of the well (measured from the top of casing).

7.11 Ground water elevations in monitoring wells containing LNAPL should be corrected for the depression of the LNAPL/water interface to obtain total hydraulic head. The depression is caused by the weight of the LNAPL. The correction is performed by multiplying the measured LNAPL thickness by an estimate of the LNAPL specific gravity, and then adding the result to the elevation of the LNAPL/water interface. Approximate specific gravities in grams per cubic centimeter (g/cc) at 20^{o} C (68^{o} F) for common petroleum product sources include the following:

- Gasoline, 0.74 g/cc
- Jet fuel or kerosene, 0.80 g/cc
- Diesel fuel, 0.85 g/cc
- Motor oil, 0.90 g/cc

The water level correction for LNAPL is very important for determining apparent ground water elevations and preparing accurate potentiometric surface maps.

7.12 Decontaminate the instrument probe and the length of tape lowered into the well in accordance with the decontamination procedures specified in FSOP 1.6, Sampling Equipment Decontamination. The probe should be cleaned as follows: wash probe thoroughly with a non-abrasive mild detergent. DO NOT use any solvents. Use a soft cloth around the pins on the end of the probe to remove all product and a soft bristle brush to remove all product from the inner part of the probe. Use lukewarm water, hot water may result in damage to the probe. Rinse the probe thoroughly with distilled water and wipe dry.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

Field Log Sheet for Depth to Ground Water and Depth to Nonaqueous Phase Liquids (NAPL) Measurements in Monitoring Wells and Piezometers

11.0 References

FSOP1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

FSOP 2.2.3, NAPL Detection and Sampling

FSOP 3.1.1, Photoionization Detector

FSOP 3.1.2, Multiple Gas Detection Meter

Field Log Sheet for Depth to Ground Water and Depth to Nonaqueous Phase Liquids (NAPL) Measurements in Monitoring Wells and Piezometers

Site Name: ____

Well or Piezometer	Date	Time	LNAPL Depth (ft TOC)	Water Depth (ft TOC)	DNAPL Depth (ft TOC)	Notes:

Electronic Water Level Indicator
FSOP 3.1.4 (February 16, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Electronic water level indicators are used to measure the depth to ground water in monitoring wells and other types of wells. [Frequently, FSOP 2.2.2 Ground Water Level Measurement is used in conjunction with FSOP 3.1.4.] Typically, electronic water level indicators consist of a reel, tape and sensor. The reel generally has an alarm, control switches and a battery pack. The tape has a wire or series of wires encased within it. The tape is connected to the reel and graduated in tenths and hundredths of feet. The sensing probe is connected to the end of the tape which is lowered into the well. When the tape is lowered into the well and the probe contacts water, an audible or visual alarm is activated.

1.2 This FSOP is only applicable to electronic water level indicators. While other types of water level indicators are available, electronic water level indicators are the environmental industry standard and are preferred by Ohio EPA.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Consult the instrument's operation manual to determine if it is intrinsically safe when working in an area where there is a potential fire or explosion hazard.

3.2 Always review the site-specific health and safety plan (HASP) for site-specific sampling hazards before beginning work

4.0 Procedure Cautions

4.1 The user should be familiar with the operation of the instrument being used. Consult the instrument manual for operating instructions specific to the instrument prior to use.

4.2 Inspect the instrument tape to make sure there are no cuts or abrasions that may impair the function of the tape.

4.3 The use of electronic water level indicators to measure the depth to water in residential or other wells with pumps and associated plumbing is generally discouraged. This is because the tape may become entangled in the downhole plumbing or centralizing disks. If water level measurements must be obtained from such wells, the pump and plumbing may need to be temporarily removed first. This generally requires the services of a registered water well drilling contractor. Additionally, for residential or other water supply wells, there may be additional sanitary requirements for disinfection of the well and/or downhole equipment required by the county or local health department that has jurisdiction over the well.

4.4 Use caution when lowering and raising the tape within a well. A sharp casing edge or burr may damage the tape if the tape is allowed to rub against the edge of the casing.

4.5 Do not use electronic water level indicators in wells known or suspected to contain nonaqueous phase liquids (NAPL). Use an interface meter instead (refer to FSOP 3.1.3, Interface Meter.)

4.6 If using the water level indicator to measure the total depth of the well, add the length of any probe extension beyond the sensor pin (*e.g.,* 0.3 ft) to obtain an accurate measurement of the total well depth.

4.7 Be sure the instrument has fresh batteries. Replace old or weak batteries as necessary.

4.8 Remove instrument batteries if the instrument is not going to be used for an extended period of time.

4.9 Always transport the instrument in a protective case or secure the instrument during transport.

4.10 When reeling the tape back in, be careful that the tape does not twist, kink or fold.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Water level indicator with battery and operation manual
6.2 Protective case for instrument transport
6.3 Field data sheet (attached) or field book and pen
6.4 Well keys or tools (*e.g.,* ratchet, bolt cutter, screwdriver) to open well
6.5 Decontamination equipment and supplies
6.6 Personal protective equipment appropriate for site-specific work activities

7.0 Procedures

7.1 Make sure the electronic water level indicator is functioning properly and the battery is functioning. (**Note:** when testing the instrument, use tap water and not distilled water. Distilled water contains no dissolved solids to act as electrolytes and the alarms will not be activated.)

7.2 Open the well by removing the lock, if present, and cap. Allow sufficient time for the water level in the well to equilibrate, especially if the well is installed in a confined aquifer or if air pressure is released (a “popping” sound is heard) when the well casing cap is removed.

7.3 Locate the designated measuring point mark on the casing. For monitoring wells this is generally marked on the highest point or north side of the top of the inner casing. If a mark is not present, use the highest visible point of the inner casing as the measuring point. If the inner casing is level (no discernible high point), use the north side of the casing.

7.4 Turn the water level indicator’s switch on to the highest sensitivity position.

7.5 Slowly lower the tape down the well taking caution not to twist the tape or allow the tape to scrape the edge of the casing as it is being lowered. When the tape’s probe contacts water, the instrument’s audible (buzzer) and visual (light) alarms will be activated.

7.6 Raise the tape slightly to lift the probe out of the water. The alarm should stop. A mild shake of the tape may also be necessary to remove water from the probe’s sensor pin. Lower the tape slightly until the alarms activate and hold the tape firmly against the side of the casing so that the probe does not move up or down.

7.7 Carefully read the tape measurement at the well’s measuring point to the nearest hundredth (0.01) foot.

7.8 Record the water level reading and supporting information (site, date, time, notes) on the attached field log sheet or in a field logbook.

7.9 If using the water level indicator to measure the total depth of the well, turn off the instrument. Next, lower the tape to the bottom of the well and record the tape reading at the measuring point. Remember to add the length of any probe extension to the total depth measurement.

7.10 Decontaminate the probe and the length of tape lowered into the well in accordance with the decontamination procedures specified in FSOP 1.6, Sampling Equipment Decontamination. The probe should be cleaned as follows: wash probe thoroughly with a non-abrasive mild detergent. DO NOT use any solvents. Use a soft cloth around the pins on the end of the probe to remove all product and a soft bristle brush to remove all product from the inner part of the probe. Use lukewarm water, hot water may result in damage to the probe. Rinse the probe thoroughly with distilled water and wipe dry.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

Field Log Sheet for Depth to Ground Water Measurements in Monitoring Wells and Piezometers

11.0 References

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

FSOP 3.1.3, Interface Meter

Field Log Sheet for Depth to Ground Water Measurements in Monitoring Wells and Piezometers

Site Name: ____

Well or Piezometer	Date	Time	Water Depth (ft TOC)	Total Depth (ft TOC)	Notes:

<u>Water Quality Meters</u>
FSOP 3.1.5 (February 16, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Water quality meters are a class of portable instruments used to determine surface water or ground water chemistry in the field. These “field parameter” measurements may be collected to evaluate:

- General water quality/chemistry
- Ground water stabilization during monitoring well development or sampling
- Regulatory standards for surface water analytes that are dependent on pH, temperature or other parameters.

1.2 There are many models and manufacturers of water quality meters. Meters are typically equipped with sensors to measure field parameters including pH, specific conductance, temperature, total dissolved solids, salinity, dissolved oxygen, oxidation-reduction potential and/or turbidity. Some meters are equipped with “flow-through” cells that allow multiple parameters to be continuously measured over time. Flow-through cells are very useful for evaluating ground water stabilization when continuously purging a monitoring well with a pump.

1.3 DERR owns several water quality meter models. The user should be familiar with the capabilities and operation of a particular meter prior to use and should always review the manufacturer’s instruction manual prior to use.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Always review the site-specific health and safety plan (HASP) for site-specific sampling hazards before beginning work.

3.2 Always be conscious of hazards associated with the water body during surface water sampling, especially if sampling a lake, pond, wetland, lagoon, impoundment, river or stream. Never enter a river or stream under high-flow conditions.

3.3 Be aware of slip, trip or fall hazards along riverbanks and lagoon or impoundment slopes.

3.4 Be aware of the dangers of working near low-head dams (*e.g.,* rapid flow and undercurrents) as well as hazards that may be posed by other man-made structures such as manholes, vaults, weirs, pump houses and associated electrical or mechanical equipment.

3.5 If sampling from a boat, always wear a personal flotation device (PFD) and follow Ohio EPA's Boating Safety SOP (SP10-12).

3.6 Never walk on a surface crust or partially submerged debris in a lagoon or impoundment.

3.7 Do not collect samples from a frozen lake, pond, lagoon, or impoundment unless authorized by a site-specific health and safety plan. Never collect samples from atop of a river, stream or any other flowing water body that is frozen over.

3.8 When collecting surface water samples, use the "buddy system," with at least two people present at all times.

3.9 Be aware of biological hazards (*e.g.,* snakes, ticks, bees, mosquitoes and poison ivy).

3.10 For ground water sampling from wells, refer to the health and safety precautions in FSOP 2.2.4, Ground Water Sampling (General Procedures).

4.0 Procedure Cautions

4.1 The user should be familiar with the capabilities and operation of the meter. Consult the user's manual for operation and calibration instructions prior to use.

4.2 Remove old batteries to prevent potential damage if the meter is not going to be used for an extended period of time.

4.3 Always transport the meter in its protective case.

4.4 Do not to drop the meter or immerse the body of the meter in a surface water body. Some meters are not waterproof.

4.5 Clean meter cells and sensors with distilled water after each use or as otherwise indicated in the user's manual.

4.6 For meters equipped with a pH probe that has a bulb-type sensor with a cap or cover, be sure to place a small amount of pH storage solution, slightly acidic pH solution (*e.g.,* pH 4.0), or tap water (depending on manufacturer instructions) in the probe's cap or cover to keep the pH probe bulb moist during storage. Allowing the pH probe bulb to dry out will shorten its life.

4.7 Don't use expired calibration standard fluids to calibrate a meter.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

Equipment and Supplies

5.1 Water quality meter with a copy of the operation manual
5.2 Standard calibration fluids
5.3 Spare batteries
5.4 Equipment and supplies to decontaminate and clean meter after each use, including spray bottles, distilled or deionized water, paper towels, etc.
5.5 Log book, log sheets (see FSOP 2.2.4), or appropriate field forms with pens or markers
5.6 Personal protective equipment appropriate for site-specific work activities

6.0 Procedures

6.1 Consult the user's manual for both general procedures and meter-specific operating functions prior to using the meter.

6.2 Be sure the meter battery is functioning.

6.3 Calibrate the meter according to the manufacturer's instructions before use with the appropriate standard calibration solutions.

6.4 If the meter has a measurement cup cell, rinse the cell three times with the standard solution or the sample to be measured.

6.5 If the meter has a flow-through cell, allow three volumes of purge water to pass through the cell before recording water quality parameter measurements.

6.6 If the meter has a probe, fill a clean jar with the sample to be measured or, in surface water bodies, place the probe directly in the water body.

6.7 Allow the meter readings to stabilize before recording.

6.8 For temperature readings, make sure the probe is placed in a sufficient volume of water to account for the temperature of the probe body on very hot or cold days. If the sample jar is small, water may need to be added to the sample jar several times to achieve an accurate temperature measurement.

6.9 Record water quality parameter readings as appropriate.

6.10 Decontaminate the meter between sampling locations in accordance with the user's manual and/or FSOP 1.6, Sampling Equipment Decontamination as appropriate.

7.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation

8.0 Quality Assurance and Quality Control

Not applicable

9.0 Attachments

None

10.0 References

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

FSOP 2.2.4, Ground Water Sampling (General Practices)

FSOP 2.3.1, Surface Water Sample Collection

<u>Radiation Detection Meters</u>
FSOP 3.1.6 (February 26, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Radiation detection meters are used to monitor for the presence of alpha, beta and primarily for gamma radiation. These instruments are used by DERR personnel for health and safety monitoring during initial site entry at former landfills or other potentially contaminated sites where radioactive materials may be present, or at potentially contaminated sites with a poorly documented history.

1.2 If, based on historical knowledge of the site, radioactivity is expected to be present, the initial site entry team will consult with management prior to entry, and with the Ohio Department of Health (ODH) Bureau of Environmental Health and Radiation (BEHR). For initial site entry purposes, the team will utilize a radiation detection meter.

1.3 ODH BEHR regulates nuclear materials and has jurisdiction over radiologic assessment in Ohio (OAC 3701:1-38-13, general radiation protection standards). Except for members of Ohio EPA's Radiation Assessment Team (RAT), DERR staff only monitor radiation for personal health and safety and not to assess or investigate radiation at sites. If radioactive materials are encountered during the initial site entry or gamma radiation measured at any location exceeds 2 millirem/hr (0.002 rem/hr), leave the site immediately and contact the ODH BEHR at (614) 466-1390. Background radiation levels for the State of Ohio range from 0.008 millirem/hr to 0 .019 millirem/hr.

1.4 There are many manufacturers and models of radiation meters available. Some radiation meters function as survey meters often equipped with separate probes to measure radiation in the surrounding area or on specific surfaces. Other meters function as personal monitors with a built-in audible alarm which will sound if given a dose or dose rate is exceeded.

1.5 This FSOP applies to DERR district and site investigation field unit (SIFU) staff. This FSOP does not apply to Ohio EPA's RAT staff.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Some meters are equipped with audio and visual alarms that may be set at threshold limits for radiation. Default alarm levels should be set at 2 millirem/hr.

3.2 Consult the meter's user manual to determine if the instrument is intrinsically safe prior to use in potentially flammable atmospheres.

3.3 A radiation meter does not monitor for hazardous/toxic vapors or gases, potentially explosive atmospheres or oxygen-deficient/oxygen-enriched atmospheres. Monitoring for these atmospheric hazards should be performed in accordance with FSOP 1.1, Initial Site Entry as necessary based on anticipated site conditions.

3.4 If radioactive materials are encountered during the initial site entry, or if gamma radiation measured at any location exceeds 2 millirem/hr, leave the site immediately and contact ODH BEHR.

3.5 Monitor for radiation in accordance with FSOP 1.1, Initial Site Entry and the site-specific health and safety plan (if one is available).

4.0 Procedure Cautions

4.1 Review the meter's manual for operating and calibration instructions prior to use.

4.2 The meter should be cleaned and calibrated annually by an equipment service center authorized by the State of Ohio emergency management agency (EMA) or recommended by the meter's manufacturer.

4.3 Always transport the meter in its protective case.

4.4 Remove the batteries to prevent potential damage if the meter is not going to be used for an extended time period.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Instrument with operation manual
6.2 Spare batteries
6.3 Logbook, log sheets or appropriate field form
6.4 Pens or markers
6.5 PPE appropriate for site-specific work activities

7.0 Procedures

7.1 Consult the user's manual for both general and instrument-specific operating procedures prior to using the meter.

7.2 Be sure the meter is functional (*i.e.,* batteries are fresh) before use.

7.3 Prior to site entry, turn on the instrument and check the display, calibration date, and operation (using a reference source, if available). If the instrument is equipped with an alarm, ensure the alarm is set at 2 millirem/hr.

7.4 Establish background by taking readings prior to site entry.

7.5 Initiate monitoring upon initial site entry and continue to monitor during the site visit. If gamma radiation is less than 2 millirem/hr, continue monitoring. If gamma radiation measured at any location exceeds 2 millirem/hr, leave the site immediately and contact the ODH BEHR at (614) 466-1390.

7.6 Observe and record the instrument readings as appropriate.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

None

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

Ohio Administrative Code 3701:1-38-13

<u>X-Ray Fluorescence Analyzer</u>
FSOP 3.1.7 (February 26, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 The X-Ray Fluorescence (XRF) Analyzer is a handheld energy dispersive X-Ray fluorescence spectrometer. The XRF easily and quickly identifies and quantifies elements over a wide dynamic concentration range.

1.2 This instrument is a screening tool for the identification and quantitative analysis of the following elements:

titanium (Ti)	chromium (Cr)	manganese (Mn)
iron (Fe)	cobalt (Co)	nickel (Ni)
copper (Cu)	zinc (Zn)	mercury (Hg)
arsenic (As)	lead (Pb)	selenium (Se)
rubidium (Rb)	strontium (Sr)	zirconium (Zr)
molybdenum (Mo)	silver (Ag)	cadmium (Cd)
tin (Sn)	antimony (Sb)	barium (Ba)

XRF is suggested to be used with confirmatory analysis using other techniques, (*e.g.,* flame atomic absorption spectrometry (FLAA), graphite furnace atomic absorption spectrometry (GFAA), inductively coupled plasma-atomic emission spectrometry, (ICP-AES), or inductively coupled plasma-mass spectrometry, (ICP-MS)).

1.3 The method sensitivity or lower limit of detection depends on several factors including the analyte of interest, the type of detector used, the type of excitation source, the strength of the excitation source, count times used to irradiate the sample, physical matrix effects, chemical matrix effects and interelement spectral interferences.

1.4 Use of this method is restricted to use by, or under the supervision of, personnel appropriately experienced and trained in the use and operation of an XRF instrument. Each operator/analyst must demonstrate the ability to generate acceptable results with this method. Each operator/analyst must be enrolled in a radiation monitoring program and issued a personal dosimeter.

1.5 The primary guidance for the performance of field-portable XRF analysis is U.S. EPA Method 6200, Field Portable X-RAY Fluroescence Spectrometry For The Determination Of Elemental Concentrations In Soil and Sediment.

2.0 Definitions

2.1 XRF: X-Ray fluorescence

2.2 Ionizing Radiation: high-energy radiation capable of producing ionization in substances through which it passes. It includes nonparticulate radiation, such as X-rays, and radiation produced by energetic charged particles, such as alpha and beta rays and neutrons.

2.3 Dosimeter: a device carried on the person for measuring the quantity of ionizing radiation to which one has been exposed, such as gamma rays.

2.4 In-situ: in its original place

3.0 Health and Safety Considerations

3.1 The X-ray source can emit dangerous levels of ionizing radiation.

3.2 When operating the instrument, operators must wear a dosimeter ring on the hand closest to the beam port. The dosimeter ring will measure any accumulated radiation received while using the analyzer. The dosimeter is a means to assure the device is being used in a safe manner. The dosimeter will be exchanged with a new dosimeter quarterly. The dosimeter will be analyzed for radiation levels and the results given to the operator.

3.3 The X-ray beam comes out of the front nose of the analyzer. Always be aware of the direction of the analyzer's X-ray beam. Never point the instrument at yourself or anyone else when operating the device.

3.4 The X-ray tube is emitting X-rays when the trigger is depressed and the "X-Ray – ON" lights are illuminated. These lights should go off when the analysis is completed and the trigger is released. If they stay on, immediately cease using the device, disconnect the battery, and contact the manufacturer.

3.5 Never put any part of your body forward of the trigger during the test.

3.6 Never activate the device with anyone within a three-foot radius of the device. If anyone enters this zone, immediately cease testing until the three-foot radius is established.

3.7 NEVER TEST A SAMPLE BY HOLDING IT IN YOUR HAND!

3.8 If any operational irregularities are experienced with the device, immediately cease its use, disconnect the battery, and contact the manufacturer.

3.9 Untrained personnel and minors are forbidden from operating the device.

4.0 Procedure Cautions

4.1 Physical matrix effects result from variations in the physical character of the sample. These variations may include such parameters as particle size, uniformity, homogeneity and surface condition. For example, if any analyte exists in the form of very fine particles in a coarser-grained matrix, the analyte's concentration measured by the XRF will vary depending on how fine particles are distributed within the coarser-grained matrix. If the fine particles "settle" to the bottom of the sample cup (*i.e.,* against the cup window), the analyte concentration measurement will be higher than if the fine particles are not mixed in well and stay on top of the coarser-grained particles in the sample cup. One way to reduce such error is to grind and sieve all soil samples to a uniform particle size thus reducing sample-to-sample particle size variability. Homogeneity is always a concern when dealing with soil samples. Every effort should be made to thoroughly mix and homogenize soil samples before analysis. Field studies have shown heterogeneity of the sample generally has the largest impact on comparability with confirmatory samples.

4.2 Moisture content may affect the accuracy of analysis of soil and sediment sample analyses. When the moisture content is between 5 and 20 percent, the overall error from moisture may be minimal. However, moisture content may be a major source of error when analyzing samples of surface soil or sediment that are saturated with water. This error can be minimized by air drying the samples or drying in a convection or radiant oven. Microwave drying is not recommended because field studies have shown that microwave drying can increase variability between XRF data and confirmatory analysis and because metal fragments in the sample can cause arcing to occur in a microwave.

4.3 Inconsistent positioning of samples in front of the probe window is a potential source of error because the X-ray signal decreases as the distance from the radioactive source increases. This error is minimized by maintaining the same distance between the window and each sample. For the best results, the window of the probe should be in direct contact with the sample, which means that the sample should be flat and smooth to provide a good contact surface.

4.4 Chemical matrix effects result from differences in the concentrations of interfering elements. These effects occur as either spectral interferences (peak overlaps) or as X-ray absorption and enhancement phenomena. Both effects are common in soils contaminated with heavy metals. Arsenic concentrations cannot be efficiently calculated for samples with Pb:As ratios of 10:1 or more. This high ratio of Pb to As may result in reporting of a "nondetect" or a "less than" value (e.g., < 300 ppm) for As, regardless of the actual concentration present.

5.0 Personnel Qualifications

5.1 Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

5.2 Use of this method is restricted to use by, or under supervision of, personnel appropriately experienced and trained in the use and operation of an XRF instrument. Each analyst must demonstrate the ability to generate acceptable results with this method.

6.0 Equipment and Supplies

6.1 XRF Analyzer
6.2 Polyethylene sample cups, 31 to 40 mm in diameter with collar or 4" x 4" plastic weight boats
6.3 X-ray window film Mylar™, Kapton™, Spectrolene™, polypropylene, or equivalent; 2.5 to 6.0 µm thick.
6.3 Stainless steel grinder for grinding soil and sediment samples
6.4 Sieves – No. 10-mesh (0.25 mm), stainless-steel, nylon, or equivalent for preparing soil and sediment samples
6.5 Plastic bags for collection and homogenization of soil samples
6.6 Drying oven – may be a standard radiant or a convection oven, for soil and sediment samples that require drying
6.7 Logbook, data sheets, marker, etc.

7.0 Procedures

7.1 Sample Prepartion

7.1.1 The XRF may be used to analyze in-situ samples, bagged samples and processed samples. In-situ and bagged testing can efficiently generate data very quickly, but generally are not as accurate as processed soil testing. Processed soil samples offer the best accuracy, but require more time for sample preparation.

7.1.1.1 For in-situ analysis, the XRF is placed directly onto the ground. Operators must remove any plant growth or foreign objects so that the analyzer probe is flush to the soil surface.

7.1.1.2 For bagged analysis, a soil sample is collected in a thin plastic bag and testing occurs directly through the bag. Except for a few elements – namely Cr and Ba testing through the thin plastic bag has little affect on the test result. However, concentration results for Cr and Ba may be underestimated by 20 to 30 percent.

7.1.1.3 Processed sample testing generally provides the most accurate results, because it provides the most uniform sample for testing. The greatest source of error for XRF (and all analytical techniques) is non-uniform samples. Processed sample tests require a sample to be collected, dried if necessary and sieved and ground into a powder. The processed sample is placed into a plastic bag, plastic weigh boat or XRF cup for analysis.

7.1.2 Detailed sample preparation procedures are provided in U.S. EPA Method 6200, Field Portable X-RAY Fluroescence Spectrometry For The Determination Of Elemental Concentrations In Soil and Sediment.

7.2 General Operation

7.2.1 Turn on the device by depressing the on button at the top of the analyzer. The device can only be activiated for testing after the user has logged on to the software. A system standardization test is required before any sample tesing is done.

7.2.2 The trigger must be depressed for the test to begin. The analyzer is actively testing whenever the indicator lights are blinking.

7.2.3 You must have a sample present in front of the window of the device in order to perform a test. If a sample moves from the window during a test, the instrument aborts the test. This will prevent accidental exposure to the user and bystanders to the open X-ray beam.

7.2.4 See Users Manual for additional information and detailed instructions.

8.0 Data and Records Management

8.1 An instrument log book is updated every time the instrument is used.

8.2 Data results are downloaded to a Ohio EPA’s computer network for review, evaluation, and records management purposes.

8.3 Data is presented in an electronic spreadsheet (Excel) format and allows for editing based on the user’s specific needs and/or project Data Quality Objectives.

8.4 All data are reported in parts per million (ppm) which is equivalent to milligrams/kilogram (mg/kg).

8.5 Project-specific field log sheets are created based on specified Data Quality Objectives (DQO’s).

9.0 Quality Assurance and Quality Control

9.1 Follow project-specific DQO's as defined in the site-specific work plan.

9.2 Operators do not need to calibrate the analyzer for soil testing. The analyzer is delivered with a factory calibration, generally based upon the Compton Normalization (CN) method. The CN method has been proven over the past several years to provide a robust calibration generally independent of site-specific soil matrix chemistry.

9.3 Operator-recommended quality assurance consists of periodically testing known standards to verify calibration, as well as testing blank standards to determine limits of detection and to check for sample cross-contamination or instrument contamination. Components of instrument QC:

9.3.1 An energy calibration check sample at least twice daily

9.3.2 An instrument blank for every 20 environmental samples

9.3.3 A periodic calibration verification check

9.3.4 A precision sample at least one per day

9.3.5 A confirmatory sample for every 10 to 20 environmental samples

9.4 Energy Calibration Check: The XRF analyzer performs this automatically; this is the purpose of the standardization check when the analyzer is started. The software does not allow the analyzer to be used if the standardization is not completed.

9.5 Instrument Blank: The operator should use the SiO_2 (silicon dioxide) blank provided with the analyzer. The purpose of this test is to verify that there is no contamination on the analyzer window or other component that is seen by the X-rays. The manufacturer recommends an instrument blank at least once per day, preferably every 20 samples.

9.6 Calibration Verification: The manufacturer provides standard reference samples for periodic calibration checks by operator. The operator should perform a test on a standard to verify relative response is within acceptable range. The difference between the XRF result for an element and the value of the standard should be 20 percent or less. As a result of the factory calibration, the calibration verification frequency will vary. This verification will take place on a daily basis when the instrument is in use.

9.7 Precision Verification: At least one precision sample run per day should be performed by conducting from 7 to 10 replicate measurements of the sample. The precision is assessed by calculating a relative percent difference (RPD) of the replicate measurements for the analyte. The RPD values should be less than 20 percent for most analytes, except chromium, for which the value should be less than 30 percent. The frequency of the precision verification may be based on project-specific needs.

9.8 The manufacturer strongly recommends that operators compare only processed sample results to fixed-base laboratory results. This is because processed-sample results yield the best possible accuracy with a portable XRF.

9.9 To compare XRF and fixed-base laboratory analytical results, use the following procedure:

9.9.1 Collect and prepare the sample as follows:

9.9.1.1 Collect at least 100 g of sample.

9.9.1.2 Dry the sample (air dry or use an oven).
9.9.1.3 Remove any obvious rocks, pebbles and organic material (*e.g.,* wood).

9.9.1.4 It may be necessary to break apart clumps of soil with a rubber mallet.

9.9.1.5 Sieve the ground sample through a No. 10 (2 mm) sieve.

9.9.1.6 Grind the dried sample using a grinder or a mortar and pestle.

9.9.1.7 Sieve the ground sample through a No. 60 (250 um) sieve.

9.9.2 Take a sub-sample (5-10 grams) of the fully-prepared sample, place it into an XRF cup and perform at least two analyses on the sample.

9.9.3 Send the same XRF sample to the fixed-based laboratory for analysis.

9.9.4 The laboratory must use a total-digestion method for sample prep. If the laboratory does not use this method all of the elemental metal from the sample may not be extracted. In this case, the lab result will be lower than the XRF result. Incomplete sample digestion is one of the most common sources of laboratory error, thus it is very important to request a total digestion method.

10.0 Attachments

None

11.0 References

User Manual Delta™ Family: Handheld XRF Analyzers

U.S. EPA Method 6200, Field Portable X-RAY Fluroescence Spectrometry For The Determination Of Elemental Concentrations In Soil and Sediment

Global Positioning System Receivers
FSOP 4.1 (March 16, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Global Positioning System (GPS) technology is an effective method to memorialize sample locations and site features, establish elevations, refine site topography, estimate material volumes, create sample grids and locate historic land features. These are advanced applications and require consultation with the appropriate user manual (see Section 11.0) and/or training sessions with an authorized trainer. Coordinates for sampling locations should be established and recorded when possible.

Ohio EPA-DERR utilizes two grades of GPS devices manufactured by Trimble®, Survey Grade and Mapping Grade. The site-specific work plan and/or data quality objectives will determine which grade of instrument is required for the project.

1.1.1 Survey Grade: A Trimble® R8 GPS is used to collect coordinates which require sub-centimeter accuracy. It is utilized to collect elevations and topography data, to estimate earth or fill material volumes and to create sample grids. For samples that are very close together, or where accurate elevations are important, the R8 is the preferred GPS instrument. Advanced training is required to operate this instrument.

1.1.2 Mapping Grade: A Trimble® Geo Series handheld unit is used when performing general mapping functions where sub-centimeter accuracy is not needed. Accuracy for this instrument ranges from sub-meter to sub-foot. Historic background aerial images can be loaded into this unit to help locate historic features in the field. Current aerial images are also helpful for sample planning and placement.

2.0 Definitions

Global Positioning System (GPS): A satellite-based system that transmits signals received by ground based receivers to establish location.

3.0 Health and Safety Considerations

3.1 GPS units may be mounted on metal antenna masts or backpacks. Due to lightning strike hazards, do not use GPS when thunderstorms are expected.

3.2 Be aware of trip and fall hazards when performing a GPS survey.

3.3 Refer to the site health and safety plan (HASP) for site-specific safety concerns.

4.0 Procedure Cautions

4.1 Handle the antenna and mast with care, especially when transporting the instrument.

4.2 Tree canopies and buildings may block satellite signals making it difficult to collect GPS survey data.

5.0 Personnel Qualifications

5.1 Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

5.2 Ohio EPA staff who perform GPS surveying must receive specialized training to operate and maintain GPS equipment, and in particular survey grade equipment.

6.0 Equipment and Supplies

6.1 GPS instrumentation
6.2 Antenna mast or backpack if required
6.3 Mobile hotspot if required for dialing into correctional network

7.0 Procedures

7.1 Turn the GPS on under an unobstructed view of the sky. Attach the antenna head to mast if using the R8 GPS. Refer to the manufacturer's manual for establishing connections between datalogger, wireless hotspot and GPS receiver or for general operation.

7.2 Create a new electronic file in which to collect your data. Software may vary depending on what is loaded. Typically for mapping grade units, the software is Terrasync™. For survey grade units, it is Trimble Access™. Follow the instrument manual for detailed data collection.

7.3 The GPS will initialize and start collecting satellite data. Ensure that the coordinate projection is set properly (*i.e.,* latitude/longitude, state plane). Most GIS systems at Ohio EPA accept the Ohio State Plane map datum. The projection used should be consistent with the GPS data user's needs.

7.4 Refer to the instrument manual for detailed operation instructions.

8.0 Data and Records Management

8.1 Data management is initially performed within the GPS datalogger while in the field. Upload and process raw GPS data by using Trimble Pathfinder™ (Section 11.0) or Trimble Business Center™ software. Special training by Trimble® is highly recommended to utilize Trimble® Business Center Software.

8.2 Store processed files the Ohio EPA computer network in accordance with agency document retention schedules.

9.0 Quality Assurance and Quality Control

Follow project specific data quality objectives as described in the site-specific work plan.

10.0 Attachments

Not applicable.

11.0 References

GPS:
Trimble® R8 GNSS Receiver User Guide
Trimble® GeoExplorer 6000 Series User Guide
Trimble® Geo-7X User Guide

Software:
TerraSync™ Software, Getting Started Guide
GPS Pathfinder™ Office Software, Getting Started Guide

Down-Hole Well Cameras
FSOP 4.2 (March 16, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Down-hole well cameras are used to record video and photographs in well casings or open boreholes. Ohio EPA DERR owns a Well-VU™ 1.75-inch diameter down-hole camera attached to 300 feet of coaxial cable which is connected to a Digital Video Recorder (DVR). The DVR can digitally record photos and video. The procedures in this FSOP are for the Well-Vu™ camera.

1.2 The well camera is used for viewing open boreholes or inspecting the integrity of monitoring, remediation or ground water supply wells. The downhole well camera can be used to quickly and accurately identify the following conditions in wells and open borings:

- Foreign objects or obstructions
- Damaged or obstructed well casings
- Silted/clogged screened or open-borehole intervals (in bedrock wells)
- Biofilms on well screens
- Changes in bedrock type and bedrock fracture zones

This information can be used to help evaluate the following concerns:

- If a well is in proper hydraulic communication with an aquifer or saturated zone
- If a representative ground water sample can be collected from a well
- When a well should be redeveloped
- Whether or not a damaged well can be repaired or needs to be replaced
- How a well should be constructed, especially with regards to screen interval placement

2.0 Definitions

Secure Digital (SD) Card: computer card designed to provide high-capacity memory for digital recording devices

3.0 Health and Safety Considerations

3.1 Refer to the site health and safety plan (HASP) for site-specific safety concerns.

3.2 If concerns exist regarding potentially toxic or explosive atmospheres within a well, open the well and screen the atmosphere (1) within the breathing zone above the open well casing and (2) within the well casing with a photoionization detector (PID) and/or lower explosive level/oxygen (LEL/O_2) meter.

4.0 Procedure Cautions

4.1 Well casings or open boreholes must be at least 2 inches inside diameter to use the camera.

4.2 Do not lower the camera into a water supply wells or other wells containing potential objects that may tangle or bind the well camera cable (*e.g.,* pump, piping, electrical wire, stabilizers, etc.). If the camera must be used in such wells, the pump and plumbing may need to be temporarily removed first, which usually requires the services of a registered water well drilling contractor. Additional disinfection of the well and/or downhole equipment may be required by the county or local health department that has jurisdiction over the well.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 Well camera and reel
6.2 DVR
6.3 Tripod and associated accessories
6.4 Tools to open wells
6.5 Decontamination supplies

7.0 Procedures

7.1 If required by the site-specific work plan or health and safety plan, or if concerns exist regarding potentially toxic or explosive atmospheres within the well, monitor the breathing zone above the open well casing and the well casing atmosphere with a photoionization detector (PID), multiple gas detection meter (with LEL/O^2 capabilities) or other required instrument. Breathing zone action levels are provided in Table 1 of FSOP 1.1, Initial Site Entry. Monitoring may need to continue during purging and sampling activities. Additionally, if the LEL is exceeded inside the well casing, allow the open well to ventilate and measure the LEL again. Allow the LEL concentration to drop to below the LEL before placing instrumentation or sampling devices inside the well. Refer to FSOP 3.1.1, Photoionization Detector and FSOP 3.1.2, Multiple Gas Detection Meter for use and operation of these instruments.

7.2 Connect the well camera to the DVR. Refer to the Well-Vu™ Setup Guide for camera set-up and use.

7.3 Position the tripod over the well and hang the pulley from the tripod.

7.4 Run the coaxial cable through the pulley and position the camera at top of the well casing or near the top of the open borehole.

7.5 Turn on the DVR and make sure the camera lights are on.

7.6 The well camera should be in “Viewing Mode”.

7.7 To collect video:

7.7.1 A video icon should be visible in the upper left-hand corner of the screen. If not, press “Menu” / “Recorder Settings” / “Work Mode” and select “Video”.

7.7.2 Return to “Viewing Mode” and press the “Record” button.

7.7.3 Slowly lower the camera into well while recording.

7.8 To take photographs:

7.8.1 Press the “Menu” button.

7.8.2 Press “Recorder Settings.”

7.8.3 Press “Work Mode” and switch to “Camera.” The video icon in the upper left corner of the screen changes to a camera icon.

7.8.4 Return to “Viewing Mode”, lower the camera and press the “Record” button to take a photograph.

7.8.5 For additional detailed instructions refer to the Well-Vu™ Digital Command Console User’s Guide.

7.9 Decontaminate the downhole camera and coaxial cable between well or boring locations in accordance with FSOP 1.6, Sampling Equipment Decontamination.

8.0 Data and Records Management

Video and photo data is recorded onto an SD card. Download videos and photos from this card. Follow FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Follow project specific data quality objectives as described in the site-specific work plan (SSWP).

10.0 Attachments

Not applicable.

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 1.6, Sampling Equipment Decontamination

FSOP 3.1, Photoionization Detector

FSOP 3.2, Multiple Gas Detection Meter

Well-Vu™ Setup Manual

Well-Vu™ Digital Video Command Console User's Guide

Magnetic Locating Instruments
FSOP 4.3 (March 16, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

Magnetic locating instruments are used to detect ferrous (iron or steel) objects such as buried drums, pipes, survey markers, manholes, septic tanks, well casings and scrap metal. Ohio EPA owns a Schönstedt GA-52C magnetic locator. This unit can detect objects to a depth of approximately 10 feet below the ground surface. The detector will not detect nonmagnetic metals such as aluminum, copper, chromium, lead or zinc. The procedures described in this FSOP are for magnetic locators in general and the Schönstedt GA-52C magnetic locator in particular. Procedures for other magnetic locators may vary. The owner's manual for each instrument should be consulted.

2.0 Definitions

Not applicable

3.0 Health and Safety Considerations

3.1 Magnetic locators are never to be used for subsurface utility clearance. The GA-52C locator is not designed for this purpose, and DERR staff are neither authorized nor trained to perform utility clearance. Refer to FSOP 1.2, Utility Clearance, to clear locations for drilling or excavation.

3.2 The GA-52C is not intrinsically safe.

3.3 The instrument should not be immersed in water or allowed to become excessively wet.

3.4 Follow manufacturer's recommendation for safe use of this product (refer to the operation manual).

3.5 Refer to the site-specific health and safety plan for any site-specific concerns.

4.0 Procedure Cautions

4.1 The user should be familiar with the operation of the instrument. Refer to the attached instrument manual for operating instructions prior to use.

4.2 If possible, the instrument operator should remove any ferrous metal (iron or steel) objects from themselves prior to using the instrument as the metal may interfere with an accurate reading. This may include protective work boots that have steel components ("steel toed" or "steel shank") as opposed to plastic or other materials.

5.0 Personnel Qualifications

Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

6.0 Equipment and Supplies

6.1 The Schönstedt GS-52C unit
6.2 Four “C” size batteries
6.3 Field book or log sheet and pen

7.0 Procedures

7.1 Turn the unit on using the circular knob and adjust the volume by rotating the control in a clockwise direction.

7.2 Using the wedge-shaped sensitivity control, adjust the sensitivity to mid-range. Calibration is not necessary.

7.3 Hold the detector by the detecting tube just below the control box.

7.4 Gently sweep the detector from side to side at approximately ground level. Hold the detector away from your feet if wearing steel-toed boots.

7.5 When detector comes within range of an iron or steel object, a gradual increase in signal frequency and intensity will be heard from the instrument speaker. After a metal object is detected, hold the locator vertically (with the control box up) and move it back and forth over the suspected area in an "X" pattern. The highest frequency signal will be heard directly over a vertically oriented target and over the ends of a horizontal target. Refer to Figure 1:

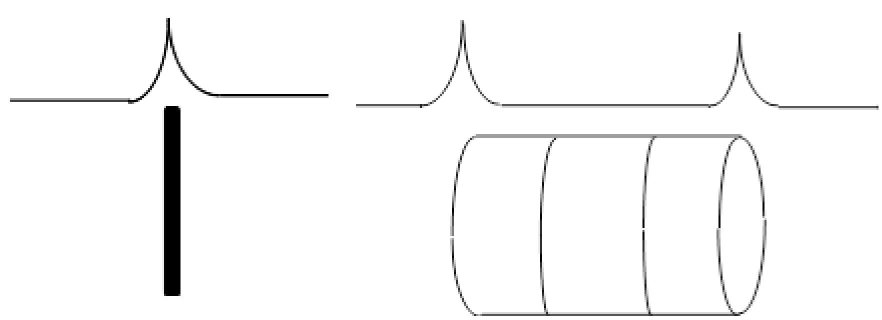


Figure 1: Frequency Spikes

7.6 If there is excessive background noise from small objects such as nails, raise the tip of the detector further above the ground to reduce the background noise and focus on larger buried objects.

7.7 Mark the locations of the buried metal either using a flag or marking paint or collect GPS coordinates with a hand-held GPS unit in accordance with FSOP 4.1, Global Positioning Systems.

7.8 When surveying is completed, turn off the unit, remove the batteries and return the instrument to its protective case.

7.9 The instrument does not require any maintenance except for battery changes.

8.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

Not applicable

10.0 Attachments

An electronic copy of the Model GA-52Cx instruction manual is available upon request.

11.0 References

FSOP 1.2, Utility Clearance

FSOP 1.3, Field Documentation

FSOP 4.1, Global Positioning Systems

Schönstedt Instrument Company Instruction Manual, Model GA-52Cx

Electromagnetic Geophysical Sensors
FSOP 4.4 (March 16, 2021)
Ohio EPA Division of Environmental Response and Revitalization

1.0 Scope and Applicability

1.1 Electromagnetic geophysical sensors can be used to identify areas of elevated soil conductivity that may be associated with buried waste materials or releases of hazardous substances. Ohio EPA owns a Geophex Ltd. GEM-2 electromagnetic sensor. The procedures described in this FSOP are for electromagnetic sensors in general and the GEM-2 in particular. Depending on circumstances and site conditions, GEM-2 geophysical surveys may help facilitate the following site assessment activities:

- Locating suspected underground storage tanks (USTs) and other buried objects or structures (*e.g.,* drums, voids or foundations)
- Placing soil borings and monitoring wells where waste materials or hazardous substances are more likely to be present (*e.g.,* the presence of landfilled material)
- Understanding site geology (*e.g.,* differentiating fill from native soil, identifying lateral changes in soil type)

1.2 The GEM-2 operates by transmitting a low frequency electromagnetic field into the ground. When contacted by the primary field, subsurface materials spontaneously generate secondary electromagnetic fields that are measured by the GEM-2 receiver (Figures 1 and 2). Based on the relationship between the transmitted field and the received field, GEM-2 data can be used to estimate the bulk (apparent) conductivity of soil or fill materials. In addition, GEM-2 data can be used to estimate magnetic susceptibility, which is a measure of the ability of soil or fill materials to become magnetized. Magnetic susceptibility data are similar to magnetometer data and can be used to locate materials or structures that contain ferrous (iron-bearing) metal.

1.3 GEM-2 data is to be used be used for site screening purposes only. Geophysical data are open to interpretation and do not typically provide definitive answers regarding subsurface conditions.

1.4 GEM-2 surveys are performed by DERR-SIFU staff who have received specialized training to properly operate and maintain the instrument. GEM-2 data evaluation and reporting are performed by DERR personnel who have received specialized training in geophysical surveying techniques.

2.0 Definitions

2.1 Anomaly: an area of relatively high or low conductivity (compared to background conditions) that may be related to a target of interest (*e.g.,* buried drums)

2.2 Apparent Conductivity: conductivity measured in millisiemens per meter (mS/m) at a given height above the earth; in general, apparent conductivity is less than the conductivity measured at the ground surface due to the airspace between the GEM-2 and the ground; apparent conductivity is also a measure of the bulk conductivity of the earth below the instrument

2.3 Conductivity: the ratio of electrical current flow to the applied voltage per unit length, measured mS/m.

2.4 Electromagnetic Induction: a geophysical technique in which the primary electromagnetic field of a transmitter induces an electrical current in the earth, which produces a secondary electromagnetic field that is measured by a receiver

2.5 Magnetic Susceptibility (or Permeability): a response from the reorientation of the magnetic domains in the earth induced by the primary field of the GEM-2 receiver, which is a measure of the ability of the earth to become magnetized (dimensionless property)

2.6 Primary Field: the electromagnetic field transmitted into the ground by the GEM-2

2.7 Secondary Field: the electromagnetic ground response received by the GEM-2

3.0 Health and Safety Considerations

3.1 Follow the site-specific health and safety plan (HASP) if one is available. Otherwise follow the health and safety procedures provided by FSOP 1.1, Initial Site Entry.

3.2 Dress appropriately for anticipated weather conditions, and always have ample drinking water available when working in hot weather due to the extensive walking involved (*e.g.,* survey grid pattern). Insect repellant may be needed for protection from ticks, mosquitoes, and other biting insects in heavily wooded areas.

3.3 Use caution when clearing brush or removing other obstacles from survey areas, and wear appropriate personal protective equipment (PPE), including but not limited to safety glasses or goggles and hard hats. Steel-toed boots may induce an anomaly during data collection.

4.0 Procedure Cautions

4.1 The GEM-2 must never be used for subsurface utility clearance. The instrument is not designed for this purpose, and DERR staff are neither authorized nor trained to perform utility clearance. Refer to FSOP 1.2, Utility Clearance to clear locations for drilling or excavation.

4.2 The GEM-2 may not operate properly under rainy weather conditions or high humidity.

4.3 GEM-2 surveys are difficult to perform (and may not provide usable data) under the following site conditions:

- Steep slopes
- Heavily wooded areas with thick brush
- Areas within buildings or other structures

- Areas with high levels of electromagnetic interference (*e.g.,* junkyards or the central areas of landfills)
- In close vicinity to large metal objects/structures or operating equipment that create high levels of electromagnetic interference (*e.g.,* vehicles, metal buildings, generators[1]).

5.0 Personnel Qualifications

5.1 Ohio EPA personnel working at sites that fall under the scope of OSHA's hazardous waste operations and emergency response standard (29 CFR 1910.120) must meet the training requirements described in that standard.

5.2 Personnel must receive specialized training to operate and maintain the GEM-2 or to evaluate GEM-2 data and prepare reports.

6.0 Equipment and Supplies

6.1 GEM-2 electromagnetic sensor and associated equipment (Trimble® GPS receiver, additional charged batteries)

6.2 Field laptop computer with cables to download GEM-2 data files

6.3 Geophysical field notebook, GEM-2 electromagnetic survey field forms, pens and markers

6.4 Power inverter (to run laptop)

6.5 Traffic cones

6.6 300 ft measuring tapes (at least four)

6.7 Flags, survey pins and marking paint

6.8 Hand tools to clear brush (axes, saws, machetes)

6.9 Tool box

6.10 Other surveying supplies as needed based on site conditions

6.11 GPS unit

7.0 Procedures

7.1 Scope of Work Development and Project Planning

7.1.1 Prior to performing a GEM-2 survey, the survey requestor needs to develop project objectives and a scope of work. DERR-SIFU staff can assist with this task and scheduling a project pre-meeting (or conference call) is recommended. The initial contact is the DERR-SIFU supervisor.

---

[1] Electrical fields from overhead power lines and transformers do not adversely affect GEM-2 surveys because the frequencies used by the instrument are out-of-phase with power line frequencies.

7.1.2 The survey requestor will arrange site access and provide DERR-SIFU staff a copy of the access agreement. Geophysical survey work cannot be performed until consent to access is obtained.

7.1.3 The survey requestor and DERR-SIFU will agree on survey and deliverable (report) dates.

7.2 Surveying

7.2.1 GEM-2 surveys will be conducted on the agreed-upon dates unless surveying cannot be performed due to inclement weather (heavy rain), site access or other unforeseen circumstances.

7.2.2 DERR-SIFU staff will design and perform the survey based the requestor's objectives and scope of work. Surveys are performed in a manner that maximizes the potential for locating targets of interest (anomalies) while minimizing potential electromagnetic interference. Typically, survey areas are gridded using measuring tapes and traffic cones or flags. The GEM-2 is capable of simultaneously running multiple frequencies (primary fields) to evaluate multiple depth intervals, and DERR-SIFU staff select frequencies based on the project objectives and site conditions. The maximum depth of investigation ranges between 15 and 100 feet depending on the frequencies used and the site conditions. DERR-SIFU staff generally can survey between two and four acres of area per eight-hour day, depending on site conditions.

7.3 Data Evaluation and Reporting Options

7.3.1 Field-Screening Only:

The "field-screening only" option includes in-field evaluation of GEM-2 data using a laptop computer. DERR-SIFU staff can prepare "real time" maps of apparent conductivity and magnetic susceptibility during surveying to locate anomalies (examples provided in Figures 3 and 4). A report is not prepared, but maps generated during the survey can be provided to the requestor in electronic format if requested. If requested, copies of raw data files will also be provided in electronic format.

7.3.2 Field Screening with Report:

The "field-screening with report" option includes field-screening activities as described above and a short report that includes a brief narrative describing the results of the survey, maps of apparent conductivity and magnetic susceptibility, photographs (as needed for supporting documentation), and copies of field notes. The report will be provided in electronic format. If requested, copies of raw data files will also be provided in electronic format.

8.0 Data and Records Management

Please refer to FSOP 1.3, Field Documentation.

9.0 Quality Assurance and Quality Control

9.1 DERR SIFU follows the manufacturer's (Geophex) recommendations for GEM-2 maintenance and repair.

9.2 DERR management and staff provide peer-review of draft reports.

10.0 Attachments

Not applicable

11.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.2, Utility Clearance

FSOP 1.3, Field Documentation

Geophex GEM-2 User's Manual

Huang, H., 2005, Depth of investigation for small broadband electromagnetic sensors: Geophysics, Vol. 70, No. 6 (November-December), pp. G135-G142

Won, I.J., Keiswetter, D.A., Fields, George R.A. and Sutton, L.C., 1996, GEM-2: A New Multifrequency Electromagnetic Sensor: Journal of Environmental and Engineering Geophysics, Vol. 1, Issue 2 (August), pp. 129-137

Won, I.J., and Huang, H., May 2004, Magnetometers and electro-magnetometers (Tutorial): The Leading Edge

U.S. EPA, September 1993, Use of Airborne, Surface and Borehole Geophysical Techniques at Contaminated Sites – A Reference Guide: EPA/625/R-92/007, pp. 4-1 through 4-32

U.S. EPA, June 1984, Geophysical Techniques for Sensing Buried Wastes and Waste Migration: prepared by TECHNOS, Inc. (subcontractors to Lockheed Engineering and Management Services Company, Inc.) for the Environmental Monitoring Systems Laboratory, Office of Research and Development under contract no. 68-03-3050, NTIS PB84-198449, pp. 63-90

Figure 1: GEM-2 Electromagnetic Induction Survey in Progress

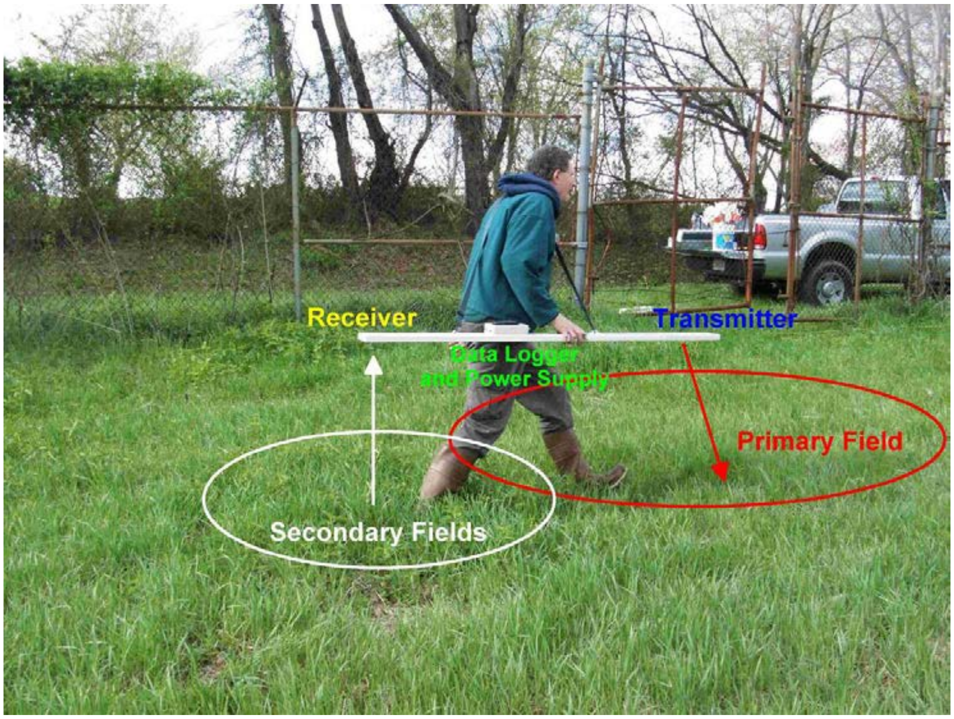


Figure 2: GEM-2 Electromagnetic Induction Survey in Progress

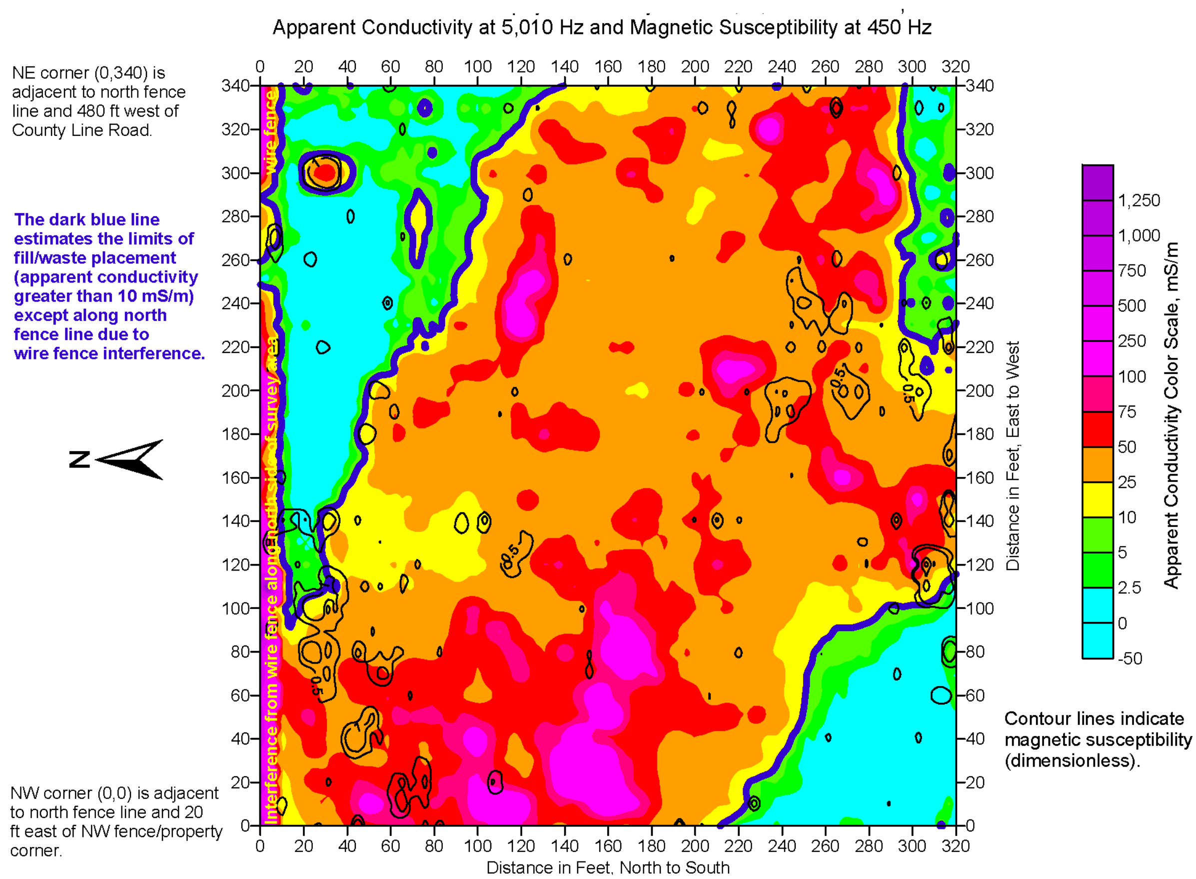


Figure 3: Example GEM-2 Geophysical Survey Map (Evaluating Former Landfill Limits of Waste Placement and High-Conductivity Target Areas for Sampling)

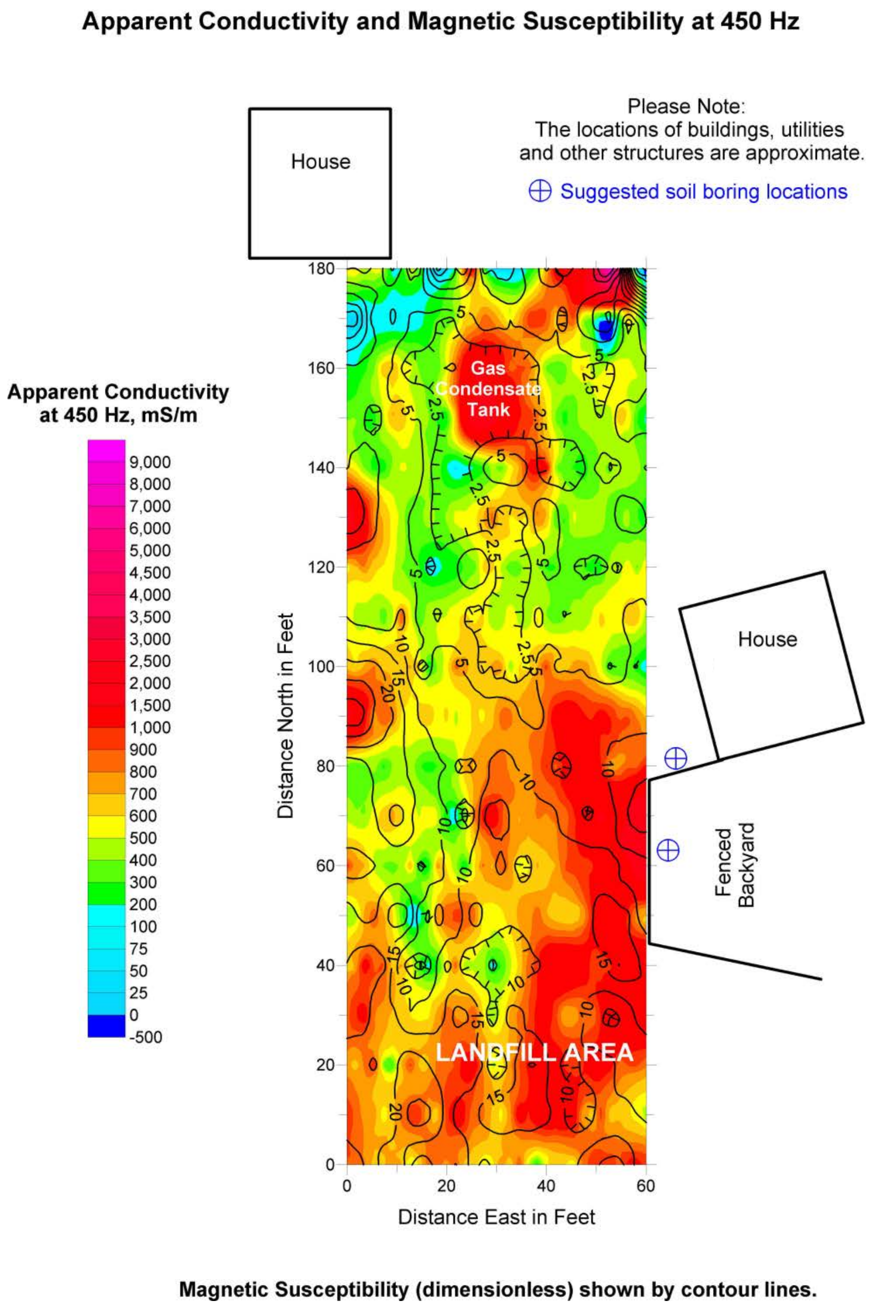


Figure 4: Example GEM-2 Geophysical Survey Map
(Evaluating High-Conductivity Target Areas for Sampling,
Residential Neighborhood Constructed over Former Landfill Area)