STANDARD OPERATING PROCEDURE FOR:

SEDIMENT SAMPLING

TVA-KIF-SOP-05, Revision 2

Prepared by
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for

Tennessee Valley Authority
Office of Environment and Research
Environmental Resources and Services

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Revision Log SOP for Sediment Sampling (TVA-KIF-SOP-05)		
Revision and Date	Page Reference	Revision Description
1, December 2009	Section 2.0	Updated with safety and JSA information. Added requirement to wear nitrile gloves Added a paragraph to require a float plan prior to using a water vessel.
	Section 3.0	Streamlined test describing role of QA/QC Lead in procedural variations.
	Section 3.1	Revised first paragraph regarding Project Manager responsibilities. Edited steps *c* and *d*. Add steps *g* and *h* on sample transport, analyses, and storage.
	Section 3.2	Added "Manual Sampling" to title.
	Section 3.3	Added "Mechanical Samplers" to title. Revised 2nd paragraph. Referenced photo-documentation SOP 26.
	Section 3.4	Added new section on procedures to follow for VibeCore sampling.
	Section 3.8	Added new section regarding photo-documentation.
	Section 4.0	Added references for *VibeCore-D Operating Manual* and *Photograph Management* SOP-26.
	Table 1	Added gravity core sampler and VibeCore-D sampler to equipment list.
28, June 2010	Section 3.4.5	Added new section on Safety Considerations while retrieving VibeCore-D core tubes.

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1.0 PURPOSE

This standard operating procedure (SOP) provides the general technical requirements and operational guidelines for collecting sediment samples at Kingston Fossil Plant (KIF) that are representative of the environment that the samples are intended to characterize.

The requirements of this SOP are applicable to sampling of sediments in streams, rivers, lakes, ponds, swamps, wetlands, and drainage ditches at KIF and surrounding areas.

2.0 GENERAL CONSIDERATIONS

Potential hazards associated with the planned tasks are thoroughly evaluated prior to conducting field activities. The *Site-Wide Safety and Health Plan* (SWSHP) provides a description of potential hazards and associated safety and control measures. Potential hazards associated with the planned tasks are thoroughly evaluated prior to conducting field activities. A pre-Job Safety Analysis (JSA) to identify potential hazards is discussed at each sampling event. Personnel use caution when collecting sediment samples and use appropriate safety equipment when working from boats. Sampling events are scheduled with the sampling coordinator and TVA Police.

Sampling personnel wear powder-free nitrile gloves while performing the procedures described in this SOP. Specifically, nitrile gloves are worn while preparing sample bottleware, preparing and decontaminating sampling equipment, collecting and processing samples, and packing samples. At a minimum, nitrile gloves are changed prior to the collection of each sample, or as necessary to prevent the possibility of cross-contamination with the sample, the sample bottleware, or the sampling equipment.

This sediment sampling SOP was developed under the guidelines provided in U.S. Environmental Protection Agency (EPA) *Sediment Sampling Operating Procedure* (Document # SESDPROC-200-R1) and EPA's SW-846 test methods.

When native sediment sampling greater than six inches deep is required, the appropriate utility notifications are made to the National 811 One Call Center. The Field Team Leader verifies, to the extent practicable, that utilities have responded to the request and have marked their respective utility. If there is uncertainty associated with potentially unmarked utilities, the Field Team Leader suspends work, immediately contacts the Project Manager, and waits until the issues can be resolved.

When collecting sediment samples for laboratory analysis, field sampling equipment is decontaminated in accordance with the *Decontamination of Equipment* SOP (TVA-KIF-SOP-08) prior to use. Although sampling is typically conducted from least to most impacted, field logistics may necessitate other sample collection orders. When sampling

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does not proceed from least to most impacted, extra precautions are taken to ensure that appropriate levels of decontamination are achieved.

Additionally, a Float Plan is completed prior to traveling anywhere on a water vessel. A Float Plan includes a description of the water vessel, specifies who is on board, provides a description of the safety equipment being carried, and indicates destination and expected time of return.

3.0 SEDIMENT SAMPLING PROCEDURES

This section documents general operating procedures and methods associated with sediment sampling activities. Any variation in these procedures is approved by the Project Manager and Quality Assurance (QA) Officer and is fully documented. Field work progresses as deviations are approved or resolved.

The sediment sampling equipment and selected methodology depend on the depth and velocity of the water and the consistency of the bottom sediments (such as soft, hard, or rocky). Care is taken when selecting equipment and designing the sampling approach to ensure that representative samples are collected.

The preferable sediment sampling location of flowing water bodies is a location downstream from a point where the water is well mixed both laterally and vertically. Sites immediately below riffle areas are excellent points to obtain sediment samples that are representative of the entire flow.

When possible, sampling proceeds from downstream to upstream locations so that disturbance related to sampling does not affect the sample quality.

The preferable sampling location of non-flowing water bodies, such as ponds and lakes, is the center of the water mass. Additionally, the water body shape, inflow pattern, bathymetry (underwater topography), and water circulation is considered when sampling sites are selected in ponds and lakes.

3.1 Pre-Job Preparation

The Project Manager is responsible for overall implementation of this SOP and ensuring that the SOP complies with current regulations and standards as these are subject to change. The Project Manager is also responsible for the following activities:

a. Obtain equipment necessary for completing the project-specific sampling activities (see Table 1 for example checklist of sediment sampling equipment and materials).

b. Ensure appropriate laboratory-provided bottleware is available for both the required analyses and for quality control (QC) samples and that there has been thorough coordination with the analytical laboratory.

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c. Provide the sampling team with sample locations and schedules.

d. Review project work control documents such as the site-specific *Quality Assurance Project Plan* (TVA-KIF-QAPP), SWSHP, and appropriate SOPs in an effort to determine the project-specific sampling requirements, procedures, and goals.

e. Verify that legal right-of-entry has been obtained and site access has been granted, where required.

f. Instruct the field team that no project information is discussed with the public and all questions are to be referred to the TVA Outreach Center.

g. Verify methods to be used to transport materials and identify appropriate laboratories to perform analyses.

h. Identify appropriate laboratory space to store samples, if necessary.

3.2 On-Shore Method (Shallow Water) – Manual Sampling

When liquid flow and depth are minimal (less than four inches) and sediment is easy to reach, a trowel or scoop may be used to collect sediment samples. This sampling technique is applicable to shallow rivers/streams, wetlands drainage ditches, or shallow portions of ponds/lakes. In general, when water is flowing or is greater than four inches in depth, a core sampler or clamshell device is used to collect the sediment sample in order to minimize the washing away of the sediment as it is retrieved through the water column. The following steps are used when collecting samples in shallow water.

a. Locate sediment sampling locations based upon the project work control documents and mark the sediment sampling locations with pin flags or survey stakes, if possible and locate with a portable Global Positioning System (GPS) unit. Document sediment sampling locations in the field logbook relative to at least two permanent fixed site features, and then conduct photo-documentation in accordance with the *Photograph Management* SOP (TVA-KIF-SOP-26).

b. Collect sediments at the appropriate depth intervals as specified in the project work control documents, using a properly decontaminated or dedicated trowel, scoop, or similar device and a plastic or tempered glass container.

Note: For metals analysis, stainless steel scoops and containers are not acceptable.

c. If necessary, subdivide the sample into appropriate depth intervals.

d. Log the sediment 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.

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3.2.1 Collection of Sediment Samples

KIF sediment sampling is generally conducted for analysis of metals; however, in some instances other non-volatile organic compounds (VOCs) (such as polychlorinated biphenyls [PCBs] or chlordane) may be analyzed in accordance with project work control documents. These non-VOC constituents are homogenized to create a representative sample. The goal of homogenization is to achieve a consistent physical appearance over the entire soil sample. When sample quantity is limited, prioritization of analytical parameters is determined by the Project Manager before sampling.

a. Remove twigs, roots, leaves, rocks, and miscellaneous debris from the sample area using a decontaminated stainless-steel scoop/spatula or a dedicated, disposable plastic sampling scoop.

b. Homogenize the sample either *in-situ* (in the case of shallow sediment samples) or in a decontaminated stainless-steel (for non-metals analysis) or glass mixing bowl/tray. Alternatively, a Teflon®-lined bowl or bucket may be used for homogenization. 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. Repeat this process at least twice. Take care to minimize contact of disposable gloves worn during sampling with sediment to be sent to the laboratory.

c. Once a consistent physical appearance over the entire sample has been obtained, transfer appropriate volumes of sediment into certified clean, laboratory-supplied, preserved (if necessary) pre-labeled bottleware with either a decontaminated stainless steel or glass scoop/spatula or a dedicated, disposable plastic sampling scoop.

d. Seal the pre-labeled containers properly, place in re-sealable plastic bags, and immediately place upright on ice in a clean cooler (see Section 3.5 of this SOP).

3.3 Off-Shore Method (Deep Water) – Mechanical Samplers

It is necessary, in some cases, to use a boat or barge to collect sediment samples. Sampling devices used to collect sediment samples from a boat or barge are selected by considering the depth and flow of the liquid above the sampling location and the bed characteristics of the water body. Usually, manual equipment (scoops and trowels) are not used for off-shore sampling—dredges, benthic samplers, or core samplers are more appropriate.

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Sediment samples collected in deep waters are normally collected using either a spring-loaded sediment dredge, benthic grab sampler, gravity core sampler, Ogeechee core sampler, or other similar equipment. The following steps are used when collecting samples in deep water.

a. Locate sediment sampling locations based upon the project work control documents. Locate sediment sampling locations using a portable GPS unit, if possible. Document locations in the field logbook and conduct photo-documentation in accordance with the *Photograph Management* SOP (TVA-KIF-SOP-26).

b. Use a properly decontaminated sampler to collect sediment samples.

c. When using a spring-loaded sediment dredge or benthic grab sampler, lower the sampler into place in an open position, and trip the sampler to close.

d. If necessary, subdivide the sample into the appropriate depth intervals when using a core sampler.

e. Log the sediment sample according to the USCS or the Burmeister Classification System in the field logbook or on project-specific soil boring logs.

3.3.1 Collection of Sediment Samples

The procedures for sediment sampling for non-VOC analysis of deep water samples are the same as that defined in Section 3.2.1 of this SOP.

3.4 Off-Shore Method (Deep Water) – VibeCore-D Sampler

The following sections describe the procedures for collecting sub-bottom profiles using the VibeCore-D in water bodies surrounding KIF. Refer to the *VibeCore-D Operating Manual* prior to use.

3.4.1 Core Tube Preparation

Core tube preparation is conducted as follows for either the aluminum/stainless-steel tube or the plastic/Lexan tube.

3.4.1.1 Aluminum/Stainless Steel Tube

a. Inspect tube for dents. Ensure that the tube end is cut cleanly and squarely and the outside of the tube end is clean and dry.

b. If cutting the tube with a tube cutter, run the cutter around the tube multiple times while applying “light” pressure. Tighten the blade after 2 or 3 cutting revolutions.

c. Use the deburring tool to remove burs and sharp edges that result when cutting the tube. Place the deburring tool blade on the inside of the tube and run it around the edge with light pressure.

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d. Place an aluminum drilling guide over the end of the core tube and secure with duct tape.

e. Mark the hole locations with permanent marker.

f. Carefully drill a starter hole with a small diameter (such as 1/8 inch) drill bit.

g. Enlarge the holes to approximately 1/4 inch.

3.4.1.2 Plastic/Lexan Tube

a. Ensure that the tube end is cut cleanly and squarely and the outside of the tube end is clean and dry.

b. Twist set screws on the core tube adapter into the tube until they are flush with the outer surface of the adapter.

c. Slide the core tube over the adapter.

d. Mark the set screw locations on the outer surface of the core tube.

e. Remove the core tube from the adapter.

f. Carefully drill a starter hole with a small diameter (for example 1/8-inch) drill bit. Take note that plastic/Lexan tubes are brittle and can crack easily when drilling.

g. Enlarge the holes to approximately 1/4 inch.

3.4.2 Core Tube Attachment

Once the core tubes are prepared, the core tube is attached to the adapter with either three set screws (metal tube) or six sets crews (plastic/Lexan tube) according to the steps below.

a. Screw the set screws into the adapter so that the head of the set screw is flush with the outer surface of the adapter.

b. Secure and seal the core tube to the adapter using electrical tape, making sure to seal over the set screws and the seam where the core tube meets the adapter. A good seal is critical to help prevent sample loss during retrieval.

c. When removing the core tube, screw in (do not unscrew) the set screws far enough to clear the core tube and allow removal of the core tube.

3.4.3 Verify Core Tube Seal

After core tube attachment, it is important to verify that the seal is secure as follows.

a. Suspend the VibeCore-D with the lifting wire that will be used for deployment.

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b. Test the air-tightness of the seal by lowering the VibeCore-D unit completely into the water and then raising it so that the bottom end of the core tube remains in the water.

c. Verify that water remains suspended in the core tube until the lower end of the core tube is raised to the surface and air is allowed to enter the bottom of the core tube. This shows that the seal to the core tube is secure.

3.4.4 Sample Collection

Once the core tubes are ready, the following procedures are used to collect samples.

a. Locate sediment sampling locations based upon the project work control documents. Locate sediment sampling locations using a portable GPS unit, document locations in the field logbook, and conduct photo-documentation in accordance with the *Photograph Management* SOP (TVA-KIF-SOP-26).

b. Deploy the VibeCore-D with the winch and cable assembly.

c. Lower the VibeCore-D until the unit reaches the sediment/ash surface.

d. Turn on the VibeCore-D and lower it slowly making sure there is always some tension on the cable.

e. When penetration stops, turn off the power to the VibeCore-D.

f. Use the lifting cable and winch to remove the VibeCore-D from the sediment/ash.

g. Continue lifting the unit until the bottom of the core tube is accessible. If necessary, install an end cap on the bottom of the core tube.

h. If it is necessary to tilt the core tube to install an end cap (in the case of long tubes), do not tilt by lifting the tube as this can damage the tube.

i. Keep the head of the VibeCore-D above the bottom of the core tube to prevent mixing the sediment/ash contained within the core tube.

j. After capping the bottom, remove the core tube by screwing the set screws into the core tube adapter until they are free of the core tube.

Note: When sampling clean, coarse sand or very soft sediments, it may be necessary to use Core Keepers to help retain the materials in the core tube. Consult the SDI *VibeCore-D Operations Manual* for additional guidance.

k. Extract the sediment/ash sample from the core tube. This can be done by either pushing the sediment/ash sample out of the core tube or by cutting the core tube open.

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l. Log the sediment sample according to the USCS or the Burmister Classification System in the field logbook or on project-specific soil boring logs.

m. Conduct photo-documentation in accordance with the *Photograph Management* SOP (TVA-KIF-SOP-26).

It is anticipated that the primary purpose of sampling sediment and ash with the VibeCore-D is to "ground truth" geophysical results. There may, however, be instances when sediment and ash samples are also collected for laboratory analysis. In these instances, the procedures for sediment sampling for non-VOC analysis of deep water samples are the same as that defined in Section 3.2.1 of this SOP.

The use of Lexan core tubes should be used if possible when collecting sediment and ash samples that will be analyzed for metals. If Lexan tubes are not available, care is taken to collect samples from the interior of the core that have not contacted the metal core tube.

3.4.5 Safety Considerations

When VibeCore-D sampling in ash deposits or sediments where slag, rocks, or hard clay is present, aluminum core tubes may become tightly lodged in the sediments and/or deflect and deform under the weight of the VibeCore-D head (Lexan/plastic tubes typically break under these conditions). A tightly lodged core tube can result in dangerous conditions due to excessive strain on the retrieval winch, cable, and rigging. Failure of any part of the retrieval system could potentially result in serious injury to the sampling crew.

In cases when this occurs, energize the vibrating head and use gentle tension to retrieve the sample tube. This procedure often results in loss of the core sample but ensures the safety of the VibeCore-D sampling personnel. In cases when vibrating does not liberate the core tube, it is better to sacrifice the VibeCore head than to risk injury to the crew.

3.5 Sample Handling, Packing, and Shipping

Samples are containerized, labeled, packaged, and shipped in accordance with the *Sample Labeling, Packing, and Shipping* SOP (TVA-KIF-SOP-07).

3.6 Field Quality Control Samples

Field QC samples may include trip blanks, 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). Determine QC sample requirements before choosing a sediment sampling device.

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3.7 Field Logbook Documentation

Field logbooks are maintained by the Field Team Leader or designee and used to record daily activities. In addition to the minimum requirements discussed in the *Field Documentation* SOP (TVA-KIF-SOP-06), the field logbooks 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 reviews the field logbook entries on a weekly basis at a minimum (daily review is preferred) for completeness and accuracy and indicates this review by initialing the entries. The Field Team Leader is responsible for completion of the required data collection forms.

3.8 Decontamination and Waste Management

Sampling equipment decontamination is performed in a manner consistent with the *Decontamination of Equipment* SOP (TVA-KIF-SOP-08). Investigation-derived wastes produced during sampling or decontamination are managed in accordance with *Management of Investigation-Derived Waste* SOP (TVA-KIF-SOP-12).

4.0 REFERENCES

- American Standards for Testing and Materials (ASTM). *ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes* (Unified Soil Classification System).
- Burmister. *Burmeister Soil Classification Naming System*. Modified from Principles and Techniques of Soil Identification, Proceedings of Highway Research Board, pp. 402-433, 1949.
- Specialty Devices, Inc. *VibeCore-D Operating Manual.* Revision 5, March 2008.
- Tennessee Valley Authority (TVA). *Field Documentation* SOP (TVA-KIF-SOP-06), February 2009.
- TVA. *Field Quality Control Sampling* SOP (TVA-KIF-SOP-11), April 2009.
- TVA. *Photograph Management for the TVA Kingston Fossil Plan Ash Recovery Project* SOP (TVA-KIF-SOP-26), October 2009.
- TVA. *Quality Assurance Project Plan for the Tennessee Valley Authority Kingston Ash Recovery Project* (TVA-KIF-QAPP), December 18, 2009.
- TVA. *Sampling Labeling, Packing, and Shipping* SOP (TVA-KIF-SOP-07), 2009.
- TVA. *Decontamination of Equipment* SOP (TVA-KIF-SOP-08), 2010.
- TVA. *Management of Investigation-Derived Waste* SOP (TVA-KIF-SOP-12), 2010.

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- TVA. *Site-Wide Safety and Health Plan for the TVA Kingston Fossil Plant Ash Release Response* (SWSHP), 2010.
- United States Environmental Protection Agency (U.S. EPA) Region 4, *Sediment Sampling Operating Procedure*. Document # SESDPROC-200-R1, November 2007.
- U.S. EPA. *Test Methods for Evaluating Solid Waste Physical/Chemical Analysis* (SW-846), most recent version.

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Table 1: Suggested Sediment Sampling Equipment and Material Checklist	
Item Description	**Check**
Health & Safety	
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)	
Sediment Sampling Equipment	
Portable GPS	
Portable table	
Plastic sheeting	
Knife/ plastic liner opening tool	
Tape measure	
Digital camera	
Sediment dredge sampler, benthic grab sampler, gravity core sampler, or similar sampling devices	
Stainless steel or glass scoops or trowels	
VibeCore-D sediment sampling device and associated equipment	
Stainless steel or glass mixing bowl	
Teflon®-lined bowls or buckets	
Disposable plastic sampling scoops	
Laboratory-supplied bottleware	
Chain-of-custody forms and custody seals	
Packing tape	
Field logbook	
Pin flags/survey stakes and marking paint	
Permanent marker	
Decontamination and Waste Management Equipment	
DOT-approved 55-gallon drums or other appropriate containers	
Drum wrench	
Duct tape	
Rinse bottle	
Potable water	
Non-phosphate-based detergent	
Decontamination fluids (deionized water, nitric acid)	
Buckets or tubs	
Brushes	
Trash bags	
Paper towels	

End of Procedure

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