Ground Water Sampling (General Practices)
FSOP 2.2.4 (September 8, 2016)
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 supervisor 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 high quality 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), combustible gas indicator (CGI or LEL/O_2 meter) 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 If the well screen contains sediment accumulation greater than 5% of its length, the well may need to 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 supervisor 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. Therefore, use of a peristaltic pump is not appropriate for collecting ground water compliance samples for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), dissolved metals or dissolved gases. Peristaltic pumps may be used to collect ground water screening samples for these constituents.

4.7 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
- Chemical-resistant gloves and PPE
- Paper towels
- Decontamination equipment and supplies
- Purge water containers
- Field forms and/or log book
- 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 (bailers and/or pumps)
- Discharge 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 wasps or other vermin 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), combustible gas indicator (CGI or LEL/O^2 meter) 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.

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 saturates 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 supervisor 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) = $\mathbf{D}^2/4 \times 3.14 \times (\mathbf{Hd} - \mathbf{Hw}) \times 7.48$ 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 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

Well Diameter (Inches)	Gallons Per Foot	Milliliters Per Foot
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° 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

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. High turbidity and pH values exceeding 8 S.U. typically indicate that grout contamination is present in the well 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 Ohio EPA's Geoprobe®, 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 absolutely necessary 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 20 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

Ohio EPA, May 2012, 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

DERR Monitoring Well Sampling Log Sheet

Site_____ **Date**_____ **Pump**_____

WELL		PURGE		SAMPLE	
Well ID		**Purge Rate**		**Sample ID**	
Size	in	**Drawdown**	ft	**Duplicate ID**	
Depth to Water	ft	**Depth of Pump**	ft	**Sample Time**	
Depth to Bottom	ft	**Notes:**		**Analyses**	
Screened Interval	ft				

Stabilization Parameters

Time▶ / **Parameter**	*Initial*										
TEMP (°C)											
pH (s.u.)											
ORP (mV)											
COND (mS/cm)											
TURB (ntu)											
DO (mg/l)											

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Residential Well Log Sheet

Site Name:_____ Date: _____

Sample ID:_____ Time: _____

Duplicate
Sample ID #: _____ Time: _____

Sampled by: _____

Sample Type: FIELD DUP BKG MS/MSD

Parameters	VOA	SVOC	PEST	PCB	Metals	CN	
# Bottles							

Residential Wells	
Name:	Phone:
Address:	Number Served:
Collected From:	
System Type/Notes:	