Tennessee Valley Authority, 1134 Swan Pond Road Trailer Park, Harriman, Tennessee 37748

July 21, 2010

Mr. Craig Zeller
U.S. Environmental Protection Agency
Region 4
61 Forsyth Street Southwest
Atlanta, Georgia 30303

Dear Mr. Zeller:

Please find enclosed the revised Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers. The enclosed plan fulfills the commitment in the Non-Time-Critical Removal Action Embayment/Dredge Cell Action Memorandum that the Surface Water Monitoring Plan be revised to make it applicable for non-time-critical removal activities. Please contact me if you have any questions.

Sincerely,

Stephen H. McCracken
General Manger, Kingston Ash Recovery

Tennessee Valley Authority
Regulatory Submittal for Kingston Fossil Plant

Documents submitted:

Summary of Changes to Surface Water Monitoring Plan
Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers (Non-Time-Critical Removal Action)

Date Submitted:
07/21/2010

Submitted to whom
Craig Zeller

Concurrence

Received	Not Applicable	TVA
☒	☐	Steve McCracken
☒	☐	Dennis Yankee – via e-mail
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Approvals

TVA _____ Date 7/21/010

EPA _____ Date 7/23/2010

cc:

- ☒ Anda Ray, TVA
- ☒ Barbara Scott, TDEC
- ☒ Leo Francendese, EPA
- ☒ Craig Zeller, EPA
- ☒ Dennis Yankee, TVA
- ☒ Kathryn Nash, TVA
- ☒ Cynthia Anderson, TVA
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- ☒ Julie Pfeffer, Jacobs
- ☒ Steve Richardson, Jacobs
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- ☒ Greg Signer, TVA
- ☒ KIF Incident Document Control
- ☒ Katie Kline, TVA
- ☒ Dannena Bowman, EPA
- ☒ Jeff Gary, Jacobs
- ☒ Robert Pullen, Jacobs

Summary of Changes to the Surface Water Monitoring Plan
From Time-Critical to Non-Time-Critical

General

- The plan takes effect upon completion of time-critical removal action dredging operations in the Emory River and approval by EPA and TDEC.
- If there is a future requirement for a dredging operation, an operation-specific surface water monitoring plan will be prepared and submitted for approval as a part of the work plan package.
- TDEC will perform sampling and analysis for the Kingston and Rockwood Water Treatment Plants weekly until completion of time critical dredging. Thereafter, TDEC will collect samples once per month through December 2010 at which time all data will be evaluated for possible frequency adjustments.
- Kingston Water Treatment Plant personnel will collect samples twice weekly through December 2010, with the data evaluated along with the TDEC data for possible frequency adjustments. TVA will continue to reimburse the City for sampling and analyses.
- TVA will strive to migrate verified data to the EPA SCRIBE system within 2 weeks; TVA will notify TDEC and EPA of any significant (e.g., exceed water quality criteria, etc.) detections upon receipt and review of initial laboratory reports.

Major Changes from Time-Critical Surface Water Monitoring Plan

- Except for the initial eight-week period following the cessation of dredging and approval of the plan, all river surface water sampling will be triggered by either local heavy rainfall (>1.0 inch) or high flow on the Emory River (>10,000 cfs measured at Oakdale).
- After the initial eight-week period referenced above, fixed locations on the river system will be reduced from ten to five. Automated samplers are being installed at these locations. Hydrolabs will be co-located with the five automated samplers on the river system. The Tennessee River will no longer be routinely sampled at fixed locations.
- During the initial eight-week period, 11 locations on the Emory, Clinch, and Tennessee Rivers will be sampled once per week, in accordance with the approved river Engineering Evaluation/Cost Analysis (EE/CA) Sampling and Analysis Plan (SAP). This will serve the dual purpose of providing data from routine locations post-dredging operations, as well as completing the surface water sampling task in the EE/CA SAP.
- Daily sampling at the Kingston Water Treatment Plant will be discontinued.
- Dredge plume monitoring and acute toxicity tests are eliminated.

Activity-by-Activity Changes

1. Municipal Water Treatment Plants (Kingston and Rockwood)/Public Water Supply (Swan Pond Area Spring)

    - Samples will be collected twice weekly at the Kingston Water Treatment Plants by plant staff and analyzed at an independent laboratory.
    - TDEC will perform weekly sampling and analysis at Kingston and Rockwood Water Treatment Plants through July 2010; and thereafter, monthly through December 2010. At this time, the data will be evaluated for possible frequency changes.
    - Local heavy rainfall or high Emory River flow will trigger sampling at Kingston Water Treatment Plant by plant staff, at their discretion. .

- TDEC will perform quarterly monitoring of the Swan Pond Area Spring.
- TDEC will also continue quarterly monitoring of three groundwater sentinel wells.

2. Emory and Clinch Rivers

   - Five TVA automated samplers at Emory River Mile (ERM) 4.0, ERM 2.0, ERM 0.3, Clinch River Mile (CRM) 2.5, and CRM 4.6 collect 24-hour composite samples if local rainfall (measured at the onsite meteorological station) is >1.0" in 24 hours, and/or Emory River flow is >10,000 cfs as measured at Oakdale, TN. This replaces the current twice weekly TVA monitoring at 10 locations on the Emory, Clinch, and Tennessee Rivers and twice weekly monitoring at the same locations by TDEC.
   - TDEC and EPA will collect and analyze split samples at their discretion.

3. Swan Pond Embayment

   - Grab samples will be collected weekly (instead of twice/week under current plan) at the Clean Water Ditch discharge and outlet of the sediment basins. Data from this monitoring will be evaluated after six months and the frequency/location may be altered with concurrence from TDEC and EPA.
   - An automated sampler will be located in the Clean Water Ditch and activated when local rainfall exceeds 0.5" in a 24-hour period. A grab sample will also be collected from the sediment basins outlet when this trigger occurs (no change from the current plan).
   - Sampling locations will be changed (with regulatory approval) as drainage in the area is modified during the removal action.

4. Stilling Pond

   - A weekly grab sample will be collected at the Stilling Pond outfall (instead of three times weekly under current plan).
   - EPA will collect and analyze split samples at their discretion.
   - Periodic acute toxicity tests at this outfall will be discontinued, except as required by NPDES permit.

5. Dredge Plume

   - Plume monitoring was eliminated after completion of hydraulic dredging.

Document No. EPA-AO-013

Kingston Ash Recovery Project
Non-Time-Critical Removal Action
Surface Water Monitoring Plan
for the
Emory, Clinch, and Tennessee Rivers

Prepared by:
Jacobs

for the Tennessee Valley Authority

Revision	Description	Date
0	River Sampling Plan for TVA Review	August 25, 2009
1	River Sampling Plan for TVA Review	June 9, 2010
2	River Sampling Plan for Regulatory Review	July 1, 2010

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List of Figures (Attached)

Attachment

List of Acronyms

µg/L	microgram per liter
BMP	best management practice
cfs	cubic feet per second
CRM	Clinch River Mile
CoC	chain-of-custody
cy	cubic yard
DMP	Data Management Plan
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ERM	Emory River Mile
KIF	Kingston Fossil Plant
mg/L	milligram per liter
msl	mean sea level
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
SOP	Standard Operating Procedure
TDEC	Tennessee Department of Environment and Conservation
TDS	total dissolved solid
TDWS	Tennessee Domestic Water Supply Criterion
TRM	Tennessee River Mile
TSS	total suspended solid
TVA	Tennessee Valley Authority
TWQC	Tennessee Water Quality Criterion

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1. INTRODUCTION AND BACKGROUND

This plan is prepared pursuant to the May 2009 Administrative Order and Agreement on Consent (the Order) between the U.S. Environmental Protection Agency (EPA) Region 4 and the Tennessee Valley Authority (TVA) to address the December 2008 ash release from the TVA Kingston Fossil Plant (KIF) (EPA 2009). This plan revises and supersedes the *Surface Water Monitoring Plan for the Emory, Clinch, and Tennessee Rivers, Kingston Fossil Plant Ash Recovery Project* (Jacobs 2009) issued by TVA and approved by the EPA in August 2009 with the commencement of aggressive dredging operations.

This plan was originally prepared as part of the time-critical removal action and has been revised to make it applicable to nontime-critical removal activities. The scope of this plan considers the tasks that will be implemented in accordance with the approved *Kingston Ash Recovery Project, Non-Time-Critical Removal Action, Embayment/Dredge Cell Action Memorandum* (Jacobs 2010a). The plan will be in effect until a post-removal action long-term monitoring plan is approved by EPA and the Tennessee Department of Environment and Conservation (TDEC). This plan addresses surface water monitoring at selected fixed locations on the Emory and Clinch Rivers, several locations in the surface water drainage system of the Swan Pond Embayment, and monitoring at the KIF Stilling Pond as utilization of the Ball Field while ash processing continues. This plan also includes continued municipal water supply monitoring to be performed by TDEC and the City of Kingston.

Implementation of the time-critical removal action has recovered the majority of the ash from the Emory River. The surface water monitoring approach is being modified to reflect completion of this milestone and the evaluation of analytical results from thousands of routine and storm-event surface water samples collected from the Emory, Clinch, and Tennessee Rivers, and at municipal water supplies.

This plan does not address surface water monitoring for any future dredging operations that might occur as the result of collection and analysis of additional data in support of the future Engineering Evaluation/Cost Analysis (EE/CA) for the Emory, Clinch, and Tennessee River systems. Should additional dredging be necessary, a surface water monitoring plan will be prepared in conjunction with the Dredging Work Plan.

The principal objectives of this plan are to monitor the re-suspension of remaining ash in the Emory River during high flow and to monitor ash not captured by engineered controls for Swan Pond Embayment ash removal.

Key elements of this plan are:

Kingston and Rockwood Municipal Water Treatment Plants/Public Water Supply (Swan Pond Area Spring) – TDEC will continue to collect raw and untreated water samples weekly at the Kingston and Rockwood Water Treatment Plants through July 2010. Thereafter, TDEC will collect monthly samples through December 2010. The data from this monitoring will be evaluated at the end of December 2010 and the frequency may be changed based on the evaluation. TDEC will collect samples quarterly at the spring head of the Swan Pond Area Spring that is used as a public drinking water source. Personnel at the Kingston Water Treatment Plant will collect samples twice weekly for analysis at an independent laboratory. Samples of raw and treated water also will be collected by plant personnel at the Kingston Water Treatment Plant after heavy local rainfall or during high Emory River flow, at their discretion.

Emory and Clinch Rivers – TVA will collect 24-hour composite surface water samples at three fixed locations on the Emory River and two fixed locations on the Clinch River during heavy local rain events and/or high Emory River flows. Samples will be collected using remotely triggered automated samplers and will be analyzed for total suspended solids (TSS) and ash-related metals. Sampling will be triggered

by 24-hour rainfall ≥ 1.0 inch at the KIF meteorological station or flows ≥10,000 cfs at the Oakdale, Tennessee gage. Additionally, TVA will perform weekly sampling at 11 locations on the Emory, Clinch, and Tennessee Rivers for a period of eight weeks after this plan is approved. This sampling and analysis will also meet the surface water sampling objectives of the approved *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP)* (Jacobs 2010b).

KIF Stilling Pond Effluent – The KIF Stilling Pond National Pollutant Discharge Elimination System (NPDES)-permitted outfall will be monitored weekly for TSS and ash-related constituents.

Swan Pond Embayment – Manual grab samples will be collected weekly at key surface water drainage ditch locations and analyzed for TSS and ash-related constituents. Data from this monitoring will be evaluated over a six-month period to determine if it should continue on a routine basis. In addition, an automated composite sample will be collected from the Clean Water Ditch (final point of surface water exit to the Emory River) following local rainfall ≥0.5 inch in a 24-hour period. TVA will initially continue to sample the current locations, with location adjustment occurring as the drainage system configuration is altered to accommodate restoration activities.

TVA sampling and analyses will be performed in accordance with the EPA-approved *Quality Assurance Project Plan (QAPP) for the Tennessee Valley Authority Kingston Ash Recovery Project. TVA-KIF-QAPP* (ESI 2009). The QAPP provides the detail for overall sampling and analysis quality assurance/quality control (QA/QC) that will be implemented for this plan. Agency (TDEC and EPA) sampling and analyses will be performed in accordance with their respective quality assurance provisions.

This monitoring plan is organized as follows:

- Section 1 Introduction and Background
- Section 2 Non-Time-Critical Surface Water Monitoring Plan Objectives
- Section 3 Evaluation of Existing Surface Water Monitoring Data
- Section 4 Non-Time-Critical Surface Water Monitoring
- Section 5 Data Management
- Section 6 Quality Assurance/Quality Control

Table 6-2 in Section 6 is the completed cross-walk table required by the approved QAPP.

The remainder of Section 1 provides background information for the TVA KIF, the ash spill event, time-critical actions completed, and the surface water monitoring performed to date. Figure 1 shows the location of KIF in the vicinity of Kingston, Tennessee, and the Emory and Clinch Rivers. It also illustrates the general areas being addressed by time-critical and non time-critical actions.

1.1 DESCRIPTION OF THE AREA AND LOCATION

The KIF is located at the confluence of the Emory and Clinch Rivers on Watts Bar Reservoir near Kingston, Tennessee. The KIF is one of the TVA's larger fossil plants. It generates 10 billion kilowatt-hours of electricity a year, enough to supply the needs of about 670,000 homes in the Tennessee Valley. Plant construction began in 1951 and was completed in 1955. Kingston has nine coal-fired generating units. The winter net dependable generating capacity is 1,456 megawatts. The plant consumes some 14,000 tons of coal a day.

The KIF is located on the Emory River arm of Watts Bar Reservoir; the Emory River discharges into the Clinch River. The Emory River borders the KIF Ash Pond and Dredge Cells to the east. The Emory River rises on the Cumberland Plateau in Morgan County, Tennessee and crosses into Roane County near

Harriman, Tennessee. Flow on the Emory River in the vicinity of the KIF is not controlled by any upstream flood control or navigation structures. The river elevation is controlled by Watts Bar Dam, approximately 44 miles downstream. Normal summer pool elevation for the Emory River at the KIF is approximately 740 to741 feet mean sea level (msl) and normal winter pool elevation is 735 to 737 feet msl. The Watts Bar annual spring reservoir fill-period is from April 1 to April 15. The Emory River typical flow volume in the winter and spring ranges from 500 to 50,000 cfs. The 10-year probable flood flow rate is 110,000 cfs.

1.2 DESCRIPTION OF THE ASH RELEASE AND INITIAL RESPONSE ACTIONS

Just before 1 a.m. on Monday, December 22, 2008, a coal fly ash spill occurred at the KIF, allowing a large amount of fly ash to escape into the adjacent waters of the Emory River. Ash, a by-product of a coal-fired power plant, is stored in dredge cell containment areas. Failure of the Dredge Cell dike caused about 60 acres of ash in the 84-acre containment area to be displaced. At the time of the slide, the cells contained about 9.4 million cubic yards (cy) of ash. The dike failure released about 5.4 million cy of coal ash that covered about 275 acres.

Fly ash filled the Swan Pond Embayment on the north side of the KIF property adjacent to the failed Dredge Cell. During the emergency response phase of the recovery, a dike (Dike 2) was constructed in the eastern portion of the Swan Pond Embayment to contain approximately 2.4 million cy of fly ash to the west of the dike until a removal action plan could be developed, approved by the regulators, and implemented. Approximately 3 million cy of ash also entered the channel and overbank areas of the riverine section of the Emory River.

The U.S. Coast Guard issued an initial advisory that the Emory River would be closed to navigation from Emory River Mile (ERM) 0.0 to ERM 4.0. The advisory later extended the Emory River closure to ERM-6, out of concern for increased dredging operations. Also during the emergency response phase, TVA installed a 615-foot long underwater rock dam (Weir 1) in the Emory River just north of the existing plant intake skimmer wall to help reduce further downstream movement of ash. Weir 1 allowed water to continue flowing and retained the ash at the bottom of the river channel.

1.3 STATUS OF THE TIME-CRITICAL REMOVAL ACTION

In accordance with the Order and following completion of a pilot project to evaluate hydraulic dredging as an ash removal method, in June 2009 TVA initiated aggressive dredging and excavation actions to recover the ash east of Dike 2. (See EPA productivity documents at http://www.epakingstontva.com/productivity). Removal of more than 3 million cy of ash from the Emory River is anticipated to be complete in June 2010. Offsite disposal of that ash is scheduled for completion by November 2010.

A quantity of ash will remain in the Emory River due to re-suspension and mixing with sediments. (See EPA On-Scene Coordinator Dredging Determination dated March 5, 2010.) . It is estimated that approximately 175,000 to 350,000 cy will remain in the river between ERM 0.0 to ERM 6.0, including material re-suspended from dredging, mixed material in sand bars and shallows, and ash mixed with sediment containing legacy cesium-137 between ERM 1.8 and ERM 0.0 from the Department of Energy activities on the Oak Ridge Reservation. Additionally, sediment-transport modeling has estimated that approximately 150,000 cy of ash were transported from the Emory River into the Clinch and Tennessee Rivers by storm events following the spill. The potential impacts of the remaining ash will be addressed by the future River System EE/CA.

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2. NON-TIME-CRITICAL SURFACE WATER MONITORING PLAN OBJECTIVES

2.1 DATA QUALITY OBJECTIVES

The data quality objective (DQO) process is a logical series of seven steps that guides investigators to a plan for the resource-effective acquisition of environmental data. The process is both flexible and iterative, and applies to both decision-making (e.g., compliance/non-compliance with a standard) and estimation (e.g., ascertaining the mean concentration of a contaminant). The DQO process establishes performance and acceptance criteria that drive the plan for collecting data of sufficient quality and quantity to support the goals of the study. The DQO process leads to efficient and effective expenditures of resources; consensus on the type, quality, and quantity of data needed to meet project goals; and full documentation of actions taken during project development (EPA 2006).

The steps in the DQO process are as follows:

1. State the problem
2. Identify the goal(s) of the study
3. Identify information inputs
4. Define the study boundaries
5. Develop the analytic approach
6. Specify performance or acceptance criteria
7. Develop the plan for data acquisition

The following paragraphs describe application of the DQO process to developing the Surface Water Monitoring Plan for the non-time-critical removal action.

2.1.1 Problem Statement

The August 4, 2009, Action Memorandum for the time-critical removal action provided direction for removal of the approximately 3 million cy of ash from the Emory River east of Dike 2 in order to reduce the potential for upstream flooding due to impairment of flow by the spilled ash; and to reduce the potential for ash migration downstream during high-flow events. Time-critical dredging in the Emory River is expected to be completed in June 2010. The Action Memorandum for the non-time-critical removal action for the Embayment/Dredge Cell (Jacobs 2010a) provides direction for removal of the approximately 2.4 million cy of ash west and upstream of Dike 2. Water quality monitoring will be needed to determine whether there are any water quality impacts from non-time-critical removal actions. The surface water monitoring plan used for the time-critical phase of the project does not appropriately address the water quality objectives of the non-time-critical phase, and is being revised in order to be resource-effective and meet project goals.

2.1.2 Project Goals

The primary objectives for water quality monitoring in support of non-time-critical removal actions are to:

- Provide continuing confirmation that KIF-related constituents have not affected public drinking water supplies;
- Provide data sufficient to detect ash-related changes in water quality of the Emory and Clinch Rivers during heavy rainfall events or high Emory River flows;

- Provide continuing confirmation that water in the Emory and Clinch Rivers continues to be safe for recreational surface water uses, consistent with any specific advisories issued by regulatory authorities;
- Evaluate the effectiveness of best management practices (e.g., settling basins and diversion ditches) in preventing or mitigating changes in surface water quality that might impact public health or the environment during non-time-critical ash excavation and removal from upstream of Dike 2, particularly during storm events; and
- Monitor the KIF Stilling Pond outfall to detect any adverse trends during the remainder of ash processing and loading.

2.2 MONITORING APPROACH

The following paragraphs state the key questions that must be addressed for each of these objectives, provides a brief basis for each question, and summarizes the monitoring approach required.

Question 1: Are ash-related contaminants affecting public water supplies during non-time-critical ash removal?

Contamination of municipal water supplies by ash-related constituents could constitute a direct public health threat to local residents. The principal route of exposure would be intake of ash-related constituents from river water at municipal water supply intakes. Although treatment processes used by water treatments plants would be expected to remove ash-related constituents, there still is a potential risk that can easily be evaluated.

Monitoring at the Kingston and Rockwood Municipal Water Treatment Plants and the Swan Pond Spring locations, supplemented by monitoring during the types of conditions that might carry ash-related contaminants to the intakes (i.e., high rainfall and river flows) enables TDEC to evaluate and document drinking water supply protection.

Question 2: Does heavy rainfall or high Emory River flows mobilize ash sufficiently to cause adverse water quality changes in the Emory and Clinch Rivers?

Monitoring during time-critical dredging showed that high flows could mobilize ash and cause water quality degradation in the immediate vicinity of the spill for up to a few days following heavy rainfall events. That monitoring and associated ash transport modeling also showed that the magnitude of ash mobilization decreased as the bulk of the released ash was removed from the river. Potential continuing sources of ash-related constituents include the residual ash mixed with sediment in the Emory and Clinch Rivers and erosion of ash from the Swan Pond Embayment.

Automated high-flow sampling at three Emory River and two Clinch River monitoring locations will allow TVA to evaluate and document any further migration of ash and ash-related constituents. Comparison of concentrations at ERM 0.3 and ERM 2.0 to ERM 4.0 provides the ability to evaluate releases from the Swan Pond Embayment and re-suspension of residual ash in the river. Similarly, comparison of concentrations at Clinch River Mile (CRM) 2.5 and CRM 4.5 enables evaluation of water quality effects of all Emory River high-flow inputs to the Clinch River.

Questions 3 and 4: Do non-time-critical ash removal and processing activities cause water quality changes that would impair water-based recreation? Are the settling basins and other best management practices (BMPs) effective in preventing offsite migration of ash-related contaminants?

Potential impacts of the non-time-critical ash recovery operations to water-based recreation and the effectiveness of BMPs for those operations are closely related. Collecting monthly grab samples to monitor the quality of water leaving the site through Dike 2, along with rain-event-triggered automated sampling of both water leaving the site and water in the Emory River will provide information on BMP effectiveness and on whether the non-time-critical ash removal and processing activities are affecting water quality in the Emory River.

Question 5: Do continuing ash processing and loading operations, including recovery of free water volume in the Ash Pond, cause unacceptable changes in water quality or violations of NPDES permit limits for the Stilling Pond discharge?

Although river dredging is expected to end in June 2010, hydraulic dredging to recover sufficient free water volume in the Ash Pond will continue, and ash loading operations will continue until all of the time-critical-dredged ash is shipped offsite. Weekly grab samples of water from NPDES Outfall 001 will provide continuing information on the quality of the Stilling Pond discharge.

2.3 INFORMATION INPUTS

The information necessary to achieve the objectives includes the following:

- Continuous rainfall measurements from the KIF meteorological station to trigger sampling;
- Continuous stream flow measurements at the National Weather Service gage for the Emory River at Oakdale, Tennessee to trigger sampling;
- Results of analyses of water samples from public water supplies for ash-related constituents.
- Results of analyses of samples from the five fixed surface water monitoring stations, Swan Pond Embayment monitoring locations, and the Stilling Pond outfall for general water quality parameters, total and dissolved metals, TSS, and total dissolved solids (TDS);
- Results of analyses of water samples associated with Stilling Pond management.

2.4 SPATIAL AND TEMPORAL BOUNDARIES, TARGET POPULATIONS, AND CHARACTERISTICS OF INTEREST

The spatial boundaries of the study are the Emory River from ERM 4.0 to its mouth, the Clinch River from CRM 4.5 to CRM 2.5, the Swan Pond Embayment, and the Stilling Pond. TVA will establish three sampling locations on the Emory River (ERM 4.0, ERM 2.0 and ERM 0.3), two sampling locations on the Clinch River (CRM 4.5and CRM 2.5), two locations to monitor releases from the non-time-critical ash removal operations (Settling Basins effluent and Clean Water Ditch), and one location to monitor discharges from the Stilling Pond related to ash processing activities.

There are three temporal boundaries of the study: the first is a three-month monitoring period during start-up of the non-time-critical removal action in Swan Pond Embayment; the second is associated with local heavy rainfall or high flows in the Emory River; and the third is quarterly monitoring or storm-event sampling of public water supplies by TDEC.

The human populations of interest are recreational users and residents receiving potable water from the Kingston and Rockwood Municipal Water Treatment Plants and Swan Pond Area Spring.

The ecological populations of interest are flora and fauna that live in or depend on the river system for food.

The analytical characteristics of interest are general water quality parameters, metals, TSS, and TDS associated with coal fly ash.

2.5 ANALYTIC APPROACH

Coal fly ash contains numerous constituents that have been linked to adverse health effects in human or ecological receptors. Specific constituents of interest include arsenic and selenium. Available screening levels are the state drinking water standards and water quality criteria; therefore, the analytical parameter of interest for samples collected from the monitoring locations will be compared to their respective screening levels. Other parameters of interest are general water quality parameters (temperature, dissolved oxygen, conductivity, and pH), TSS, TDS, and total and dissolved metals, plus low-level mercury analysis as indicators of ash loading to the river system for evaluation of best management practices.

2.6 ACTION LEVEL AND DECISION RULE

Action levels for this project are the Tennessee Drinking Water Quality Criteria for Domestic Water Supplies, Federal Maximum Contaminant Levels, Tennessee Water Quality Criteria – Fish and Aquatic Life Continuous Chronic Criteria and Tennessee Water Quality Criteria – Human Consumption of Water and Organisms, and upstream reference concentrations. The decision rule for analytical results from surface water monitoring location samples is "If the concentration of any ash-related constituent demonstrates a sustained or increasing trend that indicates unacceptable loading of ash to the river system, then the need for modification of management practices will be evaluated, else continue monitoring."

2.7 PERFORMANCE OR ACCEPTANCE CRITERIA

The null hypothesis for public water supplies is: Local heavy rainfalls or high flows in the Emory River do not result in re-suspension and transport of residual ash that impacts the municipal water supplies. The alternative hypothesis is: Local heavy rainfall or high flow in the Emory River result in re-suspension and transport of residual ash that impacts the municipal water supplies.

The null hypothesis for Emory and Clinch Rivers surface waters is: Local heavy rainfall or high flows in the Emory River do not result in a re-suspension and transport of residual ash. The alternative hypothesis for Emory and Clinch Rivers surface waters is: Local heavy rainfall or high flow in the Emory River result in a re-suspension and transport of residual ash.

The null hypothesis for Swan Pond Embayment surface water is: BMPs are adequate for controlling releases of ash-related contaminants during removal actions in the Swan Pond Embayment. The alternative hypothesis for Swan Pond Embayment surface water is: BMPs are not adequate for controlling releases of ash during removal actions in the Swan Pond Embayment.

The null hypothesis for the Stilling Pond discharge is: Ash processing activities in the Ball Field area do not result in an unacceptable release of ash-related contaminants. The alternative hypothesis for Stilling Pond surface waters is: Ash processing activities in the Ball Field area result in an unacceptable release of ash-related contaminants.

2.8 DATA ACCEPTANCE

DQOs are assessed by monitoring QA measures, such as accuracy, precision, representativeness, comparability, and completeness, as discussed in QAPP, Sections 14 and 22. Specific qualitative DQOs for the chemical analyses to be performed are presented in detail in Section 14.0 of the QAPP; in

Appendix C; and in Tables D-3, E-3, F-4, and H-3. The objectives associated with accuracy and precision of laboratory results are assessed through an evaluation of the results of QC samples. The accuracy of field measurements for temperature and other field parameters is assessed by instrument calibration and standardization, as described in the associated field Standard Operating Procedures (SOPs).

2.9 NON TIME-CRITICAL MONITORING PLAN DEVELOPMENT

Development of the surface water monitoring plan to meet the DQOs described above is based on review of event-related monitoring conducted from December 2008 through May 2010; evaluation of surface water data collected in that monitoring; and consultation with TDEC and EPA. The remaining sections of this plan provide the results of those reviews, analysis, and consultations, then describe the non time-critical surface water monitoring plan scope, sampling design, data management, and QA/QC.

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3. SURFACE WATER MONITORING CONDUCTED FROM DECEMBER 2008 TO JUNE 2010

3.1 MONITORING PROGRAM OVERVIEW

In response to the spill, TVA, TDEC, and EPA Region 4 have collected surface water samples from the Emory, Clinch, and Tennessee Rivers since immediately after the incident in December 2008. TVA has collected more than 2,500 surface water samples since the spill, with TDEC independently collecting over 800 more. Sampling locations on the rivers were selected to bracket the fly ash release area at the KIF plant and have encompassed approximately 14 miles of the river system. The objectives of the initial surface water monitoring were to determine whether there was any immediate down-river migration of ash-related constituents that posed an imminent public health or environmental threat. The intakes for two municipal public drinking water treatment systems (Kingston and Rockwood) are downstream from the spill area, so additional monitoring was initiated there. TDEC has performed weekly sampling and analysis of the raw and finished water at the Kingston and Rockwood Water Treatment Plants since January 6, 2009. TDEC also monitors three groundwater sentinel wells to assess any impacts on private drinking water supplies. In addition, TVA has reimbursed the City of Kingston for daily sampling and analysis of raw and finished water at the Kingston plant since late December 2008. TVA also has carefully monitored the quality of water discharged from the Stilling Pond since the beginning of dredging, and has monitored waters flowing from the Swan Pond Embayment into the Emory River. Dredging operations in the Emory River and associated ash processing have been monitored multiple times per week to detect changes in surface water quality that might impact public health or the environment. During this period, TVA installed and operated floating stations at strategic river locations with equipment to provide real-time information on water quality, and placed one automated sampler at ERM 0.5 that can be activated to collect storm event samples during periods of heavy local rainfall and high Emory River flows.

3.1.1 Emory, Clinch, and Tennessee Rivers—Routine Surface Water Monitoring

During time-critical dredging, TVA established routine water quality monitoring stations at five locations on the Emory River (ERM 0.1, 1.75, 2.1, 4.0, and 12.2), four locations on the Clinch River (CRM 0.0, 2.0, 4.0, and 5.5), and two locations on the Tennessee River (Tennessee River Mile (TRM) 563.5 and 568.5) (Figure 2). These locations were selected to assess possible impacts of the fly ash release on water quality and to monitor ash movement associated with high flows. TVA initially performed sampling at these locations three days per week (Monday, Wednesday, and Friday), later reducing the frequency to two days per week (Monday and Friday). TDEC has performed independent surface water sampling at these and other locations every Tuesday and Thursday since January 2009. In addition, both TVA and TDEC have performed sampling in response to heavy local rainfall (initially $\geq$ 0.5 inch in 24 hours; currently $\geq$1.0 inch) or high flows (currently $\geq$5,000 cfs) on the Emory River. TVA's samples have been analyzed for TSS and for total and dissolved forms of 24 different metals and metalloids. Field parameters (temperature, dissolved oxygen, pH, conductivity, and turbidity) also have been measured at each location using a multi-analyte programmable data logger (Hydrolab® or equivalent instrument). Figure 2 shows the locations of TVA's routine surface water stations from December 2008 through May 2010. The location of these stations and the monitoring approach will change for the non time-critical ash removal phase of the project.

3.1.2 Dredge Plume Monitoring

To monitor the effectiveness of BMPs (e.g., turbidity curtains) to reduce ash migration during dredging and to evaluate potential toxicity of re-suspended ash, TVA performed daily monitoring of dredge plumes

in the Emory River. Field turbidity measurements were used to identify the most heavily contaminated portions of dredge plumes for sample collection. Samples have been analyzed for total and dissolved metals and TSS. Periodic (weekly, then biweekly) plume samples also have been collected for acute toxicity tests. Dredge plume monitoring will be eliminated once time-critical river dredging is completed.

3.1.3 KIF NPDES-Permitted Outfall

Concurrent with the beginning of the pilot phase of dredging in March 2009, TVA began sampling the NPDES-permitted outfall, KIF 001, daily to track effects of dredging so appropriate controls could be instituted to ensure continuing compliance with NPDES permit limits. KIF 001 is the final point of discharge for water from plant operations as well as dredging operations. Figure 3 shows the overall ash recovery system and location of Outfall 001. The Stilling Pond is the final solids settling location in the ash recovery system. Monitoring of the KIF 001 Outfall will continue, but at a reduced frequency through at least the first part of non-time-critical ash removal.

3.1.4 Surface Water Flow in Swan Pond Embayment

Surface water flows from the surrounding watershed into Swan Pond Embayment and eventually to the Emory River. An interim drainage system (the Clean Water Ditch) was constructed in mid-2009 to intercept clean run-on water and divert it around the ash, discharging to the Swan Pond Embayment and Emory River after passing through Dike 2. A similar drainage system (the Dirty Water Ditch) was constructed to collect water that runs through the ash-filled embayment and send it through a series of surface water sediment basins to allow the solids to settle out before discharging to the Clean Water Ditch.

Water from an adjacent ash-filled area, the East Embayment, also was collected and allowed to settle before discharging to the Clean Water Ditch and Emory River. Ash removal from that smaller embayment was completed in spring 2010 as part of the time-critical phase; water from that embayment now flows directly into the Swan Pond Embayment and Emory River as it did before the spill.

Samples have been collected twice weekly from the Clean Water Ditch and from the Sediment Basins effluent since July 2009. See Figure 4 for current locations. Local rainfall exceeding 0.5 inch in a 24-hour period has triggered additional sampling at these locations. This monitoring will be modified for the non-time-critical ash removal phase.

3.2 EVALUATION OF TIME-CRITICAL SURFACE WATER MONITORING DATA

This section summarizes existing surface water monitoring data collected from September 11, 2009, through mid-April 2010 for the Emory, Clinch, and Tennessee Rivers fixed locations, dredge plume, and Swan Pond Embayment monitoring locations. These data provide a basis for proposed changes to the current surface water monitoring program for the non-time-critical ash removal project phase.

TVA also has compared results from TDEC's independent surface water monitoring program to the TVA dataset for general agreement. The results from the two agencies are generally consistent. As an example of the data comparability, Figure 4 displays TDEC and TVA data for arsenic at ERM 1.7(TDEC)/1.75(TVA) and ERM 2.1(TDEC and TVA) for the period referenced above.

3.2.1 Fixed-location Monitoring in the Emory River

Summary statistics for several constituents of concern, including arsenic, mercury, selenium, and thallium, which are of particular interest, are shown in Table 3-1. These statistics compare concentrations of the constituents at the ERM 12.2 background location, two locations in the immediate vicinity of the ash spill (ERM 2.1 and 1.75), and one location at the mouth of the Emory River as it enters the Clinch River (ERM 0.1) and surface water flowing through the Swan Pond Embayment. For comparison, summary statistics for the dredge plume monitoring since September 2010 are provided. Through mid-April 2010, total arsenic in one surface water sample exceeded the Tennessee Domestic Water Supply Criterion (TDWS) and Tennessee Water Quality Criterion (TWQC) of 0.01 milligrams per liter (mg/L). This exceedence was in the vicinity of the ash spill at ERM 2.1. Lead also exceeded its TDWS in one Emory River sample at ERM 1.75.

Exceedances of the TDWS reported in TDEC data through April 2010 were for arsenic at ERM 2.1 on September 15, 2009.

There are no consistent trends for maximum concentrations of any analyte related to Emory River flow or rainfall. However, maximum detected concentrations typically were observed near the area of the spill (ERM 2.1 or 1.75) suggesting that dredging operations or residual ash contributed to those observations.

3.2.2 Fixed-location Monitoring in the Clinch and Tennessee Rivers

Through mid-April 2010, TVA data indicated no exceedences of the TDWS for arsenic in samples collected from the Clinch or Tennessee Rivers. These data indicate mercury and thallium occasionally exceeded the TWQC on the Clinch and Tennessee Rivers. However, the detection frequencies were 2% and 12%, respectively, for mercury and thallium on the Clinch River; and 1% for both mercury and thallium on the Tennessee River.

3.2.3 Emory River Dredge Plume Monitoring

Dredge plume samples collected during the Emory River dredging operations had one or more concentrations of arsenic, mercury, selenium, or thallium exceed the TDWS. These samples were collected from the most turbid parts of visual dredge plumes, as identified by Hydrolab® turbidity measurements. The average of the 96 highest turbidity measurements in dredge plumes through the end of dredging was 67 nephelometric turbidity units (NTUs). Only two measurements exceeded 200 NTUs. The TSS average for all samples collected from dredge plumes was 32 mg/L. Only one TSS result exceeded 100 mg/L.

Further, 23 samples were collected from within the dredge plumes and subjected to acute toxicity testing with two different test organisms. Test results showed no adverse effects on test organisms between the laboratory controls and the samples.

Comparison of the maximum and average concentrations in Table 3-1 for dredge plume and ERM 0.1 samples indicates that even during dredging activities, ash related constituents settled out of the water column quickly.

Table 3-1
Summary Statistics

Emory River Location 0.1

Date Range - 09/11/2009 - Present
All analytes

					Summary Statistics for Emory River Location 0.1						
Analyte	Units	Tennessee Drinking Water Standard (TDWS)	TWQC for Recreation and Domestic Water Supply (RDWS)	Fish and Aquatic Life Eco Criteria (F&AL)	Maximum Detected Concentration	Average of Detected Concentrations	Number of Samples	Percent Detect	Number of Results Exceeding TDWS	Number of Results Exceeding TWQC	Number of Results Exceeding F&AL
Antimony	mg/L	0.006	0.0056		0.00064	0.00046	69	4.3	0	0	0
Antimony, Total	mg/L	0.006	0.0056		0.00089	0.00052	69	8.7	0	0	0
Arsenic	mg/L	0.01	0.01	0.15	0.00391	0.00095	69	85.5	0	0	0
Arsenic, Total	mg/L	0.01	0.01		0.00811	0.00211	69	100	0	0	0
Beryllium, Total	mg/L	0.004			0.00062	0.00047	69	4.3	0	0	0
Lead	mg/L	0.005		0.003	0.00038	0.00038	69	1.4	0	0	0
Lead, Total	mg/L	0.005			0.00388	0.00096	69	81.2	0	0	0
Mercury	mg/L	0.002	0.00005	0.00077	ND	0	69	0	0	0	0
Mercury, Total	mg/L	0.002	0.00005		ND	0	69	0	0	0	0
Nickel, Total	mg/L	0.1	0.61		0.00529	0.00153	69	100	0	0	0
Selenium	mg/L	0.05		0.005	0.00064	0.00048	69	5.8	0	0	0
Selenium, Total	mg/L	0.05		0.005	0.00066	0.00044	69	10.1	0	0	0
Thallium	mg/L	0.002	0.00024		0.0009	0.00055	69	10.1	0	7	0
Thallium, Total	mg/L	0.002	0.00024		0.00094	0.00068	69	11.6	0	8	0

Emory River Dredge Plume

Date Range - 09/11/2009 - Present
All analytes

					Summary Statistics for Emory River Dredge Plume						
Analyte	Units	Tennessee Drinking Water Standard (TDWS)	TWQC for Recreation and Domestic Water Supply (RDWS)	Fish and Aquatic Life Eco Criteria (F&AL)	Maximum Detected Concentration	Average of Detected Concentrations	Number of Samples	Percent Detect	Number of Results Exceeding TDWS	Number of Results Exceeding TWQC	Number of Results Exceeding F&AL
Antimony	mg/L	0.006	0.0056		0.00415	0.00062	164	22.6	0	0	0
Antimony, Total	mg/L	0.006	0.0056		0.00747	0.00153	164	63.4	1	2	0
Arsenic	mg/L	0.01	0.01	0.15	0.0383	0.00454	164	95.1	20	20	0
Arsenic, Total	mg/L	0.01	0.01		0.194	0.02219	164	100	95	95	0
Beryllium, Total	mg/L	0.004			0.0192	0.00181	164	80.5	12	0	0
Lead	mg/L	0.005		0.003	0.00086	0.00086	164	0.6	0	0	0
Lead, Total	mg/L	0.005			0.104	0.011	164	97.6	84	0	0
Mercury	mg/L	0.002	0.00005	0.00077	0.00019	0.00017	164	1.8	0	3	0
Mercury, Total	mg/L	0.002	0.00005		ND	0	164	0	0	0	0
Nickel, Total	mg/L	0.1	0.61		0.123	0.01101	164	100	1	0	0
Selenium	mg/L	0.05		0.005	0.00143	0.00067	164	20.1	0	0	0
Selenium, Total	mg/L	0.05		0.005	0.0123	0.00122	164	62.8	0	0	2
Thallium	mg/L	0.002	0.00024		0.00092	0.00048	164	25	0	41	0
Thallium, Total	mg/L	0.002	0.00024		0.00456	0.00085	164	54.9	6	90	0

Table 3-1
Summary Statistics (continued)

Summary Statistics for Clinch River

Date Range - 09/11/2009 - Present
All analytes

					Summary Statistics for Clinch River						
Analyte	Units	Tennessee Drinking Water Standard (TDWS)	TWQC for Recreation and Domestic Water Supply (RDWS)	Fish and Aquatic Life Eco Criteria (F&AL)	Maximum Detected Concentration	Average of Detected Concentrations	Number of Samples	Percent Detect	Number of Results Exceeding TDWS	Number of Results Exceeding TWQC	Number of Results Exceeding F&AL
Antimony	mg/L	0.006	0.0056		0.00083	0.0005	271	4.8	0	0	0
Antimony, Total	mg/L	0.006	0.0056		0.00082	0.00044	271	3.7	0	0	0
Arsenic	mg/L	0.01	0.01	0.15	0.00466	0.00069	271	90.4	0	0	0
Arsenic, Total	mg/L	0.01	0.01		0.00665	0.00106	271	97	0	0	0
Beryllium, Total	mg/L	0.004			0.00056	0.00046	271	0.7	0	0	0
Lead	mg/L	0.005		0.003	0.00037	0.00037	271	0.4	0	0	0
Lead, Total	mg/L	0.005			0.0101	0.00073	271	54.6	1	0	0
Mercury	mg/L	0.002	0.00005	0.00077	0.0002	0.00013	271	2.2	0	6	0
Mercury, Total	mg/L	0.002	0.00005		0.00016	0.00005	275	2.2	0	2	0
Nickel, Total	mg/L	0.1	0.61		0.00476	0.00086	271	98.5	0	0	0
Selenium	mg/L	0.05		0.005	0.00109	0.00052	271	5.2	0	0	0
Selenium, Total	mg/L	0.05		0.005	0.00081	0.00047	271	5.9	0	0	0
Thallium	mg/L	0.002	0.00024		0.00083	0.00051	271	11.1	0	30	0
Thallium, Total	mg/L	0.002	0.00024		0.00096	0.00051	271	12.2	0	33	0

Summary Statistics for Tennessee River

Date Range - 09/11/2009 - Present
All analytes

					Summary Statistics for Tennessee River						
Analyte	Units	Tennessee Drinking Water Standard (TDWS)	TWQC for Recreation and Domestic Water Supply (RDWS)	Fish and Aquatic Life Eco Criteria (F&AL)	Maximum Detected Concentration	Average of Detected Concentrations	Number of Samples	Percent Detect	Number of Results Exceeding TDWS	Number of Results Exceeding TWQC	Number of Results Exceeding F&AL
Antimony	mg/L	0.006	0.0056		0.00066	0.00045	73	8.2	0	0	0
Antimony, Total	mg/L	0.006	0.0056		0.00084	0.00048	73	8.2	0	0	0
Arsenic	mg/L	0.01	0.01	0.15	0.00077	0.00045	73	53.4	0	0	0
Arsenic, Total	mg/L	0.01	0.01		0.00203	0.00063	73	75.3	0	0	0
Beryllium, Total	mg/L	0.004			ND	0	73	0	0	0	0
Lead	mg/L	0.005		0.003	ND	0	73	0	0	0	0
Lead, Total	mg/L	0.005			0.0019	0.00065	73	45.2	0	0	0
Mercury	mg/L	0.002	0.00005	0.00077	0.0001	0.0001	73	1.4	0	1	0
Mercury, Total	mg/L	0.002	0.00005		0.00012	0.00012	73	1.4	0	1	0
Nickel, Total	mg/L	0.1	0.61		0.00271	0.00064	73	80.8	0	0	0
Selenium	mg/L	0.05		0.005	ND	0	73	0	0	0	0
Selenium, Total	mg/L	0.05		0.005	ND	0	73	0	0	0	0
Thallium	mg/L	0.002	0.00024		0.00027	0.00027	73	1.4	0	1	0
Thallium, Total	mg/L	0.002	0.00024		0.00036	0.00036	73	1.4	0	1	0

Table 3-1
Summary Statistics (continued)

Summary Statistics for Swan Pond Embayment

Date Range - 09/11/2009 - Present
All analytes

					Summary Statistics for Swan Pond Embayment						
Analyte	Units	Tennessee Drinking Water Standard (TDWS)	TWQC for Recreation and Domestic Water Supply (RDWS)	Fish and Aquatic Life Eco Criteria (F&AL)	Maximum Detected Concentration	Average of Detected Concentrations	Number of Samples	Percent Detect	Number of Results Exceeding TDWS	Number of Results Exceeding TWQC	Number of Results Exceeding F&AL
Antimony	mg/L	0.006	0.0056		0.0118	0.00253	163	88.3	12	13	0
Antimony, Total	mg/L	0.006	0.0056		0.0122	0.00271	163	85.9	12	13	0
Arsenic	mg/L	0.01	0.01	0.15	0.0925	0.01916	163	100	104	104	0
Arsenic, Total	mg/L	0.01	0.01		0.121	0.0238	163	100	122	122	0
Beryllium, Total	mg/L	0.004			0.00323	0.00071	162	35.2	0	0	0
Lead	mg/L	0.005		0.003	0.00349	0.00142	162	1.9	0	0	1
Lead, Total	mg/L	0.005			0.0244	0.00283	163	98.8	19	0	0
Mercury	mg/L	0.002	0.00005	0.00077	ND	0	162	0	0	0	0
Mercury, Total	mg/L	0.002	0.00005		0.00035	0.00035	162	0.6	0	1	0
Nickel, Total	mg/L	0.1	0.61		0.0204	0.00292	163	98.2	0	0	0
Selenium	mg/L	0.05		0.005	0.062	0.00745	163	96.9	2	0	74
Selenium, Total	mg/L	0.05		0.005	0.065	0.00717	163	98.8	1	0	73
Thallium	mg/L	0.002	0.00024		0.00101	0.0005	162	45.1	0	73	0
Thallium, Total	mg/L	0.002	0.00024		0.00146	0.00057	163	54.6	0	89	0

3.2.4 Hydrolab® Monitoring at Fixed Locations

Field water quality parameters were measured at four locations in the Emory River, and at the Stilling Pond discharge, KIF Intake Channel, and KIF Effluent Channel using multi-analyte programmable data loggers (Hydrolab®). The parameters measured included temperature, dissolved oxygen, pH, conductivity, and turbidity, with turbidity being the primary measurement of interest. The dissolved oxygen, pH, and conductivity measurements exhibited expected seasonal variations, but were well within acceptable ranges. Water temperature gradually increased with the warmer weather in May and June 2009. The turbidity was observed to spike with rainfall events and increased river flows. However, during warmer weather and increased algae growth, the instruments are susceptible to biological fouling causing false positive turbidity readings. These false positives have been documented and are available upon request.

3.2.5 Fixed-location Monitoring in the Swan Pond Embayment

Samples collected from the Swan Pond Embayment had one or more concentrations of arsenic, selenium, or thallium exceed the domestic water supply criteria. Sample locations for the Swan Pond Embayment are located at the outfall from the settling basin and immediately downstream of Dike 2. Analyte concentrations are typically higher in samples collected from the settling basin outfall than the Clean Water Ditch. Detections of analytes at concentrations exceeding the water supply criteria support the decision to continue monitoring of the Swan Pond Embayment during non-time-critical activities.

3.2.6 Conclusions

The maximum detected ash-related surface water constituent concentrations occurred near the area of the ash spill in the Emory River.

Dredging activities did not result in significant concentration increases of ash-related constituents that affected down-river water quality, but concentrations of some constituents were elevated in the immediate vicinity of the dredge plume. For example, the maximum detected selenium concentration in a dredge plume (164 samples) was 0.012 mg/L (total), compared to the maximum detected selenium concentration of 0.00066 mg/L at ERM 0.1 (69 samples).

Detections of analytes at concentrations exceeding the water supply criteria support the decision to continue monitoring of the Swan Pond Embayment during non-time-critical activities.

Surface water data collected by TVA and data collected by TDEC in the same general areas and time frames are very similar, with no apparent significant differences.

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4. NON-TIME-CRITICAL SURFACE WATER MONITORING PLAN

When time-critical dredging operations cease, the principal sources of ash constituents in the Emory River are re-suspension of remaining ash mixed with sediments during periods of high flow and material not captured by BMPs in the Swan Pond Embayment. Accordingly, surface water monitoring during non-time-critical activities will be triggered by local rainfall and/or high Emory River flows.

For all river locations except the embayment, the trigger for a rainfall sampling event will be ≥1.0 inch in a 24-hour period, measured at the KIF meteorological station. The automated sampling at the embayment will continue to be triggered by a > 0.5 inch rainfall in a 24-hour period. A 24-hour period with <1.0 inch (< 0.5 inch for the embayment) will be the minimum separation time for consecutive sampling events. The trigger for an Emory River high flow event will be a flow ≥10,000 cfs measured at the Oakdale, Tennessee gage. A 24-hour period with <10,000 cfs will be the minimum separation time for consecutive sampling events.

The scope of this monitoring is as follows.

4.1 MONITORING SCOPE

4.1.1 Public Water Supplies (Kingston and Rockwood Water Treatment Plants and Swan Pond Area Spring)

TDEC will continue to collect grab samples weekly at the Kingston and Rockwood Municipal Water Treatment Plants through July 2010 and will initiate quarterly sampling at the spring head of the Swan Pond Area Spring that is used as a public drinking water source. Grab samples of both raw and treated water will be collected at the treatment plants. Samples will be analyzed for general water quality parameters and ash-related constituents. Beginning in August 2010, TDEC will collect monthly samples at the treatment plants through December 2010. Samples of raw and treated water also will be collected by plant personnel at the Kingston Water Treatment Plant twice weekly for analysis at an independent laboratory. The data from this monitoring will be reviewed after December 2010 with an option to reduce the frequency of sampling to the pre-spill frequency required by state of Tennessee municipal drinking water supply rules. In addition, following local heavy rainfall events and/or high Emory River flows, plant personnel will collect an additional raw/treated water sample at the Kingston Water Treatment Plant at their discretion.

4.1.2 Emory and Clinch Rivers

TSS and ash-related constituents will be monitored at three fixed locations on the Emory River, and two fixed locations on the Clinch River following heavy local rainfall (≥1.0 inch rainfall in a 24-hour period as measured at the KIF meteorological station) or during high Emory River flows (≥10,000 cfs at Oakdale, Tennessee). Samples at these locations will be collected using automated samplers on floats. Samplers will be programmed to collect a composite sample over a 24-hour period in order to bound flow events. Co-located Hydrolab® instruments will collect real-time field water quality data. EPA and TDEC will collect split samples from these events at their discretion.

Also, during the eight-week period following completion of dredging and approval of this plan, TVA will collect weekly surface water grab samples from 11 locations on the Emory, Clinch, and Tennessee Rivers. Ten of these locations are specified in the approved River System EE/CA SAP. Sample will be taken at three reference locations (ERM 8.0, CRM 6.0, and TRM 568.5), four Emory River locations (ERM 1.0, 2.0, 3.0, and 4.0), two Clinch River locations (CRM 2.0 and CRM 3.5), and one Tennessee River location (TRM 566). The additional location for this eight-week period only is ERM 0.3. The objectives of this monitoring are two-fold: provide data over a transition period from the end of dredging in the Emory River;

and complete the surface water sampling task in accordance with the approved EE/CA SAP. A copy of SAP Appendix D, Field Sampling Summary, is attached to this plan and summarizes key information associated with surface water sampling, including locations and analyses.

4.1.3 KIF Stilling Pond Effluent

The KIF Stilling Pond NPDES-permitted outfall will be monitored weekly for TSS and ash-related metal constituents, until the ash processing on the Ball Field is completed. EPA will collect split samples at their discretion.

4.1.4 Swan Pond Embayment

Manual grab samples will be collected weekly at key surface water drainage ditch locations and analyzed for TSS and ash-related constituents. Initial locations are at the Clean Water Ditch upstream of discharge to the Emory River and at the Sediment Basins effluent ("dirty water ditch"). Data from this monitoring will be evaluated over a six-month period to determine if it should continue on a routine basis. In addition, an automated composite sample will be collected from the Clean Water Ditch (final point of surface water exit to the Emory River) following local rainfall $\geq$0.5 inch in a 24-hour period. Manual grab samples will be collected from the Sediment Basins effluent as quickly as a team can be mobilized following a >0.5 inch rainfall event. TVA will initially continue to sample the current locations, with adjustment occurring as the drainage system configuration is altered to accommodate restoration activities. EPA and TDEC concurrence is required for location adjustments. EPA will collect split samples at their discretion.

4.2 SAMPLE LOCATIONS, COLLECTION, AND ANALYSES

4.2.1 Sample Locations

Sample Locations for Emory and Clinch Rivers

Sample locations for the storm event surface water monitoring are summarized in Table 4-1. Figure 5 illustrates these locations on a map of the river system.

Table 4-1
Storm Event Surface Water Sampling Locations

Location Number	Location	RM	Site Label	Sample Type	Depth (ft)	Latitude	Longitude
1	Emory River	4.0	KIF-ERM4.0	Automated 24-hour composite	15	N35.92343	W84.48323
2	Emory River	2.0	KIF-ERM2.0	Automated 24-hour composite	15	N35.90617	W84.50322
3	Emory River	0.3	KIF-ERM0.3	Automated 24-hour composite	15	N35.89040	W84.48842
4	Clinch River	4.6	KIF-CRM4.6	Automated 24-hour composite	15	N35.88587	W84.49001
5	Clinch River	2.5	KIF-CRM2.5	Automated 24-hour composite	15	N35.89058	W84.52350

Sample Location for KIF Stilling Pond Effluent

The location for sampling the KIF Stilling Pond is shown on Figure 5 (AP_IMP001). A weekly grab sample will be collected at NPDES Outfall 001.

Sample Locations for Swan Pond Embayment

The current sample locations are shown on Figure 5. Locations will be adjusted with the concurrence of EPA and TDEC as removal action work in the embayment progresses and the surface water flow is re-configured. Grab samples will be collected at these locations.

4.2.2 Sample Collection

Water sampling and analysis will be performed in accordance with the QAPP. The QAPP implementation includes sample collection in accordance with a set of project-specific SOPs that govern the conduct of work in the field. The TVA SOPs were prepared and reviewed by KIF project staff cognizant of and experienced in implementing EPA Region 4 and TDEC field procedures. The current revisions of the SOPs are maintained on a website available to EPA and TDEC.

Samples will be collected following the procedures outlined in the SOP for surface water sampling (TVA-KIF-SOP-01 *Surface Water Sampling, Revision 1*). Duplicate turbidity, temperature, dissolved oxygen, conductivity, and pH field measurements will be performed on a 1/20 sample frequency. Duplicate samples will also be collected on a 1/20 frequency for TSS, TDS, total metals, dissolved metals, total hardness, dissolved silica, and alkalinity. Additionally, a matrix spike/matrix spike duplicate pair will be taken on a 1/20 frequency and submitted to the laboratory.

Field parameters using a multi-analyte programmable data logger (Hydrolab®) collocated at each sample location described on Table 3-1 will be collected. Parameters of interest that will be documented include temperature, dissolved oxygen, pH, turbidity, and conductivity.

Following collection, the surface water sample will be transferred into appropriately clean, preserved bottleware (as required); see QAPP Section 7.2. A chain-of-custody (CoC) record will be completed as samples are collected in the field and will remain with the samples until the samples arrive at the laboratory for analysis. The samples will be shipped to the laboratory(-ies) via overnight carrier or laboratory courier. Signatures indicating the succession of sample custody will be documented on the CoC record.

Sample collection by TDEC and EPA will be performed in accordance with their respective SOPs.

4.2.3 Sample Analyses

Surface water samples will be sent to TVA contract laboratories for analyses. TVA maintains a rigorous contract laboratory program that includes periodic assessments (by a TVA-appointed QA contractor) to ensure compliance with analytical specifications. Table 4-2 summarizes the analytical parameters, test methods, and reporting limits that will be used to fulfill the DQOs of the surface water monitoring program. The analyte list is based on initial characterization of the ash and affected environmental media for a broader range of constituents (e.g., organic compounds) that was performed by TVA, EPA, and TDEC immediately after the spill. Additional detail for analytical methods is found in the QAPP.

Data Review and Validation

Data review and validation will be performed by TVA's independent QA contractor, in accordance with QAPP Sections 21.0 and 22.0.

Table 4-2
Analytes, Methods, and Target Reporting Limits for Surface Water Monitoring

Test Parameter	Test Method	Limit of Quantitation
Basic Water Chemistry		
pH	150.2/SM 4500 H^+ B	0.1 pH Units
Alkalinity	SM 2320B	10 mg/L
Total Hardness	200.7/200.8/SM 2340B	1 mg/L
Total Suspended Solids	160.2/SM2540D	1.0 mg/L
Total Dissolved Solids	SM 2540C	1.0 mg/L
Metals –Total and Dissolved		
Aluminum	6010B/6020/200.7/200.8	20 µg/L
Antimony	6010B/6020/200.7/200.8	2 µg/L
Arsenic	6010B/6020/200.7/200.8	2 µg/L
Barium	6010B/6020/200.7/200.8	10 µg/L
Beryllium	6010B/6020/200.7/200.8	2 µg/L
Boron	6010B/6020/200.7/200.8	50 µg/L
Cadmium	6010B/6020/200.7/200.8	1 µg/L
Calcium	6010B/6020/200.7/200.8	1,000 µg/L
Chromium	6010B/6020/200.7/200.8	2 µg/L
Cobalt	6010B/6020/200.7/200.8	2 µg/L
Copper	6010B/6020/200.7/200.8	5 µg/L
Iron	6010B/6020/200.7/200.8	50 µg/L
Lead	6010B/6020/200.7/200.8	2 µg/L
Magnesium	6010B/6020/200.7/200.8	1,000 µg/L
Manganese	6010B/6020/200.7/200.8	5 µg/L
Mercury	7470A/245.1	0.2 µg/L
Molybdenum	6010B/6020/200.7/200.8	5 µg/L
Nickel	6010B/6020/200.7/200.8	5 µg/L
Potassium	6010B/6020/200.7/200.8	1,000 µg/L
Selenium	6010B/6020/200.8	2 µg/L
Silver	6010B/6020/200.8	2 µg/L
Sodium	6010B/6020/200.8	1,000 µg/L
Thallium	6010B/6020/200.8	2 µg/L
Vanadium	6010B/6020/200.8	4 µg/L
Zinc	6010B/6020/200.8	50 µg/L

Note: 1. For definitions, see the List of Acronyms section.

5. DATA MANAGEMENT

An EPA-approved KIF Project Data Management Plan (DMP) is in place to address the challenges of managing technical data from a wide array of analysis processes. This DMP provides a basis for supporting a full technical data management cycle from pre-planning of sampling events to reporting and analysis with a particular emphasis on ensuring completeness, data usability, and most importantly, defensibility of the data. As the TVA data are verified and validated, the data will be migrated to the EPA SCRIBE data management system.

The major objectives of the DMP are to:

- Maintain data control, consistency, reliability, and reproducibility throughout the life of the project;
- Establish the framework for consistent documentation of the quality and validity of field and laboratory data compiled during all investigations;
- Describe in detail the data management procedures for all site-related data including groundwater, surface water, soil, sediment, air, biological, toxicological, and any other site-specific data collected;
- Describe how these new data will be integrated and comprehensively managed with previously collected and historical data;
- Include procedures and timelines for sharing data with stakeholders, and procedures for providing both electronic and hardcopies to specified recipients of each type of data; and
- Enable the use of project data in a consistent and easily shared format among appropriate internal and external parties (such as TVA, consultants, EPA, and TDEC.

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6. QUALITY ASSURANCE/QUALITY CONTROL AND QUALITY ASSURANCE PROJECT PLAN CROSS-WALK TABLE

The Kingston Ash Recovery Project has developed a comprehensive QAPP which governs the collection, analysis, reporting, and use of environmental data associated with the overall project. The QAPP (ESI 2009) has been approved by the EPA and the TDEC and is available in the Administrative Record, available at http://www.tva.gov/kingston/admin_record/index.htm. The QAPP was prepared in accordance with EPA's *Guidance for Quality Assurance Project Plans*, EPA QA/G-5 (EPA 2002). The QAPP provides the framework for implementation of the environmental sampling to support both time-critical and non-time-critical removal actions, as needed.

The QAPP details the requirements for the performance of all field sampling and laboratory analyses in support of the TVA Kingston Ash Recovery Project objectives. It also identifies the roles and responsibilities of TVA and contractor staff who implement the QAPP requirements. Embodied within the QAPP are the fundamental elements that ensure project objectives are met. These include:

- Data collection activities are documented in sampling and analysis plans.
- Field sampling and data plans are implemented following standard procedures.
- Field personnel are trained to the procedures.
- Independent assessments are performed and documented to ensure adherence to procedures in the field and to identify opportunities for continuous improvement.
- Sample analyses are performed by laboratories qualified to national standards.
- Periodic independent audits are performed on laboratories to ensure adherence to procedures and good practices.
- Data deliverables include the necessary documentation to perform independent, third-party validation of data in accordance with EPA national functional guidelines.
- Data are validated in accordance with EPA national functional guidelines.
- Data are managed in a controlled environment that also provides flexibility for data use and interpretation.

The primary goal of TVA's QA program is to generate defensible analytical data to characterize the extent of the fly ash deposition, to monitor the spill containment and removal and remedial operations, and to assess the potential short-term and long-term health hazards and biological impact. The QA program ensures that the data generated from site-wide sampling and monitoring activities are of sufficient quality to meet the objectives of the TVA Kingston Ash Recovery Project.

The scope of the QAPP is to provide the appropriate QA procedures and QC measures to be applied to all sampling and monitoring activities associated with the TVA Kingston Ash Recovery Project.

This section supplements the QAPP by providing task-specific information for the required elements that are not included in the approved QAPP (e.g., task-specific DQOs).

Task-specific sampling procedures are described in Section 4.2 of this surface water monitoring plan. Details are specified in the SOPs listed in Table 6-1.

Table 6-1
Standard Operating Procedures for the Surface Water Monitoring Plan

SOP Number	SOP Title
TVA-KIF-SOP-01	Surface Water Sampling
TVA-KIF-SOP-06	Field Documentation
TVA-KIF-SOP-07	Sample Labeling, Packing, and Shipping
TVA-KIF-SOP-08	Decontamination of Equipment
TVA-KIF-SOP-11	Field Quality Control Sampling
TVA-KIF-SOP-12	Management of Investigation-Derived Waste
TVA-KIF-SOP-13	Sample Retain Archive and Maintenance
TVA-KIF-SOP-14	Hydrolab Datasonde® Standardization and Field Parameter Measurement
TVA-KIF-SOP-18	Management and Implementation of EQuIS-Based Chain-of-Custody

Appendix C to the QAPP presents QA requirements for aqueous matrices. For the surface water monitoring plan, aqueous matrices include mid-depth surface water.

Sample containers, preservation, and holding times for aqueous samples are listed in Table C-1 of the QAPP.

Analytes, methods, and target reporting limits are listed in Table 4-2.

Precision and accuracy objectives for QC samples for aqueous matrices are listed in Table C-3 of the QAPP.

Table 6-2 provides a "cross-walk" that summarizes the document location where the task-specific QAPP-required elements may be found.

Table 6-2
Quality Assurance Project Plan Cross-Walk

QAPP Element	Location in Surface Water Monitoring Plan	Location in SOP
Data Quality Objectives	Section 2.1 Data Quality Objectives	
Sampling Design	Section 4.0 Non-Time-Critical Surface Water Monitoring Plan	
Sampling Methods	Section 4.2 Sample Location, Collection, and Analyses	Applicable SOPs[1]
Sample Collection	Section 4.2 Sample Location, Collection, and Analyses	Applicable SOPs[1]
Data Review and Validation (QAPP Section 21.0 and 22.0)	Section 4.2 Sample Location, Collection, and Analyses	
Assessments and Response Actions (QAPP Section 19.0)		

Note: [1]Applicable SOPs are listed in Table 6-1.

7. REFERENCES

Jacobs 2010a (May 18). *Action Memorandum for the Kingston Ash Recovery Project, Non-Time-Critical Removal Action, Embayment/Dredge Cell*. Prepared for the Tennessee Valley Authority.

Jacobs 2010b (May 24). *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP).*

Jacobs 2009 (August 25). *Surface Water Monitoring Plan for the Emory, Clinch, and Tennessee Rivers, Kingston Fossil Plant Ash Recovery Project*. Prepared for the Tennessee Valley Authority.

EPA 2009 (May 11). *Administrative Order and Agreement on Consent, Docket No. CERCLA-04-2009-3766,* Region 4.

EPA 2006 (February). *Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4*, EPA/240/B-06/001, Washington, D.C.

EPA 2002 (December). *Guidance for Quality Assurance Project Plans, EPA QA/G-5*.

Environmental Standards, Inc. (ESI) 2009 (December 18). *Quality Assurance Project Plan for the Tennessee Valley Authority Kingston Ash Recovery Project. TVA-KIF-QAPP*. Prepared for the Tennessee Valley Authority, Office of Environment and Research, Environmental Resources.

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FIGURES

Figure 1
Ash Removal Scope

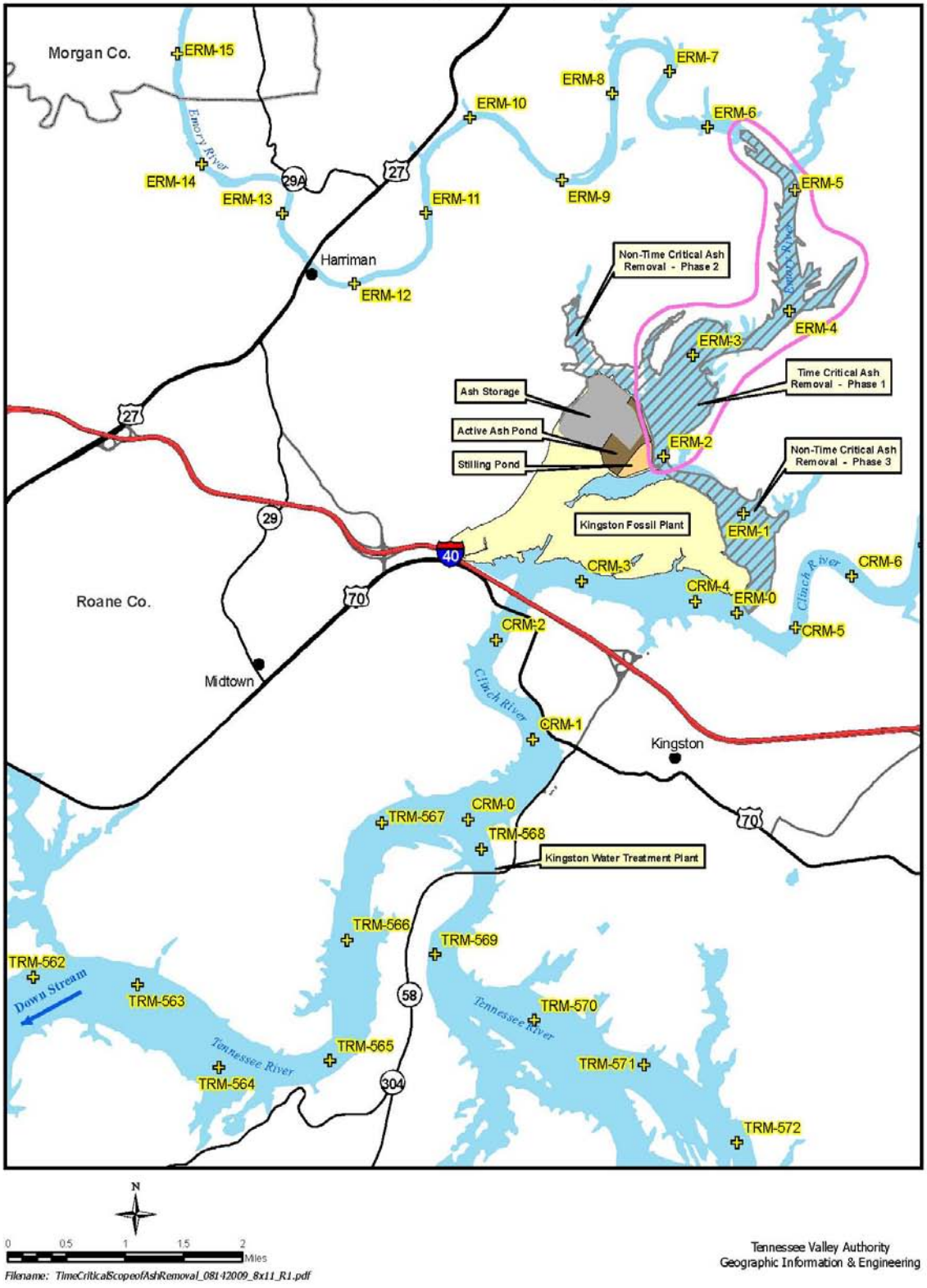

Figure 2
Time-Critical Phase Routine Surface Water Sampling Locations

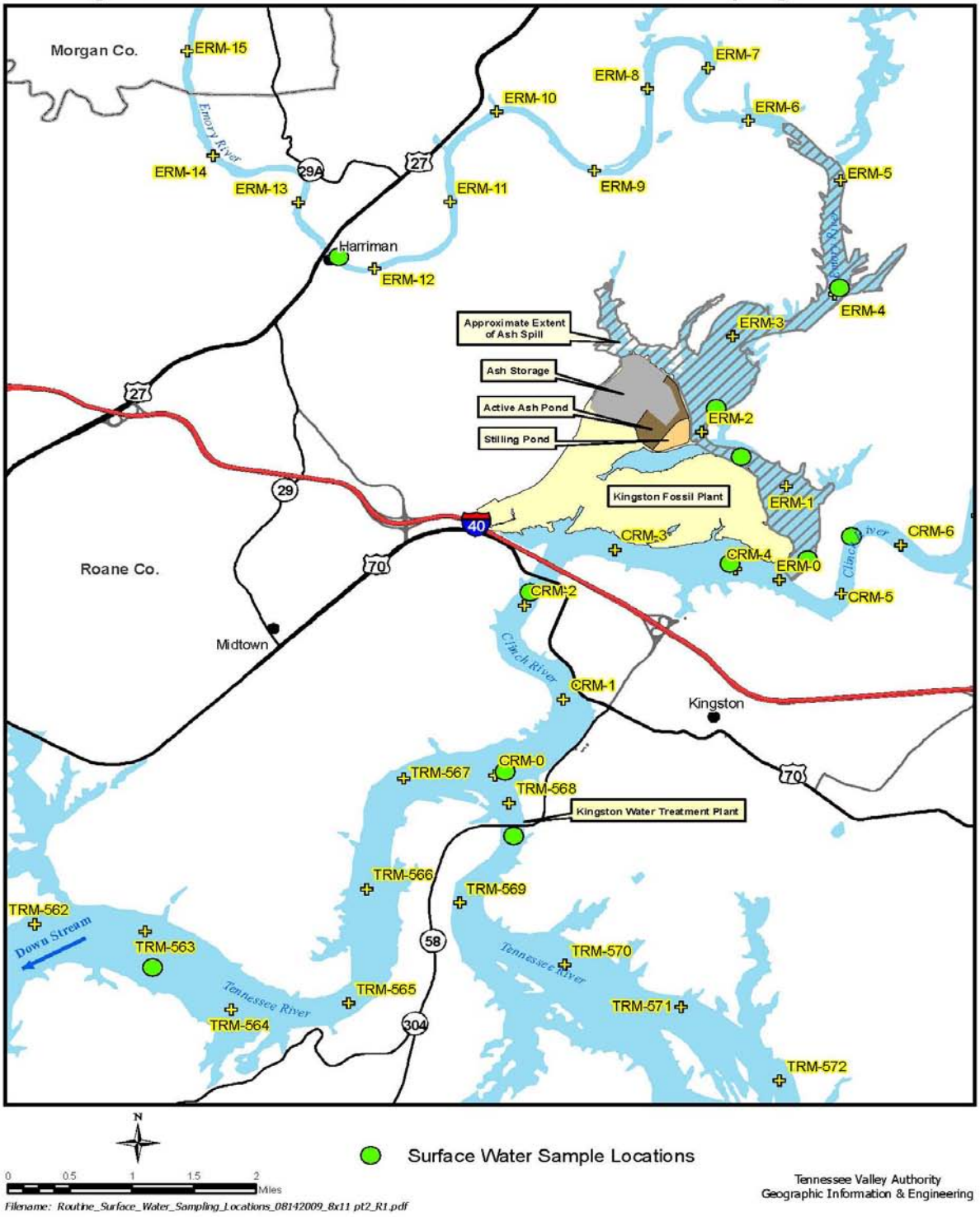

Figure 3
River Dredging and Ash Recovery

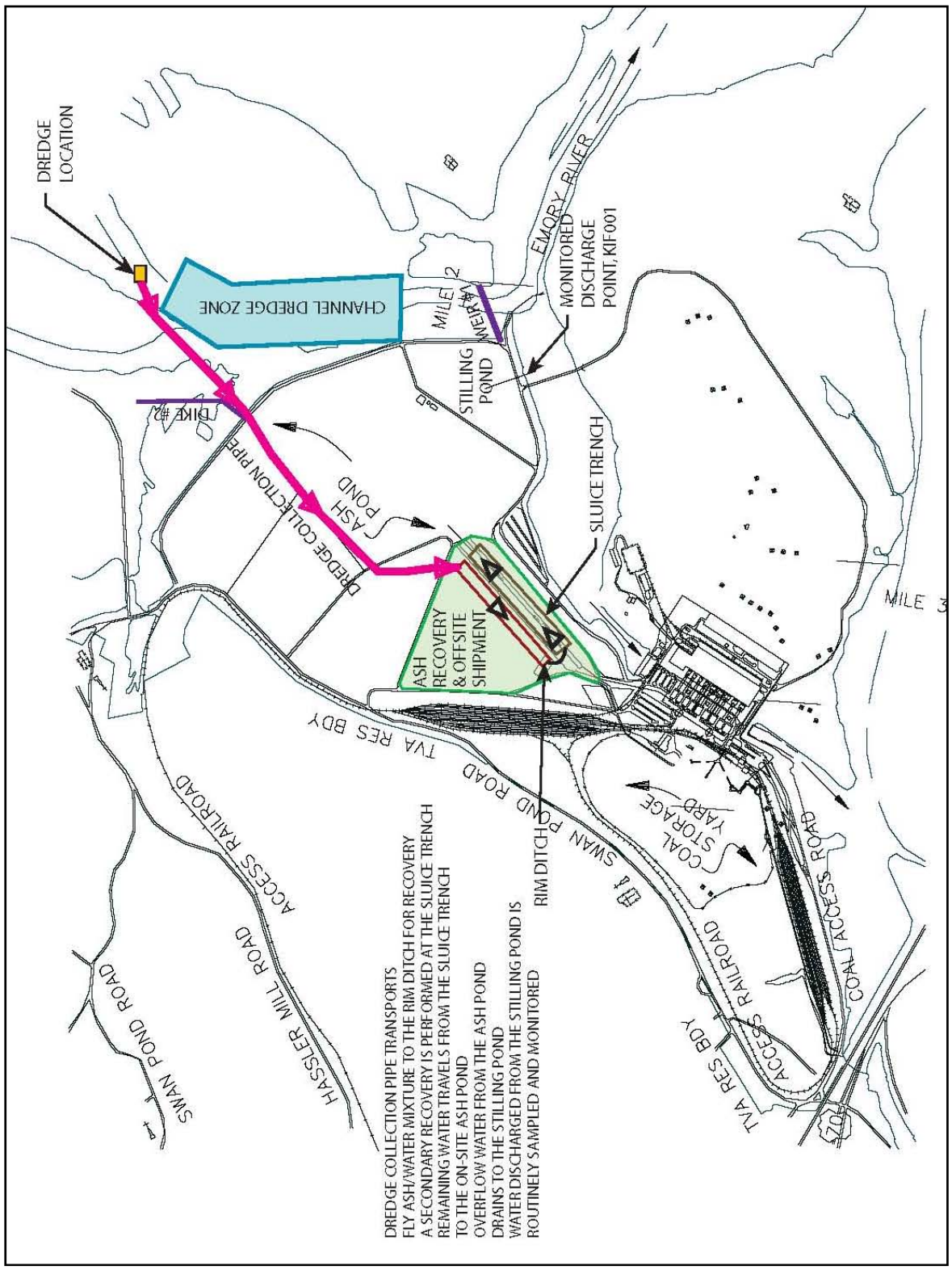

Figure 4
Comparison of TVA and TDEC Surface Water Results 09/11/2009 to Present

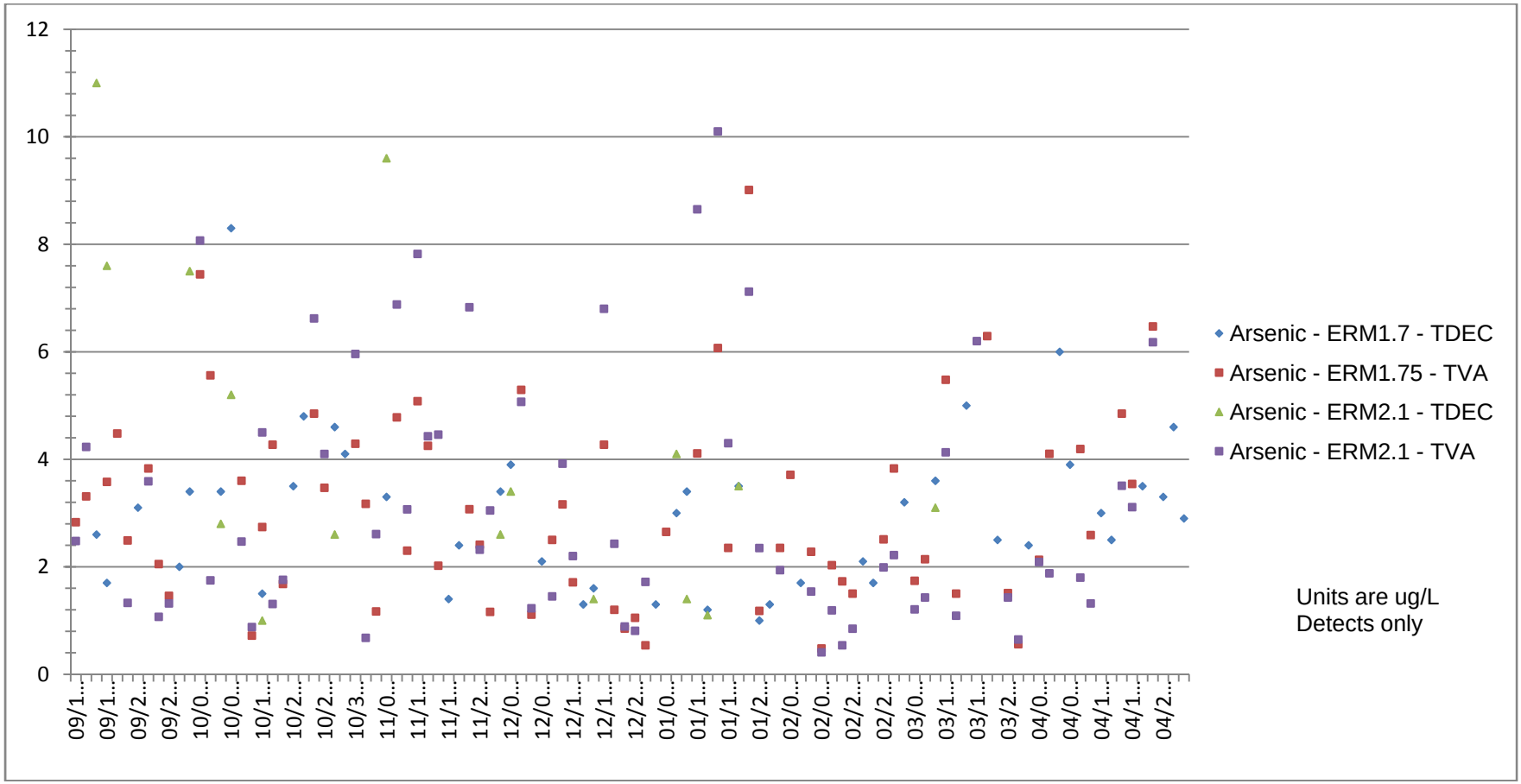

Figure 5
Kingston Fossil Plant - Non-Time-Critical Surface Water Monitoring

Date of map imagery:
May 19, 2010

Non Time-Critical Surface Water Monitoring Locations

N

0 1,000 2,000 3,000 Feet

NTC_River_Monitoring_20100524_8x11_r1.pdf

Map compiled: 06/30/2010

Tennessee Valley Authority
Geographic Information & Engineering

ATTACHMENT

Appendix D
Field Sampling Summary

Surface Water Sampling									
Reference Locations (Emory, Clinch, Tennessee Rivers)	ERM 8.0, CRM 6.0, TRM 568.5 (adjust to correlate with reference sediments) - 3 locations x 2 depths x 8 weekly rounds	48 samples	Surface Water	Peristaltic pump	Metals (total/dissolved) TSS/TDS DOC Hardness DO, pH, ORP, SC, temp, turbidity	**Metals** - SW-846 6010B/6020/7470A; EPA 200.7/200.8/245.7 **TSS** - EPA 160.2 **TDS** - EPA 160.1 **DOC** - SM 5310B **Hardness** - EPA 200.7/200.8, SM 2340B **DO, pH, ORP, SC, temp, turbidity** - direct measurement	**Metals** - 180 days **TSS/TDS** - 7 days **DOC** - 28 days **Hardness** - 180 days	**Metals** - pH<2 HNO3 **TSS/TDS** - cool <6°C **DOC** - field filter, pH<2 H2SO4, cool <6°C **Hardness** - pH<2 HNO3 cool <6°C	**Total metals** - 1 x 1-L HDPE **Diss metals** - 1 x 1-L HDPE **TSS/TDS** - 1 x 1-L HDPE **DOC** - 1 x 250-mL glass jar **Hardness** - 1 x 250-ml HDPE
Emory River Locations	ERM 1.0, 2.0, 3.0, 4.0 (adjust to correlate with submerged sediments) 4 locations x 2 depths x 8 weekly rounds	64 samples							
Clinch River Locations	CRM 2.0, 3.5 (adjust to correlate with submerged sediments) 2 locations x 2 depths x 8 weekly rounds	32 samples							
Tennessee River Location	TRM 566 (adjust to correlate with submerged sediments) 1 locations x 2 depths x 8 weekly rounds	16 samples							
Radionuclides, and Chemical Speciation Samples	Random selection of 25% of above locations	40 samples			Radionuclides (K-40, Ra-226/228, iso-Th, iso-U, Cs-137, Co-60) Metals speciation (As, Se, Hg, Cr)	**Radionuclides** - 901.1 Gamma Spectroscopy, EPA 903.1 Ra-226, EPA 904 Ra-228, EML HASL-300 Iso Th, Iso U **Cr VI** - SW846 7199 **As, Se, Hg** - Lab SOP	**Radionuclides** - 180 days **Cr VI**- 28 days **As, Se, Hg** - Lab SOP	**Radionuclides** - none **Cr VI** - pH=9 NaOH, cool <6°C **As, Se, Hg** - Lab SOP	**Radionuclides** - 1 x 2.5-gal. cube **CrVI** - 1 x 500-mL HDPE **As, Se, Hg** - 1 x 1-L HDPE
Reference Bioassay Location (Emory River)	ERM 8.0 (adjust to correlate with reference sediments) - 1 location	1 sample			*C. dubia* - 7 day *P. promelas* - 7 day	Inland Testing Manual, EPA-821-R-02-013 (EPA Method 1000.0 and 1002.0)	36 hours to first use	Cool <6°C	5-gal cubitainers
Emory River Bioassay Locations	ERM 1.0, 2.0, 3.0, 4.0 (adjust to correlate with submerged sediments) 4 locations	4 samples							