

**APPENDIX E**

**Standard Operating Procedures**

## **STANDARD OPERATING PROCEDURE**

### **EXPLORATORY SOIL BORING LOG PREPARATION**

#### **OBJECTIVE**

The objective of this standard operating procedure (SOP) is to describe a method for the preparation of an Exploratory Soil Boring Log. This log documents the subsurface information at the time of drilling. The level of detail required for soil classification will be based on project-specific considerations; however, the boring log procedures and required information described in the following sections will be the minimum. A blank boring log form is provided in Appendix C.

The exploratory borings will be installed by a subcontractor using a drill or push-probe rig. Soil sampling intervals will be based on project-specific considerations. Soil samples will be collected using a split-spoon (SPT) or push-probe sampler.

#### **MATERIALS**

- Exploratory soil boring log
- USCS visual-manual soil identification flow chart
- Hand lens (optional)
- Health and safety equipment

#### **PROCEDURE**

During drilling, the site geologist will log all pertinent information on a standard soil boring log form. Two general types of information will be collected:

1. **Stratigraphic Information:** A continuous log of subsurface materials encountered during drilling will be recorded. The site geologist will classify the soil in accordance with the Unified Soil Classification System (USCS), and note all significant stratigraphic contacts and geologic features. The site geologist will also note the color, plasticity, moisture content, density/compaction, and other project-specific information.
2. **Hydrogeologic Information:** A continuous log of soil moisture and/or saturated conditions will be recorded during drilling. The primary purpose is to obtain information that is only available during drilling regarding zones of saturation. In addition, a static water level will be collected at the beginning and end of each working day.

The exploratory soil boring log will include, at a minimum, the following items:

- Project name and number
- Boring or well number
- Boring location
- Date and time started/finished
- Name of drilling contractor
- Geologist's name
- Ground surface elevation (estimated)
- Drilling method and equipment

- Hole diameter
- Casing size
- Soil sampling method
- Depth of soil sample below grade
- Soil sample interval
- Soil sample type
- Percentage of soil sample recovered
- Geologic observations (soil description and classification)
- Graphic soil symbols
- Graphic representation of stratigraphic contacts
- Blow counts/advance rate
- Total depth of boring
- Headspace reading, if applicable
- Observations on groundwater: Degree of saturation, drill stem wet or dry, etc.
- Static water level, time of observation, total depth of boring and drive casing at time of observation.
- Well installation data (reported on separate Monitoring Well Field Installation Log)
- Borehole abandonment information, if applicable

#### **NOTES**

All drilling activities and other pertinent site information will be recorded in the field notebook. Field notes will include, at a minimum, the following:

- Project name and number
- Date
- Weather conditions
- Personnel on-site
- Any problems or corrective actions
- Any other information that will allow reconstruction of pertinent field activities without relying on personal memory

Soil samples will be retained for verification purposes until the boring log is finalized. If sampling for chemical analysis is required, sample collection and handling procedures will be determined prior to drilling activities. Drilling and logging activities will be performed under appropriate health and safety procedures.

## STANDARD OPERATING PROCEDURE SOIL AND SEDIMENT SAMPLING

### OBJECTIVES

The objective of this document is to describe procedures to be followed during soil sample collection. A blank soil sampling field form is provided in Appendix C.

### MATERIALS

- Field sampling forms
- QAPP
- Health and safety equipment
- Sampling tools (spoons, bowls, sample containers, paper towels, etc.)

### PROCEDURES

#### Soil Probe Sampling

A soil probe rig such as a Geoprobe, Strata-probe, or equivalent will be used to collect subsurface soil samples. This technique uses direct-push technology to drive a 2-inch diameter steel core barrel to pre-selected depths for collection of soil samples.

Soil samples will be collected using 1-inch diameter probe rods with a probe-driven soil sampling device attached to the end that retrieves discrete soil cores approximately two inches in diameter and four feet in length. Different samplers will be available to match subsurface soil conditions. Soil samples will be logged by a qualified geologist using the Unified Soil Classification System (USCS).

Soil samples will be collected using a stainless steel sampler. The sampler remains sealed by a piston tip at the end of the sample tube while it is pushed or driven to the desired depth. A piston stop-pin at the opposite end of the sampler is removed by means of extension rods inserted into the probe rods, and the sampler is driven to depth. This enables the piston to retract into the sample tube while the sample is collected.

Samples will be collected in disposable acetate sleeves. After sample collection, the probe rods will be retracted from the hole and the sample will be extruded from the sampler while it remained inside the acetate sleeve. The sleeves and end caps preserve bedding characteristics and soil moisture can be cut into sections to produce samples from discrete intervals, or cut lengthwise to produce composite samples.

The soil sample will be placed directly into labeled sampling containers provided by the analytical laboratory. Soil samples will be collected using dedicated stainless steel or polyethylene spoons. Samples for volatile organic compounds (VOCs) or gasoline range organics (GRO) analyses will be placed directly into labeled sample containers. These samples will be field preserved according to the procedure for EPA Method 5035A provided below. Samples for non-volatile analyses will be thoroughly homogenized in a dedicated stainless steel, polyethylene, or aluminum bowl prior to being placed in the appropriate sample containers. Additional soil will be placed in a self-sealing bag for in-field headspace analysis.

#### Surface Soil/Sediment Sampling

Soil samples will be collected from shallow depths (less than 2 feet) using decontaminated hand tools such as a post-hole digger or shovel to reach the desired sample depth. Once the sample depth is reached, soil sample collection will be conducted as in Soil Probe Sampling above.

Sediment samples will be collected from the top 4 inches of sediments using dedicated hand tools. The fine-grained portion of sediment at the sample location will be targeted for collection. Sediment sample collection will be completed as described in Soil Probe Sampling above.

### **Test Pit Sampling**

Soil samples will be collected from the base and sidewalls of excavated test pits. Specific sampling depths will be selected by the field geologist based on field conditions. Soil samples will be collected from the centre of the backhoe bucket at a depth at least 6-inches. Soil sample collection will be conducted as in Soil Probe Sampling. Test pits will be logged in a manner similar to that described in the SOP for Soil Boring Log Preparation.

### **Soil Boring Sampling**

Soil samples will be collected from the soil borings using a decontaminated 2.5-inch I.D. split-spoon (SPT) sampler. Soil samples will generally be collected at 2.5 feet intervals to the planned depth of the borings. Once the sampling depth is reached for each sample, the SPT sampler will be driven 1 foot into the undisturbed soil at the base of the boring. The sampler will then be retrieved and opened for sample logging and field screening. Selected soil samples will be placed into the appropriate sample containers using the same methods as in Soil Probe Sampling above.

### **Samples for Volatiles Analysis using EPA Method 5035A**

All soil samples for VOCs or GRO analysis will be collected using EPA Method 5035A. This method may involve field preservation using pre-weighed 40-mL vials that contain a pre-measured quantity of preservative. An alternate method is to use a proprietary disposable sample coring device such as an EnCore™ sampler. When using a disposable coring sampler, the sample is collected into the disposable coring container using the proprietary sampling tool, capped tightly, and returned to the laboratory within 48 hours for preservation and analysis.

For the field preservation method, a prescribed mass of soil is collected using a hand-held coring device and is placed directly into the sample vial with as little disturbance as possible. Soil mass and preservative volume requirements are laboratory specific. Typically, 10 grams of soil are required and are placed into vials pre-preserved with 10-mL of methanol. The pre-preserved vials are weighed in the laboratory and the weights are recorded on the sample label. Specific field procedures are as follows:

1. Calibrate the field balance and reweigh the laboratory-supplied vials. The field balance should be sensitive to +/- 0.1 grams. If the difference between the laboratory tare weight and the field weight is > 0.2 grams, do not use the vial.
2. Prepare a methanol blank by leaving a blank methanol vial open during collection of a soil sample to check for atmospheric VOCs. When sample collection is complete, cap the vial and ship it to the lab for analysis along with the other samples. Prepare at least one methanol blank per sample cooler.
3. Collect the soil sample using a pre-calibrated syringe. Several syringe types are currently commercially available. Collect the sample from undisturbed soil on a freshly-exposed surface. If the soil type is such that the syringe will not penetrate, use a dedicated stainless steel spoon to collect the sample. Extrude (or place) the sample gently into the vial. Reweigh the vial; the target soil weight is 5 +/- 0.5 grams. The desired ratio of grams soil to mL methanol is 1:1 with a +/- 25 % tolerance. In all cases, the soil sample must be completely immersed in methanol. Collect as many vials as required by the laboratory (typically one to two).

4. Record sample information on the sample label applied by the laboratory. Do not place an additional label on the vial as this will alter the tare weight and affect the analytical results.
5. For each sample, collect a full 40 mL-vial for moisture content analysis. Fill the vial so no headspace is present.

### **Sample Handling**

Samples for chemical analysis will be stored at 4 (+/- 2) degrees C, and shipped or hand carried under chain-of-custody procedures to the analytical laboratory.

### **Headspace Measurements**

During sampling operations, a field photoionization detector (PID) will be used to measure for the presence of VOCs vapors in the soil. For each sample, approximately 200 to 300 grams of soil will be collected and placed in a self-sealing bag. After approximately 10 minutes, during which the bag will be warmed in the sun and shaken, the intake tip of the PID will be inserted through the seal and the highest concentration of VOCs measured will be recorded on the field form. The PID will be calibrated to 100 ppm isobutylene at the beginning of the field day.

### **Decontamination**

All drilling tools, non-disposable soil sampling equipment, and excavator buckets will be decontaminated prior to commencing sampling activities, between boring or test pit locations, and upon demobilization. Equipment will be cleaned using the method described in the Decontamination Standard Operating Procedure.

### **NOTES**

All soil sampling activities and other pertinent site information will be recorded on filed sampling forms (Appendix B). Field notes will include, at a minimum, the following:

- Project name and number
- Date
- Weather conditions
- Personnel on-site
- Sample number, depth, and time, soil classification (USCS), analyses to be performed, and number and types of sample containers
- Any other information that will allow reconstruction of pertinent field activities without relying on personal memory

## **STANDARD OPERATING PROCEDURE STATIC WATER LEVEL MEASUREMENT**

### **OBJECTIVE**

The objective of this standard operating procedure is to describe a method for collecting a static water level measurement. Measurements will be made from groundwater monitoring wells accurate to the nearest 0.01-foot from a standard reference point on the well casing.

### **MATERIALS**

The following materials are required for the collection of static water level measurements:

- Well keys
- Electronic water-level indicator
- Weighted steel tape
- Paper towels
- Deionized water
- Health and safety equipment

### **PROCEDURE**

The following steps will be taken during the collection of a static water level measurements:

1. Unlock and open well. Verify well integrity.
2. Lower electronic water level indicator to the water surface.
3. When the sounder indicates that the indicator probe has contacted water, raise and lower the probe to verify exact point at which measurement should be taken.
4. Measure the depth to water, to the nearest 0.01-foot, from the reference point (notch or mark on well casing).
5. Record the measurement, to the nearest 0.01-foot, in the field notebook or on the Groundwater Sampling Data Sheet.
6. Measure total well depth to the nearest 0.1-foot using weighted steel tape.
7. Replace well cap and close and lock protective well casing.

### **DECONTAMINATION**

The following steps will be taken during decontamination of down-hole measuring equipment:

1. While winding the equipment up from the well, thoroughly rinse with deionized water.
2. Remove excess water from the equipment with clean paper towels prior to rewinding equipment on the reel.

**Notes:** Measurements will be made under appropriate health and safety procedures.

## STANDARD OPERATING PROCEDURE GROUNDWATER SAMPLING

### OBJECTIVE

The objective of this document is to describe methods for the collection of groundwater samples from monitoring wells. Groundwater sample collection procedures include equipment cleaning, water elevation measurements, well purging, and sampling. A groundwater sampling field form is provided in Appendix C.

### MATERIALS

The following materials will be used for collection of groundwater samples:

- Sample containers
- Multi-parameters meter with flow-through cell
- Electronic water-level indicator
- Purging and sampling pump
- Filters for dissolved metals

Prior to the sampling event, all non-disposable equipment which will be placed in the well or come in contact with the groundwater sample will be decontaminated using the procedure described in the section titled "Decontamination Standard Operating Procedure."

### PROCEDURES

1. Prior to purging a monitoring well, measure the depth to water using the method described in the "Static Water Level Measurement Standard Operating Procedure."
2. Purging and sampling will be performed using a pump. Typically, the same pump used for purging is used for sampling. Groundwater samples for volatiles analysis will be collected using a decontaminated, positive-displacement down-hole pump. Non-volatiles samples may be collected using a peristaltic pump. An alternative is to purge using a peristaltic pump and collect volatiles samples using a check-valve type inertial pump or a bailer. For purging, lower the pump or sample tubing to the desired depth in the well. Purge the well by pumping at a flow rate of  $\leq 0.5$  liters per minute. Pumping rates should be adjusted so that groundwater surface drawdown stabilizes with a maximum total drawdown of less than 0.3 feet. A stable groundwater surface elevation indicates that fresh groundwater is being obtained directly from the aquifer. Check drawdown with electronic water-level indicator periodically. Record all measurements. The volume of water to be purged shall be determined by stabilization of measured parameters. Stabilization shall be considered complete when the following stabilization criteria is met over three measurement intervals of at least 3 minutes duration:

#### Purging Stabilization Criteria

Parameter	Stabilization Criteria
pH	+/- 0.1 unit
Specific conductance	+/- 3%

(Table Continues)

### **Purging Stabilization Criteria (Continued)**

---

Oxidation-reduction potential (ORP)	+/- 10 millivolts
Turbidity	+/- 10% (when greater than 10 NTUs)
Dissolved Oxygen	+/- 0.3 milligrams per liter

3. After purging is complete, begin sample collection at the purging flow rate. Ensure that the pumping rate does not exceed 0.5 liters per minute to minimize turbulence and aeration of the sample. If a bailer is used for volatiles sampling, it will be lowered gently into the well to prevent off-gassing.
4. Fill sample containers for volatile samples so that no headspace exists. After capping, invert the container and tap to verify that no air bubbles are present. For parameters other than volatile organic compounds, fill the sample container to within 2- to 5-cm of the top, in a manner to minimize aeration. When sampling for dissolved metals, filter the sample using an in-line disposable 0.45 $\mu$  filter.
5. Label all sample containers at the time of sampling. Sample labels will include the following information:
  - Project name and number
  - Sample station
  - Sample number
  - Date and time of sample collection
  - Sampler's initials
  - Analyses requested
6. Store all samples at approximately 4°C for transport to the laboratory under chain-of-custody procedures. Samples that will be analyzed for volatile organic compounds will not be placed in direct contact with ice. Upon completion of sampling, the well will be locked and secured.

### **DECONTAMINATION**

During field sampling, all equipment surfaces placed in well or in contact with groundwater samples will be cleaned before purging and sampling the next well. Plastic sheeting will be placed around the well-head to keep work area clean. The equipment will be cleaned using the method described in the "Decontamination Standard Operating Procedure."

## **STANDARD OPERATING PROCEDURE DECONTAMINATION**

### **OBJECTIVE**

The objective of this document is to describe decontamination procedures to be followed during the performance of field activities. Dedicated, disposable sampling equipment (such as spoons, bowls, and tubing) will not require decontamination

### **MATERIALS**

The following materials are required for performance of equipment decontamination:

- Scrub brush
- Alconox or equivalent soap
- Deionized water
- Water tubs
- Health and safety equipment

### **PROCEDURES**

The following steps will be taken during decontamination of equipment and materials, which may affect sample quality:

1. Scrub with non-phosphate detergent
2. Rinse with tap water
3. Rinse thoroughly with deionized water
4. Air dry

Down-hole sampling pumps will be decontaminated using the above procedures and clean tubs or buckets that allow the pump to be immersed in the decontamination fluid. The pump will be operated for approximately 1 minute in each decontamination solution.

### **Notes:**

- Decontamination wastes will be disposed of according to project-specific considerations.
- Decontamination will be performed under Level D Health and Safety Procedures. Site-specific conditions may require additional health and safety precautions.