



**STANDARD OPERATING PROCEDURE FOR:  
SOIL SAMPLING FOR INORGANIC ANALYSES**

TVA-KIF-SOP-04

Prepared by  
Environmental Standards, Inc.  
for  
Tennessee Valley Authority  
Office of Environment and Research  
Environmental Resources and Services

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## 1.0 PURPOSE

This standard operating procedure (SOP) provides the general technical requirements and operational guidelines for collecting surface and subsurface soil samples for inorganic analysis at Kingston Fossil Plant (KIF) in Tennessee. The requirements of this procedure are applicable to project activities that involve soil sampling and the generation of residual materials.

Surface soil and subsurface soil samples will be collected using manual and/or mechanical methods including the following:

- Manual collection methods (such as hand auger systems, sampling trowels, sampling spatulas, and core samplers),
- Direct-push equipment, and
- Drilling equipment.

Field personnel conducting soil sampling activities are required to be familiar with the procedures provided in this SOP as well as standard industry practices. The requirements and guidelines for KIF surface and subsurface soil sample collection and handling using the methods listed above are included in this SOP.

## 2.0 GENERAL CONSIDERATIONS

Potential hazards associated with the planned field soil sampling tasks shall be thoroughly evaluated prior to conducting field activities. The site-specific Health and Safety Plan (HASP) provides a description of potential hazards and associated safety and control measures.

Soil sampling shall follow the guidelines provided in U.S. Environmental Protection Agency (EPA) *Soil Sampling Operating Procedure* (Document Number SESDPROC-300-R1) and EPA's SW-846 test methods.

Prior to intrusive subsurface activities (greater than one foot in depth) at residences or at locations known or suspected to have subsurface utilities, the appropriate utility notifications (National 811 One Call Center) must be made, and the dates of intrusive activities must be within the lawful dates provided by the One Call Center. The Field Team Leader should verify, to the extent practicable, that utilities have responded to the One Call Center request and have marked their respective utility. If there is uncertainty associated with potentially unmarked utilities, the Field Team Leader should suspend work until the issues can be

resolved. (This does not apply to dredge cells and some ash flow areas not associated with residences.)

Field sampling equipment shall be decontaminated in accordance with the *Decontamination of Equipment* SOP (TVA-KIF-SOP-08) prior to use. Although sampling should typically be conducted from least to most impacted, field logistics may necessitate other sample collection orders. When sampling does not proceed from least to most impacted, extra precautions must be taken to ensure that appropriate levels of decontamination are achieved.

### **3.0 PROCEDURES**

This section documents general operating procedures and methods associated with surface and subsurface soil sampling activities for inorganic analysis. In the event these procedures cannot be performed as written in this SOP, field personnel must contact the immediate supervisor to get approval for the deviation to the procedure prior to conducting sampling activities. If the immediate supervisor cannot rectify the circumstances leading to the deviation, then the immediate supervisor shall contact the Quality Assurance/Quality Control (QA/QC) Lead to determine if the deviation is acceptable from the standpoint of effecting data reliability. If the deviation is not acceptable to the QA/QC lead, then the field team must cease sampling activities until the issue associated with the deviation is resolved. Documentation of approved deviations will be recorded in the field logbook.

#### **3.1 Pre-Job Preparation**

Prior to leaving for the collection site, the Field Team Leader will ensure that the following activities have been completed.

- a. Review copies of the site-specific HASP, Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and any other applicable project work control documents.
- b. Ensure that appropriate sample bottleware has been procured for the required routine and quality control (QC) sample analyses and that the analytical laboratory has been contacted and is prepared to receive the samples.
- c. Obtain appropriate site maps with planned soil sample locations clearly labeled, if appropriate. Identify location staking and survey requirements.
- d. Verify with the Project Manager that the appropriate number of solid and liquid U.S. Department of Transportation (DOT) -approved drums or other suitable containers is available for disposal of investigation-derived soil cuttings.

- e. Obtain the equipment necessary for completing the sampling activities (see Table 1 for an example checklist of soil sampling equipment and materials).
- f. Provide the TVA Project Manager with the sampling schedule. Verify that site access and legal right-of-entry has been obtained, where required.
- g. Obtain utility clearance for subsurface excavation/penetration locations, as required.

### **3.2 Field Preparation**

The Field Team Leader will introduce the field team to the property owner, if present, upon arrival at the site. After introductions, the following steps will be performed.

- a. Locate and mark planned sampling locations and verify utility clearance prior to intrusive subsurface sampling deeper than one foot (usually conducted by Field Team Leader or a designee). Verify that the appropriate utility clearance service has marked utilities at off-site sampling locations. Confirm with the Project Manager that clearance and right-of-access permission has been obtained from the landowner(s) for off-site soil sample location access. Document all clearance activities and utility markings in the field logbook and request sign-offs from the Project Manager.
- b. Pre-identify any potential site access logistical issues. Note any slope stability, overhead obstruction, or other physical constraints that could hinder or preclude sample collection. Notify the Project Manager of any identified sample collection issues and provide recommendations for any relocation based on field observations.
- c. Establish the decontamination area away from (and preferably up wind of) potentially contaminated areas where possible. Decontaminate non-disposable sampling equipment and all downhole tools that may come in contact with the sample matrix prior to use in accordance with *Decontamination of Equipment* SOP (TVA-KIF-SOP-08).
- d. Obtain potable and deionized (DI) water for decontamination. Record the water source in the field logbook. Obtain approval for using on-site water for decontamination from the Project Manager/Technical Lead prior to use.

### **3.3 Soil Sampling Using Manual Methods**

Surface and subsurface soil sampling may be conducted using one of two general methods - manual or mechanical. The manual method involves the use of hand equipment such as hand augers, trowels, or core samplers. The following steps will be followed for soil sample collection with manual devices.

- a. Remove vegetation, rocks, leaves, debris, or other surface obstructions that may interfere with soil sample collection prior to sampling.
- b. Use a manual collection device to collect the soil sample from the appropriate sample location and depth based on either pre-determined sample intervals or field-screening techniques.
- c. Log the soil sample according to the Unified Soil Classification System (USCS) or the Burmeister Classification System in the field logbook or on project-specific soil boring logs.

### 3.3.1 Collection of Samples for Inorganic Analysis

Soil samples for analysis of inorganic constituents must be homogenized to create a representative sample. The goal of homogenization is to achieve a consistent physical appearance over the entire soil sample. Homogenization can be performed either *in-situ* (in the case of shallow soil samples) or in a decontaminated stainless-steel or glass mixing bowl/tray. Prior to homogenization, twigs, roots, leaves, rocks, and miscellaneous debris should be removed from the sample using a decontaminated stainless-steel scoop/spatula or a dedicated, disposable plastic sampling scoop. When sample quantity is limited, prioritization of analytical parameters should be determined by the Project Manager before sampling. The following sampling procedure is to be used for collection of soil samples for inorganic analysis.

- a. Conduct homogenization by mixing the sample and then quartering the sample. Once quartered, mix each quarter individually and then roll the quarters to the center and mix the entire sample again. This process should be repeated at least twice. Care should be taken to minimize contact of disposable gloves worn during sampling with soil to be sent to the laboratory.
- b. Once a consistent physical appearance over the entire sample has been obtained, transfer appropriate volumes of soil into certified clean, laboratory-supplied, preserved (if necessary) bottleneare with either a decontaminated stainless steel or glass scoop/spatula or a dedicated, disposable plastic sampling scoop.
- c. Seal the containers properly and immediately place upright on ice in a cooler.

### 3.4 Soil Sampling Using Direct-Push Technology

Direct-push technology (DPT) systems are hydraulically powered machines that use static and dynamic percussion force to advance small-diameter sampling tools to retrieve soil samples (among other sampling media). Various machines that use a range of sampling

tools for collection are available. The Macro Core Sampler (or its equivalent for other name-brand systems) will typically be utilized for Geoprobe<sup>®</sup> systems to collect soil samples.

The following section describes the procedure for collecting soil samples using DPT.

- a. Decontaminate reusable down-hole equipment prior to initiating use of the DPT system and between samples/borings (refer to TVA-KIF-SOP-08).
- b. Remove vegetation, rocks, leaves, debris, or other obstructions that interfere with soil sample collection prior to sampling. If it is necessary to relocate a sampling point, document the reason for relocation, and note the new location information in the field logbook.
- c. Thread the DPT sampler onto the leading end of a probe rod and begin advancing the probe rod to the desired sampling depth. Do not apply petroleum-based lubricants to the pipe threads to facilitate ease of connection. Advance DPT sampler approximately four to five feet at a time and then bring to the surface.
- d. Directly following core retrieval from the sample location, remove the liner containing the soil core from the DPT sampler and place the liner on plastic sheeting.
- e. Log the soil sample according to the USCS or the Burmeister Classification System in the field logbook or on project-specific soil boring logs.
- f. Collect soil samples for inorganic analysis according to the procedures in Section 3.3.1 of this SOP and the project work control documents.
- g. Reattach DPT sampler to probe rods, advance down the borehole, and drive another four to five feet. Since borehole sloughing is likely, record all observations of this collapse in the boring log. Add additional probe rods as necessary. Keep track of the rod measurements and number of rods added as the sampler is advanced such that an accurate sampling depth can be recorded. Also, note in the field logbook the difficulty/ease with which the sampler is advanced, as well as other important subsurface probing/sampling characteristics. Continue this process to the termination of the borehole.
- h. Once a case of acetate liners has been opened, place the liners in large plastic bags for storage to keep them clean until used. Place plastic bag in the cardboard box in which the liners were shipped.
- i. Place the used liners in a trash bag and dispose of them in a residual waste container.

### 3.4.1 Borehole Abandonment

Boreholes exceeding two feet in depth should be backfilled and sealed with bentonite pellets (holeplug). For borings less than two feet, backfilling the boring with native soil materials (non-impacted) is acceptable.

If bentonite pellets are used, the pellets should be poured slowly into the borehole to avoid “bridging.” Bentonite should be placed from the bottom of the boring to approximately two feet from the ground surface. Sufficient potable water should be added to hydrate the bentonite. Native soil material (non-impacted) should be placed on top of the bentonite to the ground surface.

Surface paving (such as concrete or asphalt) should be repaired using asphalt cold patch or concrete.

## 3.5 Soil Sampling Using Drilling Methods

The following section describes the procedures for collecting soil samples using hollow stem augers or other conventional drilling techniques to ensure that acceptable, consistent subsurface samples are collected for chemical analysis and physical characterization. The drilling rig and associated equipment and materials must arrive on site in a clean condition and should be free of oil, grease, and debris. The Field Team Leader will inspect the rig for any significant fluid leaks. If leaking fluids are present, the equipment will be repaired before any drilling activities begin. Once the drilling equipment passes inspection, the following procedure will be followed.

- a. Set up the decontamination area for the drill rig and associated equipment and materials such that all liquids will be collected for proper disposal. To the extent practical, perform initial decontamination away from marked boring locations and existing monitoring wells, preferably at a location away from and down-gradient of proposed boring locations and existing wells.
- b. Decontaminate reusable down-hole equipment prior to initiating drilling activities and between samples/borings in accordance with *Decontamination of Equipment* SOP (TVA-KIF-SOP-08).
- c. Remove vegetation, rocks, leaves, debris, or other surface obstructions that may interfere with soil sample collection prior to sampling. If it is necessary to relocate a sampling point, document the reason for relocation, and note the new location information in the field logbook.

- d. Collect soil samples with a split-barrel sampler (split spoon), typically at two-foot intervals, to characterize subsurface conditions.
- e. To collect intact subsurface soil samples, advance the auger in the borehole to the top of two-foot sample interval. Drive the split-barrel sampler, in six-inch increments, the length of the split spoon past the bottom of the auger into the underlying material and withdraw.
- f. Log the soil sample according to the USCS or the Burmeister Classification System in the field logbook or on project-specific soil boring logs.
- g. Collect soil samples for inorganic analysis according to the procedures presented in Section 3.3.1 of this SOP.
- h. Reattach the decontaminated split-barrel sampler to the drilling rods, advance down the borehole to the top of the next sampling interval, and repeat the process. Keep track of the rod measurements and number of rods added as the sampler is advanced such that an accurate sampling depth can be recorded. Also, note in the field logbook the difficulty/ease with which the sampler is advanced, as well as other important subsurface drilling/sampling characteristics. Continue this process to the termination of the borehole.

### 3.5.1 Borehole Abandonment

Borehole abandonment procedures have been developed for shallow boreholes that extend less than two feet into groundwater (defined as the first permanently saturated strata) and for deep boreholes that extend two feet or more into groundwater.

Boreholes that extend less than two feet into groundwater will be sealed with pelletized bentonite or a cement/bentonite grout. If bentonite pellets are used, the pellets should be poured slowly into the borehole to avoid "bridging." Bentonite should be placed from the bottom of the boring to approximately two feet from the ground surface. Sufficient potable water should be added to hydrate the bentonite. Native soil material (non-impacted) should be placed on top of the bentonite to the ground surface.

Deep boreholes that extend two feet or more into groundwater should be tremie grouted with either a bentonite slurry or a cement/bentonite grout. Bentonite slurries should consist of potable water and bentonite formed into a slurry of approximately 20% solids. Cement/bentonite grout, if used, should consist of water, Portland cement, and bentonite mixed in the following ratio - 6 gallons water:94 pounds Portland cement:2% to 8 %

bentonite. The grout mixture should be placed to approximately two feet below ground surface and covered with native soil materials.

Surface paving (such as asphalt or concrete) should be repaired using asphalt cold patch or concrete.

### **3.6 Sample Handling, Packing, and Shipping**

Chain-of-custody (COC) forms for all samples will be completed and accompany the samples in accordance with the *Field Documentation* SOP (TVA-KIF-SOP-06) and the *Sample and Equipment Labeling, Packing, and Shipping* SOP (TVA-KIF-SOP-07). Samples will be marked, labeled, packaged, and shipped in accordance with the *Sample and Equipment Labeling, Packing, and Shipping* SOP (TVA-KIF-SOP-07).

### **3.7 Field Quality Control Samples**

Field quality control (QC) samples may include equipment rinsate blanks, field duplicate samples, and matrix spike and matrix spike duplicate samples. A description of common field QC samples and the associated collection method are provided in the project-wide QAPP and the *Field Quality Control Sampling* SOP (TVA-KIF-SOP-11).

### **3.8 Field Logbook Documentation**

Field logbooks to record daily activities, including sample collection and tracking information will be maintained by the Field Team Leader. Information will be entered into the field logbook by the appropriate field team member. Entries will be made in waterproof ink. In addition to the minimum requirements discussed in the *Field Documentation* SOP (TVA-KIF-SOP-06), the field logbooks should document those sampling characteristics specific to this SOP and as defined in the applicable project work control documents.

The Field Team Leader and/or designee will review the field logbook entries on a daily basis for completeness and accuracy and indicate this review by initialing the entries. As specified in the FSP, the Field Team Leader is also responsible for the completion of all required data collection forms.

### **3.9 Decontamination and Waste Management**

All sampling and excavating equipment will be decontaminated in a manner consistent with the *Decontamination of Equipment* SOP (TVA-KIF-SOP-08). Decontamination procedures should be documented in the field logbook. Investigation-derived wastes produced during

sampling or decontamination will be managed in accordance to *Management of Investigation-Derived Waste* SOP (TVA-KIF-SOP-12).

#### 4.0 REFERENCES

- ASTM-D2487-06 ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- Burmeister Soil Classification Naming System. Modified from Principles and Techniques of Soil Identification, Proceedings of Highway Research Board, pp. 402-433, 1949.
- Tennessee Valley Authority (TVA). *Decontamination of Equipment* SOP (TVA-KIF-SOP-08), March 2009.
- TVA. *Health and Safety Plan* (HASP), Kingston site-specific plan, 2009.
- TVA. *Field Documentation* SOP (TVA-KIF-SOP-06), March 2009.
- TVA. *Field Quality Control Sampling* SOP (TVA-KIF-SOP-11), April 2009.
- TVA. *Field Sampling Plan* (FSP), 2009.
- TVA. *Management of Investigation-Derived Waste* SOP (TVA-KIF-SOP-12), March 2009.
- TVA. *Quality Assurance Project Plan* (QAPP), TVA, 2009.
- TVA. *Sample Labeling, Packing, and Shipping* SOP (TVA-KIF-SOP-07), March 2009.
- United States Environmental Protection Agency (EPA) Region 4, *Soil Sampling Operating Procedure*. Document # SESDPROC-300-R1, November 2007.
- U.S. EPA. *Test Methods for Evaluating Solid Waste Physical/Chemical Analysis* (SW-846), most recent version.
- U.S. EPA. SW-846 Method 5035, *Closed-System Purge-and-Trap Extraction for Volatile Organics in Soil and Waste Samples*, December 1996.

<b>Table 1: Soil Sampling Equipment &amp; Material Checklist</b>	
<b>Item Description</b>	<b>Check</b>
<b>Health &amp; Safety</b>	
Nitrile gloves	
Hard hat	
Steel-toed boots	
Hearing protection	
Field first-aid kit	
Eyewash	
Safety glasses	
Respirator and cartridges (if necessary)	
Saranex™/Tyvek® suits and booties (if necessary)	
<b>Soil Sampling Equipment</b>	
Portable table	
Plastic sheeting	
Safety cutter/liner opening tool	
Tape measure	
Digital camera	
Hand auger system	
Stainless steel or glass scoops or trowels	
Stainless steel or glass mixing bowl	
Disposable plastic sampling scoops	
Laboratory-supplied bottleware	
Chain-of-Custody forms and custody seals	
Packing tape	
Field logbook	
Pin flags and marking paint	
Permanent marker	
<b>Decontamination and Waste Management Equipment</b>	
DOT-approved 55-gallon drums or other appropriate containers	
Drum wrench	
Duct tape	
Rinse bottle	
Potable water	
Non-phosphate detergent	
Decontamination fluids (deionized water, nitric acid)	
Buckets or tubs	
Brushes	
Trash bags	
Paper towels	

**End of Procedure**