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FINAL ENVIRONMENTAL ASSESSMENT

EMERGENCY DREDGING FOR THE KINGSTON FOSSIL PLANT ASH DIKE FAILURE

Roane County, Tennessee

PREPARED BY:
TENNESSEE VALLEY AUTHORITY

COOPERATING AGENCIES:
U.S. FISH AND WILDLIFE SERVICE
TENNESSEE WILDLIFE RESOURCES AGENCY

MARCH 2009

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LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
APA	Ash Processing Area
APE	Area of Potential Effect
BMP	Best Management Practices
CBSQG	Consensus-Based Sediment Quality Guidelines
CCW	Condenser Cooling Water
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CRM	Clinch River Mile
CTEH	Center for Toxicology and Environmental Health
EA	Environmental Assessment
EO	Executive Order
ERM	Emory River Mile
FRP	Flood Risk Profile
GPS	Global Positioning System
HPA	Habitat Protection Area
KIF	Kingston Fossil Plant
LOS	Level of Service
m	Meter(s);1 meter equals 39.4 inches
MGD	Million Gallons per Day
msl	mean seal level
NAAQS	National Ambient Air Quality Standard
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
PCB	Polychlorinated Biphenyls
ppm	parts per million
PEC	Probable Effects Concentration
RFP	Request for Proposal
SQG	Sediment Quality Guidelines
TCLIP	Toxicity Characteristic Leaching Procedure
TDEC	Tennessee Department of Conservation
TEC	Threshold Effect Concentration
TN SHPO	Tennessee State Historic Preservation Officer
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WOA	Wildlife Observation Area

CONVERSION TABLE

Volume	
1 cubic yard	0.76 cubic meter (m^3) 27 cubic feet (ft^3) 764.55 liter 201.97 gallon
1 cubic meter	1000 liter (L)
1 gallon	3.785 liters
Weight	
pound	453.59 grams (g) 453592 milligrams (mg)
ton	2000 pounds (lb) 907.18 kilograms (kg)
Distance	
1 inch	2.54 centimeters (cm) 254 millimeters (mm)
1 foot	0.3048 meter (m) 304.80 millimeters 12 inches (in)
1 meter	39.4 inches 1000 millimeters
1 mile	5280 feet 1609.34 meters 1.61 kilometers (km)
Area	
1 acre	0.40 hectare 43560 $feet^2$ 4840 $yard^2$
Density	
1 g/m^3	1000 mg/m^3 1000000 $\mu g/m^3$
1 µg/L	1 mg/m^3
1 lb/gallon	1198326.43 mg/L
1 mg/kg or 1 mg/L	1 ppm 0.001 g/L

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FINAL ENVIRONMENTAL ASSESSMENT

EMERGENCY DREDGING FOR THE KINGSTON FOSSIL PLANT ASH DIKE FAILURE ROANE COUNTY, TENNESSEE

TENNESSEE VALLEY AUTHORITY

MARCH 2009

The Proposed Decision and Need

Tennessee Valley Authority (TVA) has prepared this environmental assessment (EA) for emergency actions in response to the ash dike failure at its Kingston Fossil Plant (KIF) in Roane County, Tennessee. TVA proposes to remove debris and ash material from the Emory River between Emory River Mile (ERM) 1.5 and ERM 3.5. This is one of several initial actions being taken to respond to the ash dike failure. Other initial actions evaluated in this EA include dewatering the dredge material and drying the recovered ash for storage. Temporary on-site storage options, along with nearby off-site storage options, are being considered for dredging to be completed without interruption.

Other emergency actions, as well as the long-term restoration and remediation of the area affected by the slide, are being addressed in separate *National Environmental Policy Act* (NEPA) documents.

Background

KIF is located at Clinch River Mile (CRM) 2.6 and is at the headwaters of Watts Bar Reservoir near the confluence of the Clinch and Emory rivers (Figure 1). Construction of the plant began in 1951 and was completed in 1955. Kingston generates 10 billion kilowatt-hours of electricity a year, enough to supply the needs of about 670,000 homes in the Tennessee Valley.

On Monday, December 22, 2008, a dike containing ash from the operation of the power plant collapsed, releasing about 5.4 million cubic yards of fly ash and bottom ash. Ash was released from about 60 acres of the 84-acre dredge cell complex. The spilled material now covers about 300 acres of adjacent parts of Watts Bar Reservoir, including most of Swan Pond embayment, and reservoir shorelands. Most of the spilled ash is on TVA property. Approximately 8 acres of non-TVA property has visible ash. Figure 2 illustrates the area prior to the dike failure, and Figure 3 shows the area on December 30, 2008, after the dike failure.

Fly Ash and Bottom Ash Properties and Characteristics

Coal is pulverized to a powder before being burned in a power plant. This allows better contact with air and more rapid and complete combustion. The Kingston plant consumes approximately 14,000 tons of coal every day when operating at full power.

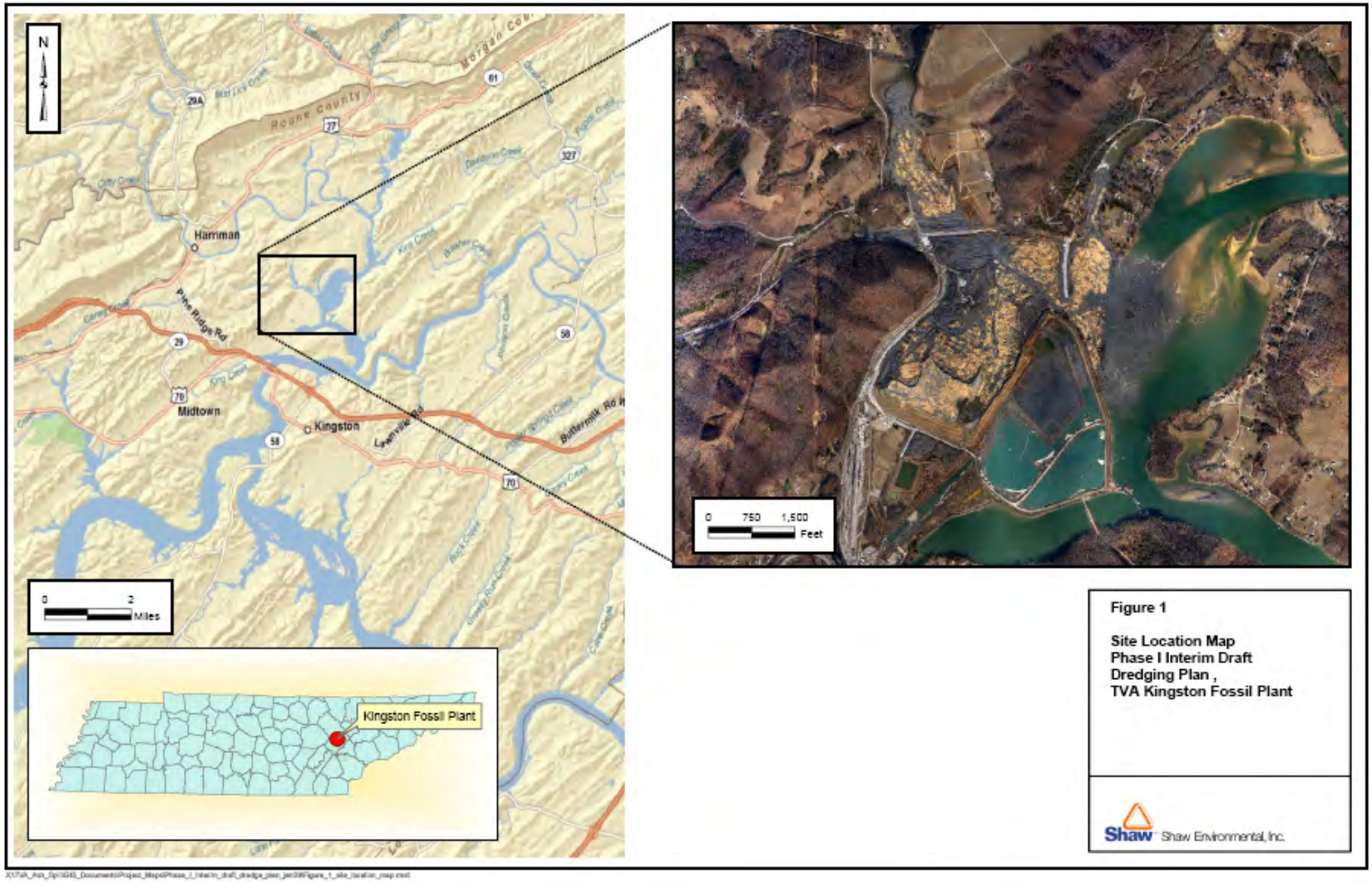


Figure 1. Kingston Fossil Plant Site Location Map

Figure 2. Kingston Fossil Plant Area Pre-Dike Failure

Figure 3. Kingston Fossil Plant Area Post-Dike Failure

For ease of handling, water is used to flush fly ash from the hydrostatic ash collectors and bottom ash from the bottom of furnaces. The ash is carried in the resulting slurry to an on-site ash pond where the ash is allowed to settle. It is subsequently removed ("dredged") and placed in a dredge cell for long-term storage. Table 1 shows the major chemical components of the initial dry fly ash before being flushed with water. Several of these chemical components are hydrolyzed to form acids or bases when in contact with water.

Table 1. Major Chemical Components of Kingston Fossil Plant Fly Ash Before it is Flushed With Water

Component	Average KIF Fly Ash Composition (%)
Silicon Dioxide (silica)	55.3
Aluminum Oxide	27.8
Iron Oxide	6.8
Calcium Oxide	3.0
Magnesium Oxide	1.4
Sodium Oxide	0.7
Potassium Oxide	2.3
Titanium Dioxide	1.3
Sulfur Trioxide	0.6
Phosphorus Pentoxide	0.3

Fly ash particles are mostly silt size (0.002 mm to 0.05 mm) and most are spherical in shape. KIF samples from fly ash ponds typically have a median particle size of 0.01 mm, with 75 percent of the material in the silt size range (Figure 4). Another 22 percent of the fly ash consists of clay-size particles (< 0.002 mm). Approximately 5 percent of the material is smaller than 0.0013 mm, but common analytical procedures do not measure particle content smaller than that size, so it is unknown what portion of that 5 percent is made up of nanoscale particles (smaller that 1 nanometer or 0.0001 mm). The extent to which particles were sorted by size during the slide is unknown. Specific gravity of the particles is 2.31. Using the procedure from Yang 1996, the dry bulk density of the ash as deposited by the slide is estimated to be about 64 pounds per cubic foot. The pH of water extracted from pond ash is has a pH of 6.8.

Bottom ash is composed of coarser, heavier particles of ash that settle to the bottom of the furnace. Bottom ash is generally angular with a porous surface. Median particle size of bottom ash samples from KIF are sand-size (0.075 to 2 mm in the AASHTO system) (Figure 5) and just less than 40 percent in the gravel category (2 to 75 mm). Specific gravity of bottom ash particles is 2.35. The bottom ash contains some pieces of pyrite rejected by the coal grinding process. These fragments are predominantly iron sulfide (FeS_2), and their presence is reflected in the pH (4.0) and sulfate ion concentration (490 mg/kg) of water extracted from the bottom ash.

Fly ash can be used to improve the quality of many building products like cement, mortar, stucco, and grout. It is an inexpensive replacement for Portland cement used in concrete, while it actually improves strength, segregation, and ease of pumping of the concrete. Fly ash is also used as an ingredient in brick, block, paving, and structural fills. It also is used in some potting soils and as a soil conditioner. Cenospheres, ash particles formed around bubbles of flue gas, have their own uses as lightweight fillers. Bottom ash is used as aggregate in concrete and its size and angularity makes it desirable as fill material.

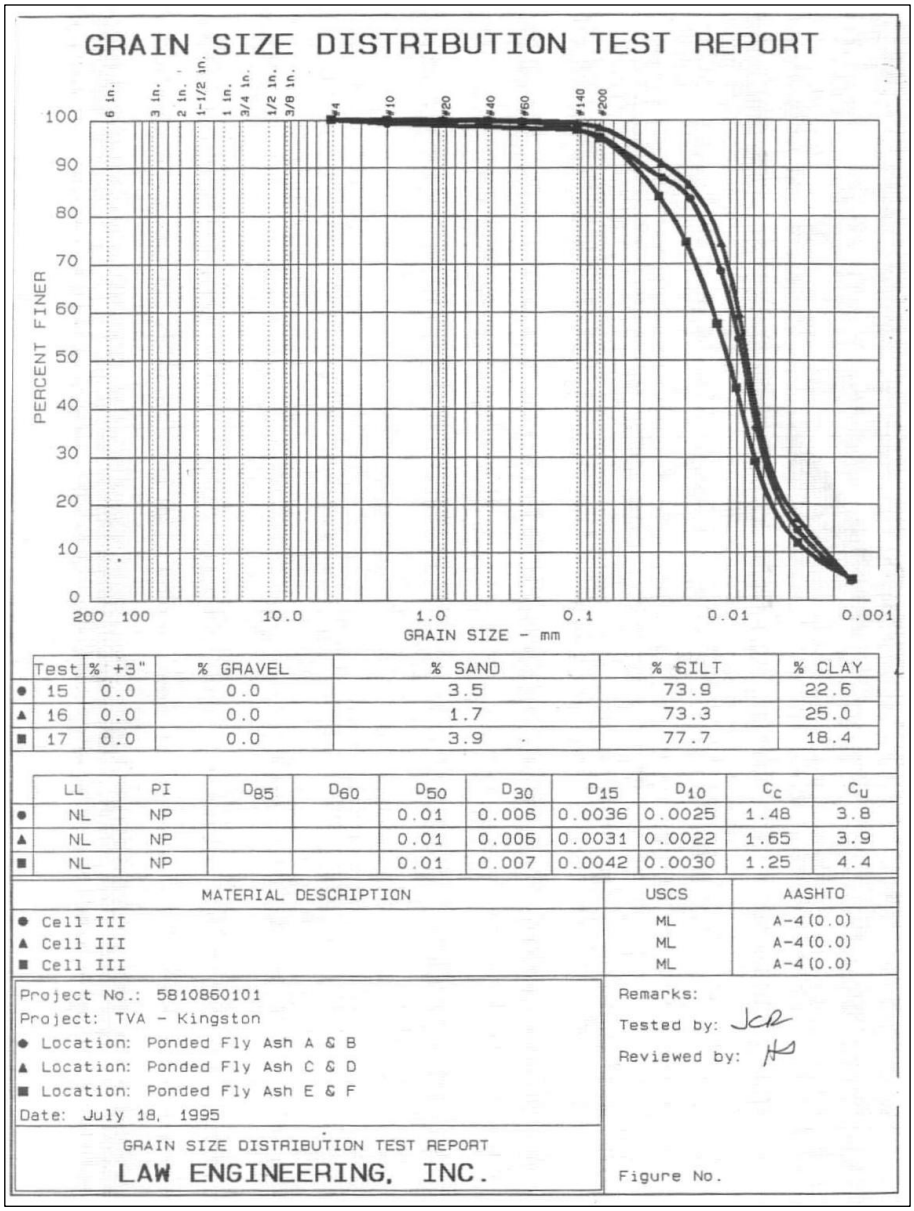
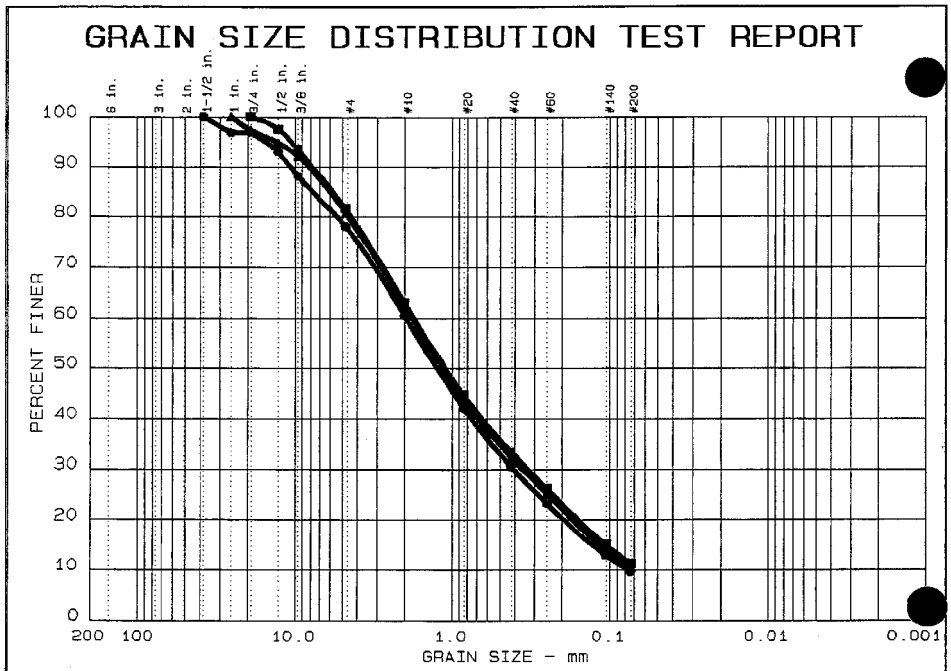


Figure 4. Particle-Size Analysis of Fly Ash From Kingston Ash Pond



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	18	0.0	21.9	68.4	9.7	
▲	19	0.0	19.3	70.0	10.7	
■	20	0.0	18.4	70.3	11.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP	7.67	1.95	1.24	0.407	0.1287	0.0766	1.11	25.4
▲	NL	NP	5.96	1.78	1.15	0.355	0.1148			
■	NL	NP	5.69	1.74	1.10	0.327	0.1047			

MATERIAL DESCRIPTION	USCS	AASHTO
●	SW-SM	A-1-b
▲	SP-SM	A-1-b
■	SP-SM	A-1-b

Project No.: 5810860101
Project: TVA - Kingston
● Location: Bottom Ash A & B
▲ Location: Bottom Ash C & D
■ Location: Bottom Ash E & F
Date: July 18, 1995

Remarks:
Tested by: JCR
Reviewed by: HS

GRAIN SIZE DISTRIBUTION TEST REPORT
LAW ENGINEERING, INC.

Figure No.

Figure 5. Particle-Size Analysis of Bottom Ash From Kingston Ash Pond

KIF fly ash is not homogeneous. The specific chemical composition of fly ash depends on the source of the coal. KIF mostly burns eastern bituminous coal, but has also used coal from Illinois, and blends low-sulfur Western coal to reduce emissions. The material at KIF is mostly fly ash, but has some bottom ash mixed in. The pyrite fragments mixed with the bottom ash may have a different combination of trace constituents than the ash.

The principal chemical components of fly ash are those that are typical of rock and soil. Oxides of silicon, aluminum, iron, and calcium, chemically combined in an amorphous (noncrystalline or glasslike) form, comprise 95 percent to 99 percent of fly ash (Ray and Parker 1977). Ash also contains variable but significant amounts (0.5 percent to 3.5 percent) of magnesium, titanium, sulfur, sodium, and potassium. A limited number of KIF fly ash analyses are available, but they indicate that KIF ash chemistry is consistent with this general characterization (Table 1).

Although the main chemical components of ash are relatively benign, ash may contain trace amounts of other constituents that occur naturally in coal, such as arsenic, cadmium, lead, mercury, and selenium. Many of these trace constituents are metals, but some are metalloids (e.g., arsenic and antimony) and non-metals (e.g., boron and selenium). These trace constituents are chemically combined with the other components of the ash. The tendency of these constituents to be dissolved in water or otherwise become available to organisms (bioavailability) is difficult to predict because it depends not only on the specific ways the metals are chemically combined or bound, but also on many other factors, including temperature, pH, hardness of water, availability of oxygen, and amount of agitation. All agencies consulted believe that the sooner the ash is removed from the aquatic environment, the less the potential for long-term impacts. Twenty-eight ash samples from different locations and depths in the fly ash dredge cells and spilled ash have been analyzed for trace constituents (Table 2).

As shown in Table 2, 28 samples from different locations and depths in the fly ash dredge cells and spilled ash (converted to dry-weight basis for this table) and nineteen surface samples from the ash flow areas have been analyzed for trace constituents. Variable amounts of bottom ash are mixed in with these ash samples. One historic analysis of bottom ash is included in Table 2 for comparison.

Many of these trace constituents also occur in natural soils in the region, and average concentrations are also included in Table 2. These concentrations vary depending on geologic parent material and depth. In particular, arsenic concentrations averaged as high as 45 mg/kg in subsurface layers of soils formed over rock of the Knox formation (ORNL 1993a).

Table 2. Trace Constituent Analysis of TVA Pond Ash

	Number of ash samples	Number of ash samples below detection limit	Maximum ash concentration (mg/kg)	Mean ash concentration (mg/kg)[1]	Bottom ash (1 sample)	Typical concentration in regional surface soil (ORNL 1993b)
Aluminum	47	0	41,322	26,716	2,600	14,900
Antimony	47	32	3.42	0.70	<MDL	0.0812
Arsenic	47	0	113.0	46.2	280	9.04
Barium	47	0	1,304	577	79	74.8
Beryllium	47	0	6.32	3.86	0.13	0.704
Boron	19	2	150.4	63.6	NA	1.55
Cadmium	47	26	1.500	0.211	<MDL	None detected
Calcium	28	0	27,548	9,182	2,900	NA
Chromium	47	0	34.8	22.2	<MDL	23.3
Cobalt	47	0	16.5	11.5	7.2	13.8
Copper	47	0	73.4	45.2	15	9.89
Iron	47	0	25,090	14,931	98,000	23,200
Lead	47	0	30.00	17.55	21	25.5
Lithium	28	0	280.0	35.2	2	7.3
Magnesium	47	0	6,063	2,441	1,100	1070
Manganese	47	0	657.0	70.3	150	1020
Mercury	47	0	1.220	0.292	0.8	0.210
Molybdenum	47	0	5.27	2.44	<MDL	1.15
Nickel	47	0	34.2	22.7	20	12.8
Selenium	47	0	10.50	4.23	<MDL	0.605
Silica	19	0	1,079	435	NA	468
Silver	47	18	7.11	4.10	<MDL	None detected
Strontium	28	0	452	289	39	5.00
Thallium	47	0	7.70	4.28	<MDL	0.0449
Tin	47	0	6.72	2.19	<MDL	NA
Titanium	47	0	1,903	947	110	NA
Vanadium	28	0	104.5	74.9	21	32.5
Zinc	47	0	59.8	37.7	140	42.0

[1]Dry Weight Basis
mg/kg = Milligrams per kilogram

The U.S. Environmental Protection Agency (USEPA) Toxicity Characteristic Leaching Procedure (TCLP) uses acid digestion (pH of less than 2) to provide a screening-level indication of the potential for leaching of metals. The TCLP characterization is performed to define the material as either hazardous or non-hazardous for the purpose of regulated landfill disposal (40 Code of Federal Regulations [CFR] 261.24). Preliminary TVA fly ash samples do not exceed hazardous waste screening concentrations for any of the metals in the TCLP test (Table 3).

One reason for expediently dredging the Emory River is to remove the spilled ash from the river, thereby reducing further contact with the aquatic environment. Further assessment of the bioavailability and toxicity of this fly ash will be addressed in the environmental review for remediation and long-term recovery of the affected area and resources that includes natural resource damage assessment. Additional testing of ash from the Emory River will be conducted within the next month to evaluate bioavailability of metals, (including selenium), potential toxicity, and bioaccumulation potential.

Table 3. TVA Toxicity Characteristic Leaching Procedure Results for 28 Ash Samples

	No. of Samples Below Detection Limit (of 28 samples)	Maximum Concentration (mg/L)	Median Concentratio n (mg/L)	Level for Definition as Hazardous Waste (mg/L) (40 CFR 261.24)
Arsenic	1	1.81	1.15	5
Barium	0	11.7	7.17	100
Cadmium	0	0.008	0.004	1
Chromium	0	0.672	0.295	5
Lead	0	0.18	0.119	5
Mercury	22	0.08	0.0005	0.2
Selenium	0	0.07	0.0285	1
Silver	28	0		5

CFR = Code of Federal Regulations
mg/L = Milligrams per liter

NEPA Coverage for Kingston Fossil Plant Event and Related TVA NEPA Documents

At this stage, TVA is conducting environmental reviews for actions necessary to contain the immediate effects of the emergency. Since the photo (Figure 1) was taken, TVA has constructed an emergency weir (Weir #1) in the Emory River to contain ash and a second control structure (Dike #2) at the entrance to Swan Pond embayment to prevent additional ash from entering the Emory River (Figure 6). These actions were addressed in a separate EA (TVA 2009a).

This EA addresses actions that are scheduled to begin approximately within the next 90 days, including dredging, repair of the intake skimmer wall, dewatering of dredge material in the ash sluice channel area, further drying of the ash, temporary on-site storage, and off-site storage options at nearby permitted landfills.

Rail, barge, and trucking would be used to transport ash to off-site storage. Beneficial reuse such as in mining and quarry reclamation and as fill material for construction projects would be considered.

Future environmental reviews will assess the effects of the ash slide on the human, physical, and biological environment including a natural resource damage assessment. Alternatives for clean-up methods, clean-up levels, remediation, monitoring, and mitigation for the entire event will be considered.

Figure 6. Location of Emergency Weir #1, Dike #2, Plant Intake, Plant Discharge, and Existing Dike C

Other Environmental Reviews and Documentation

The following NEPA documents are also in progress or completed and address aspects of TVA actions responding to the ash slide event.

- *Watts Bar Reservoir Land Management Plan Final Environmental Impact Statement* (TVA 2009b)
  This document proposes and evaluates the impacts of alternative plans for the future use of TVA property.

- *Initial Emergency Response Actions for the Kingston Fossil Plant Ash Dike Failure Environmental Assessment* (TVA 2009a)
  This EA evaluates the impacts of emergency site stabilization and restoration activities including weir construction, emergency operations, and restoration of infrastructure in the Kingston-Harriman area.

- *Installation of Flue Gas Desulfurization System at Kingston Fossil Plant Environmental Assessment* (TVA 2006)
  This EA assessed the impacts of installing flue gas desulfurization equipment that employs wet limestone forced oxidation technology. This project was designed to help reduce system wide sulfur dioxide emissions to meet requirements under the 1990 *Clean Air Act* amendments. Included was an assessment of gypsum storage areas.

Agencies Consulted

TVA has actively engaged numerous federal, state, and local agencies throughout the ongoing recovery efforts. Detailed comments in response to the draft EA were received from USEPA, U.S. Fish and Wildlife Service (USFWS), and Tennessee Wildlife Resources Agency (TWRA). These comments and TVA's responses are located in Attachment E.

TVA also consulted with the Tennessee State Historic Preservation Officer (TN SHPO), the Advisory Council on Historic Preservation (ACHP) and 18 federally recognized tribes on the proposed action. TVA provided agencies an abbreviated period to review a preliminary draft of the EA for comment and offered the agencies the opportunity to be cooperating agencies.

The ACHP responded on March 5, 2009 that they are in agreement with TVA's proposed course of action regarding Phase 1 dredging activities. From what they reviewed, it would appear that the proposed Phase 2 and 3 dredge activities are also appropriate to remediate the ash spill, and would not affect historic properties on or eligible for the National Register of Historic Places. The United Keetoowah Band of Cherokee Indians in Oklahoma had no comments other than the standard– please cease work as soon as possible if any human remains are inadvertently discovered, and be contacted. The Alabama-Coushatta Tribe expressed their appreciation on TVA's efforts to consult regarding potential impacts to historic properties by the proposed actions. They conducted an expedited review of the documents submitted to their office on February 27, 2009 and have concluded no objections to this proposal. The Tennessee Department of Environment and Conservation (TDEC) provided their comments through the Corrective Action Plan, Phase 1 Dredging Plan, Sampling Plan, Ash Processing Area Plan, and the respective permit applications.

Relevant Regulations and Statutes

Archaeological and Historic Preservation Act (16 USC 469)

Bald and Golden Eagle Protection Act (54 Stat. 250, as amended: 16 U.S.C 668-668d)

Clean Water Act (86 Stat. 816, as amended: 33 U.S.C 1251 et seq.)

Clean Air Act (42 USC 7401)

Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 et seq.)

Farmland Protection Policy Act (7 USC 4201)

Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Properties, Executive Order 12898 (59FR 7629 (Feb. 16, 1994))

Floodplain Management, Executive Order 11988 (42 FR 26951, 3 CFR, 1977 Comp., p. 117

Invasive Species. National Invasive Species Council, Executive Order 13112

Migratory Bird Treaty Act (16 U.S.C. 703-711)

National Historic Preservation Act (16 USC 470)

Protection of Wetlands, Executive Order 11990 (42 FR 26961, 3 CFR, 1977 Comp., p. 121)

Responsibilities of Federal Agencies to Protect Migratory Birds, Executive Order 13186

Purpose and Need

The debris in the Emory River channel continues to migrate downstream due to the flow of the Emory River. Immediate action is necessary to minimize this movement of ash and the resulting additional impacts. This movement of ash has been temporarily minimized through construction of weirs and dikes in the Emory River and Swan Pond embayment. However, because the ash/debris and weir in the Emory River are obstructions to river flow and storm water drainage, their removal from the Emory River is necessary to minimize flood risk. Hydraulic modeling results indicate that the 100-year flood post-slide elevations would be about 5 feet higher than preslide elevations immediately upstream of Weir #1 and about 8 feet higher than preslide elevations in the vicinity of the houses located along Emory River Road and Lakeshore Drive. The increased 100-year flood post-slide elevations would affect land and structures that TVA currently does not own. TVA has estimated that structures would be flooded between Weir #1 and ERM 3 in the event of a 100-year flood. TVA has also estimated that structures would be impacted upstream of this point. The 100-year flood post-slide elevations would be higher than preslide elevations all the way to Harriman, which is about 11 miles upstream.

TVA is proposing to dredge the ash from the Emory River east of Dike #2, remove Weir #1, and return the streambed of the Emory River to preslide conditions or contours as used later in document. Once this is completed, the Emory River flood elevations would be the same as those shown on Roane County Flood Insurance Rate Maps. Ash in Swan Pond embayment that is above the elevation of the reservoir could also be washed downstream during a large rain event. The proposed action would restore the Emory River and surface waters east of Dike #2 to preslide elevations.

Proposed Alternatives

Because the ash is underwater and has the potential to migrate further downstream under certain conditions (e.g., heavy rainfall), TVA proposes to dredge ash materials and debris from the Emory River and place it in a temporary holding area on the KIF site to minimize ongoing impacts of the ash slide. The Action Alternative for this EA includes dredging ash from the Emory River channel, repairing the plant intake's skimmer wall, dewatering the ash in the sluice channel area, further drying of the ash in the ash processing area (APA), temporary on-site storage, and off-site disposal, which is necessary to continue dredging without interruption. Off-site disposal could involve nearby permitted landfills or using the ash for beneficial purposes such as mine reclamation. The No Action Alternative consists of not taking these emergency response measures.

Dredging Ash from the Emory River

The ash material would be dredged hydraulically in discrete segments to minimize sediment transport. It is anticipated that large debris such as trees or boulders would also be entrained with the ash material. Removal of the large material would require use of a mechanical dredge on a barge with a clamshell bucket.

The proposed dredge operation would occur in three phases. TVA has developed an Emory River Phase 1 Dredging Plan, and it is incorporated by reference (Shaw 2009). The dredging plan provides the methods and objectives for the first of three planned phases of dredging operations to remove ash and debris from the Emory River. A Pilot dredging program would begin in the first phase of the dredging plan and could continue for the first 60 days. TVA would use adaptive management during Pilot dredging. As knowledge is gained from monitoring, observations would aid in refining the plan and minimizing dredge impacts.

Phase 1

The Phase 1 dredging operation would focus on reopening the original Emory River navigation channel. Currently, nearly 1 mile of the river channel is blocked by ash material and debris, causing river flow to be diverted around the blockage. Phase 1 operation would be conducted in discrete segments to minimize the potential for downstream migration of ash material and debris and to maximize the immediate effect of the dredging. Phase 1 dredging segments are delineated in Figure 7.

Hydraulic Dredging

To minimize the downstream migration of ash and siltation due to the dredging, a "Pilot" dredging program would begin in Segment 1 and would continue for up to the first 60-days. The Phase 1 dredging operation would begin on the northern-most block of Segment 1. The dredging would process the first block from north to south with the exception of a single pass from the south (downstream) to north (upstream) end of Segment 1 to reach the starting end of Segment 1.

The main equipment for Phase 1 dredging operations would be the Ellicott 750HP dredge. The maximum draft for the dredge is 2.67 feet. The dredge will use a 31.5-inch diameter cutter head that operates to a maximum of 39 rotations per minute (RMP). During this Pilot, dredging methods would be developed for clearing the impacted river channel to an elevation of 710 feet mean sea level (msl) without further impacting preslide legacy sediments by primarily utilizing hydraulic dredging and limited mechanical dredging. The

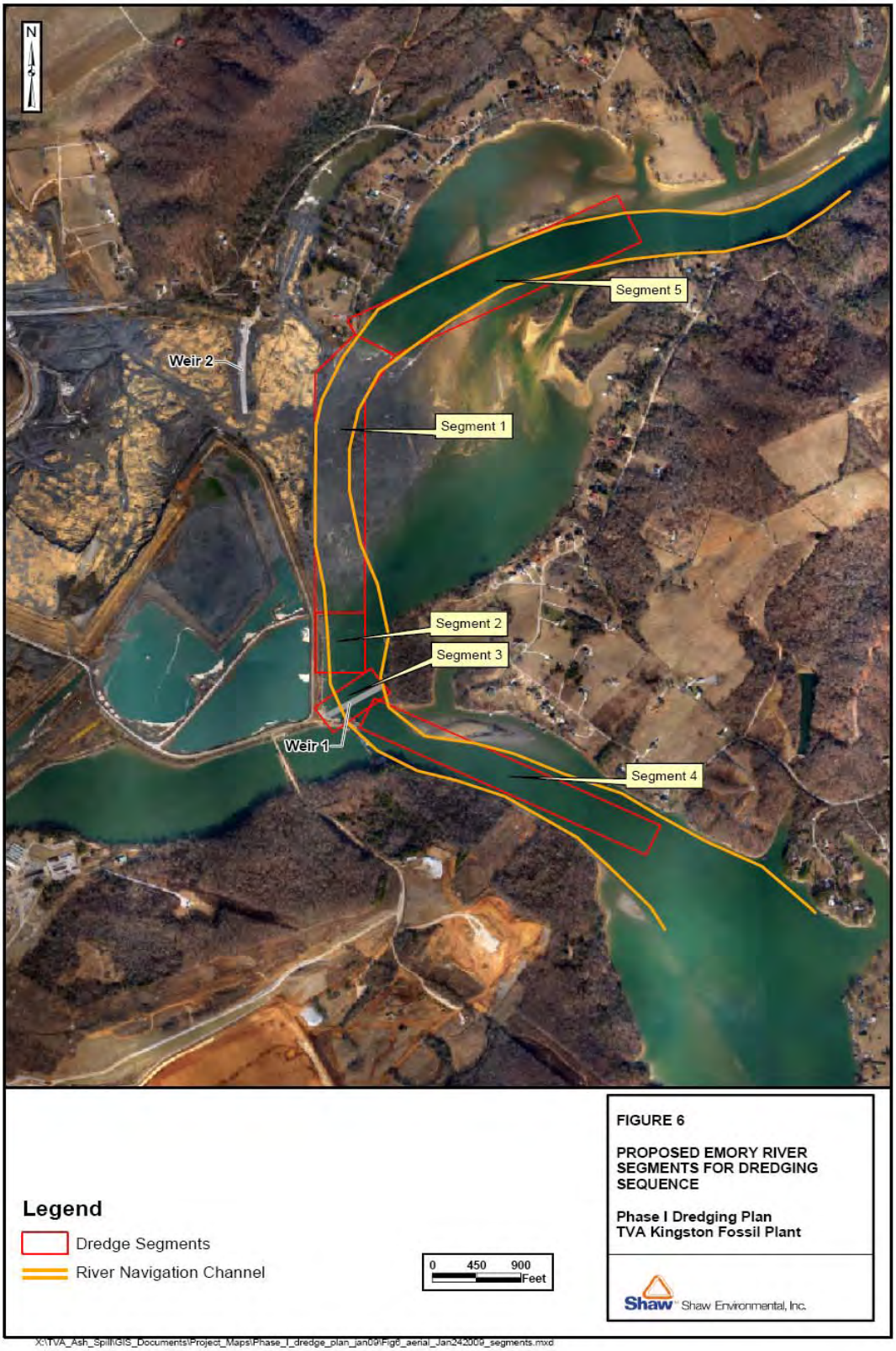


Figure 7. Proposed Emory River Segments for Dredging Sequence

710-msl elevation was chosen based on preslide bathymetric data collected by the U.S. Army Corps of Engineers (USACE) in September 2007. Best management practices (BMPs) would to be prescribed to control effects on water quality from dredging operations. BMPs could include operational controls such as cutter head speed, cutter head rate of advance, reverse cutter head rotation, and/or engineering controls such as turbidity curtains. Dredging would only occur during flow conditions that minimize migration of ash and do not cause the downstream turbidity to be 200 Nephelometric Turbidity Units (NTU) or greater than the background turbidity.

The dredging operations would be staffed and operated 24 hours per day, 7 days per week. The dewatering and processing equipment would also be staffed continuously as needed to meet the needs of dredging. Because dredging would take place 24 hours per day, lights would be installed on land and barges in the work area as necessary to provide lighting required for dredging work occurring from dusk until dawn.After completion of the Pilot, the dredging of Segment 1 and the other segments would continue at a pace determined to be sustainable in the Pilot. TVA would use adaptive management during Pilot dredging to determine the most likely place for plumes and locate monitors that will collect field data including turbidity when collecting TSS and TDS samples. Bathymetric surveys would be performed covering the area of Phase 1 at critical stages of the work to track dredging progress. These surveys would also be the basis for determining removal quantities throughout Phase 1 dredging of the project. All dredges would be outfitted with Global Positioning System (GPS) devices that allow the operator to track the location of the dredge to ensure that cutting are within the main channel. Mechanical indicators would provide cutting depth control to limit cutting to the 710-foot msl elevation. Hydrographic surveys would be performed on at least a weekly basis, or more often as needed, to verify progress of ash removal. Segment 1 would be dredged from east to west at approximately 60-foot wide passes starting at the north end of Segment 1. Each pass would be limited to a depth of no more than 5 feet per pass. The underwater side slopes of each pass are expected to be sloped at a 10 horizontal to one vertical ratio. East-west passes moving downstream would stair-step so that no adjacent pass is more than 5 feet deeper than its contiguous downstream dredge prism.

Mechanical Dredging

A specially designed rake and grapple may also be used as required during debris removal operations, depending upon the nature and size of the debris encountered. The debris would be transferred to an on-site debris processing area.

Silt Curtain

The floating silt curtain containment systems fastened to the crane barge would be deployed prior to initiation of mechanical dredging operations in all Phase 1 dredging areas. The top of the silt curtain would float with the curtain hanging in the water stopping the movement of suspended ash that has reached the surface from moving out of the immediate area being mechanically cleared.

Phase 2

Phase 2 would focus on returning the river channel back to its original depths while minimizing disturbance of legacy sediments. This would be achieved by using river bathymetry and GPS controls onboard a 10-inch Ellicott 370 dredging machine with a 50-foot maximum cutting depth. This would be an on-water operation. As part of Phase 2, the remainder of Weir #1 would be completely removed.

Phase 3

Phase 3 would focus on removal of ash deposits to the east of Dike #2 but outside of the immediate Emory River channel. This operation would utilize bathymetry derived from the 1940 preimpoundment topographic maps unless information that is more recent can be identified. If no current bathymetric information were available, TVA would develop controls to identify changes in the composition of material being dredged in order to minimize over-dredging.

Monitoring

A water quality sampling plan has been developed and specifically addresses the dredging operations. The monitoring measures are also described in Appendix A. Five continuous monitoring stations would be established to support environmental monitoring during dredging activities. Stations would be located both upstream and downstream to monitor the potential impacts of the Phase 1 dredging operations. Adjustments to dredging activities would be made as needed if turbidity measurement triggers are exceeded or when visual observations indicate excessive turbidity.

Due to high variability of water current direction and velocity, variation in settling rates of various particle sizes (with particular concern about transport of the finest “nanoscale particles”) and density currents, the nature and size of turbidity plumes is expected to vary. Consequently, boats would be deployed with appropriate field instruments to identify plumes and collect samples for analysis. Dredge operators would be guided by a combination of their experience and professional judgment, supplemented by information from both boat surveillance and the floating continuous monitoring stations as a basis for operational decisions. Data would be supported by lab confirmation and calibration (total dissolved solids, total suspended solids broken down into particle-size classes, etc.). Similar data would be collected upstream to characterize background conditions.

These data would be used to characterize normal operation as well as variations in operation and river conditions. Analysis results would be included in an adaptive management plan and used to develop a standard or reference for subsequent phases of dredging.

Dewatering Dredge Material

Ash Processing Area

TVA proposes the construction, operation, maintenance, and closure of an APA on site at KIF for the purpose of dewatering and temporarily stockpiling dredged ash material. The area is also commonly known as the “ball field area” (Figure 8). The area is triangular in shape and roughly 65 acres in size. It is bordered to the north by the existing ash dredge cell 1, on the east by a line parallel to and approximately 250 feet east of the existing ash sluice channel, and on the west by the plant entrance road. The APA was formerly an ash pond that is now soil-covered. It currently contains several athletic ball fields and two chemical treatment ponds.

Prior to beginning dredging operations, the KIF fly ash sluice channel would be modified to facilitate recovery of dredged materials. The ash being produced during normal plant operations would be diverted from this channel. The channel would be excavated to a depth of 10 feet and a width of 40 feet. Dredged material would flow into this channel; the solid material would subsequently drop to the bottom of the canal and be removed by a mechanical dredge, followed by dewatering to 20 percent moisture, and processing for

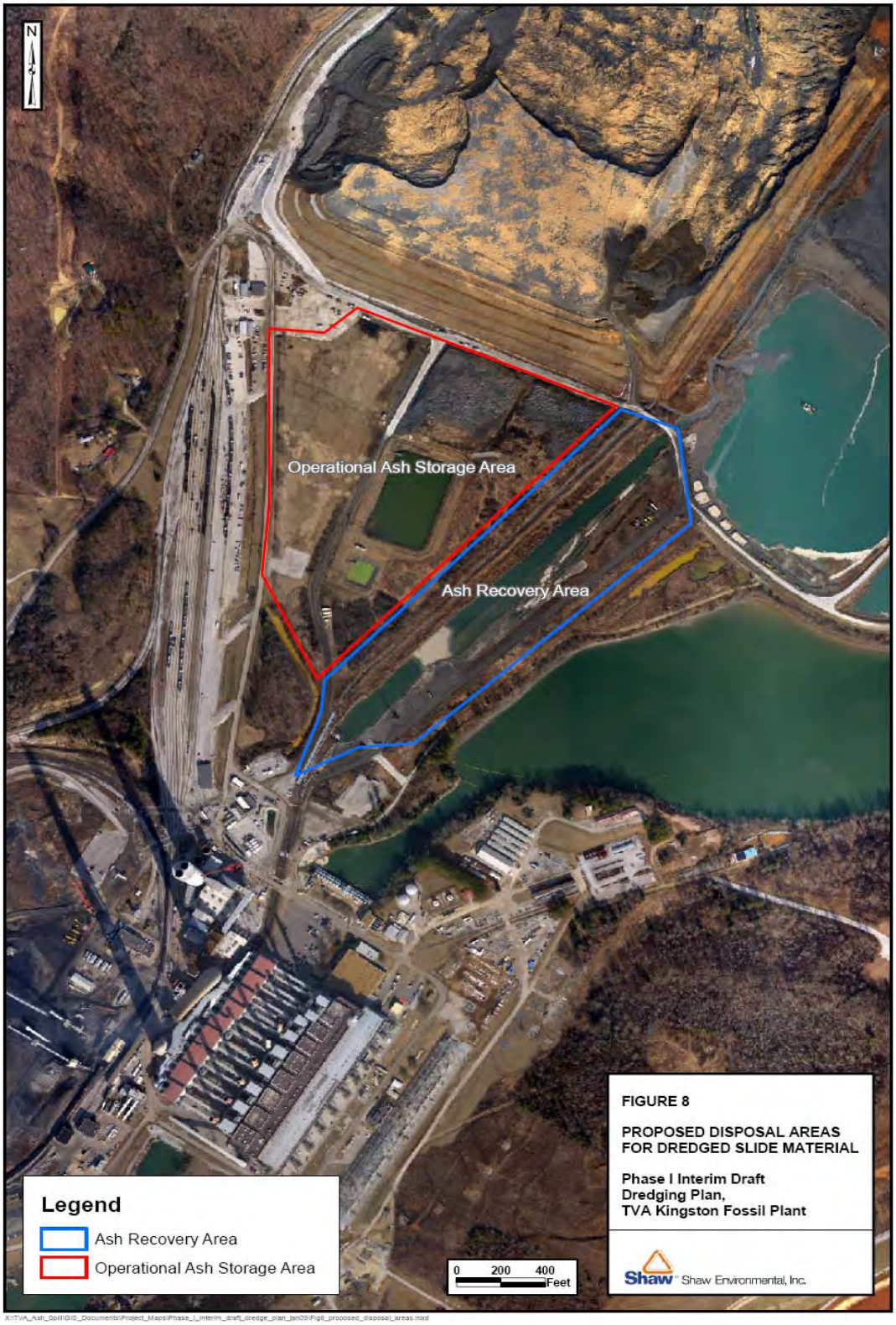


Figure 8. Proposed Ash Processing Area

temporary storage and/or transportation off site. The dry material would either be trucked to locations off site that are permitted to receive ash or would be stockpiled in designated approved areas on site.

A construction and operation plan for the APA has been prepared and submitted to TDEC for approval (TVA 2009c). The site preparation for this area would include clearing vegetation and modifying drainage utilizing BMPs. This grading and drainage plan provides ash processing and handling adjacent to the east and west rim ditches as well as relatively flat areas for temporary storage. Any water from this area would drain to the ash sluice channel and then to the ash pond.

The chemical ponds located in this area would be temporarily decommissioned as part of the site preparation. The chemical ponds are no longer needed for plant operation as alternative processing for metals in wastewater has been implemented. The interim closure would involve leaving the sludge material in place after stabilizing and capping with a demarcation layer of crushed stone and filter fabric. Final closure of the pond would be accomplished at a later date when the sludge is removed or a determination is made to allow it to remain in place.

TVA proposes to stockpile the ash in the operational ash temporary storage area on a short-term basis (see Figure 8). Ash that has been dewatered would be moved to the ash operation/temporary storage area for further drying. Based on the results of an initial geotechnical analysis, the maximum height of the stack would be limited to approximately 8 feet, providing approximately 434,000 cubic yards of storage. Assuming three dredges are operating, this would allow for about 55 dredging days before storage space is exhausted. The total amount estimated to be dredged in the three dredge phases is 2.3 million cubic yards. TVA is currently conducting additional geotechnical investigation of the site to determine whether material can be stored at heights greater than 8 feet in this area. Preliminary results indicate that the installation of prefabricated vertical drains (PVD or wick drains) could enhance the subsurface and stability of the area to allow up to a 30-foot stack height (TVA 2009c). Upon completion of the final stability analysis of the area, TVA will present final design placement of the wick drains and the stability analysis results. TVA would not exceed the existing stack height limit of 8 feet until the results of the stability analysis are presented to TDEC and USEPA for review and consideration. The additional storage height would allow three hydraulic dredges to operate for about 170 days before exhausting storage capacity at this site.

Fugitive dust from ash storage would be controlled through the use of a water truck with spray bars and water cannon. If the stockpile is inactive for a period of time or water spray is ineffective, TVA would apply a crusting agent (binder) to the surface of the stockpile. It is anticipated that as the dredged ash is further dewatered in the temporary ash process area, it could be stored in this location for no more than one year. This is effectively a rolling one year as each volume of ash that is dredged can only stay in temporary storage for one year. However, ash processing in this location could be continued until a dry ash operational system can be designed and installed for daily plant fly ash production. Further environmental reviews would be conducted on the proposed dry stacking operations. The groundwater monitoring network for the APA would consist of one upgradient and two downgradient monitoring wells.

Gypsum Storage Area Phase II

TVA is currently installing flue gas desulfurization or scrubber equipment that employs the wet limestone forced oxidation technology project that would be used to reduce sulfur dioxide (SO2) emissions from KIF. This system would produce gypsum and would be dewatered in the area known as the Peninsula (see Figure 6) before storing onsite. TVA planned to develop a gypsum storage area in two phases, with the first phase providing approximately 10 years of storage space. Since it is foreseeable that Phase II would not be needed for another 10 years, and there is a need to provide for more on-site ash processing and temporary storage areas, TVA is considering Phase II of the gypsum storage area as an additional site to dewater and dry the dredged fly ash material. A conceptual plan has been developed and could potentially store up to 2.3 million cubic yards of the dredged fly ash material. TVA would conduct a stack height stability analysis and would seek approval from TDEC prior to utilizing this area. TVA proposes to construct drainage cells in which the supernatant would be returned to the plant's ash pond. When using the gypsum storage area for ash storage, TVA would install a clay layer as a demarcation layer before placement of ash, to provide a clear boundary between the ash and underlying soil. Leachate from the ash would be expected to penetrate only the upper few inches of the underlying clay layer. Use of this area for ash processing would be limited to a two-year operation. Mechanical dredging is being used to remove any debris that is found as dredging progresses. That could include large rocks, trees, limbs, and other items that may be submerged in the river and are likely mixed with the ash in the river as a result of the initial slide. During the dredging operations, TVA would process this material in the gypsum area (washing ash from debris, chipping wood, and hauling debris to an approved landfill, or potentially using as mulch for airborne ash suppression).

This site is the eastern section of the area previously identified and permitted to receive flue gas desulfurization (FGD) byproducts from the scrubber system, currently under construction at KIF. A detailed discussion of the site can be found in the Solid Waste and Groundwater section (Section 3.2) of TVA 2006 (*Installation of Flue Gas Desulfurization System at Kingston Fossil Plant Environmental Assessment*). The proposed plan for this area includes details for mass excavation and grading to construct settling trenches, dewatering trenches, a stacking area for drying operations, and temporary fly ash stacking areas all to be located on a temporary basis within the Phase II gypsum area. TVA would install a compacted clay layer in this area to act as a low permeable barrier limiting the migration of leachate from the fly ash processing and temporary ash storage areas. Based upon laboratory testing of the geologic buffer constructed for the Phase I gypsum area, recompacted soil materials at the site would be anticipated to yield a relatively low permeable clay layer. After fly ash processing and temporary stacking operations cease in this area, TVA proposes to remove the impacted upper reaches of the constructed clay layer and stockpile the material for further laboratory analytical testing. Final disposition of the clay material would then be determined based on laboratory results.

The proposed plan calls for the Phase II area to be designed to accept the discharge from two dredges that would be located to remove approximately 1.5 million cubic yards of fly ash, which was previously released to the river channel. A settling trench would be utilized to remove approximately 90 percent of the solids from the dredge flows. The solids would then be removed from this trench and placed in an adjacent dewatering trench via clamshell. After moisture was allowed to drain from the ash material in the dewatering trench, it would be removed with excavating equipment and placed in the temporary stacking area. Material in the temporary stacking area would be "wind-rowed" using grading equipment to promote further drying. It is anticipated that the moisture content of

the ash at this phase of the process would be approximately 20 percent. The fly ash would then be hauled from the temporary stacking area to the dry stacking area. Discharge water from the dredging and dewatering operations would be returned to the existing ash pond using pumps and solid piping. Prior to the commencement of ash processing activities in this area, the groundwater monitoring wells, which comprise the monitoring network previously proposed for the Phase II gypsum disposal area, would be installed and monitored in accordance with the current schedule for the groundwater wells associated with the adjacent Phase I area.

Other Initial Minor Actions

Dike C is the preexisting, northern dike of the ash pond, east of the failed dredge cell. Because the spilled ash has rerouted the flow of the Emory River, eddies are likely to develop during a flood event in the vicinity of the abutments of Dike #1 where it ties into Dike C. Eddies could lead to scouring of Dike C. Interim scour protection is needed for Dike C (Figure 6). The proposed riprap placement on Dike C only involves repair or replacement material that may have already been lost to erosion and would be placed as shown in Figure 9. Ongoing engineering analysis is being performed on the stability of Dike C; repair will be performed as needed.

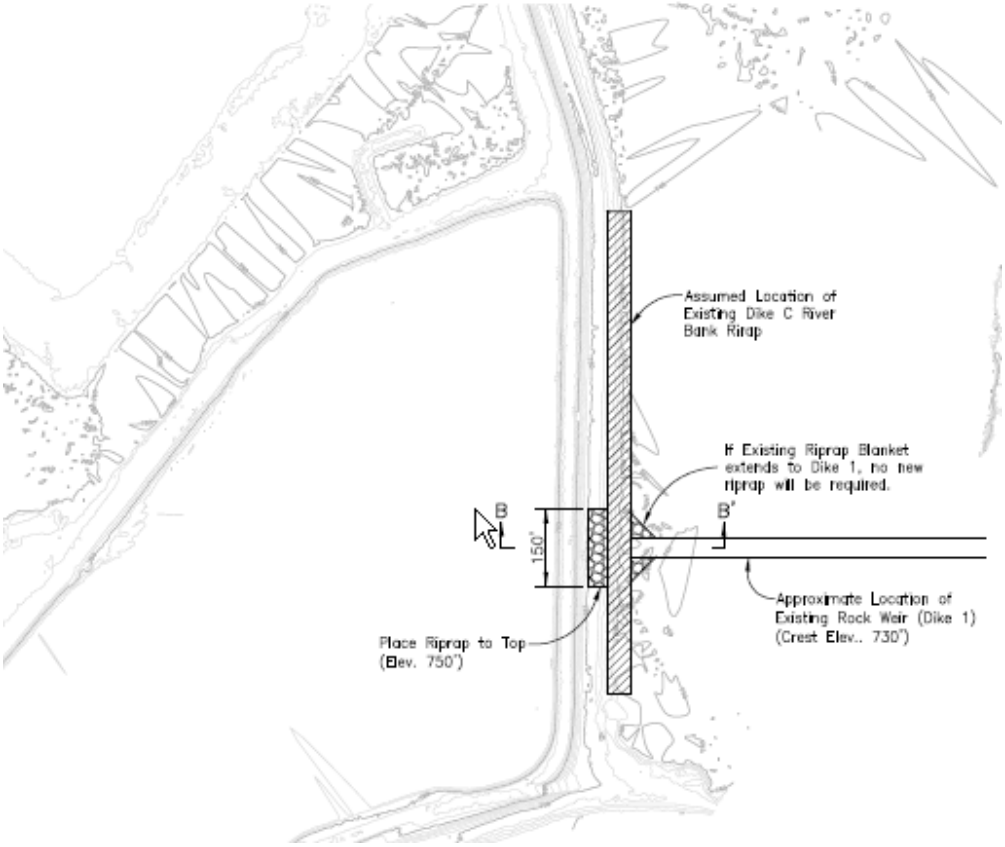


Figure 9. Proposed Riprap Placement for Dike C

Initial Off-Site Disposal Options

TVA has begun exploring off-site disposal options for the dredged ash. These options could include transportation of dewatered material by truck, rail, or barge to a variety of nearby sites, as well as sites already permitted that can be accessed by rail. Disposal would be through beneficial reuse of the ash in mine or quarry reclamation or through placement in a Class I landfill or a Class II industrial landfill.

Affected Environment and Evaluation of Impacts

The affected reach of Watts Bar Reservoir at KIF transitions from the upstream riverine (riverlike) reaches of the Emory River and the Clinch River below Melton Hill Dam to the more lacustrine (lakelike) conditions found in the impounded portions of the Clinch and Emory rivers backwaters of Watts Bar Reservoir. Overbank areas near KIF in the Swan Pond embayment are very shallow. The Emory River embayment enters Watts Bar Reservoir on the right bank (descending bank, facing downriver) of the Clinch River about 2 river miles upstream of the KIF condenser cooling water (CCW) discharge. The reservoir pool extends upstream to above Harriman (ERM 11).

The magnitude of ash deposits in the areas nearest the plant (ERM 1.75 to 3.0) range from about 5 feet in depth to complete filling of the navigation channel (greater than 30 feet depths) and complete filling of the Swan Pond embayment. Ash deposit depths decrease with increased distance downstream from the ash slide site, but the actual amount of deposition in some of these areas has yet to be determined. Deposits greater than 5 feet in depth appear to be confined to the Emory River in the immediate vicinity of KIF.

Several different field sampling surveys have been performed to characterize the spatial extent of ash deposition. Results indicate that ash may have traveled upstream as far as ERM 5.75, and as far downstream as Tennessee River Mile (TRM) 564. In the upstream direction, the depth of ash appears to diminish quickly beyond about ERM 3.5. In the downstream direction, ash deposition generally diminishes to trace amounts by about ERM 1.0, with pockets of greater depth (about 2 inches to about a foot in some places) occurring in depositional areas in the Clinch River. Downstream of CRM 2.0 amounts vary from trace amounts to 2 inches. Ash deposition of 0.5 to 1 inch was observed in the Tennessee River at TRM 566 (mouth of the Clinch River). Only trace amounts of ash have been observed further downstream.

The slide itself and a relatively large rainfall event (resulting in about 26,000 cubic feet per second [cfs] Emory River flows) shortly following the ash slide resulted in ash deposition of only 0.5 to 3 inches in the Clinch River and minimal deposition in the Tennessee River. These measurements indicate that, despite the ash slide itself and a relatively large rainfall event, large amounts of ash did not migrate out of the Emory into the Clinch or Tennessee rivers.

Two rock structures were constructed to contain spilled ash and minimize migration of ash down the Emory River and into the Clinch River or Tennessee River (Figure 6). Weir #1, completed on January 5, 2009, is built across the Emory River just north of the existing intake skimmer wall (ERM 1.9). Dike #2 extends across the Swan Pond embayment a short distance upstream of its mouth. Weir #1 is designed to reduce the movement of ash in the Emory River. Dike #2 is intended to minimize the movement of ash from the embayment into the Emory River.

Floodplains and Flood Risk

Affected Environment

The area affected by the failure of the KIF ash dredge cells extends from ERM 1.5 to 3.5. Prior to the failure of the dredge cells, the 100-year flood elevations for this reach of the Emory River varied from elevation 747.6 feet above msl at ERM 1.5 to elevation 749.4-feet msl at ERM 3.5. The TVA Flood Risk Profile (FRP) elevations for this reach of the Emory River varied from elevation 749.9 feet above msl at ERM 1.5 to elevation 752.3-feet msl at ERM 3.5.

The 100-year flood post-slide elevations would be about 5 feet higher than preslide elevations immediately upstream of Weir #1 and about 8 feet higher than preslide elevations in the vicinity of the houses located along Emory River Road and Lakeshore Drive. The 100-year flood post-slide elevations would likely affect land and structures that TVA currently does not own. About 30 to 35 structures have the potential to be flooded between Weir #1 and ERM 3 in the event of a 100-year flood event. From ERM 3 upstream to Harriman, about 8 miles, an additional 40 to 45 structures could be impacted.

In early February, TVA contacted homeowners in the potentially affected areas to assure them that if a flood were to occur, TVA will be financially responsible for flood damage to homes that would not have occurred under normal conditions, in the absence of the ash in the river and the temporary weir. For any property located within the 100-year floodplain, there is a 1 percent (1 in 100) chance that this flood level would be reached or exceeded in any given year. Every property owner in this group was directly contacted to inform them of the situation. Once the ash and the underwater weir are removed, the Emory River will be returned to pre-spill conditions. Flood elevations will return to levels established before the spill, and TVA's financial responsibility related to flood damages will also end at this time.

The FRP is used to control flood-damageable development for TVA projects and residential and commercial development along TVA reservoirs. At this location, the FRP elevations are equal to the 500-year flood or "critical action" elevations. Roane County participates in the National Flood Insurance Program (NFIP). The NFIP regulates floodplain development and requires demonstration that a project within the floodway would not increase flood elevations by any amount. There is a published floodway on this portion of the Emory River.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, TVA would not dredge the spilled ash materials from the Emory River. The ash and other debris is an obstruction to river and storm water flow. Through hydraulic modeling, TVA has determined there is risk to exceed the flood stage by 5 to 8 feet should a 100-year flood rain event occur while this debris and ash remain in the Emory River. Without dredging, the ash and debris would be transported further down the Emory River and into the Clinch and Tennessee rivers. Flood elevations would likely be increased. The No Action Alternative would not restore 100-year flood elevations to preslide levels. The 100-year flood post-slide elevations would be higher than preslide elevations from KIF to Harriman, which is about 11 miles upstream.

Action Alternative

Under the Action Alternative, TVA would dredge ash and debris from the Emory River in three phases. Phase 1 dredge operations would remove ash material from the Emory River

down to elevation 710 msl. Phase 2 operations would dredge the river channel to restore it to preslide levels, as determined by bathymetric sampling. Phase 3 dredge operations would focus on removal of ash deposits outside of the Emory River channel. Implementation of the Action Alternative would restore the floodway and flood elevations to preslide conditions, as they existed before December 2008.

As noted in TVA's Emergency Response EA (TVA 2009a), to ensure that Weir #1 and the ash in the Emory River would not adversely impact floodplains and flood control, TVA commits to the following:

- Removal of Weir #1 after removal of the ash in the Emory River and downstream east of Dike #2 such that flood elevations on the Emory River are returned to preslide conditions.

- TVA will perform individual home floor elevation surveys. TVA will be financially responsible for flood damages to homes that would not have occurred under normal conditions, in the absence of the ash in the river and the temporary weir until the ash and weir are removed. TVA's financial responsibility related to flood damages will also end at this time.

Navigation

Affected Environment

The Emory River at KIF is part of Watts Bar Reservoir. Commercially navigable portions of the reservoir include the Tennessee, the Clinch, and the Emory rivers to approximately River Mile 12 at Harriman, Tennessee. Watts Bar Reservoir is part of the 800-mile, commercially navigable Tennessee River system, which links to the 10,000 mile national inland waterway.

The Emory River has seen little commercial navigation traffic in the last 20 years, as industries have closed in downtown Harriman. Currently, there is one commercial dock supporting a dock builder in Harriman. Other large vessels operating on the Emory River regularly include the U.S. Coast Guard (USCG) and TVA boats that maintain navigation aids. Recreational boating is popular on the Emory River.

The ash slide from KIF has partially blocked the marked navigation channel between approximately ERM 1.5 and 3.5. For the first 30 days, the USCG closed the Emory River to all boat traffic (except those boats participating in cleanup and monitoring) from ERM 0.0 to ERM 4.0 to prevent accidents and groundings. The USCG has subsequently removed the boating restrictions on the Emory River. TVA has installed a series of danger buoys to alert recreational boaters of the danger in river navigation and construction-type dredge activities. Additionally, Swan Pond embayment complex north of KIF was impacted when the ash material entered the area. This embayment is no longer navigable. Furthermore, in order to restrict the movement of the spilled ash into and down the Emory River, TVA constructed one temporary underwater rock weir (Weir #1) on the Emory River. To contain ash within Swan Pond embayment, TVA constructed Dike #2 near the mouth of the embayment.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, TVA would not remove the ash material from the Emory River. As a result, the ash material would likely spread downstream and result in impacts

to navigation over a larger area. It would also complicate the eventual restoration of the area and could result in the affected areas remaining closed to navigation for a longer time than would occur under the Action Alternative.

Action Alternative

Under the Action Alternative TVA would dredge the ash material from the Emory River channel in a three-phased operation. Once the dredging is complete and the weir is removed, it is expected that the river would again be navigable to commercial and recreational boat traffic.

Surface Water and Water Quality

Affected Environment

The KIF facility is located at the confluence of the Emory and Clinch Rivers on Watts Bar Reservoir on the right-descending bank (Figure 10). Cooling water for KIF's condensers is pumped from the Watts Bar Reservoir pool at ERM 1.9. At full operating capacity, cooling water flows through the condensers at a rate of 2,154 cfs. Water from the ash pond is mixed with CCW and discharged across the peninsula at CRM 2.6.

Water at the KIF site originates in the Emory and Clinch River systems. River flow rates past KIF are regulated by upstream dams on the Clinch River (Melton Hill and Norris dams) and downstream on the Tennessee River by Watts Bar Dam (Table 4), which is 39.4 river miles below KIF. The KIF facility is 2.6 river miles above the confluence of the Clinch and Tennessee rivers (at TRM 567.7), and the flow rates can also be influenced by upstream dam operations on the Tennessee River (Tellico and Fort Loudoun dams).

Flow patterns can be complex in the Emory and Clinch River embayments (Attachment A). When Emory River flow is greater than the 2,100 cfs required by the cooling water system for KIF, the Emory River flows downstream into the Clinch River, and the Emory River water alone provides all KIF cooling water. According to stream gauge records, this happens about 18 percent of the time and is most likely in the winter flood season, which occurs December through March.

When Emory River flow is not adequate (less than 2,100 cfs) to provide all of the cooling water needed by KIF, water flows upstream from the Clinch River through the Emory River embayment. This is encouraged by the presence of an underwater weir in the Clinch River just downstream of the Emory River confluence. Under some other conditions, the Emory River also flows backward upstream of the plant. Water is pushed up the Emory River as a result of inflows that raise the pool elevation in Watts Bar Reservoir. Inflow typically occurs when the reservoir is filling in the spring or during a spring flood event.

Different rates and timing of releases from Watts Bar, Fort Loudoun, and Melton Hill reservoirs can cause reverse flows in the Clinch River arm of Watts Bar Reservoir. There is the potential for the water from the Clinch River to flow upstream on the Tennessee River during filling of Watts Bar Reservoir.

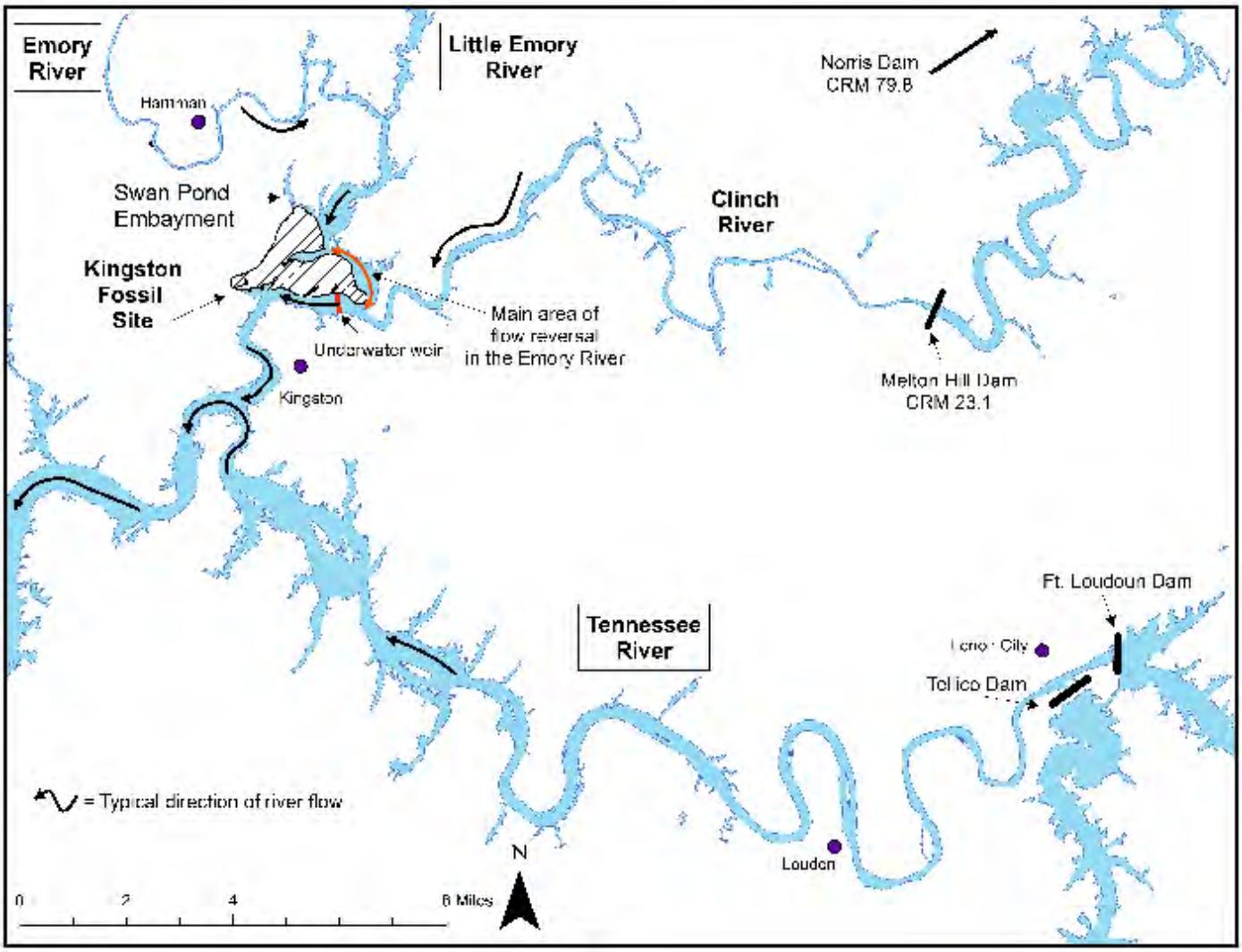


Figure 10. Kingston Fossil Plant Watershed Area and River Flows

Table 4. Kingston Fossil Plant Area Watershed Average River Flows

Location	Watershed Area (square miles)	Average Annual Flow (cfs)	Average Summer Flow (cfs)	Average Winter Flow (cfs)
Emory River at River Mouth	865	1,778	504	2,675
Clinch River Mile 2.6	3,540	5,226	4,306	6,221
Tennessee River at Watts Bar Dam (TRM 567.7)	17,310	26,873		

These flow patterns are further complicated by temperature and density differences in the water. Warmer water is less dense and therefore stays on the surface of a reservoir. In the summer, sun and air temperatures warm the surface water, and this thermal layering becomes stable (stratification). The Emory River water also warms up, though not as much as the water on the surface of the reservoir, while Norris Dam and Melton Hill Dam

discharges keep the Clinch River cool. When Clinch River water flows upstream into the Emory River embayment to the KIF intakes in the summer, this cooler water flows along the bottom of the embayment, and the warmer Emory River water can flow downstream over the top of the cooler Clinch River water.

TVA would continue to manage flows to the extent possible on the Clinch and Tennessee rivers to minimize impacts on recovery and monitoring activities associated with the KIF ash release provided it does not conflict with meeting the flows and water levels established in the TVA *Reservoir Operations Study* (TVA 2004). The KIF water supply intake is located on the Tennessee River about 0.5 mile upstream of its confluence with the Clinch River. By managing river flows through the KIF area, TVA expects to keep ash that may be flowing down the Clinch River from moving upstream toward the water intake.

Water Quality (Pre-slide)

The Emory River arm of Watts Bar Reservoir is on the state 303(d) list of impaired waters (TDEC 2008) because of sediments contaminated with polychlorinated biphenyls (PCBs) and chlordane from industrial point sources. The section of the Emory above the influence of the Watts Bar impoundment is listed because of mercury from atmospheric deposition. The Emory River may have elevated metal levels because several upstream tributaries are listed for manganese, iron, and pH from historic coal mining activities. Furthermore, a few of the upstream tributaries are also impacted by sediment or other causes from agriculture or development.

The Clinch River arm of Watts Bar Reservoir is also on the state 303(d) list. The Clinch River is on the list due to PCBs, chlordane, and mercury contamination of sediment from industrial point source discharges and atmospheric deposition. Nearby tributaries to the Clinch that are also listed for PCBs, chlordane, and mercury and one nearby tributary listed for arsenic may be sources of contamination to the Clinch. Some of this contamination occurs as a result of former U.S. Department of Energy (DOE) operations on the Oak Ridge Reservation (TDEC 2008). Past DOE actions at Oak Ridge resulted in the contamination of sediments by radioactive and other wastes. The primary concern is PCB contamination in fish. Other contaminants include radioactive materials and metals.

In 1991, TVA entered an interagency agreement with DOE, USEPA, TDEC, and USACE to establish a procedure for interagency coordination and review of permitting and other use authorizations that could result in the disturbance, resuspension, removal, and/or disposal of contaminated or potentially contaminated sediment in Watts Bar Reservoir. The interagency group reviews and screens all activities that may impact previously contaminated sediments and provides appropriate remediation. Based on information gathered during the implementation of this agreement, the contaminants of interest have been narrowed to 137 cesium and mercury. Projects are reviewed to determine whether the sediment contains 137 cesium or mercury contamination at levels that when disturbed or removed constitute environmental risk or require special handling techniques or equipment to protect human health and the environment from injury or harm.

TVA conducted the Vital Signs Monitoring Program on Watts Bar Reservoir annually from 1991 through 1994 to establish baseline data on the reservoir's ecological health under a range of weather and flow conditions. Watts Bar is now evaluated every other year. The Vital Signs program uses five metrics to evaluate the ecological health of TVA reservoirs: chlorophyll concentration, fish community health, bottom life, sediment contamination, and

dissolved oxygen. Values of good, fair, or poor are assigned to each metric TVA monitored.

In 2008, the overall ecological health condition for Watts Bar Reservoir rated a “low fair,” which is comparable to results from previous dry years (2000, 2002, and 2006) (Figure 11). The reservoir ratings for Watts Bar have fluctuated between “high fair” and “poor” and have generally followed reservoir flow conditions. Of the indicators included in the Vital Signs program, dissolved oxygen is the most responsive to flow rates.

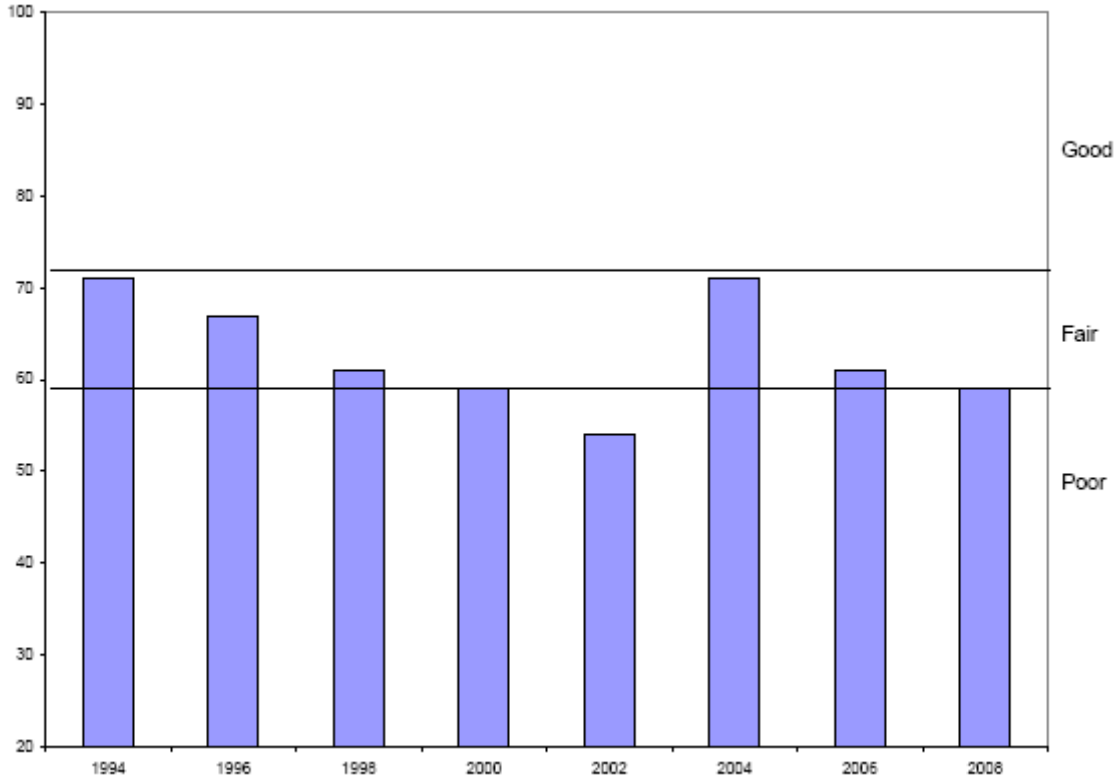


Figure 11. Watts Bar Reservoir Ecological Health Ratings, 1994-2008

Water Quality (Post-slide)

The KIF dike failure of December 22, 2008, released about 5.4 million cubic yards of coal ash along with about 327 million gallons of water. This ash and water spread over nearly 300 acres of land and water adjacent to the plant and into the Emory River.

USEPA (Region 4), TDEC, and TVA crews have been sampling water to assess the quality of public drinking water supplies, private wells, in-stream river water (both near the slide and at multiple downstream locations), and local springs. As of February 23, TVA has collected 378 surface water samples from the Emory, Clinch, and Tennessee rivers. TDEC has taken more than 80 samples, and from December 23 to December 29, 2008, USEPA’s contractor collected 26 river surface water samples. Each agency is using certified labs for chemical analysis. In addition to these samples for chemical analysis, TVA crews have

taken over 370 in-stream measurements of pH, dissolved oxygen, and conductivity. Furthermore, TDEC has taken more than 25 in-stream measurements.

Ash has been found on the river bottom from the mouth of the Clinch River up to ERM 5.75. Much of this ash distribution is relatively thin, but deposits are over 25 feet deep in the immediate vicinity of the slide. This plug of ash and debris material in the Emory River deflects water flow rates such that bank erosion may be accelerated in the area as a result of the river channel being blocked.

There are two types of water quality impacts that can result from the ash slide, physical, from the bulk material; and chemical, derived from any constituents within the ash that enter the water and interfere with the uses of the water body or violate water quality standards. Ash deposits in the river physically degrade or eliminate the habitat for bottom-dwelling organisms (see Aquatic Life section, pages 45 and 46). At sufficiently high-flow velocities, ash would be suspended in the water column, causing deleterious effects for organisms swimming (fish) or suspended (algae) in the water. The small size and lack of cohesion of the ash particles mean that they are easily detached and entrained in flowing water, so this material would continue moving downstream as suspended sediment during periods of high-flow rates. TVA has contracted with a nationally recognized hydrogeomorphologist to develop suspended sediment transport models for the Emory River to predict where resuspended particulates would deposit downstream.

The chemical constituents of greatest concern are the metals contained in the ash. These trace constituents are chemically combined with the ash. Depending on the temperature, pH, and oxygen availability in the water, the metals may disassociate from the ash.

Monitoring of water quality measures either the total amount of a chemical constituent in all of its physical forms (solid or dissolved) or only the dissolved portion (the solid portion is filtered out before analysis). Water samples that have ash entrained in them will have higher total concentrations of chemical constituents since the ash is suspended in the water column and included in the total analysis. The dissolved metals analysis measures what is currently dissolved in the water, but does not give an indication of bioavailability of the metals in the ash.

USEPA, TDEC, and TVA water treatment plant sampling results indicate municipal drinking water has met and continues to meet the drinking water standards. Untreated river water samples closest to the Kingston water treatment plant have consistently met requirements for primary drinking water standards. All USEPA, TDEC, and TVA water treatment plant and residential well sampling results also indicate drinking water continues to meet the standards. Water samples have been tested from a total of four local water treatment facilities, Rockwood, Harriman, Cumberland, and Kingston, as well as numerous residential wells, each with no results above regulatory limits (drinking water standards). Through February 3, TDEC has sampled more than 100 private groundwater wells within a 4-mile radius of the plant, and the results showed all were within safe drinking water standards. TDEC plans to continue well water sampling until the well of any property owner within the designated radius who has made a request has been sampled. TDEC provides those results directly to the property owners as results become available. TDEC will also sample wells in the area that can be monitored periodically to detect changes in groundwater over time (TDEC 2009a).

At the KIF site, analysis of water samples taken from the Emory River immediately after the release on December 22 and 23, 2008, showed high amounts of suspended materials, with

concentrations of some metals exceeding Tennessee state requirements for drinking water. Furthermore, the analysis of total metals indicated some metals exceeded Tennessee state requirements for drinking water. These included arsenic, antimony, beryllium, cadmium, chromium, lead, and thallium.

Later in-stream testing (December 28, 2008 and December 29, 2008) near KIF yielded much lower amounts of suspended materials, indicating that much of the ash had settled out of the water column. In those samples, with the exception of one arsenic value, metals concentrations met state drinking water criteria. The highest levels of contaminants in the water consistently have been found in the immediate area of the ash slide. More recent results (January 1, 2009, through January 5, 2009) from other sites sampled on the Clinch and Tennessee rivers portions of Watts Bar Reservoir showed metal contaminants were at levels that either met drinking water criteria or were below detection limits.

TDEC found exceedences of the more stringent criteria for chronic exposure of fish and aquatic life at least once in January for aluminum, cadmium, iron, and lead. Most of these exceedences were in the Emory River near the ash slide.

Through February 26, mercury was found at concentrations just above detection limits in four TDEC-collected samples, and three results were above Tennessee criteria for protection of fish tissue for human consumption: January 8 at ERM 4.0; January 22 at ERM 0.1; and February 4 at ERM 12.1 and ERM 2.1 (TDEC 2009b). Only one of these samples was taken close to the slide site.

Criteria for thallium in waters that serve as a source of drinking water and from which fish are consumed have also been exceeded in some TDEC samples from both the Tennessee and Emory rivers, but there have been no exceedences of the Tennessee thallium standard for drinking water only.

As an indication of the types of risks that may exist for aquatic organisms from ash toxicity in the river, USEPA reported that preliminary data on samples obtained and analyzed by USEPA, TVA, TDEC, USFWS, and USACE indicate several parameters may exceed some sediment quality guidelines (SQGs) requiring further evaluation of the material (USEPA 2009). USEPA's conclusion was that the material is categorized as "low-moderate" ranking (i.e., available data indicate low-moderate concentrations of contaminants of concern in the proposed material in a range known or suspected to cause adverse response in biological tests).

Using Consensus-Based Sediment Quality Guidelines (CBSQGs) for 12 metals (MacDonald et al. 2000, Wisconsin DNR 2003),TVA came to a similar "low-moderate" conclusion after performing a screening analysis of ash sample data reported by USEPA (13 samples, December 23 to 28, 2008), USFWS (3 samples, December 8, 2008), and TDEC (12 samples, January 6 to 12, 2009) (Table 5). These samples were collected by TDEC from the ash along Swan Pond Creek property, by USEPA along the east shore of the Emory River down to Kingston City South boat ramp public area, and by USFWS from the Emory River along the east dyke of the ash pond. Ash data for individual metals was compared to the CBSQGs derived from effects levels reported in numerous previous studies compiled by McDonald et al. (2000). Total metals data were compared to the Threshold Effect Concentration, or TEC, the concentration below which adverse effects on sediment-dwelling organisms are not expected to occur, and the Probable Effect Concentration, or PEC, the concentration above which adverse effects on sediment-dwelling organisms could be expected to frequently occur (McDonald et al. 2000). TEC

values were exceeded in the ash by the 28 sample mean concentration of arsenic, copper, iron, and manganese and the PEC was exceeded for the sample mean concentration of arsenic but not for any other analyte for which a PEC has been developed (Table 5). These results indicate that further testing is warranted.

Table 5. Comparison KIF Ash Metals to Consensus-Based Sediment Quality Guidelines (MacDonald et al. 2000, Wisconsin DNR 2003)

	Maximum Concentration (of 28 Ash Samples) (mg/kg dry wt.)	Mean Concentration (of 28 Ash Samples) (mg/kg dry wt.)	Threshold Effect Concentration (TEC) for Sediment (mg/kg dry wt.)	Probable Effect Concentration (PEC) for Sediment (mg/kg dry wt.)
Antimony	1.87	1.05	2.0	25
Arsenic	100.6	54.5	9.8	33
Cadmium	1.23	0.45	1.0	5.0
Chromium	86.7	33.6	43.4	111
Copper	76.0	38.3	31.6	149
Iron	40800	22916	20000	40000
Lead	71.8	35.2	35.8	128
Manganese	4160	481	460	1100
Mercury	0.21	0.09	0.18	1.06
Nickel	37.0	21.7	22.7	48.6
Silver	0.4	0.4	1.6	2.2
Zinc	84.5	46.8	121	459

Maximum Individual Ash Sample Mean PEC-Q_{metals} = **0.63**
Minimum Individual Ash Sample Mean PEC-Q_{metals} = **0.12**
Overall Mean PEC-Q_{metals} (28 Ash Samples) = **0.41**

CBSQGs using the PEC have also been used to provide an accurate basis for predicting sediment toxicity in sediments that contain mixtures of contaminants (MacDonald et al. 2000, Ingersoll et al. 2000). Quotients are calculated for each metal in a sample by dividing its measured concentration by its respective PEC. Quotients are then averaged to provide an overall mean PEC for mixed metals (mean PEC-Q_{metals}) in the sample. A mean PEC-Q of 0.5 represents a useful threshold that can be used to accurately classify sediment samples as both toxic and non toxic, although toxicity has sometimes been associated with mean PEC-Qs less than 0.5. Toxicity assessments utilizing the 10- to 14 day and 28- to 42 day *Hyalella azeca* (amphipod) and *Chironomus* spp. (midge) 10-to 14 day tests show there is a consistent increase in the toxicity at mean PEC-Qs of > 0.5 (Ingersoll et al. 2000). In one study to explore the potential application of freshwater mussels in large-scale field studies germane to natural resource damage assessments (NRDAs), the distribution, diversity, and abundance of mussels in a temperate watershed contaminated with metal-bearing wastes from historical lead and zinc mining and ore processing was conducted (Angelo et al. 2007). That study showed mussels' species richness was not impaired at PEC-Q_{metals} < 0.5, and that consistent impairment occurred at PEC-Q_{metals} > 2.7. Mean PEC-Q_{metals} for the 28 samples evaluated by TVA ranged from 0.12 to 0.63 (average = 0.41), predicting a "low to moderate" incidence of toxicity. These values also indicate a need for additional evaluation using biological testing.

Preliminary screening of ash samples utilizing CBSQG methodology should be interpreted with caution because of the limited scope of the sampling and because these sediment quality guidelines were developed from studies using sediments collected from natural water bodies. Fly ash may behave differently than the natural sediments for which these sediment quality guideline numbers were developed, but this approach does provide a general point of reference for assessing potential risks from materials that may end up in aquatic systems. Ingersoll et al. 2000 lists appropriate uses of CBSQGs to include:

(1) interpreting historical data,
(2) identifying potential problem chemicals or areas at a site,
(3) designing monitoring programs,
(4) classifying hot spots and ranking sites,
(5) making decisions for more detailed studies,
(6) identifying the need for source controls from problem chemicals before release,
(7) linking chemical sources to sediment contamination,
(8) triggering regulatory action, and
(9) establishing target remediation objectives.

As TVA works with natural resource agencies on a damage assessment, the accuracy of these guidelines as indicators of effects from ash in the aquatic environment will be examined. Additionally, toxicological monitoring will be conducted as part of the KIF Sampling Plan for Phase 1 dredging to evaluate whole sediment, dredge plume, and ash elutriate toxicity to representative aquatic species including juvenile freshwater mussels.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, TVA would not dredge the spilled ash and dike material in Swan Pond embayment east of Dike #2 and the Emory River. The spilled ash would continue changing water flow patterns within the Emory River embayment. These new flow patterns would likely contribute to erosion of bars and shoreline in the Emory River embayment and, thereby, damage habitat and increase concentrations of suspended sediment and downstream sedimentation. Though slowed by the emergency construction of new weirs, the ash would continue migrating downstream during periods of high flow, mostly as suspended sediment, and most would settle out in the deeper parts of Watts Bar Reservoir. It would likely take decades to recover the benthic habitat in the Emory River embayment, during which time there would be continuing impacts in the water column from suspended solids and potentially from exposure to trace constituents as the material moves downstream.

Action Alternative

The Action Alternative includes the dredging of ash from the Emory River. A hydraulic dredge would be used to remove most of the material. A mechanical dredge would be required to remove boulders, trees, and other debris that the hydraulic dredge is unable to remove. In addition, the staging area would be cleared, grubbed, graded, and surfaced, and an APA would be constructed.

Legacy river bottom sediment in place before the ash slide could be contaminated with PCBs, chlordane, and mercury. During the dredging process, this material could be exposed, resuspended, or dredged along with the ash. To minimize the risk of this occurring, data would be gathered to map the thickness and extent of the ash and the

nature of the underlying sediment. GPS technology would be used to control cutter depth and prevent exposure of contaminated underlying sediment to the extent practicable.

During dredging, hydraulic dredging equipment resuspends less dredged material than do other forms of dredging. However, some loss of material into the water column is inevitable. Depending on operating and environmental conditions, usually less than 0.5 percent of the material dislodged by the dredge is lost into the water column (Hayes et al. 2000).

Mechanical dredges have less control over dredged materials. Mechanical dredging would likely suspend a proportionately greater amount of material while removing logs, boulders, and other large debris.

Resuspension of ash would also likely result from other work activities, such as spillage, prop wash, spuds, and anchoring systems.

Any material resuspended and lost by dredging operations, and then transported by flowing water out of the control of the dredging equipment would move with the current and most would settle to the bottom. Characteristics of the suspended sediment plume and extent of area over which the material would settle would depend on direction and speed of current.

During the dredging process, there would be increased risk of downstream dispersal of fly ash during high flows. The greatest risk would occur when enough of the ash has been removed to return flow to the original river channel and before the channel has been restored to its original dimensions. If a storm event were to increase flow in the Emory River, velocities in this restricted channel would be relatively high, and transport rates would also become high.

Where practical, silt curtains would be used to control downstream loss of material. These structures are sheets of fabric suspended from a floating boom that slows water velocity upstream of the curtain and thus allows suspended material to settle. Silt curtains are ineffective or impractical at flow greater than about 1.5 feet per second and water depths greater than about 20 feet (Francingues et al. 2005). Since dredging would likely require operating in conditions in which these limits are exceeded, silt curtains cannot be used at all times.

TVA has investigated the use of polymers to aid in the separation of water from solids in dredge materials. Polymers for the ash pond would be used to control the amount of additional solids sent to the ash pond through the processing area, and possibly to aid in settling the material in the ash pond. Initially, the processing area would be operated without polymers to determine the efficiency of solids settling and removal in the process ditch. The polymers would only be used as needed.

TVA requested proposals from certain water treatment vendors to determine potential levels of toxicity. The requests resulted identification of three effective polymer products that passed acute and chronic toxicity testing. Two of the three polymers tested are from Kemira Water Solutions, and the third is from GE Betz, Inc. Kemira PAX-XL 19 is the preferred product because it is a liquid, which makes it easier to use. The other two are dry polymers and would be considered as secondary alternates. A separate request will be submitted to TDEC providing information on the specific polymers that TVA has investigated and requesting approval of one or more for use in the ash recovery operations.

The most likely application of polymers would be to help settle total suspended solids (TSS) in the ash recovery area or ash pond. TVA would be applying it through a manifold system along the lower end of the rim ditch, or possibly at the point where that water flows over a weir to the bottom ash/fly ash ditch, or lastly, the least preferred option would be at the discharge from that ditch to the ash pond

Additionally, the injection of polymers or other flocculents is under consideration as a means to control suspended sediment. A flocculent binds with suspended particles causing them to clump together and settle. Any use of flocculent dispensed from a boat would be subject to a National Pollutant Discharge Elimination System (NPDES) permit. No flocculent with unacceptable toxicity characteristics would be used. For use in the ash recovery process or in the ash pond, TVA would request approval from TDEC beforehand.

Water quality would be monitored during dredging to track the amount of ash resuspended by dredge activities and transported out of the work area by water currents. The data collected by this monitoring would be used to guide dredging work to minimize impacts. This would be accomplished by using fixed turbidity monitoring systems both upstream and downstream of the Phase 1 project area, along with additional turbidity monitoring and visual assessment from boats.

Five continuous monitoring stations would be established at ERM 0.5, ERM 4.0, 0.25 mile north of the dredging operations, 0.25 mile south of the dredging operations, and in the KIF intake channel. The five monitoring stations would be used to measure the river flow (velocity and direction) and water quality parameters (turbidity, temperature, dissolved oxygen, conductivity, and pH). Data from these stations would be transmitted at 15-minute intervals to a server located at KIF where it would be automatically processed to identify changes that would require modification of dredging operations or implementation of other mitigating actions.

As discussed above, flow patterns in the Emory River embayment can be complex, and flow direction can be short-lived. The monitoring station located 0.25 mile from the dredging operations that is determined to be upstream of dredging (depending on the river flow direction) would be considered the background station. The two downstream monitoring stations would be compared to the background station to evaluate water quality impact from dredging operations. Because of the possibility of thermal stratification and different current directions at different depths, sensors would be placed at different depths as conditions require.

Supplementary monitoring data would be gathered from boats. During the first two weeks of Phase 1 dredging, boats would be deployed during daylight hours and thereafter at least three days each week and as necessary to capture data from changes in conditions. Trained personnel in these boats would use visual observation and turbidity monitoring to define the three-dimensional boundaries and characterize the concentration of any plume of suspended solids downstream of dredging. The boat crews would also collect water samples that would be analyzed for total suspended solids and total dissolved solids to confirm and calibrate the turbidity readings. In addition, the samples would be analyzed periodically to estimate concentrations and transport of nanoscale particles.

Boat crew observations, along with real-time fixed station measurements, would be used for operational assessment. If plume turbidity or size were to become unacceptable, dredge activities would be modified to reduce dredge impacts. For example, dredge production would be decreased, cutting depth would be modified, and/or other operational

controls would be exercised, up to shutting down the operation. A Pilot dredging program would begin in the first phase of the dredging plan and could continue for the first 60 days. As knowledge is gained from monitoring, observations would aid in developing a more objective basis. Evaluation of the data from early Phase 1 activities would be used to determine the acceptable turbidity bounds for normal dredge operations, help determine the appropriate frequency, depths, and locations for water quality monitoring needed for subsequent dredging phases, and help determine the bounds on acceptable environmental conditions (flow velocity, wind, temperature, etc.) for dredging operations. If field observations and/or water quality data trends indicate that this approach is not protective enough of the downstream water uses, TVA would consult with TDEC regarding implementation of more protective mitigation measures.

In addition to dredge activities, clearing, grubbing, grading, and surfacing the staging area would create the potential for erosion and sedimentation. Construction of the APA would also require excavation activities and expose bare soil to weather. Construction BMPs such as silt fences would be used as appropriate to control discharges of sediment from these sources.

Ash slurry pumped from the dredge would be dewatered in the APA (Figure 8). Discharge from this dewatering process would flow into the ash pond and ultimately discharge through the outfall under the KIF NPDES permit.

The physical properties and trace constituent chemical composition of the ash may cause chronic toxicity impacts to aquatic organisms. Little is known about the toxicological properties of fly ash after it has been released in the environment. TVA will cooperate with USEPA, USFWS, TDEC, and TWRA to continue analyses of physical and chemical properties of the ash and any chronic toxicological effects. Findings would be used to modify activities as necessary to protect the ecological health of the affected water bodies.

Dredging would decrease the amount of ash present in the Emory River and decrease the amount of ash subject to continued downstream transport. This would restore basic river function (e.g., flow within a defined channel and sediment transport) within a matter of months. Restoration of river function would occur under the No Action Alternative but would require a much longer time (years or decades).

Resuspension of ash during the dredging operation would likely cause moderate impacts to water quality and aquatic life in the impacted area during the dredging process. Most of these impacts would be from the increase in suspended solids. Though impacts would be mitigated by following the adaptive management process, there is a risk of impacts to aquatic organisms from exposure to the trace constituents in the ash. These impacts would continue as long as dredging operations were taking place. Long-term impacts resulting from this exposure would be evaluated in subsequent monitoring. Some long-term impacts to habitat are likely unavoidable, although they would be less severe if dredging occurs. Dredging would open the Emory River navigation channel and decrease the amount of ash subject to continued downstream transport. Management practices, such as silt curtains and flocculents, and administrative practices, including operational corrections based on water quality data, would be put in place to prevent impacts from becoming significant. Dredging is a necessary step toward restoration of river function and habitat in the Emory River embayment.

Groundwater

Affected Environment

Bedrock beneath the proposed APA is represented by the Lower Conasauga Group. The Conasauga Group generally consists of thin interbedded shale, siltstone, limestone, and conglomerate, and is locally of low water-producing capacity. Drilling within the Conasauga in the site locality has revealed no evidence of karst features such as fissures, caves, and sinkholes (Boggs and Julian 2004). Alluvial deposits consisting of clay, silt, and sand with occasional gravel overlie bedrock. Thickness of the alluvium beneath the APA ranges from about 15 to 25 feet based on logs for six recent borings completed in the APA (Kelvin Campbell, MACTEC Engineering and Consulting, Inc., personal communication, February 5, 2009). Ash deposits associated with a former ash pond, ranging from 40 to 50 feet in thickness, lie above the alluvium. Ash deposits are predominantly composed of fly ash, although layers of bottom ash ranging up to 15 feet in thickness were observed at a few recent borings. A thin layer of topsoil fill is present in some areas.

The uppermost occurrence of groundwater below the area occurs within the existing ash deposits. Groundwater movement is generally southeastward across the APA site toward the CCW intake channel (Figure 6). All groundwater originating on, or flowing beneath, the proposed APA ultimately discharges to the intake channel without traversing private property.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, the APA site would not be used. Any other ash handling sites would be evaluated for groundwater impacts before their use was approved.

Action Alternative

The only proposed actions having the potential to impact groundwater resources are those associated with construction and operation of the APA. Activities connected with dredging and transportation of ash from the Emory River would not be expected to affect groundwater.

Construction activities would generally include (1) removal of surface vegetation, (2) site grading to promote drainage to the ash sluice channel, (3) excavation of shallow rim-ditch dewatering channels on either side of the ash sluice channel, and (4) placement of approximately 12 inches of crushed limestone and filter fabric over both the ash recovery and ash storage areas. None of the proposed excavations are expected to encounter groundwater. Site preparations would also include closure of two chemical treatment ponds as described in APA section. Drainage of these ponds and in-situ chemical stabilization of bottom sediments are expected to reduce the potential for future groundwater contamination beneath these ponds. Overall groundwater impacts associated with APA construction activities are expected to be insignificant.

Operational impacts to groundwater would be limited to infiltration of ash leachate from the ash sluice channel, rim-ditch ash dewatering operations, and the temporary dredged ash storage area. The limestone gravel layer constructed over the area would be expected to provide some buffering of ash leachate acidity and, in turn, some reduction of metals concentrations. Even without buffering, infiltration of ash leachate from dredged ash processing activities would not be expected to significantly alter groundwater quality within the underlying ash deposits associated with the former ash pond.

Groundwater gradients in the site locality indicate that all ash leachate entering shallow groundwater beneath the APA area would flow southeastward and ultimately discharge into the plant CCW intake channel (Figure 4). The potential impact of ash leachate contaminated groundwater seeping into the intake channel can be evaluated using the ash dredging metals mass balance analysis presented in Table 6. The purpose of the analysis was to estimate concentrations of ash-related contaminants in the intake channel (and ultimately the Emory River downstream of the plant) resulting from ash dredging operations. The analysis accounts for ash-related contaminants associated with (1) dredged ash supernatant, (2) ash sluice water from plant operation, and (3) background river water entering the intake channel. All dredged ash supernatant and ash sluice water were assumed to discharge into the ash pond and ultimately into the intake channel at NPDES Outfall 001. Although the mass balance does not explicitly address effects of APA-derived ash leachate entering the intake channel via groundwater seepage, all ash leachate associated with ash dredging supernatant is accounted for in the analysis, including any fraction of the supernatant that might enter groundwater as seepage through the bottom of the rim-ditch network and sluice channel. All input data and assumptions used in the mass balance including initial concentrations of the ash leachate contaminants are given in Table 6.

Results of the mass balance analysis summarized in Table 6 show that all of the constituents except aluminum and cadmium meet the TDEC lowest criteria (i.e., limit equal to minimum of the drinking water and aquatic toxicity limits). The predicted aluminum level exceeded the secondary drinking water standard, but with further mixing of plant cooling water discharge downstream of the plant, aluminum concentrations would be expected to fall below this limit. The cadmium exception is an artifact produced by the method of treating censored data in mass balance calculations (i.e., values below detection limits set equal to one-half detection limit), and the fact that the cadmium detection limit of 0.0005 mg/L exceeded the TDEC criteria of 0.00025 mg/L. The mass balance analysis indicates that the overall impact of dredged ash processing on surface water quality would be insignificant.

The quantity of ash leachate produced by precipitation infiltrating dredged ash temporarily stored at the APA was not covered by the mass balance analysis, but would be negligibly small compared to that connected with dredged ash supernatant. For example, the average annual ash leachate generation rate for ash covering the estimated 40-acre storage area would be approximately 0.047 millions of gallons per day (MGD), conservatively assuming net infiltration of 30 percent of average annual precipitation of 52.9 inches. This amounts to about 1 percent of ash leachate associated with the estimated 4.6 MGD per dredge of supernatant produced by dredging operations. Again, the overall impact of dredged ash processing on groundwater quality would be insignificant. Furthermore, even without buffering, infiltration of ash leachate from dredged ash processing activities would not be expected to significantly alter groundwater quality within the underlying ash deposits associated with the former ash pond.

Table 6. Metals Mass Balance Results

Analyte	Intake Concentration (mg/L)	River Loading* (lb/day)	Total Ash Pond + CCW (lb/day)	Total Ash Pond + CCW (mg/L)	TDEC Lowest Criteria** (mg/L)
Aluminum	0.5	5411	5795	**0.51**	0.2
Arsenic	<0.001	5.41	27.5	0.0024	0.01
Barium	0.041	444	589	0.052	2
Beryllium	<0.001	5.41	5.64	0.0005	0.004
Cadmium	<0.0005	2.71	2.85	**0.0003**	0.00025
Chromium	<0.001	5.41	10.6	0.0009	0.011
Copper	0.0013	14.07	16.1	0.0014	0.009
Iron	0.3	3247	3323	0.295	0.3
Lead	<0.001	5.41	6.73	0.0006	0.0025
Mercury	<0.0002	1.08	1.13	0.0001	0.00077
Manganese	0.049	530	545	0.048	0.05
Nickel	<0.002	10.82	13.8	0.0012	0.052
Selenium	<0.001	5.41	9.4	0.0008	0.005
Silver	<0.0005	2.71	3.37	0.0003	0.0032
Thallium	<0.001	5.41	17.9	0.0016	0.002
Zinc	<0.01	54.1	62.5	0.0055	0.12

mg/L = Milligrams per liter
lb/day = Pounds per day
* River loadings were calculated using 0.5 the Minimum Detection Limit.
**TDEC Criteria, Rule 1200-4-3-.03

Visual Resources

Affected Environment

Potential user groups that would likely have direct views of the proposed project area would include authorized employees and contractors and residents near the project area. Views of the project area would likely be up to distances in the middleground (0.5 mile to 4 miles) to the north and east.

Consequences of the impacts to visual resources are examined based on changes between the existing landscape and the landscape character after alteration, identifying changes in the landscape character based on commonly held perceptions of landscape beauty and the aesthetic sense of place.

Scenic attractiveness of the project area is minimal, and scenic integrity is low. The proposed APA is visible to motorists passing KIF on Swan Pond Road.

Environmental Consequences

No Action Alternative

Under this alternative, there would be little initial change in the appearance of the ash slide area in the Emory River or of the proposed APA. The ash visible in the Swan Pond embayment would remain until further decisions are made on long-term disposal.

Action Alternative

During dredging operations, there may be some minor visual discord during the construction and subsequent post-construction maintenance period due to an increase in

personnel and equipment and the use of laydown and materials storage areas. Ancillary activities would include clearing and grading, delivery and installation of equipment and trailers, dewatering activities, installation of a silt curtain containment system, and construction of temporary dock systems for water access.

Because dredging could take place 24-hours per day, 7 days per week, lights would be installed on land and barges in the work area as necessary to provide lighting required for dredging work occurring from dusk until dawn. In order to reduce impacts to nearby residents, lights would be oriented to minimize shine into nearby homes. Although impacts to visual resources are potentially adverse, they would be temporary during the dredging operations period, and unavoidable.

The appearance of the proposed APA would be changed from grassed ball fields and shrubby wildlife habitat to an industrial ash disposal area. All of these activities would temporarily add to the number of discordantly contrasting elements seen in the landscape. The long-term appearance of the proposed APA would be determined by the long-term site recovery and ash storage plans, which are still under development.

Aquatic Life

Affected Environment

The affected reach of Watts Bar Reservoir at KIF is in the impounded portions of the Clinch and Emory rivers. Overbank areas exist but are not extensive and are relatively shallow; likewise, embayment areas near the plant such as in the Swan Pond Creek are very shallow. The Emory River merges with the Clinch River on the right bank about 2 river miles upstream of the KIF CCW discharge. The cooling water intake is located about 2 miles upstream of the confluence with the Clinch. The reservoir pool extends up to and beyond Harriman, Tennessee (ERM 11).

Existing survey information compiled by TVA and TWRA is being used to provide an estimate of the aquatic community affected by the physical impact of the ash slide.

Aquatic Life (Pre-slide)

TVA has systematically monitored the ecological conditions of its reservoirs since 1990. The closest Vital Signs Monitoring Program sample sites to the ash slide area are at CRM 1.5, downstream of KIF, and CRM 4.4, upstream of KIF, and TRM 560.8, about 10 miles downstream of KIF. Compared to other reservoirs, the fish assemblage at these sites has consistently rated “good”. The most abundant species in the TRM 560.8 sample were bluegill, gizzard shad, and spotfin shiners (TVA 1999; TVA unpublished data). A total of 33 fish species were collected at the upstream Clinch River site, and 28 species at the downstream Clinch River site (Attachment B, Tables B-1 and B-2). The Reservoir Fish Assemblage Index scores at the KIF Clinch River monitoring sites were comparable to scores from the Vital Signs reference sites. As occurred elsewhere, they declined in 2007, a likely result of widespread drought conditions that continued into 2008. Watts Bar Reservoir rated at or above the Valley-wide average in the quality of its sport fishery (TVA unpublished data).

Benthic macroinvertebrates were sampled at the TRM 560.8 site where they rated good before 1998, fair from 1998 through 2002, and excellent in 2004. The mussel fauna in the Emory River near KIF has been substantially altered by the impoundment of Watts Bar Reservoir and upstream impacts including mining and urbanization. Six mussel species (giant floater, fragile papershell, pistolgrip, pimpleback, wartyback, and threehorn

wartyback) and a common aquatic snail (hornsnail) were found in a recent survey of this area (Yokley 2005). All of these species, except pistolgrip, are generally tolerant of reservoir conditions.

Aquatic Life (Post-slide)

Two rock structures were constructed to contain spilled ash, and minimize migration of ash down the Emory River and into the Clinch River or Tennessee River. Weir #1, completed on January 5, 2009, is built across the Emory River, just north of the existing intake skimmer wall (~ERM 1.9). Dike #2 extends across the Swan Pond embayment a short distance upstream of its mouth. This structure minimizes the movement of ash from the embayment into the Emory River.

Phase 1 dredging would occur in the Emory River in areas identified in the dredge plan (Shaw 2009) Segments 1, 2, and 5 are located upstream of Weir #1. Segment 3 includes Weir #1. Segment 4 includes areas downstream from Weir #1 to ~ERM 0.9 (Figure 7).

Fish, mussels, and other benthic macroinvertebrates (e.g., insects and crayfish) were killed in Segments 1, 2, 3, 5, and the upstream portion of Segment 4 as a result of the ash slide. Dead fish (including threadfin shad, freshwater drum, largemouth bass, and sunfish) were observed immediately following the slide. It appears that this fish kill was primarily the result of direct trauma from the slide or from fish stranding as water receded from flooded areas. Any bottom-dwelling animals (e.g., mussels, insects, crayfish) in areas where large amounts of sediment were deposited were likely unable to escape the slide and were smothered by ash deposits. Some organisms may have survived the initial impacts and some larger fish may have moved into the area, but the immediate slide area (Segments 1, 2, 3, 5, and the upstream portion of Segment 4) is essentially devoid of aquatic life.

Environmental Consequences

No Action Alternative

If no action were taken to remove spilled ash, additional ash would migrate downstream in the Emory River, the lower end of the Clinch River, and the Tennessee River (Watts Bar Reservoir). The Emory River watershed is not regulated by a dam, and any increase in its flow would transport ash to downstream areas.

Additional areas of aquatic habitat in Watts Bar Reservoir would be buried under ash, and further impacts to aquatic life would occur from direct impacts of ash deposition and potentially from water quality issues. These impacts could include the smothering of organisms such as mussels, snails, and insects living in or on the bottom of the reservoir in areas currently unaffected (or minimally affected) by the slide. The smothering effect of spilled ash could alter the benthic macroinvertebrate community in portions of Watts Bar Reservoir that could, in turn, diminish the food base for fish species in these areas. Deposition of ash could also impact freshwater fish species by covering up areas necessary for spawning.

Migration of ash is limited by the presence of Weir #1 and Dike #2. However, due to the volume of ash in the Emory River upstream of Weir #1, this weir would eventually be overtopped and ash would continue to migrate. Any ash downstream of Weir #1 would continue to migrate downstream if not removed.

Action Alternative

Dredging would minimize additional impacts to aquatic habitat in the Emory, Clinch, and Tennessee rivers downstream of the slide site by removing material from the rivers. The dredging would also facilitate the recovery of aquatic life in the slide area.

Impacts to these areas could occur as a result of resuspension of ash during dredging operations. Ash would then be deposited in areas downstream of active dredging. Dredging at and upstream of Weir #1 (Segments 1, 2, 3, and 5) would result in suspension of ash that would likely settle mainly in areas that are already heavily impacted by the initial slide. Because the initial slide and subsequent rain event resulted in deposition of only 0.5 inch to 3 inches of ash in the Clinch River, the comparatively small amounts of ash released during dredging would cause minimal additional impacts to aquatic resources in the Clinch River. When compared to the effect of leaving this material in the Emory River and allowing it to migrate into the Clinch River, these impacts would be minimal.

Appropriate controls would be used to minimize resuspension of ash and downstream transport during dredging operations. In-stream turbidity would be monitored, and operations would be modified or halted if turbidity measurements exceed the threshold outlined in the Water Quality section of this document.

Ash would be pumped to dewatering areas on the KIF site. These areas are previously disturbed and contain no aquatic resources. Decanted water would pass through the existing ash ponds and exit via the existing NPDES permitted outfall. No additional impacts to aquatic resources would occur.

Wetlands

Affected Environment

Wetland acreage impacted by the ash spill was determined using land use/land cover data (LULC). The data was derived from a base line stereo-analysis of 1:12000 color-infrared aerial photography dated January 7, 2003. Recent (2003 and 2008) National Agriculture Imagery Program (NAIP) digital imagery was then used to augment the base data where features had changed over the course of time. Classification is based on the standard Anderson system (Anderson et. al 1976), modified to capture additional detail. Acreage calculations are based on the area of each individual polygon classified in the interpretation process.

This analysis determined that there were approximately 2.51 acres of wetland affected by the ash spill. Habitat types area described by Cowardin et al. (1979) are listed in Table 7.

Table 7. Impacted Wetlands at Kingston Fossil Plant Area

Wetland Type	Impacted Acreage
Palustrine Emergent Wetland	1.56 acres
Palustrine Forested Wetland	0.65 acres
Palustrine Scrub-shrub Wetland	0.30 acres
Total Impacted Acreage	**2.51 acres**

Analysis of pre-spill LULC imagery indicates the 2.51 acres of wetlands present in the spill footprint were filled with ash materials, thereby eliminating these wetlands.

In addition, wetland habitats in the vicinity of KIF have been monitored as part of a larger study associated with the 2004 TVA Reservoir Operations Study (ROS). In the ROS wetland design, there are two wetland study sites in the vicinity of Swan Pond embayment, north of the KIF spill area. Baseline data was previously collected on these sites beginning in 2004 and subsequently in 2006. One scrub-shrub and one forested wetland plot were part of the initial ROS design (TVA 2004). The Swan Pond sites were selected because they were high-quality wetland sites on TVA land, which ensured the long-term availability of these sites.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, spilled ash would likely move downstream in Watts Bar Reservoir. This would impact some aquatic bed wetlands. Little additional impacts to the already affected wetlands would occur.

Action Alternative

All of the wetlands in the areas covered by the ash material have already been eliminated. Implementation of the proposed Action Alternative would not result in any further impacts to wetlands in the KIF area. However, the proposed actions would reduce the potential for additional impacts to wetlands resulting from the downstream movement of ash. Development of the APA would eliminate a small area of wetlands; the long-term plan for the APA is not yet known. Overall impacts to wetlands from the proposed dredging and spoil treatment would be insignificant.

Terrestrial Ecology

Affected Environment

Plant and animal communities in the ash pond area have been greatly altered by KIF operations. The dominant plant communities consist of a variety of wetland species in and on the fringe of the lower settling ponds and at the outer base of the dikes. The collapsed dredge cells contained very little vegetation. The dikes were mostly herbaceous vegetation with a mixture of common, weedy native and nonnative grasses and herbs. A band of riparian trees and shrubs, including sycamore, willow, boxelder, and alder occurred along much of the outer edge adjacent to the reservoir. Other affected areas of the reservoir shoreline were landscaped, suburban lawns or oak-hickory forest.

The Emory River and Swan Pond embayment adjacent to KIF are used by a variety of shorebirds, waterfowl, gulls, herons, and other wildlife typically found in rivers and riparian

corridors. Typical species observed in the area include great blue heron, great egret, double-crested cormorants, Canada geese, wood ducks, gadwall, hooded merganser, bufflehead, mallard, belted kingfishers, and ring-billed gulls. A variety of songbirds, semiaquatic mammals, turtles, and snakes are also abundant along the shoreline. Ospreys are common in the area, often nesting on natural and man-made structures at KIF properties. Heron colonies also occur near the fossil plant; the closest is approximately 0.3 mile upstream and in direct line of sight of the affected area. Ash material has been deposited along the shoreline of this island. A second colony including great blue herons and double-crested cormorants occurs just downstream of the junction of the Emory and Clinch rivers.

Many species of wildlife forage and rest on exposed ash and sediment bars in the lower ash settling ponds and drainages at KIF. Although the configuration of the settling ponds is modified regularly during KIF operations, they attract a diversity of waterfowl and shorebirds during spring and fall migration. Resident geese, herons, killdeer and aquatic turtles also forage in these areas during summer months.

The areas filled with spilled ash are no longer suitable for most of these species. However, Canada geese, great blue herons, cormorants, and large numbers of gulls are frequently observed on the margins of the ash in the Emory River.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, TVA would not remove the spilled ash material in Swan Pond embayment and the Emory River. The downstream movement of ash would have adverse effects on waterfowl, other aquatic wildlife, and potentially terrestrial wildlife that forage along the shoreline. Failure to remove the material would contribute to an increased risk of flooding upstream of Weir #1 and Dike #2, potentially resulting in transporting additional ash in associated upstream riparian zones and upland habitats.

Action Alternative

The Action Alternative would result in the removal of ash and debris east of Dike #2, restoring the immediate portion of the Emory River bottom to preslide contours. The proposed action would have little to no adverse effect on either terrestrial vegetation or wildlife and would minimize additional adverse effects on wildlife that could result from the downstream movement of ash. Since plant communities known to occur in the immediate vicinity of KIF are common and representative of the region, measures to remove the ash from the river by dredging, would have no significant impacts to the terrestrial ecology of the impacted area.

Breeding activities of herons can be disrupted by disturbance (i.e., noise) in close proximity of a colony. The proposed operation of the dredging equipment at Dike #2 is not expected to disrupt the breeding activities of the herons, given that the birds have nested in close proximity to KIF and appear to be acclimated to KIF operational activities and the large amounts of recreational boating in the Emory River.

To reduce the potential for operational impacts to these birds, TVA would not stage barges adjacent to the heron colony. TVA would monitor noise levels at the colony to document potential disturbance from dredging activities. Observations on breeding and nest success would be noted. TVA would work with regulatory cooperators and others to determine appropriate studies needed to address potential long-term impacts from the intake of ash

and potential bioaccumulation of trace constituents in herons and other wildlife at KIF. Likely monitoring activities would include sampling eggs and/or nestlings for potential contaminants and monitoring nesting success of species that breed in the nearby colony.

Wildlife such as herons, shorebirds, gulls, and waterfowl could be exposed to polymers during the dewatering process. Some polymers can be toxic to aquatic resources such as fish and invertebrates, and these food resources could be consumed by water birds. In order to minimize impacts to species, KIF staff would notify TVA biologists 24 hours before polymers are initially used. TVA Heritage staff would follow up by examining the site within 48 hours of polymer use to make sure terrestrial resources are not harmed. KIF staff would notify the TVA biologists 24 hours before polymers are used in subsequent applications. If it determined by the TVA biologist that no impacts (or discountable impacts) occur from polymer use, this notification process and monitoring may be suspended. If warranted, additional steps such as developing a hazing plan employing the use of wildlife decoys or harassment measures to keep wildlife from areas where polymers would be used.

In order to minimize potential impacts to wildlife, TVA would test toxicity levels of various polymers to ensure that appropriate selection is made that would effectively reduce sedimentation and protect aquatic resources and wildlife. TVA has monitored migratory water bird populations at KIF ash ponds for several years. TVA would continue to monitor the area to make certain that these resources are not further impacted.

To prevent the introduction and spread of exotic invasive plant species, disturbed areas along riverbanks and areas of exposed soil near ash storage ponds should be revegetated using native or noninvasive plant species. Suggested plant species include native warm season grasses as well as annual ryegrass, Bermuda grass, brown millet, crimson clover, foxtail grass, milo/sorghum, oats, or Timothy grass.

Endangered and Threatened Species

Affected Environment

Although several federally listed plant and animal species are known from Roane County (Table 8), only one, the piping plover, is known to occur in the area affected by the ash slide. The piping plover has been reported from KIF ash ponds on five occasions between 1978 and 2002. The species would not be found in the dredge area and would not be impacted by the proposed action.

A second listed as endangered species, the gray bat, likely forages along the Clinch and Emory rivers. The closest cave known to be occupied by gray bats is 16 miles from KIF. Suitable habitat for the other federally listed species does not occur in the vicinity of KIF.

Bald eagles (*Haliaeetus leucocephalus*), protected by the Bald and Golden Eagle Protection Act, are occasionally observed foraging and resting in riparian areas surrounding KIF. The closest known nest is located on the Tennessee River, approximately 2.5 miles from the mouth of the Clinch River.

Table 8. Federally Listed as Endangered and Threatened Species That Are Currently Present in Roane County, Tennessee

Common Name	Scientific Name	Federal Status
Plants		
American Hart's-tongue fern	*Asplenium scolopendrium* var. *americanum*	Threatened
Cumberland rosemary	*Conradina verticillata*	Threatened
Virginia spiraea	*Spiraea virginiana*	Threatened
Mussel		
Pink mucket	*Lampsilis abrupta*	Endangered
Fish		
Spotfin chub	*Cyprinella monacha*	Threatened
Bird		
Piping plover	*Charadrius melodus*	Endangered
Mammal		
Gray bat	*Myotis grisescens*	Endangered

Several other plants and aquatic and terrestrial animals listed as endangered, threatened, or of special concern by the State of Tennessee have been reported from within a few miles of KIF. Two state-listed species are known from within 2 miles of KIF. One is spreading false foxglove, *Aureolaria patula*, a species of special concern, known to occur along the banks of the Melton Hill, Watts Bar, and Norris reservoirs. Closest known populations are found within 2 miles downstream of the ash slide in Sugar Grove Habitat Protection Area (HPA) (ERM 0-0.5, left bank) and Rayburn Bridge HPA (CRM 2.5, right bank). The second is fetterbush, *Leucothoe racemosa,* state-listed as threatened and known to occur from one population within the KIF reservation along the banks of the Clinch River approximately 1 mile from the ash slide site. This species is a common coastal plain plant with several disjunct populations in Tennessee.

Environmental Consequences

No Action Alternative

Under the No Action Alternative TVA would not initiate the dredging plan. This would result in the continued deposition of ash materials downstream of KIF, further degrading the aquatic communities in the vicinity. While this would not likely result in significant impacts to gray bats due to their large foraging areas, it could locally reduce the insect prey base used by the species.

Action Alternative

Adoption of the Action Alternative would result in the removal of the spilled ash material from the river and minimize its downstream movement. The proposed action would have no adverse effects on terrestrial wildlife and would minimize additional adverse effects on wildlife that could result from continued downstream movement of ash.

Dewatering activities of dredged ash is not expected to result in impacts to listed species of animals or plants.

Natural Areas

Affected Environment

The TVA Natural Heritage database indicated that the proposed action is within or immediately adjacent to two natural areas and within 3 miles of five other natural areas. No Nationwide Rivers Inventory streams or Wild and Scenic rivers are in the vicinity.

Both the Kingston Refuge and the KIF State Wildlife Observation Area (WOA) are on the KIF reservation. The Kingston Refuge is an 835-acre area that includes KIF and the KIF State WOA. These properties are owned by TVA, and the southeast peninsula of the tract is managed by the TWRA under a revocable land use permit. The refuge provides habitat for a variety of wildlife, and limited hunting is permitted. TWRA has reported low use of the area by hunters in recent years, and subsequently, limited wildlife management activities have occurred on the refuge. Although the land use permit to TWRA remains in place, no hunting was scheduled by TWRA at the Kingston Refuge for the 2008-2009 hunting season. The KIF State WOA is a 200-acre area of the Kingston Refuge that includes KIF's ash settling ponds. It provides a temporary stopover base during migration for a wide variety of shorebirds, wading birds, and waterfowl and is regularly visited by birdwatchers. Because operations at KIF result in a continual flux of fill within the various ash ponds, the number of birds present varies greatly. Portions of both of these areas have been adversely affected by the ash slide, and they are closed to public access.

The other natural areas in the vicinity of KIF are the Rayburn Bridge TVA HPA, Stowe Bluff TVA HPA, Sugar Grove TVA HPA, Kingston City Park, and Southwest Point Park. None of these areas are in the immediate vicinity of the spilled ash, and none were directly impacted by the ash slide.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, TVA would not take the proposed actions to remove the spilled ash, which would likely move downstream in Watts Bar Reservoir. The ash plug created by the slide would continue to obstruct the river and storm water flow. The unnatural impoundment of the Emory River created by the ash slide would create a flood risk that could jeopardize sections of the KIF State WOA and the Kingston Refuge and potentially impact downstream natural areas.

Action Alternative

The KIF State WOA and the Kingston Refuge are within the area of the proposed dredging activities. The other five natural areas listed above and a major portion of the Kingston Refuge are downstream of the proposed dredge site. Dredging the ash material from the Emory River to restore its natural flow would reestablish shoreline conditions surrounding the KIF State WOA and the Kingston Refuge, both areas that support various wildlife and plant species and also have public use objectives. The Action Alternative would also prevent ash from migrating further down river and potentially impacting downstream natural areas.

Recreation

Affected Environment

The Emory River arm of Watts Bar Reservoir has traditionally received heavy recreational boating use, especially during the summer months. In particular, several natural sand

beaches above the ash slide area receive concentrated use, and several public recreation facilities in the immediate vicinity provide water access to the area.

The public recreation facilities include:

1. Ladd Park, located near the mouth of the Emory River, has picnic facilities, a fishing pier, and a boat launching ramp.

2. Sugar Tree Boat Launching Ramp is a TWRA ramp located on the left bank at ERM 0.75.

3. Little Emory Boat Launching Ramp is a TWRA ramp located on the left bank at ERM 5.25.

4. Harriman Waterfront Park is located on the left bank at ERM 12 and provides picnic facilities, walking trails, and a boat-launching ramp.

5. KIF Launching Ramp and the Fisherman's Parking Lot have been closed to the public because of the presence of heavy equipment associated with the ash slide response.

Other recreation areas in the immediate vicinity of the ash slide include a public softball field and soccer area located on TVA's KIF property. The softball field was developed by TVA for employee use in the 1980s. However, the public has also been allowed to use the facility, and various community groups have regularly used the area. The soccer fields were established by community volunteers in the mid-1990s under an informal arrangement with TVA's KIF management. The area is primarily managed by the local chapter of the American Youth Soccer Organization and has received heavy use during the spring and fall soccer seasons. Both areas have been closed since the ash slide and are within the proposed APA.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, TVA would not take the proposed actions to contain and remove the spilled ash, which would likely move downstream in Watts Bar Reservoir. Recreational boating in the vicinity of KIF, especially on the Emory River arm of the reservoir, would continue to be restricted indefinitely, and the downstream movement of ash material could reduce the quality of the recreational experience on other parts of Watts Bar Reservoir.

Action Alternative

Adoption of the Action Alternative would result in the removal of the spilled ash material and minimize downstream movement. This alternative would result in minor negative impacts on recreation in the KIF area. However, it would reduce the potential for impacts to recreation downstream of KIF. This alternative would also lead to restoration of recreational boating and use of the Emory River arm of the reservoir.

While this area of the Emory River near KIF would remain open, navigation would be limited during the ash removal effort. Due to safety concerns, recreational boaters would be encouraged to avoid this area over the course of the dredging and clean up operations. To ensure that boaters are aware of potential hazards, TVA would collaborate with other

appropriate agencies such as TWRA and USCG to make boaters aware of the hazards. Recreational boating advisories would be posted for the affected area of the Emory River. Additionally, danger/warning buoys would be installed in strategic locations to facilitate boater safety. Furthermore, marine patrols would occur in the vicinity of the ash slide.

Under the Action Alternative, the softball and soccer area on KIF property are within the area designated for temporary stacking and handling of dredged ash material. As a result, these areas would no longer be available for public recreation use in the foreseeable future. Losing access to the KIF ball fields would increase the need to use other outdoor sports facilities in the surrounding community. Shared facilities at area public schools would be considered a viable alternative. However, suitable alternative accommodations for soccer may be especially difficult to find. A minor adverse impact resulting from adoption of the Action Alternative could include longer travel times. This would be due to youth field sports' participants having to travel outside the community for scheduled events and to avoid scheduling conflicts with other team field sports such as football. The long-term fate of these KIF ball fields is not known at this time and depends on the long-term restoration and ash disposal plan, which is currently under development.

Cultural Resources

Affected Environment

For the undertaking addressed in this EA, the area of potential effect (APE) for historic properties is the area to be dredged, trucking routes, and temporary ash storage/de-watering area. For historic architecture/sites, the APE is considered the project areas plus any areas containing historic resources from which the project areas would be visible. The size of the APE beyond the actual project area would depend on such factors as topography and vegetation (line of site) or 0.5-mile-radius boundary, whichever is closer. The APE, as defined in 36 CFR Part 800.16(d), is "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist." Archaeological investigations of the proposed temporary ash storage/dewatering area have been previously conducted (Wild et al. 2002 and D'Angelo 2005). No historic structures eligible for listing on the National Register of Historic Places are within the direct line of site of the project area (communication with Tennessee Historical Commission 2008).

Historic Architecture/Sites/Resources

TVA staff contacted the Tennessee Historical Commission (THC) to determine if historic structures were within the direct line of site of the project area. THC confirmed that no historic architecture/sites/resources are recorded within a direct line of sight to the project area.

Archaeological Resources

TVA has completed several cultural resource surveys in this portion of Watts Bar Reservoir (Cannon 1986; Ahlman et al. 2000; Franklin and Frankenberg 2000). There is one archaeological site that is recorded in the area affected by these dredging, dewatering, and storing (temporary) activities is 40RE46 (Figure 8). This site, near the confluence of Swan Pond Creek and the Emory River, was recorded as a prehistoric artifact scatter in 1941 by C. H. Nash prior to inundation of Watts Bar Reservoir. The site was not relocated during subsequent shoreline surveys (Cannon 1986 and Ahlman et al. 2000).

Environmental Consequences

No Action Alternative

If the No Action Alternative were selected, no additional effects would occur to cultural resources.

Action Alternative

The Phase 1 dredging operations would have no effect on historic properties because the removal proposed is contained within the ash layer and the underlying sediments would remain undisturbed. The ACHP and the TN SHPO concurred that this method would have no effects on historic properties. The temporary ash storage/dewatering areas and trucking routes are either existing or the locations have been previously impacted by ground disturbing activities. There are no historic properties present in the temporary storage/dewatering areas or trucking routes, and the use of these areas will have no effects on historic properties. Per 36 CFR Part 800.4(b)(2), phased identification and evaluation, additional consultation with the TN SHPO and appropriate consulting parties will occur regarding Phase 2 and 3 dredging methods when the plans have been formalized.

Transportation

Affected Environment

Roadway, railway, and waterway modes of transportation can serve KIF. However, there are currently no barge facilities on site. Much of the property along the Clinch River a few miles upstream from KIF belongs to DOE; however, shoreline residential properties and recreational areas are in close proximity to the site.

TVA is considering building two spur tracks on site in the ash processing are to help load rail cars. Each rail spur would hold 22 cars each if built. Maximum output volume is 85 car trains out everyday. Minimum volume is four to 60 car trains per week. TVA is currently soliciting options through a Request for Proposals (RFP) for rail and barge transportation as well as loading of rail and barges at KIF. Data from the RFP would not be available in time to complete the analysis for this EA in order for dredging in the river to begin as expeditiously as possible. TVA will evaluate these proposed alternatives in either a supplement to this review or in another environmental review.

Because of the need for immediate action, the EA focuses primarily on truck hauling while recognizing the need to evaluate rail and barge transport at a future date. No rail or barge transport is currently available to transport the ash. TVA proposes to use two or more of the four identified permitted Class 1 landfills simultaneously for ash disposal/storage in order to reduce the number of vehicles traveling a particular route and therefore mitigate traffic congestion, noise and diesel emissions. Additionally, noise suppression equipment would be used on haul trucks, and truck routes would avoid schools, historic districts, and downtown areas to the extent possible. Operations requiring truck hauling are projected to be short term.

This analysis evaluates the impacts of transporting ash materials by trucks on roadways and is based on the proposed removal of approximately 2,550 cubic yards of ash material per day at an estimated 20 percent moisture content (600-700 trucks per day). This ash quantity estimate represents the amount of material that can be recovered by one dredge operating 23 hours a day.

KIF adjoins Swan Pond Road just off U.S. Highway (US) 70. US 70 is a principal, four-lane divided highway with wide shoulders traversing a gently rolling suburban area in an east-

west direction. Swan Pond Road is a rural, two-lane road. Trucks exiting the KIF reservation by way of Swan Pond Road would travel west on US 70 to Pine Ridge Road and then to Interstate (I-) 40 or State Route (SR) 27. Therefore, Swan Pond Road, US 70, and Pine Ridge Road are the common routes considered and are identified as such in Table 9. Figure 12 illustrates the common routes.

Table 9. Annual Average Daily Traffic From 2007 With Projected Data and Level of Service Data From the Analyses

Landfill	Route	Traffic Data 2007 AADT	Projected 2009 Traffic	LOS	Traffic 2009 With Increase	LOS	Comments
Common	Swan Pond Road	2,980	3,412	C	3,922	C	Common access road from plant
	US 70	9,483	10,857	A	11,367	A	Common access
	Pine Ridge Road	9,567	10,953	B	11,463	B	Access road common to I-40 or US 27
Anderson	SR 170	3,356 4,649	3,842 5,323	C D	4,352 5,833	D D	Low AADT High AADT
	Fleenor Mill Road	No data					
Athens	SR 30	13,008	14,893	E	15,403	E	Two lane
	SR 30	21,253	24,333	C	24,843	C	Four lane
	SR 750	2,240	2,565	C	3,075	C	
Dayton	US 27	4,622	5,292	A	5,802	A	
	US 27	4,622 10,378	5,292 11,882	A B	5,802 12,392	A B	Low AADT High AADT
	Smyrna Road	1,370	1,569	B	2,079	C	
Oneida	Ruitan Road	11,050	12,651	D	13,161	D	
	US 27_a[1]	17,954	20,556	B	21,066	B	
	US 27_b	12,001	13,740	C	14,250	C	
	US 27_a	8,871 10,430	10,156 11,941	A A	10,666 12,451	A A	Low AADT High AADT
	US 27_c	2,134 5,180	2,443 5,931	C D	2,953 6,441	C D	Low AADT High AADT
	US 27_d	6,159	7,051	D	7,561	D	
	US 27_b	13,766	15,761	B	16,271	B	
	US 27_c	8,755 15,837	10,024 18,132	D E	10,534 18,642	D E	Low AADT High AADT
	Bear Creek Road	(No data)					

[1] Note: The subscripts for US 27 refer to the number of lanes. US 27_a indicates four-lane divided highway. US 27_b indicates four-lane undivided highway. US 27_c indicates two lanes, and US 27_d is for three lanes.

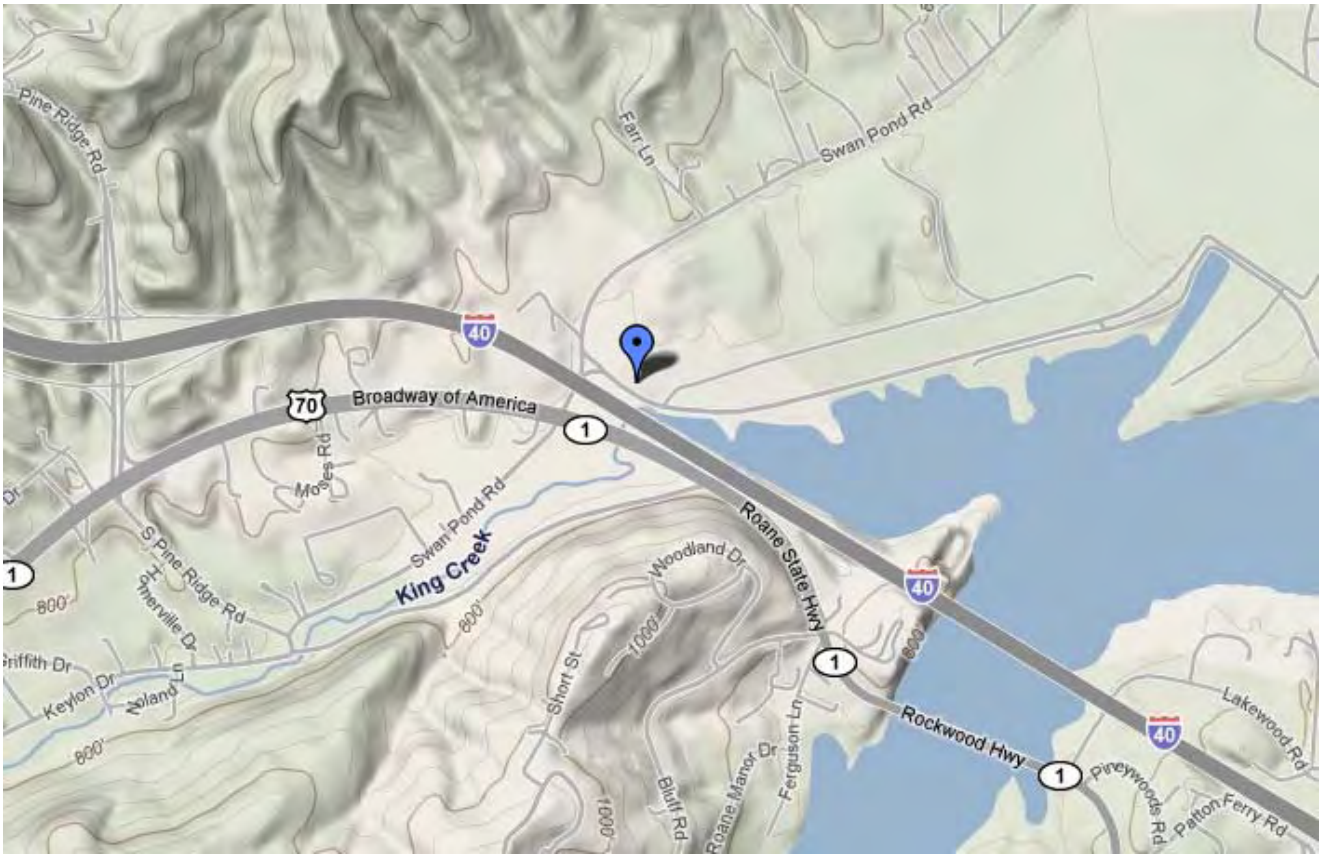


Figure 12. Kingston Fossil Plant Common Route

Four Class I landfill locations are potential sites in Tennessee for ash removal placement: Anderson County, Athens, Dayton, and Oneida. If used, the Anderson County location (Chestnut Ridge Landfill) would be accessed by I-40 East to I-640 East/I-75 North to Exit 117 (SR 170) and right on Fleenor Mill Road. This route is approximately 50 miles in length (one way) and most of the route is interstate highway. The Athens Landfill would be accessed by I-40 East to I-75 South to Exit 49 (SR 30 [Decatur Pike]) to right on SR 750 (Piney Grove Road). This route is approximately 65 miles (one way). The Dayton Landfill would be accessed by I-40 West to Exit 347 (SR 27) toward Harriman/Rockwood, to Smyrna Road. This route is approximately 36 miles (one way). The Oneida Landfill would be accessed by Ruitan Road (SR 29) to US 27 to Bear Creek Road. This route is approximately 62 miles (one way). Figures 13-16 depict the four proposed routes.

Environmental Consequences

<u>No Action Alternative</u>

If ash materials were not removed from the Emory River and transported to locations off site of KIF, no transportation impacts would occur.

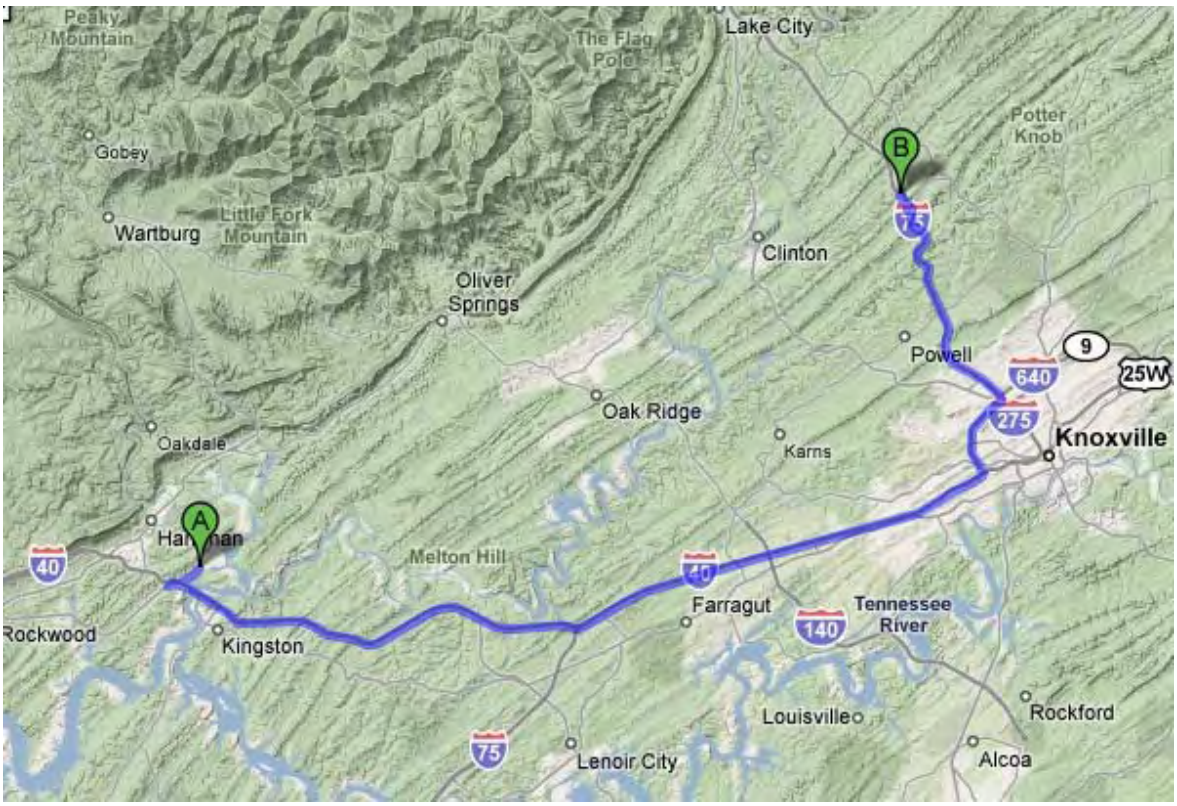


Figure 13. Area Map (Kingston to Anderson County Landfill)

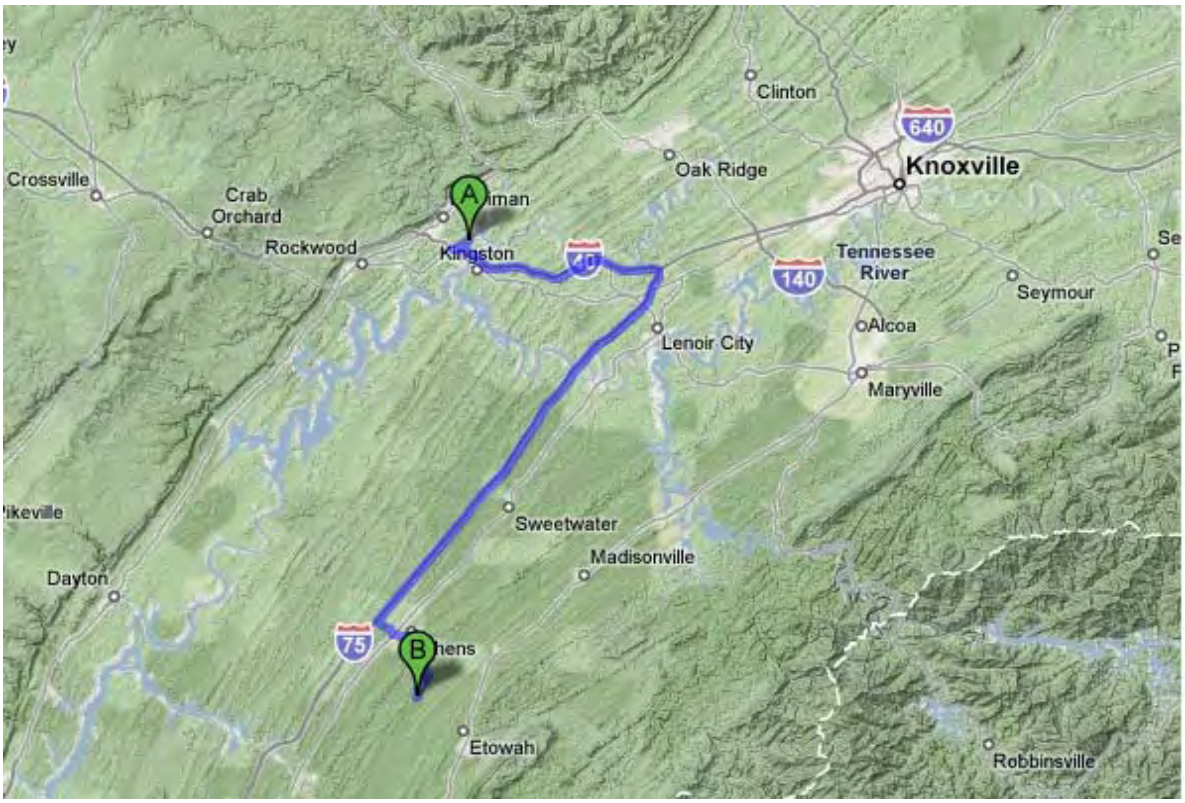


Figure 14. Area Map (Kingston to Athens Landfill)

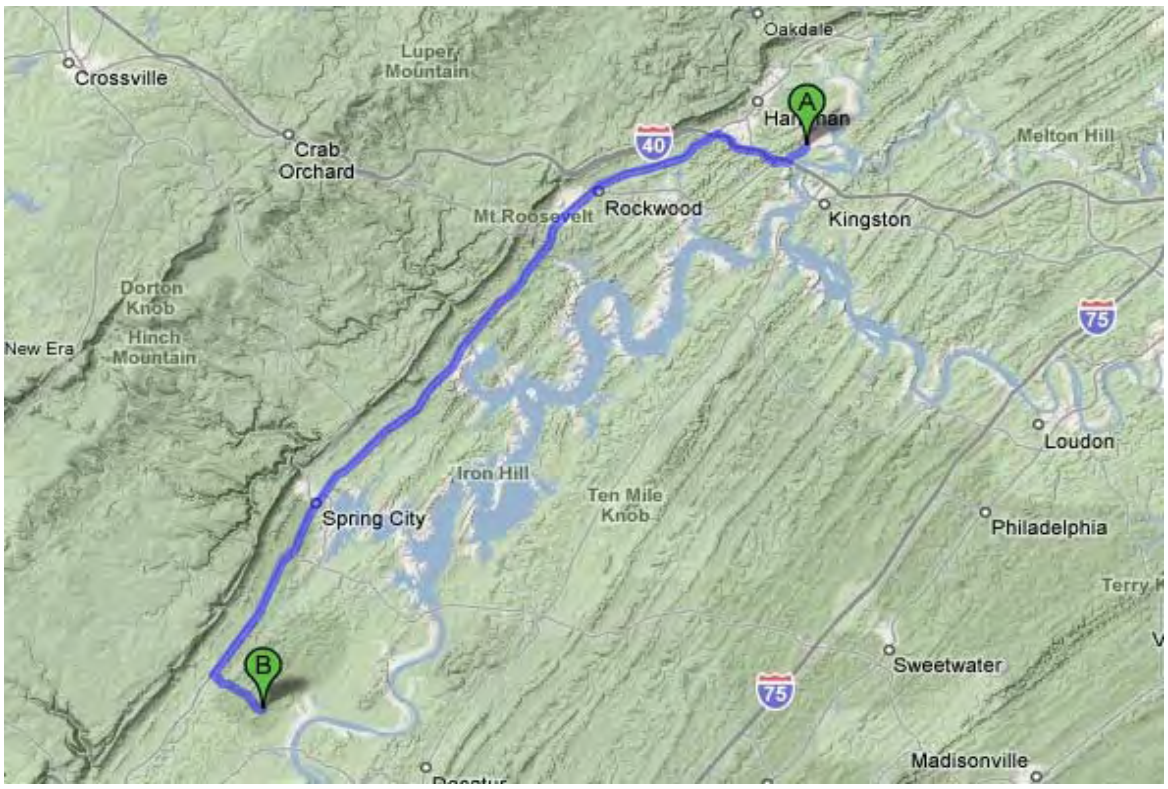


Figure 15. Area Map (Kingston to Dayton Landfill)

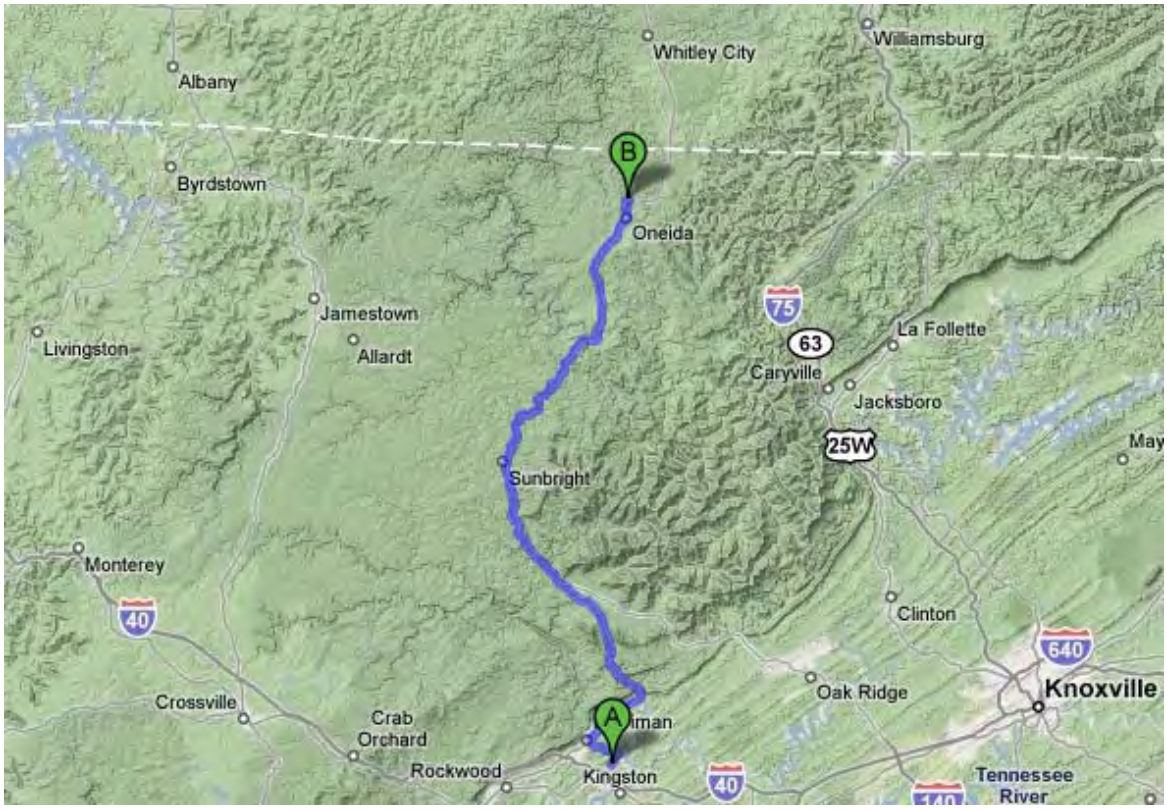


Figure 16. Area Map (Kingston to Oneida Landfill)

Action Alternative

Removing ash and debris materials from the Emory River and moving it to locations off site of KIF would result in additional highway traffic. The *Highway Capacity Manual* (Transportation Research Board 2000) outlines methods for evaluating the operational conditions within a traffic stream. These methods take into account average highway speed, lane widths, shoulder widths, and alignment among other inputs. These methods define six levels of service (LOS), using the letters A through F:

- LOS A is defined as the highest quality of service that a particular class of highway can provide. It is a condition of free flow in which there is little or no restriction on speed or maneuverability caused by the presence of other vehicles.

- LOS B is a zone of stable flow. The restriction on maneuverability is negligible, and there is little probability of major reduction in speed or flow.

- LOS C is a zone of stable flow, but at this volume and density level, most drivers are becoming restricted in their freedom to select speed, change lanes, or pass.

- LOS D approaches unstable flow. Tolerable average operating speeds are maintained, but could be subject to considerable and sudden variation. This condition is tolerable for short periods.

- LOS E is unstable with lower operating speeds and some momentary stoppages. There is little independence of speed selection and maneuverability. The upper limit of this level is the capacity of the facility.

- LOS F indicates forced-flow operations at low speeds. The level of density increases to the effect of a traffic jam

Table 9 contains the Average Annual Daily Traffic (AADT) from 2007 with projected data and LOS data from the analyses, based on 2,550 cubic yards of ash per day (TDOT 2007). The projected values for 2009 include: (a) 7 percent annual increase in AADT and (b) 7 percent annual increase in AADT plus the additional traffic due to ash removal. The analyses assume that 100 percent of the additional traffic would use Swan Pond Road, US 70, and Pine Ridge Road to reach SR 27 or I-40 and the final destinations.

As seen in Table 9, there are two drops in LOS for the various routes analyzed. SR 170 would experience a drop for the low AADT value, and projections for Smyrna Road also show a drop in AADT value. In the case of SR 170, the drop is due to a slight increase in percent time spent following from 49.6 percent to 53.4 percent with the cutoff at 50 percent. For Smyrna Road, the change is somewhat higher but still relatively small going from 47.2 percent to 53.5 percent. In both cases, the increase in following time is relatively small, and the drop in LOS is not significant.

The remaining routes have varying LOS (A through E) with no other decreases. According to the *Highway Capacity Manual* (Transportation Research Board 2000), most design or planning efforts typically maintain service rates at LOS C or D, to ensure an acceptable operating service for facility users that minimizes the inconveniences resulting from traffic delays.

Two-lane portions of US 27 and SR 30 have the worst LOS of any of the routes examined. In both cases the increases are less than 4 percent of the total AADT and do not result in an increased LOS rating.

Although removing ash material generated by operation of one dredge by truck would not significantly degrade the LOS, as defined by the *Highway Capacity Manual*, there would be an increase in congestion and reduction in speeds. Operations requiring trucking of large amounts of ash are projected to be short term, on the order of one year, and are not expected to impact local roads long term.

Table 10 2007 Projected Data and Level of Service Data From the Analyses

	Route	Traffic Data 2007	Projected 2009	LOS	Traffic 2009	LOS	Comments
Common	Swan Pond Road	2,980	3,412	C	4,432	D	Common access road from plant
	US 70	9,483	10,857	A	11,877	A	Common access
	Pine Ridge Road	9,567	10,953	B	11,993	B	Access road common to I-40 or US 27

If output from a two-dredge operation were considered (5,100 cubic yards per day), LOS would drop for all of the routes. To avoid this, at least two of the available landfills should be used simultaneously. Table 10 shows a decrease in LOS for Swan Pond Road, one of the common routes. If two or more of the potential sites were used, the remainder of Table 10 would remain the same. If output from a three-dredge operation were considered, (7,650 cubic yards per day) LOS would be additionally reduced for all of the routes. Again, in this instance, two or more of the available landfills should be used simultaneously to somewhat mitigate the effects on roadways.

In order to minimize the impacts of the trucks transporting ash materials, TVA's request for proposals (RFP) requires potential bidders to consider reducing the potential impact of its KIF trucking activities upon the environment. Contractor shall take into account such factors as, air pollution, erosion control, noise control, solid waste disposal, and wastewater disposal, among other things. The contract would require that truck owners are to properly maintain trucks, including tune-ups. Additional requirements such as use of ultra-low sulfur diesel fuel and minimizing idling time would also be required.

Noise

Affected Environment

The primary affected environments from the dredging and associated activity noise include the residents who live on either bank of the Emory River within the planned dredging area and riverbank residents who live in the line of site of the dredging operations. Secondary affected environment includes the residents who live along the trucking routes for materials that are hauled into and out of the dredging operation. The preceding Transportation section of this EA (pages 50-57), describes the proposed hauling routes from KIF to four proposed Class I landfills. The majority of the hauling routes are four-lane interstates and state highways. However, there are stretches where roadway switches from four-lane roadways to two-lane or three-lane portions, and then back to four-lanes again. The route

to Oneida on US 27 has the most roadway variability. In Dayton, local roads accessing the landfills like Bear Creek Road or Smyrna Road are two-lane roadways. The routes to Anderson and Athens landfills are primarily four-lane interstates and state highways.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, TVA would not dredge and remove the spilled ash material from the Emory River, and none of the associated activities would take place. There would be no noise generated from dredging, weir removal, and material haul operations, and there would be no impact on the affected environment of residents.

Action Alternative

The planned on-water operations would use diesel engines to power the hydraulic dredging equipment. The vacuum dredging would produce engine, exhaust, and pump related noise along with booster pump noise on the pipeline. The weir removal would probably use a towboat and barge mounted hoe that would generate engine, exhaust, and mechanical noise. Clamshell removal of debris would produce crane or derrick engine, exhaust, and mechanical noise along with the towboat noise. These generated noise levels would be about the same as those from similar land operated equipment. The noise from these operations is usually in the low and mid frequency range.

Sound (noise) travels very well over water where there are no obstructions and the water surface reflects the sound. High frequency sounds interact with air and significantly decrease with the distance between the noise source and the receptor at distances over 300 feet (Harris 1991). Low frequency sound does not interact well with air and travels further with less attenuation. Enclosed structures, such as houses, attenuate high frequency sound better than low frequency sound.

The proposed dredging equipment, Ellicott Model 370HP powered by a Cat 410 horsepower diesel engine can produce about 73 decibels (dB) (Beranek and Vér 1992) at a 500 foot distance. If two dredges were working close together, the 500-foot noise level would be about 76 dB, and three dredges would produce about 78 dB.

Removing submerged debris such as logs requires a clamshell and crane combination mounted on a barge. The crane barge and a second debris barge would be moved and held in place by a tug- or towboat. The combined noise from the crane and boat operations would be about 68 dB (USEPA 1971 and Harris 1991) at 500 feet. Removing Weir #1 would require a long reach track hoe mounted on a barge along with a debris barge and tug- or towboat. The noise from this operation would be similar to that of the clamshell operation.

The associated activities would include site preparation for the operations center and truck hauling of the dewatered material for disposal. Site preparation requires using heavy construction equipment for a relatively short time. Equipment would probably include a bulldozer, track hoe, grader, and roller/compactor. Usually, the construction starts with the bulldozer and track hoe clearing and grubbing the area, then the bulldozer and grader spread crusher-run rock, and finally the grader and roller produce the finisher work surface. Typical noise from these combinations of equipment at 500 feet would be about: 70 dB for the bulldozer and track hoe; 70 dB for the bulldozer and grader; and 68 dB for the grader and roller (USEPA 1971 and Harris 1991).

Truck hauling produces engine, exhaust, and tire noise. At low speeds the low and mid frequency engine and exhaust noise are predominate and high speeds the higher frequency tire noise dominates. Typical noise from a 35 mph passing heavy haul truck under load at 50 feet is in the 88 - 90 dB range (Beranek and Vér 1992). The truck noise level increases with speed because tire noise becomes significant above 35 mph. Truck noise is not steady happening whenever a truck passes.

These typical machinery and equipment noise levels at 500 feet distance from all of the different operations can substantially change based on several variables, including after market noise control improvements; maintenance and condition of equipment; directionality of the noise generated by the equipment; and wind direction. Because of the equipment mobility and variable wind direction, these last two variables cannot be controlled.

In order to reduce noise impacts, the engines used for the hydraulic dredging and pipeline booster pumps would have after market “hospital-grade” mufflers and would be housed in acoustic enclosures. The commercial hospital-grade mufflers have an overall noise reduction in the 32 to 40 decibels, A-weighted (dBA) range. The acoustic engine enclosures are built by a noise control engineering company, but the noise reduction is not specified.

Typically, acoustic engine enclosures produce about 10 dBA noise reduction for the noise radiating from the engine casing (USEPA 1971). These engine noise reductions are not additive or linear at the receptor because A-weighted measurements emphasize higher frequencies that drop off faster with distance. Extensive frequency measurements are needed to make accurate predictions of the noise reduction at the receptor for these controls. Conservatively, these after market noise control improvements should give about 15 - 20 dBA reduction at 500 feet for the dredge and booster pump engines. The 500 foot noise level for the operating dredges would decrease to about 53 - 58 dBA for one dredge, 56 - 61 dBA for two dredges, and 58 - 63 for three.

Houses typically reduce noise by about 20 dBA indoors with the windows closed (USEPA 1978). The dredging noise should not disturb residents while they are indoors in the immediate work areas. Although the dredging noise might be heard if the residents are outside on the river bank.

The equipment used for site preparation and weir and debris removal would be inspected for properly functioning mufflers prior to operation. These operations would be limited to daylight hours, and would cause insignificant, short-term impacts. Likewise, the noise from the site preparation for the operations center would cause insignificant impacts because of its very short duration and occurring during daylight hours.

The truck hauling noise could be disturbing to residences that are close to haul roads, especially if travel occurs during sleeping hours. However, TVA is developing an adaptive management planning strategy to reduce impacts to residents who live near KIF and Swan Pond Road. TVA is considering routing haul trucks to a back-gate as an alternative to taking the common route of Swan Pond Road to access KIF. Additionally, TVA will when TVA receives proposal responses from potential vendors, TVA is considering negotiating two price points, one for hauling only during daylight hours, and one for 24-hour hauling.

None of the intruding noise would be high enough to cause hearing loss for any of the nearby residents. Possible environmental noise impacts are substantially decreased by

requiring after market noise control for the dredging equipment and booster pumps, requiring well-maintained equipment for all other operations, and using an adaptive management process to manage haul routes. Overall, the environmental noise impacts from the ash dredging and associated activities should be insignificant with these noise control and operational limitation commitments.

Air Quality

Affected Environment

Air quality is an environmental resource value considered important to most people. Through its passage of the *Clean Air Act*, Congress has mandated the protection and enhancement of our nation's air quality resources. USEPA has set primary National Ambient Air Quality Standards (NAAQS) for airborne particles to protect the public health with an adequate margin of safety. USEPA has also established secondary NAAQS to protect public welfare. Airborne particles (or dust) are emitted from many sources, including coal-fired power plants, automobiles, diesel trucks, wood-burning stoves, agricultural activities, volcanoes, and wind-blown dust. Fine particles, also called $PM_{2.5}$, are particles less than 2.5 microns in size. Fine particles are so small that several thousand of them could fit on the period at the end of this sentence. PM_{10} are slightly larger particles, less than 10 microns in size, but still small enough to be inhaled. Research has shown that at high levels, airborne particles can cause reduced lung function and increased risk of heart attacks.

The Center for Toxicology and Environmental Health (CTEH) began real-time, hand-held monitoring at various locations on site and off site on December 28, 2008. These are instantaneous measurements of PM_{10} concentrations. As of March 3, 2009, CTEH has taken over 17,000 real-time measurements, and only 11 were greater than the level of the 24-hour PM_{10} NAAQS (Figure 17). Nine of these were associated with either smoke from residential chimneys or smoke from open burning or brush fires not associated with the Kingston ash slide. Two were associated with dust from gravel trucks. All of the daily averages are well below the 24-hour NAAQS, the level that USEPA considers safe.

TVA began monitoring continuous fine air particle ($PM_{2.5}$) concentrations using mobile instantaneous instruments and stationary sampling pumps on site on December 28, 2008, shortly after the ash slide. Figure 18 shows the 24-hour average fine particle concentrations measured on site at Kingston from January 2, 2009, to January 22, 2009. These levels are well below the level of the NAAQS, the level that USEPA considers safe.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, TVA would not take the proposed actions to remove the spilled ash, which would likely move downstream in Watts Bar Reservoir. If the ash remains submerged, there would be no air quality impacts. However, if ash deposits were washed onto riverbanks or were exposed during low river flows, they would become airborne once they were dried and were exposed to wind. These uncontrolled fugitive dust emissions could potentially cause minor, transient, localized air quality impacts adjacent to the river for some distance downstream of the ash slide.

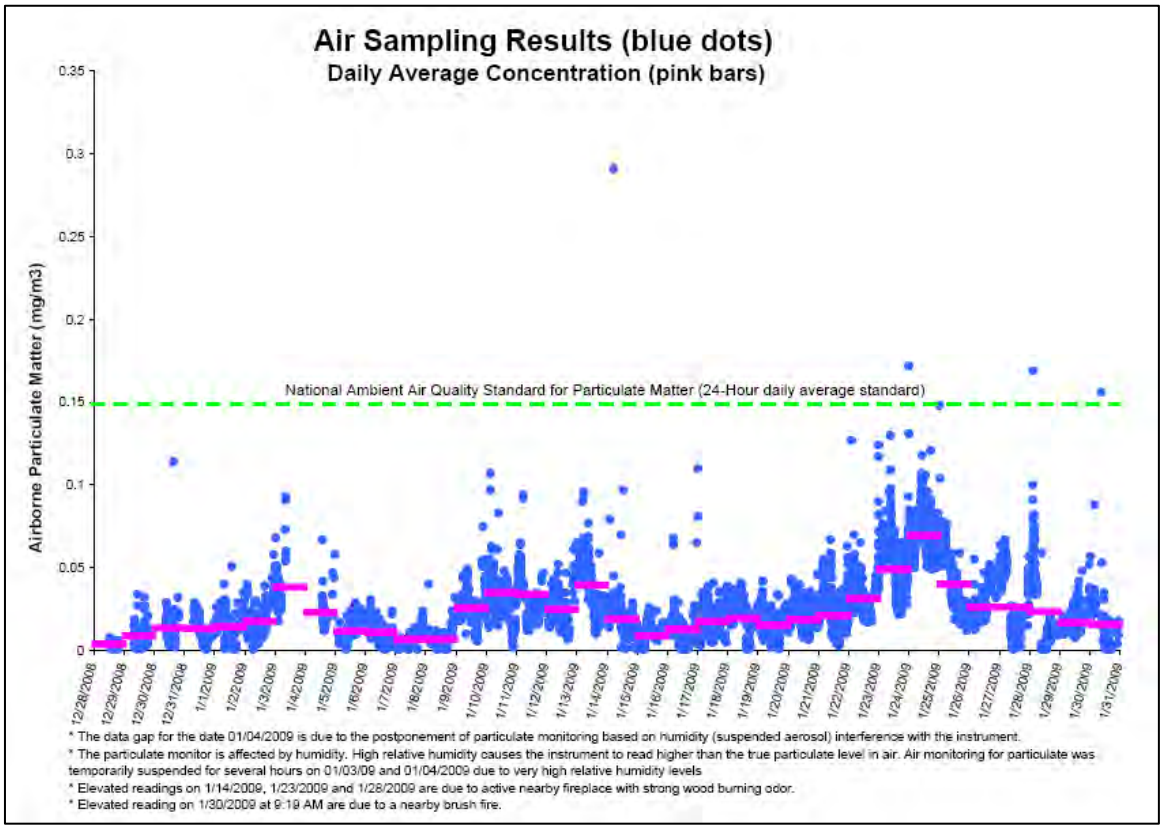


Figure 17. Real-Time Air Particle (PM_{10}) Measurements in the Vicinity of Kingston Fossil Plant

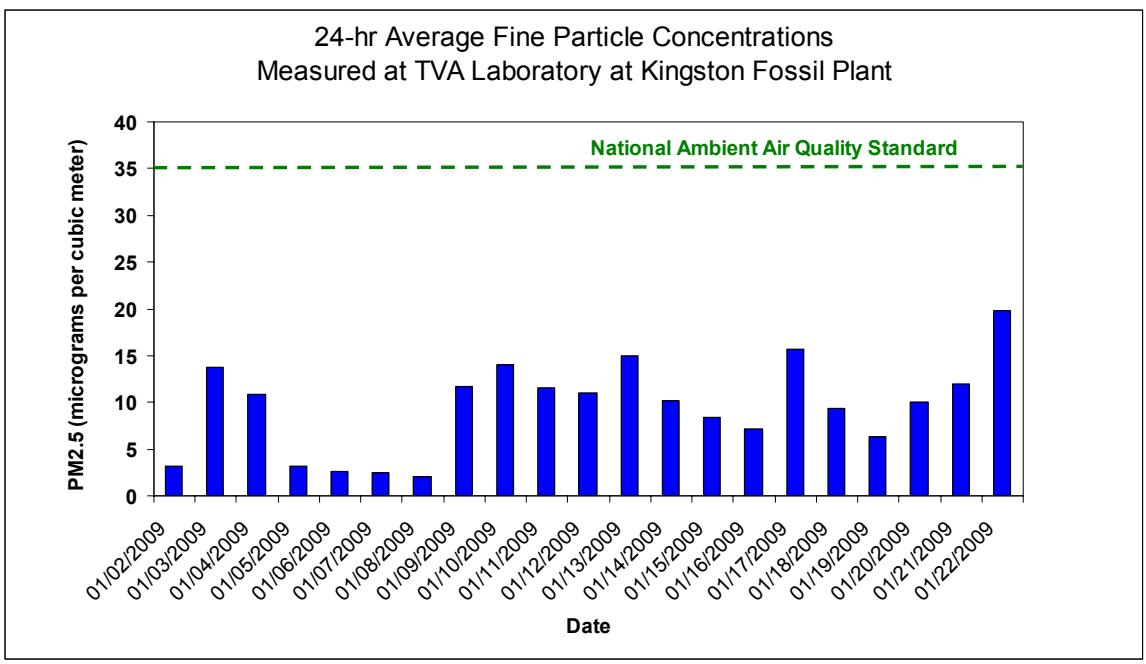


Figure 18. Fine Particulate (PM2.5) Measurements On Site at Kingston Fossil Plant

Action Alternative

Adoption of the Action Alternative would result in the removal of the spilled ash material from the river and minimize its downstream movement. Two potential air quality impacts of the Phase 1 dredging activities are fugitive dust emissions and an increase in emissions of diesel exhaust from heavy equipment and trucks.

Fugitive Dust Emissions

The dredging process would include dredging, dewatering, moving ash to the storage location, and temporary ash storage. Fugitive dust emissions during the dredging and dewatering process are not expected due to the high water content of the ash. While moving ash to the storage location, there is a potential for fugitive dust emissions due to equipment and truck traffic on unpaved roads. The largest fraction of fugitive dust emissions would be deposited within KIF boundaries, because of off-site transportation would require trucks to be covered and the off-site routes would be paved roads. This would be monitored by plant personnel and controlled with appropriate measures, such as watering or using chemical dust suppressants on unpaved roads. Since on-site ash storage would be limited to one month, the potential for fugitive dust emissions is low. Plant personnel would monitor the storage location for visible dust, and appropriate measures would be used to control any fugitive dust emissions. Any potential off-site impacts of fugitive dust emissions would be temporary and dependent on both man-made factors (e.g., intensity of activity, control measures, etc.) and meteorological conditions (e.g., wind speed, wind direction, soil moisture, etc.). These emissions would have, at most, a minor, transient impact on off-site air quality and are unlikely to have any impact on ambient air quality standards.

Diesel Exhaust

Diesel equipment would be used for dredging, dewatering, and moving ash to the storage location. Diesel exhaust contains particulate matter, nitrogen oxides, and air toxics that can contribute to air quality problems. USEPA considers diesel exhaust to be a likely human carcinogen that can also contribute to acute and chronic health effects. The increase in diesel exhaust due to dredging activities would be small compared to current emissions of diesel exhaust at the Kingston plant and emissions in the immediate vicinity of the plant due to its proximity to I-40. Any potential for off-site impact of diesel exhaust would be dependent on meteorological conditions. However, even under adverse meteorological conditions, this diesel exhaust would have, at most, a minor, transient impact on off-site air quality and would be unlikely to impact ambient air quality standards.

Overall, fugitive dust emissions and diesel exhaust from the proposed dredging activities would not have a significant impact on off-site air quality.

Environmental Justice

Affected Environment

Roane County (the location of KIF) has a total population estimated to be 53,399 in 2007 (U.S. Census Bureau 2008). The county is primarily rural in distribution of population with about 60 percent of the population outside incorporated cities and towns. In 2008, the civilian labor force of the county was 27,170. Of these, about 1,560 were unemployed on average during the year yielding an unemployment rate of 5.7 percent (Tennessee Department of Employment Security 2008).

Environmental justice is concerned with the possibility of disproportionate impacts to minority and low-income populations in the area. The minority population in Roane County is small, 5.7 percent of the total in 2007, which is well below the state average of 22.8 percent and the national average of 34.0 percent (U.S. Census Bureau 2008). The estimated poverty level in the county was 16.0 percent, higher than the national average of 13.0 percent and slightly higher than the state average of 15.8 percent.

Environmental Consequences

No Action Alternative

Under the No Action Alternative, TVA would not dredge the ash and there would be no off-site disposal. If the ash remained in place, there would be no socioeconomic and environmental justice impacts.

Action Alternative

Under the Proposed Action Alternative, dredging activities would occur over a period of about one year, resulting in a small increase in employment in the county during this time. Most of the workers likely would already live in commuting range of KIF, and therefore few workers would be expected to move into the area. Some workers might be hired from the Chattanooga area, but they most likely would commute as well, given the temporary nature of the work.

The jobs and income from dredging operations would be a relatively small, positive impact on the economy of the area and would probably have a small, positive impact on local government revenues. However, since few workers would likely move into the area, no noticeable impacts to community services would be expected. After the completion of operations, plant staffing could likely increase by a few individuals. This would be a small, positive impact to the local economy and to local government revenues, with no noticeable impacts to community services. Off-site disposal of the ash would require between 600 to 700 truck deliveries per day, 7 days per week over 9 to 12 months. This would require employment of truck drivers and a minor temporary increase in employment at nearby landfills. The result would be a small, positive impact to the economy of the area.

Dredging operations would occur within an area that has been heavily disturbed by previous KIF operational activities and the ash slide. The increase in truck traffic hauling of ash to nearby landfills would be felt by the few scattered residents along the routes (as described in the Transportation Section of this EA, pages 50-57) and by workers and customers of the few businesses located there. Residents in the larger area would be affected because they would normally use some part of this route for access to work, shopping, and other purposes. Workers likely would approach KIF from several directions and would constitute a small addition to current traffic flows.

The common routes to all the disposal sites would include short sections of Swan Pond Road to US 70, then following Pine Ridge Road to I-40. This short route has a small number of residences, primarily along US 70. This area is included in Census Tract 306, Block Groups 1 and 4. The minority population in the area immediately around the site is very low. There are a total of seven blocks in the immediate vicinity, Blocks 4000, 4001, and 4002 in Block Group 4 and Blocks 1005, 1007, 1008, and 1016 in Block Group 1 (U.S. Census Bureau 2000). The minority population in these blocks is 3.8 percent of the total. Poverty data are not available for individual blocks. The poverty level in Block Group 1, according to the 2000 Census of Population, is 28.2 percent, and in Block Group 4, 14.6

percent. These levels are higher than the county, state, and national levels. However, as discussed in the Transportation Section of this document (pages 50-57), the LOS of the impacted roadways would remain the same and the duration of the impacts would be temporary. Due to the short extent of the common area and to the small number of minorities in the area, disproportionate impacts to disadvantaged populations are not anticipated.

Should the Chestnut Ridge (Anderson) site be selected, traffic would proceed from the common area east on I-40 to Knoxville, where it would proceed on I-640 to I-75 North to Exit 117 (SR 170), and then almost immediately onto Fleenor Mill Road to the landfill. This increased traffic would lower the LOS for a portion of SR 170 (see Transportation Section pages 50-57). However, this would impact a wide range of motorists using this intersection, not specifically disadvantaged populations. Once past the Common area, this route would all be either interstate or adjacent to I-75 and the landfill. Therefore, no disproportionate impacts to disadvantaged populations are anticipated.

If the Athens site is chosen, no LOS would be reduced. The route would proceed along I-40 East to the intersection with I-75, then proceed south on I-75 to Exit 49. It would then proceed east on SR 30 (Decatur Pike) to Piney Grove Road (SR 750), then to the disposal site. The route from I-75 through Athens passes through a highly commercial area. It then travels through less densely populated areas below Athens, Block Group 4, Census Tract 9704. This block group has a minority population of 2.9 percent of the total, with a low poverty level, 4.4 percent, both well below the county levels of 8.1 percent minority and 14.5 percent below poverty levels. Because of the routings along interstate and state highways, and commercial areas for most of the distance, along with low poverty and minority population levels elsewhere, no disproportionate impacts to minority populations are expected.

The route to the Dayton site would follow I-40 West to SR 27, then south on SR 27 to Smyrna Road between Spring City and Dayton. This alternative would downgrade the level of service for Smyrna Road during the period of use for ash disposal. Smyrna Road is located in Census Tract 9752, Block Group 1, Rhea County, Tennessee. This block group, according to the 2000 Census of Population, has a minority population that is 3.7 percent of the total, lower than the rate in Rhea County, 5.4 percent, and much lower than the state rate of 20.8 percent and the national rate of 30.9 percent. The poverty level in Block Group 1, Census Tract 9752, is 14.2 percent, according to the 2000 Census of Population. This rate is slightly higher than the Census Tract, at 12.0 percent, but slightly lower than the county average of 14.7 percent.

Most of the distance traveled would be along SR 27, with only a short distance once the trucks leave that roadway. Because the minority population shares and the poverty rates in the area around the site are similar to or slightly lower than in the county and the census tract, no disproportionate impacts to disadvantaged populations are anticipated.

The route to the Oneida site would follow I-40 West to Ruritan Road (SR 29), then proceed north to SR 27 to Bear Creek Road north of Oneida in Scott County, TN. The site is located on Bear Creek Road just off SR 27. Although some segments of SR 27 along this route already have low levels of service, no reductions in the LOS are likely if this option is chosen, although the impact might be noticeable at times on some segments. The disposal site is located in Census Tract 9750, Block Group 3, in Scott County. This block group has a very small minority population, as does the census tract and the county as a whole. In

the block group, only 1.0 percent of the population is minority; in the census tract, the share is only slightly larger at 1.4 percent and in the county as a whole, only 1.9 percent. All of these are well below the state average of 20.8 percent and the national average of 30.9 percent. The poverty level Census Tract in 9750, Block Group 3, where the site is located, is 18.7 percent (U.S. Census Bureau 2000), slightly higher than the state average of 13.5 percent and the national average of 12.4 percent. However, it is lower than the county average of 20.2 percent. The site is located a short distance from Hw 27, through an area that is sparsely populated. Given this, no disproportionate impacts to disadvantaged populations would be expected if this option were selected.

Cumulative Impacts

Past actions that have affected the Emory River in the vicinity of KIF are included in the affected environment, as it existed before the ash slide. Prior to the slide, there was some residential shoreline development and minor recreation on both banks of the Emory River and in Swan Pond embayment. Past releases from industrial activities primarily from Oak Ridge facilities have resulted in some legacy contaminants in the Clinch, Emory and Tennessee Rivers, which now primarily occur in their deep sediments and under the recent ash layer of the dredge area. Disturbance of these sediments would be minimized through the use of bathymetric data and a dredge machine equipped with GPS technology. TVA would also collect sediment samples between Phases I and II and determine the appropriate dredging and handling practices for Phases II and III. TVA is not aware of any currently proposed activities in the vicinity of the proposed Emory River dredge area that would affect the same resources potentially impacted by the dredging. Other than KIF, none of the alternatives of the proposed Watts Bar Reservoir Land Plan have existing activities involving the river bottom or propose any in the vicinity of the dredge area (TVA 2009b). Future proposals for major water based projects are unlikely in the immediate dredge area given the lack of potential industrial or developed recreation sites and TVA's current land policy which considers disposal of reservoir lands for industrial purposes or other businesses, if the property is located in an existing industrial park or the land is designated for such purposes in a reservoir land management plan.

Mitigation Measures

In its evaluation of the impacts of the proposed action, TVA, in coordination with other agencies, has determined that mitigation measures are needed to avoid and minimize the impact of the emergency actions. These measures include:

River Flow Management

TVA will continue to manage flows to the extent possible of the Clinch and Tennessee rivers in the Kingston area by controlling the releases from Melton Hill, Fort Loudoun, and Watts Bar dams, provided it does not conflict with meeting the flows and water levels established in the *TVA River Operations Study* (TVA 2004). This flow management is designed to minimize the downstream movement of spilled ash and to prevent flow of potentially ash-laden water from the Clinch River into the Tennessee River.

Environmental Monitoring

During the emergency dredging, TVA, TDEC, and USEPA have established a comprehensive program for sampling and monitoring air quality, water quality, ash toxicity, and radioactivity during the emergency dredging. The agencies will continue to conduct

water sampling and will monitor the quality of public drinking water supplies, private wells, in-stream river water (both near the slide and at multiple locations downstream), and local springs. In addition to these samples for chemical analysis, TVA and TDEC crews will take in-stream indicator readings to check pH, dissolved oxygen, and conductivity.

Sedimentation

- Any use of polymers or other flocculents applied to waters of the Emory River would be subject to applicable state or an NPDES permit requirements. No flocculent with unacceptable toxicity characteristics would be used.
- Silt curtains would be used to control downstream loss of material where flow is less than 1.5 feet per second and water depths less than 20 feet.
- To minimize the risk of disturbing legacy river bottom sediment, data would be gathered to map the thickness and extent of the ash and the nature of the underlying sediment. GPS technology would be used to control cutter depth and prevent exposure of contaminated underlying sediment to every extent practicable.
- Water quality would be monitored to track the amount of ash resuspended by dredge activities and transported out of the work area by water currents. The data collected by this monitoring would be used to guide dredging work to minimize impacts.
- TVA would use adaptive management during Pilot dredging to determine the most likely place for plumes and locate monitors that will collect field data including turbidity when collecting TSS and TDS samples.
- Five continuous monitoring stations would be established at ERM 0.5, ERM 4.0, 0.25 mile north of the dredging operations, 0.25 mile south of the dredging operations, and in the KIF intake channel. The five monitoring stations would be used to measure the river flow (velocity and direction) and water quality parameters (turbidity, temperature, dissolved oxygen, conductivity, and pH).
- Through the duration of Phase 1 dredging, field crews in boats, along with real-time fixed station measurements, would be used for operational assessment. If plume turbidity or size became unacceptable, dredge production would be decreased, cutting depth would be modified, and/or other operational controls would be exercised, up to shutting down the operation. As knowledge is gained from monitoring, these decisions would result in changes to minimize impacts.
- Construction BMPs would be used to control discharges of sediment from staging areas and the APA.
- Discharge from the dewatering process in the APA would be subject to, and in compliance with, the NPDES permit for the KIF discharge.

Dust and Erosion

TVA plant personnel will monitor and control fugitive dust using measures such as truck watering or chemical dust suppressants on unpaved roads to minimize dust and erosion. Fugitive dust from ash storage would be controlled through the use of a water truck with spray bars and water cannon. If the stockpile is inactive for a period of time or water spray is ineffective, TVA will apply a crusting agent (binder) to the surface of the stockpile. Plant personnel will monitor the storage location for visible dust.

Wildlife and Plants

TVA will not stage barges adjacent to the heron colony and will monitor noise levels at the colony to document potential disturbance from dredging activities. TVA will also monitor breeding and nesting activities at the colony. If warranted, additional steps such as a hazing plan that would employ the use of wildlife decoys or harassment measures to keep wildlife from areas where polymers would be used. If polymers are used, TVA biologists will examine the site within 48 hours to make sure resources are not harmed.

TVA will work with regulatory and cooperating agencies and others to develop long-term studies to assess the impacts of the ash slide to wildlife resources.

Recreation

TVA will collaborate with other appropriate agencies such as TWRA and USCG to ensure that boaters are aware of the potential hazards in the vicinity of the proposed dredging operations. Recreational boating advisories would be posted for the affected area of the Emory River. Additionally, danger/warning buoys would be installed in strategic locations to facilitate boater safety. Furthermore, marine patrols would occur in the vicinity of the ash slide.

Transportation

If necessary, TVA will use two or more of the four identified permitted landfills simultaneously for ash disposal/storage in order to reduce the number of vehicles traveling a particular route and therefore mitigate traffic congestion, noise, and diesel emissions. Additionally, noise suppression equipment would be used on haul trucks and truck routes and will avoid schools, historic districts, and downtown areas to the extent possible.

TVA's request for proposals (RFP) for off-site roadway ash transport will require potential bidders contract to require that truck properly maintained, including tune-ups. Additional requirements such as use of low sulfur diesel fuel and minimizing idling time will also be required.

Noise and Lighting

Industry noise suppression equipment will be used for on-water operations, site preparation, and for haul trucks, especially for dusk to dawn operations. TVA is developing an adaptive management planning strategy in order to reduce impacts to residents who live near KIF and Swan Pond Road. TVA will consider haul trucks using a back-gate route as an alternative to Swan Pond Road to access KIF during nights and weekends.

In order to reduce adverse lighting impacts to nearby residents resulting from lighting used during dusk to dawn dredge operations, lights will be oriented to minimize shine into nearby homes.

Preferred Alternative

TVA's preferred alternative is the Action Alternative. Implementation would minimize the further downstream movement of spilled ash, restore the floodplain and floodway to preslide elevations, and restore river navigation.

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Agencies and Others Consulted

TVA has actively engaged numerous federal, state, and local agencies throughout the ongoing recovery efforts, including 18 federally recognized tribes. The following were notified of TVA's emergency actions:

Advisory Council on Historic Preservation (ACHP)
Council on Environmental Quality (CEQ)
Eighteen Federally Recognized Tribes
Tennessee Department of Environment and Conservation (TDEC)
Tennessee State Historic Preservation Officer (TN SHPO)
Tennessee Wildlife Resources Agency (TWRA)
U.S. Army Corps of Engineers (USACE)
U.S. Coast Guard (USCG)
U.S. Environmental Protection Agency (USEPA)
U.S. Fish and Wildlife Service (USFWS)

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