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

April 22, 2015

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

Dear Mr. Zeller:

Please find enclosed the Completion Report for TVA Kingston Fossil Fuel Plant Release Site. The enclosed report fulfills the requirements of Section XXXVIII, paragraph 101 of the Administrative Order and Agreement on Consent. Please contact me if you have any questions.

Sincerely,

Carol Eimers
General Manager
Kingston Recovery Project

Enclosures

Tennessee Valley Authority
Regulatory Submittal for Kingston Fossil Plant

Documents submitted:
Completion Report for the TVA Kingston Fossil Fuel Plant Release Site

EPA –AO-064

Date Submitted:
04/22/2015

Submitted to whom
Craig Zeller

Concurrence

Received	Not Applicable	TVA
☒	☐	Carol Eimers
☒	☐	Michelle Cagley
☒	☐	Jodie Birdwell

Received	Not Applicable	Jacobs
☒	☐	Bruce Haas
☐	☐	_____
☐	☐	_____

Approvals

TVA Carol Eimers Date 4/21/2015

EPA Craig Zeller Date 9/15/2015

cc:

- ☒ Jonathon Burr, TDEC
- ☒ Brenda Brickhouse, TVA
- ☒ Susan Jacks, TVA
- ☒ Craig Zeller, EPA
- ☒ Carol Eimers, TVA
- ☒ EDMS
- ☒ Bruce Haas, Jacobs
- ☒ Michelle Cagley, TVA
- ☒ Greg Signer, TVA
- ☒ KIF Incident Document Control
- ☒ Jodie Birdwell, TVA
- ☒ Ryan Stubbs, EPA
- ☒ Document Control, Jacobs (Barbara Peratrovich)

Document No. EPA-AO-064

Kingston Ash Recovery Project

Completion Report

TVA Kingston Fossil Fuel Plant Release Site, Roane County, Tennessee

Tennessee Valley Authority

Revision	Description	Date
00	Completion Report for TVA Review	April 14, 2015
01	Completion Report for EPA Review	April 22, 2015
02	Completion Report Final	August 27, 2015

Table of Contents

Appendices

List of Acronyms

ADEM	Alabama Department of Environmental Management
ARAR	Applicable or Relevant and Appropriate Requirement
BERA	Baseline Ecological Risk Assessment
BHHRA	Baseline Human Health Risk Assessment
BSL	Business Service Library
CCR	Construction Completion Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cy	cubic yard
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ERM	Emory River Mile
FCN	Field Change Notice
ft	foot
FML	flexible membrane liner system
FMLS	flexible membrane liner system
Jacobs	Jacobs Engineering Group Inc.
NPDES	National Pollutant Discharge Elimination System
NTCRA	non-time-critical removal action
MCL	maximum contaminant level
mg/kg	milligram per kilogram
MNR	Monitored Natural Recovery
OSC	On-Scene Coordinator
PLM	polarized light microscopy
POLREP	Pollution Report
PWS	Perimeter Wall Stabilization
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QMP	Quality Management Plan
RAO	Removal Action Objective
RFI	Request for Information
RG	remedial goal
RPM	Remedial Project Manager
SITREP	Situation Report
SPEER	Swan Pond Embayment Ecosystem Restoration
Stantec	Stantec Consulting Services Inc.
TAP	Technical Assistance Plan
TCRA	time-critical removal action
TDEC	Tennessee Department of Environmental Conservation
TP	test parcel
TVA	Tennessee Valley Authority
WI	Work Instruction

CERTIFICATION

I certify that to the best of my knowledge all response activities have been completed in full satisfaction of the requirements of the Administrative Order and Agreement on Consent, as executed on May 11, 2009, between the U.S. Environmental Protection Agency and the Tennessee Valley Authority (TVA) regarding the TVA Kingston Fossil Fuel Plant Release Site in Roane County, Tennessee. Information provided by TVA for documentation of response action completion is included in this Completion Report.

Carol Eimers, TVA General Manager, Kingston Ash Recovery Project

Signature Carol Eimers Date 8/31/15

1 INTRODUCTION

1.1 SUMMARY OF THE RELEASE AND RESPONSE ACTIONS

On December 22, 2008, approximately 5.4 million cubic yards (cy) of ash material were released into the environment from the Tennessee Valley Authority (TVA) Kingston Fossil Plant (plant) in Harriman, Roane County, Tennessee. In response to this release, a Unified Command structure was implemented consisting of the U.S. Environmental Protection Agency (EPA) Region 4 as the lead agency, the Tennessee Department of Environmental and Conservation (TDEC), and TVA. TVA undertook immediate response actions and worked in close coordination with the EPA, TDEC, and other agencies to provide for the safety of area residents, to contain released ash and minimize its downstream migration, and to monitor and assess air and water quality.

Following initial response actions, EPA transferred lead agency authority from EPA to TVA on January 11, 2009. On January 12, 2009, TDEC issued a Commissioner's Order to TVA requiring, among other things, the comprehensive assessment, cleanup and restoration of areas impacted by the release (TDEC 2009). On May 11, 2009, an *Administrative Order and Agreement on Consent* (EPA Order) was signed between EPA and TVA providing the regulatory framework for the restoration efforts under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (EPA 2009).

TVA undertook response actions to achieve short-term strategic Site objectives defined in the EPA Order as time-critical removal actions. Those actions, completed in December 2010, were summarized in an On-Scene Coordinator (OSC) Report (TVA 2011) and report addendum (TVA 2012a). TVA subsequently undertook further response actions to achieve mid-term Site objectives as non-time-critical removal actions. Those actions, completed in December 2014, were summarized in a second OSC Report (TVA 2015d) and report addendum (TVA 2015e). TVA has also begun long-term monitoring of the river system to satisfy long-term Site objectives.

1.2 FINAL INSPECTION

A pre-final inspection was held at the Site on January 29, 2015. The pre-final inspection was conducted by EPA, assisted by technical advisors from the U.S. Bureau of Reclamation. The pre-final inspection verified that the response actions were completed and that removal action objectives had been met (TVA 2015a).

As part of the pre-final inspection, a pre-final punchlist was provided to TVA. TVA subsequently completed the remaining punchlist items by April 2015. A final inspection was conducted by EPA on April 9, 2015 to verify that the punchlist items had been completed (TVA 2015c).

2 SUMMARY OF SITE CONDITIONS

2.1 SITE BACKGROUND

The TVA Kingston plant is located just off Swan Pond Road in Harriman, Roane County, Tennessee, near the city of Kingston. The plant is located on the Emory River close to the confluence of the Clinch and Tennessee Rivers. The Emory River at the plant site is impounded by Watts Bar Dam.

Construction of the plant began in 1951 and was completed in 1955. Ash is a product of burning pulverized coal in the plant and consists of both bottom ash and fly ash. Bottom ash is a coarse-grained material that is washed out of the bottom of the plant's production furnaces. Fly ash is a fine powdery material that is removed from the plant's exhaust stream by electrostatic precipitators. The collected bottom ash and fly ash had historically been sluiced as a water-based slurry to an Ash Pond for settling. Prior to the release, the ash was then dredged from the Ash Pond and piped to storage ponds, also known as dredge cells. The ash contains naturally-occurring metals, including arsenic and selenium, and radionuclides that are hazardous substances as defined by CERCLA Section 101(14).

The dredge cells were permitted by TDEC on September 26, 2000, as a Class II Solid Waste Landfill under state regulations. The three permitted dredge cells (Cells 1, 2, and 3) that failed during the release (referred to as the "Dredge Cell") covered about 127 acres and stored about 16.2 million cy of both fly and bottom ash at the time of the release. A fourth permitted dredge cell (referred to as the "Lateral Expansion Area", or Cell 4) was being constructed at the time in the northern half of the Ash Pond. Together, the Ash Pond and Lateral Expansion area covered about 120 acres and contained about 4.0 million cy of ash at the time of the release. The Dredge Cell, Ash Pond, and Lateral Expansion areas therefore contained a combined total of approximately 20 million cy.

2.2 INITIAL SITUATION

On Monday, December 22, 2008, a containment dike surrounding a portion of the Class II landfill collapsed, releasing about 5.4 million cy of fly ash and bottom ash. The wet ash material flowed into area waters, including the Emory River, adjacent tributaries and sloughs, and adjoining shorelines. The released material covered about 300 acres of adjacent parts of Watts Bar Reservoir, including most of Swan Pond Embayment.

The released ash extended through several miles of riverways. The main area affected by the failure of the Dredge Cell was in the area nearest the plant, extending from Emory River Mile (ERM) 1.5 to 3.5. The ash may have traveled upstream as far as ERM 5.75 and as far downstream as Tennessee River Mile 564. Since that time, further downstream migration of ash has likely occurred into the Clinch and Tennessee Rivers.

2.3 EMERGENCY RESPONSE AND INITIAL RECOVERY ACTIONS

TVA undertook considerable emergency response and initial recovery actions immediately after the release happened (TVA 2011). Actions included:

- Closing the Emory River to boat traffic
- Managing of river flows by controlling releases from nearby dams
- Controlling ash migration by constructing a Weir 1 across the Emory River and a Dike 2 across the Swan Pond Embayment; repairing damaged railroads, roads, and utilities
- Collecting cenospheres (floating ash residue) and floating debris from the river system

- Installing storm water management systems (clean water diversion, ash water collection, and settling basin)
- Dust control systems
- Dike stabilization

Comprehensive community outreach activities were implemented to provide for immediate safety and housing of affected residents, individual confidential health assessments, and multiple communication formats to provide local residents and officials with information on potential hazards and actions being taken.

3 CONSOLIDATED RECORD OF ALL RESPONSE ACTIVITIES

3.1 TIME-CRITICAL REMOVAL ACTION

Time-critical actions began following issuance of the EPA Order to address short-term strategic objectives for the Site. An Action Memorandum for the time-critical removal action was approved on August 4, 2009 (Jacobs 2009b). Time-critical actions included hydraulic and mechanical dredging of ash from the river, mechanical excavation of ash from the Swan Pond Embayment east of Dike 2, dewatering and processing of the recovered ash (including water management), loading of the dewatered ash into railcars, transport of the ash via rail offsite, and ultimate disposal of the ash at the Arrowhead Landfill in Perry County, Alabama. Other related actions included cenospheres recovery, air monitoring and dust control, surface water monitoring, storm water management, dike stability evaluations and stabilization, and construction of a test embankment to demonstrate the constructability of dry ash stacking. These actions are described in detail in the OSC Report (TVA 2011), and summarized below.

A pilot program for hydraulic dredging in the river began in March 20, 2009 and continued until July 20, 2009. At the end of the pilot program in July 20, 2009, nearly 468,000 cy of material had been removed by hydraulic dredging. Large-scale dredging of the Emory River began under the time-critical removal action in August, 2009, and was conducted in two phases. Phase 1 focused on removing the greatest volume of ash in the quickest time frame. At the end of Phase 1 on February 1, 2010, a total of 1.5 million cy of ash had been removed from the river, which opened the river channel and minimized downstream ash migration. Phase 2 focused on dredging to the original river bottom contours to further minimize the potential for ash migration downriver. This dredging was considered "precision" dredging, since shallow depths of ash were to be removed. At the end of Phase 2 in June 2010, an additional 750,000 cy of ash had been removed from the river.

Mechanical dredging using clamshells and excavators (trackhoes) was used in conjunction with hydraulic dredging to remove debris, rock, and/or ash deposits located far upstream. A total of 62,000 cy of ash were removed from the river by mechanical dredging. Land-based excavation of ash using bulldozers, excavators, and amphibious equipment was implemented in the area east of Dike 2 at the mouth of the Swan Pond Embayment. A total of 737,000 cy were mechanically excavated east of Dike 2 from June 2009 through May 2010.

Recovered ash was dewatered, then loaded onto railcars for transport to the Arrowhead Landfill in Uniontown, Alabama, which is a permitted Class I, Subtitle D, facility (Permit No. 53-03), permitted by the Alabama Department of Environmental Management (ADEM). Offsite shipments began on July 2, 2009; the last train shipment left the site on December 1, 2010. A total of 4,025,000 tons of material were disposed at the Arrowhead Landfill.

Stabilization of the existing Dike C surrounding the Lateral Expansion, Ash Pond, and Stilling Pond also was completed during the time-critical removal action. Construction of a rock buttress reinforcement along Dike C was begun on December 7, 2009, and was completed on August 6, 2011. A total length of 5,220 lin. ft. of Dike C was reinforced (TVA 2012a).

3.2 NON-TIME-CRITICAL REMOVAL ACTION

The non-time-critical actions focused on removing ash from the Swan Pond Embayment areas west of Dike 2 to address mid-term strategic objectives for the Site. TVA prepared an *Engineering Evaluation and Cost Analysis (EE/CA) for the Embayment/Dredge Cell* (Jacobs 2010a) to evaluate alternatives for restoration of the Swan Pond Embayment and for stabilization and closure of the former Dredge Cell and

Ash Pond as a single Ash Landfill. An *Action Memorandum* for the non-time-critical removal action was approved on May 18, 2010 (Jacobs 2010c).

Actions included removing ash from both the North Embayment and Middle Embayment with land-based equipment. Recovered ash was then dry-stacked onsite in the Dredge Cell and Ash Pond. Closure of the Dredge Cell and Ash Pond involved construction of a perimeter containment berm and final cap over the Ash Landfill. Efforts during this time also included continued dust management and storm water management. These actions are described in detail in the OSC Report for the Embayment/Dredge Cell (TVA 2015d) and summarized below.

- Ash was removed from the Swan Pond Embayment area west of Dike 2 using land-based and amphibious mechanical excavators. Excavation began on August 11, 2010. Mechanical excavation was completed in the North Embayment area by November 19, 2011, and in the Middle Embayment area by March 29, 2013. A total of 2,293,000 cy (in place) were removed from the North and Middle Embayment areas, including the area of a former Settling Basin and beneath Dike 2.

Ash processing activities were conducted concurrent with the mechanical excavation. Ash that was too wet for dry stacking was stockpiled in several areas of the Site, including the Ball Field, central Dredge Cell, and relic area of the Dredge Cell. Dewatering was conducted by gravity drainage and by windrowing to enhance evaporation. Lime treatment of wetter ash was conducted on a portion of the recovered ash and spoils from slurry trench construction during wet winter months, between January 13, 2010 and March 28, 2013.

- Ash placement and compaction within the former Dredge Cell and Ash Pond progressed in stages across the area. Initial subgrade preparation and recontouring began in the former Dredge Cell on August 11, 2010; the subgrade was completed and active ash stacking operations began on September 13, 2010. Ash stacking continued until July 1, 2013, when the final lift of ash was placed in the area of the former Ash Pond. A total of 3,595,000 cy (compacted) of ash material was ultimately stacked within the Ash Landfill, which included material from the relic area of the Dredge Cell, the adjacent Ball Field area, and alongside Swan Pond Road, in addition to that removed from the embayments.

- Perimeter containment included subgrade preparation, installation of a Perimeter Wall Stabilization (PWS) system, and construction of an earthen berm surrounding the Ash Landfill. The PWS was the most significant component of the perimeter containment system. The stabilized perimeter was designed to contain material both under static conditions as well as following a seismic event. The PWS involved excavating a grid of slurry trenches through saturated fly ash that were backfilled with self-hardening slurry composed of cement slag and bentonite. Each segment of the PWS system contained shear walls (perpendicular to the perimeter); some segments also contained an inboard and/or outboard perimeter wall (parallel to the perimeter). Each wall panel was nominally 4 ft wide and excavated in "cuts" approximately 30 ft long. The PWS system was a total of 12,000 ft long, and varied from 60 to 100 ft in width, and 45 to 75 ft in depth, keyed into bedrock. Design strengths varied from 200 to 265 pounds per square inch. Construction of the PWS system began as a pilot test in April 2011; full-scale production of the first segment of the wall began on July 19, 2011. The final segment of the wall was completed on August 2, 2013. Final repairs to the wall were made by installing replacement walls and by jet grouting, which were completed on February 20, 2014.

- Closure of the Ash Landfill included construction of a flexible membrane liner system (FMLS) and soil cap. The FMLS consisted of a multilayer cap built in the following successive layers: Subgrade preparation, 40-mil textured linear low density polyethylene geomembrane, geocomposite drainage medium, 20 inches of cap soil consisting of a silty or clayey borrow material, 4 inches of topsoil, and vegetative cover. Drainage systems were installed in conjunction with the FMLS and included:

Underdrain pipes in swales and ditches, downslope flumes lined with riprap, ditches lined with turf reinforcing mat, and low-water crossings of the perimeter access road lined with riprap. Placement of the cap system over the stacked ash progressed in stages across the area. Initial cap placement began in the former Dredge Cell on June 18, 2013, and continued until January 21, 2015, when the final section of cap was placed. A total of 9,836,000 square ft (planar area) of cap was constructed.

- Restoration of the ecosystem in the Swan Pond Embayment included establishment of a complex mosaic of forested, scrub-shrub, and emergent wetland plant communities (TVA 2015e). This included the restoration of floodplain microtopography and wetland hydrology (i.e., constructed vernal pools) that historically provided important off-channel, seasonal, aquatic habitat for amphibians, birds, and other semi-aquatic species. Enhancements included constructing weirs to control water levels in the North Embayment and constructing additional wetlands in the former borrow area. Restoration began in January 2014, and was substantially completed in December, 2014, with the planting of trees in reforestation areas. Final tree planting and seeding of disturbed areas was deferred over the winter until the arrival of the spring planting season, and was completed on June 12, 2015.

- Throughout the non-time-critical removal action, TVA continued other related routine actions, including air monitoring and dust control, surface water monitoring, and storm water management. Dike stability evaluations and inspections were routinely conducted.

4 PERFORMANCE MONITORING AND QUALITY CONTROL

4.1 ENVIRONMENTAL MONITORING

Environmental monitoring during construction of the response activities included sediment/soil sampling, water sampling, air monitoring, and groundwater monitoring. Monitoring is described in detail in the OSC Reports (TVA 2011) and (TVA 2015d), as summarized below.

4.1.1 Sediment/Soil Sampling

Sediment/soil sampling was performed to confirm that ash had been sufficiently removed and to collect samples of ash for chemical or radiological analysis. During river dredging activities, samples were collected of the sediment at the bottom of the river using vibracore techniques; during embayment excavation activities, samples were collected from the bottom of the excavation using either hand shovels or geoprobe techniques. Verification of ash removal was supplemented with polarized light microscopy (PLM) analysis of grab samples as confirmation of visual observations. If the proportion of ash was 50% or greater within the sample, the sample was designated as being ash, and excavation continued until the ash was removed.

Ash waste characterization sampling was performed during the time-critical removal action for offsite disposal to meet waste acceptance criteria described in the landfill's permit. Routine waste characterization included analysis for Toxicity Characteristic Leaching Potential metals, total metals, and radiological constituents. Paint filter tests were also performed to assess the absence of free liquids.

4.1.2 Surface Water Monitoring

Surface water sampling was performed to determine whether there was any down-river migration of ash-related constituents that posed an imminent public health or environmental threat. Sampling was performed during routine operation (non-rainfall events), following rainfall events, directly downriver of dredge plumes, in the Stilling Pond outfall, and in Swan Pond Embayment. Samples were analyzed for total suspended solids and total and dissolved metals. Results of routine (non-rainfall event) sampling indicated that concentrations for some metals were highest in the area of the release, suggesting that dredging operations or residual ash may have contributed to elevated concentrations in the river. Results of rainfall event monitoring were generally similar to non-rainfall event sampling. Results of monitoring within the dredge plume in the Emory River indicated that numerous metals had one or more concentrations that exceeded water quality criteria, demonstrating impact from the dredging activities, but that ash-related constituents rapidly settled out of the water or were rapidly diluted downriver. Routine river sampling was discontinued in August 2010 once dredging was completed; after an 8-week transition period, river sampling was performed only following storm events or in conjunction with long-term monitoring.

Results of sampling within the Stilling Pond and from the Swan Pond Embayment indicated impacts due to direct contact with ash. Surface water monitoring in the embayment was discontinued in August 2014, once the geomembrane cap had been placed to cover all the ash in the Ash Landfill.

4.1.3 Air Monitoring

Ambient air samples were analyzed for particulate air concentrations (PM2.5 and PM10), metals, and crystalline silica. Regional air quality conditions triggered Site action levels for PM2.5 to be exceeded on occasion, but monitoring showed that the Site did not contribute to local airborne PM2.5 for any of those events. Mobile real-time monitoring recorded instantaneous measurement of PM10; no 24-hour average

concentration was found to exceed Site action levels. Air monitoring was discontinued in August 2014, once the FMLS cap had been placed to cover all the ash in the Ash Landfill.

4.1.4 Groundwater Monitoring

TVA collected groundwater samples from one bedrock well and five shallow wells during the time-critical removal action. Results for the bedrock well showed that no analyte exceeded its maximum contaminant level (MCL) for domestic water supply. Results for shallow groundwater wells showed that arsenic exceeded its MCL three times in one well downgradient of the Ball Field in 2009, but not since. During the non-time-critical removal action, three additional wells (one shallow and two bedrock) were installed upgradient of the Site. Following closure, the groundwater monitoring network was expanded to include two additional downgradient bedrock wells and one additional downgradient shallow well; the expanded monitoring network will continue to be analyzed during the 30-year post-closure period.

4.1.5 Environmental Quality Assurance

Quality Assurance (QA) surveillances were performed during sample collection to check that the collection met Site objectives and sampling protocols. Laboratory surveillances were conducted of each contracted analytical laboratory to assess compliance with the contract technical requirements, the Quality Assurance Project Plan, and referenced analytical methods. EPA performed quarterly audits of the ambient air monitoring network and conducted a quality audit focusing on field sampling and data management for surface water and solid matrices. EPA also conducted three laboratory audits. The analytical data generated from the sampling activities were compared with the defined data quality objectives for precision, accuracy, representativeness, completeness, and comparability and sensitivity. Contracted laboratories for chemical analysis provided fully-documented (Level 4) data packages, for data validation.

4.2 CONSTRUCTION QUALITY CONTROL

Quality control (QC) during construction of the response activities including full-time QC inspection and testing during ash removal, ash stacking, PWS construction, and cap and closure activities. These are documented in detail in the OSC Reports, and their attached Construction Completion Reports (CCRs).

4.2.1 Ash Removal Quality Control

Jacobs Engineering Group Inc. (Jacobs) was responsible for QC during ash removal. During the time-critical removal action, upon completion of dredging activities in a given area of the river, supporting QC information was compiled to document completion. There were three ways in which an area of the river was considered to have been completed: (1) the dredge reached the target elevations as documented either by bathymetric survey or by the onboard dredge computer illustrating elevation of the cutter head; (2) the dredge reached a hard bottom (defined as cuts less than 6 to 12 inches per pass) as indicated on logs prepared by the dredge operator; and (3) the dredge reached native material as shown by the color and consistency of the dredging effluent. Completion was confirmed based on results of vibracore sampling with PLM analysis of grab samples. After the supporting information was gathered, a concurrence form was submitted to EPA for review and approval. EPA consulted with TDEC prior to granting approval. Copies of the concurrence forms are presented in the OSC Report (TVA 2011).

During the non-time-critical removal action, upon completion of the ash removal from a portion of the embayment, supporting QC information was compiled to document completion. Because the embayments were kept dewatered, all ash removal was completed using mechanical excavation. Verification of ash removal was based on the visual observations of the bottom of the excavation for the

presence of ash, supplemented with PLM analysis of grab samples. Confirmation sampling was conducted in accordance with the Construction Quality Control Plan, which was included in the approved design package. A sampling grid of sections not greater than 200 ft by 200 ft was established; four discrete samples were collected from each grid section. After the supporting information and confirmation sampling test results were gathered, a concurrence form was attached and the package was submitted to EPA for approval of the ash removal in that portion of the embayment. Copies of the concurrence forms are presented in the OSC Report (TVA 2015c).

4.2.2 Perimeter Wall Stabilization Quality Control

Stantec Consulting Services Inc. (Stantec) was responsible for QC during PWS construction. Upon completion of a portion of the PWS wall, supporting information was compiled to document completion and satisfaction of QC requirements. Each wall segment was divided into a series of test parcels (TPs). In each TP, QC testing included the following:

- Checks for rock embedment were completed by making soundings during slurry trench excavation. Excavation continued until sufficient rock embedment was reached. No further mitigation was required.

- Checks for horizontal and vertical alignment resulted in three walls having been excavated at an incorrect location, requiring corrective action. All walls were installed with acceptable vertical alignment.

- Unconfined compressive strength testing of grab samples and core samples was used to confirm suitable strength of the wall. Results generally indicated wall sections passing the specification requirements for Adjusted Mean Strength and Adjusted Exceedance Fraction. For TPs not meeting requirements, extending the curing period and retesting any stored samples frequently proved successful. In Segment 1 (TP-121), corehole samples were collected for testing, since there were no stored samples remaining, and those results showed the wall passing strength requirements. However, in Segment 2 (TP-212, -213, -214, and -215), Segment 5 (TP-506), and Segment 6 (TP-606 and -608) retesting of samples even after 112 days of curing did not produce acceptable strength results; therefore replacement walls were excavated adjacent to the original wall sections as corrective action.

- Coring through completed wall sections was used to check continuity of the wall, or presence of inclusions. Field Assessment forms (letters from Stantec) were completed to outline where continuity corings were to be drilled. Depending on the results of those corings, additional delineation corings were drilled to better define the extent of an identified defect. Field Addendums were prepared to outline where mitigation panels or jet grout mitigation holes were to be installed. Results indicated defect rates corresponding to an average of 18% of the trench excavation, requiring corrective action for mitigation of defects. Construction sequencing resulting in creation of cold joints between adjacent walls in an average of 20% of the construction joints, requiring corrective action for mitigation of cold joints.

Details of the coring and mitigation and results of QC testing are presented in concurrence forms and other supporting documentation for the respective TP. The concurrence packages were submitted to EPA for approval of the PWS wall. Copies of the concurrence forms are presented in the OSC Report and the associated CCRs for the various wall segments.

4.2.3 Ash Stacking Quality Control

Stantec was responsible for QC during ash stacking. QC testing included laboratory material testing for grain size and Proctor density, and field testing for in-place compacted density and moisture content. This testing verified compliance with the design specification requirements.

Additional geotechnical engineering data were collected for use in evaluating stability of the completed embankment. Geotechnical instrumentation, consisting of piezometers, slope inclinometers, and settlement plates, were installed prior to and during embankment construction. The following threshold limits were used for monitoring ash stacking operations:

- Pore pressure ratio. The pore pressure ratio was defined as the change in pore water pressure, measured by the piezometers, divided by the change in fill pressure, estimated from surveyed cross sections routinely scheduled during the stacking operations. When the pore pressure ratio was 10% or below, stacking could continue with regular monitoring. When the pre pressure ratio was 10 to 15%, stacking could continue, but with an increase in monitoring. When the pore pressure ratio was greater than 15%, stacking was stopped until pressures dissipated or additional stability analyses demonstrated that the stack was stable.

- Displacement ratio. The displacement ratio was defined as the maximum horizontal displacement, measured by the slope inclinometers, divided by the vertical displacement, measured by the settlement plates. When the displacement ratio was 20% or below, stacking could continue with regular monitoring. When the displacement ratio was 20 to 30%, stacking could continue, but with an increase in monitoring. When the displacement pressure ratio was greater than 30%, stacking was stopped until displacements stopped or additional stability analysis demonstrated that the stack was stable.

4.2.4 Cap and Closure Quality Control

Stantec was responsible for QC during cap and closure construction. QC testing included laboratory material testing of geosynthetic materials for interface friction. Field seam tests and confirmatory offsite laboratory seam tests were conducted on samples (coupons) of flexible membrane liner (FML) seams; non-destructive air lance testing of FML seams was also conducted in the field. Vertical and horizontal control was provided by detailed topographic surveys of the subgrade, FML, cap soil, and topsoil components of the FMLS at specified control points and breaks in grade.

4.2.5 Construction Quality Assurance

Construction QA was implemented in accordance with a Project Execution Plan, which complied with TVA Corporate guidelines to achieve requirements specified in the design QC Plans. The QA Plan defined work responsibilities and expectations for Site personnel with respect to construction quality. The QA Plan also emphasized implementing programs for Lessons Learned, Corrective Actions, and Document Control/Records Management. Work Instructions (WIs) were prepared to provide direction to project personnel regarding work flow processes. Modifications of the design packages were tracked via Field Change Notices (FCNs) and Requests for Information (RFIs).

QA checks were performed of the concurrence packages and of daily performance reports for reporting of progress and completeness of documentation. QA personnel monitored daily, weekly, and monthly QC data for compliance with the design specifications. QA checks were also performed of the Records Management Program to verify that record documents were properly captured in the TVA Vault (archive).

Self-assessments and surveillances were performed during construction to check that the activities met Site objectives and QC design specification requirements. In particular, TVA performed QA surveillances during construction of the PWS and cap and closure. One laboratory surveillance was conducted of the offsite laboratory performing the seam testing to assess compliance with the contract technical requirements and referenced protocols. In all, 16 self assessments and 134 surveillances were performed; appropriate findings and observations were added to the Corrective Action Program for tracking to resolution.

During the time-critical removal action, EPA maintained considerable onsite QA personnel as part of the Unified Command management through the OSC, and with onsite support provided by the U.S. Coast Guard and contractors Tetra Tech and OTIE. During the non-time-critical removal action, EPA's Remedial Project Manager (RPM) obtained technical support of the U.S. Bureau of Reclamation, who provided full-time onsite QA oversight and annual audits of the construction.

5 COMPLIANCE WITH REQUIREMENTS OF THE ORDER

Appendix A documents compliance with the requirements of the EPA Order. The documentation includes a listing of the requirements, the corresponding document reference in which the requirement is satisfied, and the date of completion of the document.

6 SATISFACTION OF SITE COMPLETION CRITERIA

This section documents that the Site completion criteria have been satisfied, so that the Site is eligible for completion. This includes the following criteria: (1) Response Objectives have been met, and all cleanup actions and other measures identified have been successfully implemented; (2) the Site is protective of human health and the environment; (3) land use controls are in place as appropriate; and (4) the only remaining activities at the Site are long-term management activities, including long-term monitoring.

6.1.1 Response Objectives

The time-critical removal action was completed to address the following short-term strategic objectives for the Site, as specified in the EPA Order (§IX, ¶26):

a. prevent the coal ash release from negatively impacting public health and the environment;

b. contain and remove coal ash from the Emory River and the area east of Dike 2 as appropriate to restore flow and minimize further downstream migration of the ash material; and

c. ensure that coal ash material recovered during these efforts is properly managed pending ultimate disposal decisions, or to the extent required by limited storage capacity, properly disposed.

Emergency response actions taken in 2008 and 2009 had initially addressed these response objectives. To prevent the ash from impacting public health, the Emory River was closed to boat traffic. Several actions were taken to minimize further downstream ash migration: river flows were managed through controlled releases from nearby dams; a weir was constructed across the Emory River and a dike (Dike 2) across the Swan Pond Embayment; cenospheres and floating debris were removed from the river; storm water management and dust control systems were installed; and dikes were stabilized to prevent further release.

Time-critical actions further satisfied these response objectives. To prevent the coal ash release from negatively impacting public health and the environment, large-scale dredging of the Emory River and the area east of Dike 2 was completed between August 2009 and June 2010. Phase 1 dredging focused on removing the greatest volume of ash in the quickest time frame to restore flow and minimize the potential for flooding ("bulk removal"). Phase 2 dredging focused on continued ash removal to the original river bottom to further minimize the potential for ash migration downriver ("precision dredging").

To verify that the coal ash release was not negatively impacting either public health or the environment, TVA conducted extensive environmental monitoring of municipal water supplies, private wells, onsite monitoring wells, surface water, soil/sediment, air, and biota (fish, benthic invertebrates, birds, mammals, reptiles, amphibians, and aquatic plants). These studies are documented in the *EE/CA Work Plan* (Jacobs 2009a); the *EE/CA for the Embayment/Dredge Cell* (Jacobs 2010a); the *EE/CA for the River System* (TVA 2012b), with associated Baseline Ecological Risk Assessment (BERA) and Baseline Human Health Risk Assessment (BHHRA).

The coal ash material recovered during the time-critical removal action was properly managed onsite, primarily in the Ball Field area, where the material was dried sufficiently for offsite disposal. The material was properly contained for transport using lined railcars and added polymer to absorb any excess water. The material was properly disposed at the Arrowhead Landfill in Uniontown, Alabama, as approved by the Alabama Department of Environmental Management through the EPA Region 4 RCRA Division. The Arrowhead Landfill is a permitted Class I, Subtitle D, facility with a composite liner system consisting of compacted clay, geomembrane liner, drainage layer, leachate collection system, and

protective cover. The secondary containment feature consists of the Selma Group chalk formation, a low-permeability formation that ranges from 200 to 570 ft thick beneath the landfill property.

The non-time-critical removal action was completed to address the following mid-term strategic objectives for the Site, as specified in the EPA Order (§IX, ¶26):

a. remove any remaining coal ash from the Emory River and the area east of Dike 2, as well as the coal ash from embayments and tributaries west of Dike 2, to the maximum extent practicable, as determined by EPA in consultation with TDEC and TVA, pending further Site assessment;

b. remove the coal ash from impacted surface soils to the maximum extent practicable, as determined by EPA in consultation with TDEC and TVA, pending further Site assessment;

c. restore area waters impacted by the coal ash release in accordance with the required jurisdictional assessment; and

d. ensure proper disposal of all coal ash material recovered during these efforts.

Ash removal from the Emory River and the area east of Dike 2 was completed to the maximum extent practicable during the time-critical removal action. It is estimated that approximately 532,000 cy of material remain in the river system. The *Action Memorandum for the River System* (TVA 2012d) provided the justification for leaving that material in place so as to avoid impairing the ecological habitat or increasing short-term risks to human health or the environment. The selected remedy, Monitored Natural Recovery (MNR), will not disturb the sediments on the river bottom, avoiding short-term turbidity and suspended solids impacts on water quality and avoiding any exposure of cesium-137 contaminated sediments or other legacy constituents (such as mercury or polychlorinated biphenyls) to the aquatic environment. The Action Memorandum further cited the following justification: (1) Scour and sedimentation processes are effective in naturally covering the ash deposits and reducing concentrations of arsenic and selenium in the river sediment; (2) the proposed action is effective in meeting each of the Removal Action Objectives (RAOs) for protecting benthic invertebrate and bird populations and restoring the ecological function and recreational use of the river system to pre-release conditions; (3) the proposed action has been demonstrated to be effective at other sites; (4) ecological populations will be adequately protected over the short term; and (5) the proposed action is the most cost-effective. For these reasons, ash has been removed from the Emory River and the area east of Dike 2 to the maximum extent practicable.

Ash removal from the Swan Pond Embayment, tributaries, and surface soils west of Dike 2 was completed to the maximum extent practicable during the non-time-critical removal action. It is estimated that approximately 77,400 cy of material remain in the embayment. The *OSC Report for the Embayment/Dredge Cell* (TVA 2015d) provided the justification for leaving that material in place. Ash beneath paved roadway embankments (Swan Pond Road or Swan Pond Circle Road) could not be removed without endangering the roadway. Ash located below elevation 743 ft mean sea level next to the PWS buttress wall could not be removed without endangering wall stability (as shown on the approved design drawings). The materials left in place have been covered to prevent migration into the embayment and to prevent contact by human or ecological receptors. Ash within embankment slopes along Swan Pond Road and Swan Pond Circle Road and beneath the PWS buttress has been covered with sand, gravel, and riprap. Ash beneath the roadways has been covered with asphalt. Ash beneath the rail lines has been covered with railroad ballast. For these reasons, ash has been removed from the embayment, tributaries, and surface soils west of Dike 2 to the maximum extent practicable.

Restoration of area waters impacted by the coal ash release was satisfied during the non-time-critical removal action. Ecosystem restoration included establishment of a complex mosaic of forested, scrub-shrub, and emergent wetland plant communities. This included the restoration of floodplain microtopography and wetland hydrology that provide off-channel, seasonal, aquatic habitat for amphibians, birds, and other semi-aquatic species. Enhancements included constructing weirs to control water levels in the North Embayment and constructing additional wetlands in the former borrow area. A vegetative retaining wall was built along the Emory River to repair historical bank erosion. Planting of reforestation areas and hydroseeding of riparian habitat areas provided a jump-start to ecological succession growth. A transitional wetland habitat was constructed in the North Embayment and fish and bird habitat structures were installed in both the North and Middle Embayments. Restoration of the river system will occur gradually over time through MNR processes, as described in the *Action Memorandum for the River System* (TVA 2012c).

Proper disposal of the coal ash material recovered during the non-time-critical removal action was satisfied by containing the material in the onsite Ash Landfill. The PWS system provides stable containment of the ash under static and earthquake-induced conditions. The cap and cover system provides protection against direct contact with the ash and reduction in infiltration of rainwater, in accordance with TDEC solid waste regulations.

6.1.2 Long-Term Monitoring

Long-term monitoring was initiated beginning in 2013 to address the following longer-term strategic objectives for the Site, as specified in the EPA Order (§IX, ¶26):

a. perform a comprehensive Site assessment to determine what actions may be necessary to address any residual contamination remaining after previous cleanup activities;

b. implement any such actions; and

c. ensure the proper disposal of all ash material recovered during these efforts.

A comprehensive Site assessment was completed in accordance with the approved *Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan* (TVA 2010). Results of that assessment were presented in the *Non-Time-Critical Removal Action for the River System Engineering Evaluation/Cost Analysis* (TVA 2012b), which included the detailed BERA and BHHRA. The subsequent *Action Memorandum for the River System* (TVA 2012c) selected MNR, with appropriate long-term monitoring, as the preferred alternative for managing the residual ash in the river system remaining after previous cleanup activities.

A *River System Long-Term Monitoring Sampling and Analysis Plan* (TVA 2013) was prepared and approved by EPA for implementing the recommended longer-term monitoring actions. These actions consist of the following general scope of work:

- Characterization of ash deposits. Discrete vibracore samples will be taken of sediment, focusing on depositional areas identified by model results, for measurement of ash depth plus percent ash, and grain size distribution. Bathymetric data will also be collected to establish baseline conditions and after major storm events in support of sediment transport modeling.

- Characterization of sediment contamination. Sediment will be characterized for assessment of potential toxicity to benthic invertebrate populations and to verify declining concentrations predicted by the sediment transport modeling. Vibracore samples will be collected from transects across the

river, composited by area, and analyzed for arsenic and selenium in the upper 6 inches of sediment and focusing on areas with suitable benthic habitat. Samples will also be taken from the ash deposit locations and concurrent with each benthic community sample to support periodic ecological risk assessment.

- Characterization of sediment toxicity. Composite samples were taken in 2013 from multiple transects and tested for definitive 10-day survival and growth with *Hyalella Azteca* to confirm prior ecological risk assessment conclusions.

- Benthic invertebrate community sampling. Composite samples of depurated mayfly nymphs will be collected biennially in the spring from the sediment to measure abundance and diversity in support of ecological risk assessment.

- Benthic invertebrate bioaccumulation sampling. Samples will be analyzed for metals in support of ecological risk assessment. Mayfly nymphs (depurated) will be collected biennially in spring in conjunction with the community sampling. Mayfly adults (both male and female imagos and subimagos) will be collected biennially in summer. Snails (both depurated and non-depurated) were collected in 2013 to confirm prior sampling results.

- Aerial-feeding insectivores sampling. Birds will be assessed annually in support of ecological risk assessment. Tree swallow eggs will be collected and analyzed for metals to assess bioaccumulation. Field observations will be recorded on clutch size, hatchling success, and 15-day hatchling survival.

- Supplemental long-term monitoring of fish. Fish bioaccumulation, fish health and reproduction, fish community survey, and spring sport fish survey will be performed in support of long-term environmental stewardship of Watts Bar Reservoir.

The long-term monitoring plan uses an adaptive monitoring and management framework that includes pre-defined strategies for evaluating results. These periodic evaluations will serve as decision points for responding to monitoring results and recommending changes for optimizing data usefulness and cost-effectiveness.

Results of long-term monitoring will be reported annually as Preliminary Assessment Reports for individual media to evaluate trends and document results. Formal 5-year reviews of the selected remedy will be conducted in accordance with CERCLA requirements for up to 30 years. The 5-year reviews may include updates of the sediment transport model and/or the ecological risk assessment to support adaptive management decision-making.

6.1.3 Protection of Human Health and the Environment

As reported in the *Action Memorandum for the River System* (TVA 2012c), a BHHRA was conducted to develop quantitative and qualitative estimates of potential cancer risks and noncancer hazards for human populations (receptors) exposed to environmental media impacted by ash remaining in the river system. The risk assessment was conducted in accordance with EPA Risk Assessment Guidance for Superfund protocols. Results of the BHHRA (Jacobs 2012) are included as an Appendix to the *River System EE/CA* (TVA 2012b).

Human receptors evaluated in the BHHRA included a resident exposed to surface water, a recreator (swimmer/beachcomber) exposed to seasonally-exposed sediment or surface water, and a recreator from fish consumption. The risk analysis was based on analytical data collected from seasonally-exposed sediment, surface water, and fish filet sampling. Although there is potential unacceptable noncancer

hazard due to ingestion of fish, these hazards are associated with legacy contaminants in the river system and not TVA-related or ash-related. Prior to the ash release, the State of Tennessee issued a fish consumption advisory for the Emory and Clinch Rivers that remains in effect. Results of the BHHRA concluded that there is no unacceptable cancer risk or noncancer hazard to current human receptors due to ash-related constituents.

A BERA was conducted to evaluate potential risks to ecological receptors exposed to environmental media impacted by ash remaining in the river system. The risk analysis followed an eight-step process in accordance with EPA's Ecological Risk Assessment Guidance for Superfund protocols. Results of the BERA (Arcadis 2012) are included as an Appendix to the *River System EE/CA* (TVA 2012b).

Receptor groups evaluated included the benthic invertebrate and fish communities, aquatic- or riparian-feeding bird and mammal populations, aerial-feeding bird and mammal populations, amphibians, reptiles, and aquatic plant communities. Benthic invertebrates (e.g., mayflies or snails) were considered to be at moderate risk in the Emory River and low risk in the Clinch River due to biouptake of arsenic and selenium in ash-contaminated sediment. Riparian-feeding birds (e.g., killdeer) that feed on benthic invertebrates in ash-impacted areas of the river system were considered at low risk due to biouptake of arsenic and selenium in their diet (larval mayflies and snails). Aerial-feeding birds (e.g., tree swallows) were also considered to be at low risk due to biouptake of selenium in their diet (adult mayflies). Risk management actions were recommended for protection of these receptor groups; the proposed MNR action with long-term monitoring is presented in the *River System Action Memorandum* (TVA 2012c).

Other ecological receptor groups were considered to be at low to negligible risk. These include fish, fish-eating birds, mammals, amphibians, reptiles, and aquatic plant communities. No further actions were recommended for protection of these receptor groups.

The proposed action is effective in meeting each of the RAOs that were identified in the *River System EE/CA* (TVA 2012b) to mitigate the threat or potential threat to the public or the environment as a result of the residual ash in the Emory and Clinch Rivers. The following describe how the proposed MNR action meets each of the RAOs.

a. ***Protect benthic invertebrate populations in Watts Bar Reservoir from adverse effects due to arsenic and selenium in ash-contaminated sediment.*** The BERA concluded there is a moderate risk to benthic invertebrates due to exposure to arsenic and selenium in sediment. Results of toxicity testing suggested statistically significant reductions in growth and biomass could occur when percent ash in the sediment yields concentrations greater than the selected remedial goals (RGs) for arsenic and selenium. Risks to benthic invertebrate populations will gradually diminish over time as ash-related constituent concentrations in sediment decline to below the selected RGs. Based on the results of the sediment transport modeling, sediment mixing and redeposition will likely result in average arsenic concentrations declining to less than the uppermost part of the RG range of 41 mg/kg in all areas of the river system in less than 12 years. Similarly, average selenium concentrations will decline to less than the uppermost part of the RG range of 3.2 mg/kg in less than 26 years.

   Following periodic severe storm flow events, exposures may increase briefly in some scour areas; however, as the natural cover redevelops, exposure concentrations and associated risks will decline. Given that baseline levels of unacceptable ecological risk are confined to few receptors and are already low, these short-term scour events will have little likelihood of increasing risks over the long term. MNR will therefore effectively meet RAOs for protection of benthic invertebrate populations.

b. ***Protect riparian-feeding bird (e.g., killdeer) and aerial-feeding bird (e.g., tree swallow) populations from adverse effects due to uptake of arsenic and selenium in ash-contaminated sediment through their diet (benthic invertebrates).*** The BERA concluded there is a low risk to birds that feed on benthic organisms. These low risks will further diminish over time, as ash-related constituent concentrations in benthic invertebrate tissue decline to below the selected tissue monitoring endpoints. MNR will therefore effectively meet RAOs for protection of invertebrate-feeding bird populations.

c. ***Restore the ecological function and recreational use of the river system to pre-release conditions.*** Results of the BHHRA concluded that there is no unacceptable risk to current human receptors from the remaining ash, so that recreational use of the river system has been restored to pre-release conditions. By allowing natural processes of scour and sedimentation to occur, a natural cover will develop in depositional areas of the river system. This natural cover will be effective in eliminating exposure and biouptake by benthic organisms, restoring the ecological function of the reservoir throughout the food web.

d. ***Dispose of waste streams from the removal action in accordance with Applicable or Relevant and Appropriate Requirements (ARARs).*** There will be no waste streams from the MNR removal action requiring disposal. Because only monitoring activities will be conducted within the rivers, no location- or action-specific ARARs will be invoked.

6.1.4 Land Use Controls, Maintenance, and Monitoring for the Ash Landfill

Long-term land use controls for the closed Ash Landfill are defined in the *Closure/Post-Closure Plan* (TVA 2014). In accordance with the EPA Order (§XV,¶37), TVA shall be responsible for post-removal Site control consistent with Section 300.415(l) of the National Contingency Plan and the EPA Office of Solid Waste and Emergency Response Directive No. 9360.2-02.

TVA will retain ownership of the closed Ash Landfill, and will control access to this Site following the CERCLA removal action as part of the Kingston Fossil Plant federal facility. The closed landfill shall remain undeveloped. Per TDEC's rule 0400-11-01.04(8)(f), TVA will enter a "Notice in Deed to Property" identifying that the land has been used as a disposal facility and its use is restricted in accordance with the *Closure/Post-Closure Plan*.

There will be no need for security fencing around the closed Ash Landfill. Visitors and trespassers will be subject to existing Site security inspections and procedures for access control to TVA properties. TVA workers will be controlled through existing procedures, which include excavation work permits to preclude excavation through the liner. These work permits will be required for any excavation extending more than 1 ft below the ground surface, whether for geotechnical instrumentation, monitoring wells, utility trenching, or other applications. The CCR for the cap and cover will serve to delineate the closed landfill boundaries where such excavation shall be controlled.

The manufacturer for the geosynthetic components installed as part of the FMLS has provided recommendations for the minimum cover soil thickness required for various equipment ground pressures. These recommendations (provided in the *Closure/Post-Closure Plan*) are intended to reduce the potential for damage to the geosynthetic components resulting from equipment traffic across the closed landfill. TVA will determine the ground pressure for any equipment that will access the Site and the thickness of cover soil along the travel route(s) for this equipment to verify these recommendations are followed.

Long-term maintenance and monitoring of the closed Ash Landfill will be in accordance with TDEC's Rule 0400-11-01-.04. TVA, as the owner of the Ash Landfill, will maintain the approved final contours

by conducting quarterly inspections for 2 years, then semi-annually thereafter, and making repairs as needed to eliminate ponded water or erosion features. Similarly, TVA will maintain the drainage system (ditches, flumes, culverts, and pipes) by making repairs as needed to remove obstructions, vegetation, debris, or sediment. TVA will maintain the vegetative cover by irrigating (if needed), periodic mowing, removing unwanted vegetation, and re-establishing vegetation (if needed).

TVA has installed an extensive network of geotechnical instruments (slope inclinometers and piezometers) to measure lateral deformations and porepressures for use in verifying stability of the Ash Landfill. Geotechnical instrumentation monitoring will be conducted quarterly for the first 2 years, and semi-annually thereafter. Some of these instruments will be equipped with remote telemetry to allow real-time automated measurement of inclinometer and piezometer readings. Threshold limits will be established for individual piezometers corresponding to predicted long-term, static groundwater levels; if piezometer readings are at or below the threshold limits, then no further action is required. Threshold limits were established for individual slope inclinometers based on considerations for tolerable undrained shear strains in the saturated deposits at the base of the landfill. The threshold limit is defined as a horizontal offset of 0.2 inches between adjacent readings vertically in a given inclinometer. If measurements exceed these thresholds, TVA will evaluate the conditions on a case-by-case basis to determine the potential cause and need for repair. Notification will be made to both EPA and TDEC if conditions are realized that warrant engineering evaluation; this notification will include a description of the issue(s) and any required action(s).

Groundwater monitoring will be conducted semi-annually in accordance with the approved Groundwater Monitoring Plan included with the *Closure/Post-Closure Plan* (TVA 2014). Groundwater samples will be analyzed for the 17 inorganic constituents listed in Appendix I of TDEC Rule 0400-11-01-.04, which include arsenic and selenium, plus radium-226. A statistical methodology consistent with both the requirements of TDEC Rule 0400-11-01-.04(7)(a)(4)(v) and the statistical characteristics of the historical groundwater monitoring data will be applied to future monitoring data to assure timely detection of groundwater quality exceedances at the compliance monitoring wells. If groundwater detection monitoring results indicate either a statistically significant increase above background, TDEC will be notified within 14 days of this finding. If this increase is confirmed, then an assessment monitoring program will be initiated as required in TDEC Rule 0400-11-01-.04(7)(a)6.

7 REFERENCES

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Jacobs 2009b. August 4, 2009 (EPA approval). *Action Memorandum; Request for Removal Action at the TVA Kinston Fossil Fuel Plan Release Site, Roane County, Tennessee*. Document No. EPA-AO-005.

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TVA 2011. March 31, 2011 (EPA approval). *TVA Kingston Fossil Fuel Plant Release Site On-Scene Coordinator Report for the Time-Critical Removal Action May 11, 2009 through December 2011*. Document No. EPA-AO-030.

TVA 2012a. January 30, 2012 (EPA approval). *TVA Kingston Fossil Fuel Plant Release Site, On-Scene Coordinator Report Addendum for the Time-Critical Removal Action, Addendum No. 01*. Document No. EPA-AO-030A.

TVA 2012b. August 10, 2012 (EPA approval). *Kingston Ash Recovery Project Non-Time Critical Removal Action River System Engineering Evaluation/Cost Analysis (EE/CA)*. Document No. EPA-AO-051.

TVA 2012c. November 7, 2012 (EPA approval). *Kingston Ash Recovery Project Non-Time-Critical Removal Action River System Action Memorandum*. Document No. EPA-AO-054.

TVA 2013. May 23, 2013 (EPA approval). *Non-Time-Critical Removal Action for the River System Long-Term Monitoring Sampling and Analysis Plan*. Document No. EPA-AO-059.

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TVA 2015a. January 29, 2015. Meeting Notes. Kingston Ash Recovery Project, Pre-Final Inspection, Non-Time-Critical Removal Action, Embayment/Dredge Cell.

TVA 2015b. March 20, 2015 . *Kingston Ash Recovery Project, Natural Resources Damages Assessment Monitoring, Maintenance, and Reporting Plan*. Document No. EPA-AO-062.

TVA 2015c. April 9, 2015. Meeting Notes. Kingston Ash Recovery Project, Final Inspection, Non-Time-Critical Removal Action, Embayment/Dredge Cell.

TVA 2015d. August 27, 2015 (submitted for EPA approval). *Kingston Ash Recovery Project, On-Scene Coordinator Report for the Non-Time-Critical Removal Action for the Embayment/Dredge Cell.* Document No. EPA-AO-063.

TVA 2015e. August 27, 2015 (submitted for EPA approval). *Kingston Ash Recovery Project, On-Scene Coordinator Report Addendum for the Non-Time-Critical Removal Action for the Embayment/Dredge Cell.* Document No. EPA-AO-063A.

APPENDIX A

Compliance with Requirements of the Order

COMPLIANCE WITH REQUIREMENTS OF THE ORDER

Section	Paragraph	Requirement	Document	Doc. No.	Date (EPA approval)
VIII	22, 25	Project Coordinator designation; Michael Scott named in the Order	Letter designating Steve McCracken as Project Coordinator	N/A	1-May-2010
			Letter designating Kathryn Nash as Project Coordinator	N/A	16-Apr-2012
			Letter designating Carol Eimers as Project Coordinator	N/A	21-Jan-2014
VIII	23	Notification of identity and assigned tasks of each of its contractors upon selection and contract award	Verbal communication with EPA onsite representatives (OSC and RPM) during bidding, selection, contract award, and execution of assigned tasks	N/A	N/A
VIII	23	Contractors performing quality work must submit Quality Management Plan (QMP)	All contractors performed environmental work under the EPA-approved Quality Assurance Project Plan (QAPP)	EPA-AO-014	18-Dec-2009
IX	28	Action Memorandum for TCRA	Action Memorandum for TCRA	EPA-AO-005	4-Aug-2009
IX	28(a)	Site Storm Water Management Plan	Site Storm Water Management Plan	EPA-AO-002	29-Jun-2009
IX	28(b)	Site Dust Control and Air Monitoring Plan	Site Dust Control and Air Monitoring Plan	EPA-AO-006	14-Aug-2009
IX	28(c)	Schedule for development of a Dike Integrity Plan	Several Investigations and Work Plans: • Dike D & Dike 2 Evaluation Report • Dike 2 Remediation Work Plan • East Dike Work Plan • Dike C (D) Risk Mitigation Work Plan • Dike C (C) Risk Mitigation Work Plan • Dike C (A) Risk Mitigation Work Plan • Dike C (B1) Risk Mitigation Work Plan • Dike C (B2) Risk Mitigation Work Plan	 EPA-AO-031 RAWP-076 RAWP-059 RAWP-035 RAWP-067 RAWP-086 RAWP-092 RAWP-095	 26-Aug-2009 26-Aug-2010 25-Mar-2010 2-Dec-2009 24-Apr-2010 27-Jan-2011 26-May-2011 31-May-2011
IX	28(d)	Schedule for development of a Dredging Plan for East of Dike 2	Revised Emory River Dredging Plan	EPA-AO-011	3-Aug-2009
IX	28(e)	Offsite Ash Disposal Options Analysis	Offsite Ash Disposal Options Analysis	EPA-AO-001	2-Jul-2009
IX	28(f)	Financial Expenditure Report (updated Quarterly)	Form 10-Q, Quarterly Report Pursuant to Section 12, 15(d), or 37 of the Securities Exchange Act of 1934.	N/A	Transmitted quarterly

COMPLIANCE WITH REQUIREMENTS OF THE ORDER (continued)

Section	Paragraph	Requirement	Document	Doc. No.	Date (EPA approval)
IX	28(g)	Schedule for development of work plans (for TCRA)	More than 50 Work Plans were developed on an ongoing basis throughout the TCRA as work progressed and need for plans was identified. Key plans included the following: • Revised Dredging Plan • TC Ash Removal East of Dike 2 Work Plan • Loading Work Plan • Offsite Disposal Options Plan	 EPA-AO-011 EPA-AWP-009 EPA-AWP-023 EPA-AO-001	 3-Aug-2009 9-Jun-2009 23-Jun-2009 2-Jul-2009
IX	28(h)	Information/Data Management Plan	Data Management Plan	EPA-AO-019	30-Nov-2009
IX	28(i)	Surface Water Monitoring Plan for the Rivers	Surface Water Monitoring Plan for the Emory, Clinch, & Tennessee Rivers	EPA-AO-013	23-Aug-2009
IX	29	Notice of availability of Administrative Record	TVA Public Notice for Availability of Administrative Record	EPA-AWP-050	18-Aug-2009
IX	29, 30	Written response to comments submitted during public comment period	Multiple Responsiveness Summaries, including those included in the Action Memorandums for the Embayment / Dredge Cell and the River System	EPA-AO-024; EPA-AO-054	18-May-2010 7-Nov-2012
IX	30	Work Plan for performing one or more EE/CAs for NTCRA; include schedule	NTCRA Scope and EE/CA Work Plan	RAWP-085	16-Oct-2009 (TVA)
		NTCRA EE/CA(s)	NTCRA Embayment/Dredge Cell EE/CA	EPA-AO-008	15-Jan-2010
		NTCRA EE/CA(s)	NTCRA River System EE/CA	EPA-AO-051	10-Aug-2012
		Sampling and Analysis Plan(s) for EE/CA(s)	NTCRA for the River System Sampling and Analysis Plan (SAP)	EPA-AO-021	24-May-2010
		Health and Safety Plan(s) for EE/CA(s)	See Site Wide Safety and Health Plan; §XIII, ¶35	EPA-AO-003	30-Jun-2009
		Restoration of area waters per the Jurisdictional Assessment (Para 34(b))	BERA (included as Appendix to EE/CA for the River System)	EPA-AO-050	10-Aug-2012
		Action Memorandum for NTCRA(s)	AM for the Embayment/Dredge Cell	EPA-AO-024	18-May-2010
		Action Memorandum for NTCRA(s)	AM for the River System	EPA-AO-054	7-Nov-2012
		Non-Time-Critical Removal Work Plan	RAWP for the Embayment/Dredge Cell	RAWP-057	18-Aug-2010
		Non-Time-Critical Removal Work Plan	RAWP for the River System	RAWP-096	6-Mar-2013
IX	31	Remedial Site Work Plan	None Required, as documented in the Completion Report; NTCRA for the River System Long-Term Monitoring SAP written instead	EPA-AO-059	23-May-2013

COMPLIANCE WITH REQUIREMENTS OF THE ORDER (continued)

Section	Paragraph	Requirement	Document	Doc. No.	Date (EPA approval)
IX	32	Preliminary Assessment	Included in the NTCRA scope and EE/CA Work Plan; see §IX,¶30	RAWP-085	16-Oct-2009 (TVA)
		Preliminary Assessment	Included in the NTCRA Embayment/ Dredge Cell EE/CA; see §IX,¶30	EPA-AO-008	15-Jan-2010
		Preliminary Assessment	Included in the NTCRA for the River System EE/CA with BERA; see §IX, ¶30	EPA-AO-051	6-Aug-2012
		Preliminary Assessment	Annual Data Summary Reports for Groundwater and Surface Water	EPA-AO-055 EPA-AO-055A EPA-AO-055B EPA-AO-055C	5-Sep-2012 27-Feb-2014 (no document) 7-Oct-20141
		Preliminary Assessment	Updated Biota Report 2009-2013; Emory and Clinch River Sediment Chemistry and Toxicity Testing …; Summary of 2013 Results for Biota Monitoring …	N/A	31-Oct-2014
XI	33	Structural Integrity Assessments of Other TVA Facilities	Phase I Facility Assessments (AL, KY, TN) Stantec	N/A	20-Jul-2009
		Structural Integrity Assessments of Other TVA Facilities	Phase 2 Geotechnical Exploration (Widows Creek, John Sevier)	N/A	26-Feb-2010
		Structural Integrity Assessments of Other TVA Facilities	Phase 2 Geotechnical Exploration (Allen, Cumberland, Gallatin, etc.)	N/A	2-Aug-2010
XII	34(a)	All Removal Actions comply with ARARs	Action Memorandums for TCRA, for NTCRA Embayment/Dredge Cell, and NTCRA for River System clarify ARARs; see §IX, ¶'s 28 & 30	EPA-AO-005; EPA-AO-024; EPA-AO-054	4-Aug-2009; 18-May-2010; 7-Nov-2012
XII	34(b)	Jurisdictional Assessment (Para 34(b))	BERA (included as Appendix to EE/CA for the River System)	EPA-AO-050	10-Aug-2012
XIII	35	Health and Safety Plan	Site Wide Safety and Health Plan, with revisions 2-7	EPA-AO-003	30-Jun-2009
XIV	36(a)	Laboratory QA/QC programs	Laboratory QA/QC programs are included in the QAPP	EPA-AO-014	18-Dec-2009
XIV	36(b)	Laboratory analysis of EPA-provided samples for QA monitoring	Laboratory analysis of EPA-provided samples is included in the QAPP	EPA-AO-014	18-Dec-2009
XIV	36(b)	QA/QC procedures followed by all sampling teams and laboratories	Quality Assurance Project Plan	EPA-AO-014	18-Dec-2009
XV	37	Post-Removal Site Control	Closure/Post-Closure Plan for the Ash Landfill	EPA-AO-060	28-Mar-2014

COMPLIANCE WITH REQUIREMENTS OF THE ORDER (continued)

Section	Paragraph	Requirement	Document	Doc. No.	Date (EPA approval)
XVI	38	Weekly Progress Reports TCRA	Weekly Reports Prepared by TVA; see OSC Report TCRA §XVI, ¶41	N/A	multiple
		Monthly Progress Reports NTCRA	Monthly Reports Prepared by TVA; see OSC Report NTCRA §XVI, ¶41	N/A	multiple
		Monthly POLREP/SITREP Progress Reports NTCRA	Prepared by EPA on EPA website	N/A	multiple
		Weekly/Monthly POLREP/SITREP Progress Reports TCRA & NTCRA	Prepared by EPA on EPA website	N/A	multiple
		Final POLREP/SITREP Report TCRA	EPA website; Last Train Out	POLREP No. 195	7-Dec-2010
		Final POLREP/SITREP Report NTCRA	EPA website; last ash compacted in Ash Landfill	POLREP No. 255	5-Nov-2014
XVI	39	Use of SCRIBE & ArcMap 9.3	Scribe was used until December 2010, when Craig Zeller/EPA directed that all further data be entered into EQUIS	memo	9-Dec-2010
XVI	40	Notice of property transfer	No property has been transferred from TVA to others; TVA purchased properties impacted by the release, which remain in TVA possession	N/A	N/A
XVI	41	OSC Report TCRA, with certification	OSC Report TCRA	EPA-AO-030	31-Mar-2011
			OSC Report Addendum Dike C	EPA-AO-030A	30-Jan-2012
		OSC Report NTCRA, with certification	OSC Report Embayment/Dredge Cell	EPA-AO-063	29-Mar-2015[a]
			OSC Report Addendum SPEER	EPA-AO-063A	22-Apr-2015[a]
XVII	42, 43, 44	Notification of offsite waste shipment to State environmental official	Written Notification to ADEM sent June 2, 2009; letter Anda Ray/TVA to Onis Trey Glenn III/ADEM	letter	2-Jun-2009
			ADEM Permit modification was subsequently granted	Permit No. 53-03	20-Jul-2009
XVII	45	Subtitle D requirements for onsite landfill	N/A; no onsite landfill was used; closure of the Ash Landfill was in-place closure per TDEC ARARs.		
XVIII	46	Permits	No permits were required for performance of the work under CERCLA; technical requirements under existing permits (NPDES and solid waste management) were complied with to the extent practicable.	N/A	N/A

COMPLIANCE WITH REQUIREMENTS OF THE ORDER (continued)

Section	Paragraph	Requirement	Document	Doc. No.	Date (EPA approval)
XVIII	47	Compliance with ARARs	See §XII,¶34(a)	N/A	N/A
XIX	48	Emergency Response to release of waste material	TVA did not have a further release of ash material, other than through inadvertent sediment transport during dredging, flooding, or surface water discharges.	N/A	N/A
XIX	48	Emergency Response to release of waste material	TVA did experience minor releases of other types of wastes (e.g., hydraulic fluids), as documented in the OSC Reports, and implemented immediate response actions to clean up the minor releases	N/A	N/A
XIX	49	Notification of any release above reportable quantities	There were no releases above reportable quantities during the removal actions	N/A	N/A
XXI	51, 52	Administrative Record available for public review	TVA Public Notice for Availability of Administrative Record; copies of the Administrative Record were held at the Outreach Center in Kingston, Kingston Public Library, Harriman Public Library, and online website	EPA-AWP-050	18-Aug-2009
XXII	53	TVA Site Access for EPA & TDEC	TVA provided full access for EPA & TDEC to all TVA-owned property; access necessary to conduct actions was granted by private property owners; EPA & TDEC were permitted to move freely onsite and offsite	N/A	N/A
XXII	54	Private Site Access for TVA	None required; TVA negotiated purchase agreements with private property owners and purchased impacted properties	N/A	N/A
XXIII	55	Access to Information	TVA provided full access to EPA of all information through direct transmittals, email correspondence, website, SCRIBE database, and other methods	N/A	N/A
XXIII	56	Access to Information	TVA has not asserted business confidentiality claims	N/A	N/A
XXIII	57	Access to Information	TVA has not asserted attorney-client privilege for any documents or other information requested by EPA	N/A	N/A
XXIV	59	Record Retention	Litigation Hold, Document Control, BSL, TVA Archive	N/A	N/A

COMPLIANCE WITH REQUIREMENTS OF THE ORDER (continued)

Section	Paragraph	Requirement	Document	Doc. No.	Date (EPA approval)
XXV	60, 61	Payment of EPA costs	Prompt payment of EPA invoices, per account payables transaction records	N/A	N/A
XXXVII	95-96	Community Relations Plan	Community Involvement Plan, with revisions	EP-AO-020	16-Oct-2009
			Community Involvement Plan, response to public comments	N/A	20-Dec-2009
XXXVII	97	Notification of EPA of press release	Mutual EPA/TVA cooperation on multiple press releases; see OSC Report	N/A	multiple
XXXVII	98, 99	Administrative Record available for public review	See §XXI,¶51,52	N/A	N/A
XXXVII	100	Technical Assistance Plan (TAP)	Technical Assistance Plan	N/A	28-Oct-2009
XXXVIII	101	Completion Report	Completion Report	EPA-AO-064	22-Apr-2015

Notes:

[a] Date submitted to EPA.
[b] For definitions, see the List of Acronyms